Technical Program

MoPL1 Auditorium (301)
Reduced Complexity Control Systems by Roger Brockett (Plenary Session)

Chair: Kwon, Wook Hyun — Seoul National Univ.

08:00-09:00 MoPL1.1
Reduced Complexity Control Systems, pp. 1-6.
Brockett, Roger — Harvard Univ.

MoPL2 Auditorium (301)
Overview of Potential Evolutions of Technologies Applied in Commercial Transport Airplanes by Etienne Tarnowski (Plenary Session)

Chair: Isidori, Alberto — Univ. of Rome

09:00-10:00 MoPL2.1
Overview of Potential Evolutions of Technologies Applied in Commercial Transport Airplanes, pp. 7-21.
Tarnowski, Etienne — AIRBUS

MoA01 Atlantic Hall
Automotive & Manufacturing Systems (Poster Session)

Chair: Nielsen, Lars — Linköping Univ.
Co-Chair: Nof, Shimon Y. — Purdue Univ.

10:30-12:30 MoA01.1
A Control Software Development Method Using IEC 61499 Function Blocks, Simulation and Formal Verification, pp. 22-27.
Cengic, Goran — Chalmers Univ. of Tech.
Akesson, Knut — Chalmers Univ. of Tech.

10:30-12:30 MoA01.2
Complex Automation of Technological Processes with Involving Event Model in Feedback Control Scheme, pp. 28-33.
Ambartsumian, Alexander — Russian Acad. of Sciences Inst. of Control Sciences
Kazansky, Dmitry — PLC_Systems

10:30-12:30 MoA01.3
New Approach for Risk Analysis Update Based on Maintenance Events, pp. 34-39.
Mili, Aymen — INP Grenoble - France
Bassetto, Samuel — INP Grenoble - France

10:30-12:30 MoA01.4
Stability Analysis of a Closed-Loop Thermoforming Reheat Process Using an Affine Quadratic Stability Test, pp. 40-45.
Azarnoush, Hamed — McGill Univ.
Boulet, Benoit — McGill Univ.

10:30-12:30 MoA01.5
Fuzzy Soft Sensors for Chemical and Oil Refining Processes, pp. 46-50.
Bakhtadze, Natalia — Inst. of Control Sciences of Russian Acad. ofSciences

10:30-12:30 MoA01.6
Throughput Optimization of Automated Flats Sorting Machines, pp. 51-56.
Tarau, Alina — Delft Univ. of Tech.
De Schutter, Bart — Delft Univ. of Tech.
Hellendoorn, Hans — Delft Univ. of Tech.

10:30-12:30 MoA01.7
An Approach for Re-Ordering and Scheduling of Feature-Based NC Program, pp. 57-62.
Berger, Ulrich — Brandenburg Univ. of Tech. Cottbus
Kretzschmann, Ralf — Brandenburg Univ. of Tech. Cottbus
Aner, Matthias — Daimler AG

10:30-12:30 MoA01.8
A Quantum Genetic Based Scheduling Algorithm for Stochastic Flow Shop Scheduling Problem with Random Breakdown, pp. 63-68.
Gu, JinWei — East China Univ. of Science and Tech. 200237,Shanghai
Gu, Xingsheng — East China Univ. of Science and Tech.
Jiao, Bin — Shanghai Dianji Univ.

10:30-12:30 MoA01.9
Hierarchical Control Architectures in Industrial Automation: A Design Approach Based on the Generalized Actuator Concept, pp. 69-76.
Faldella, Eugenio — Univ. of Bologna
Paoli, Andrea — Univ. of Bologna
Sartini, Matteo — Univ.
Tilli, Andrea — Univ. of Bologna

10:30-12:30 MoA01.10
Defects Detection of Billet Surface Using Optimized Gabor Filters, pp. 77-82.
Yun, Jong Pil — POSTECH
Choi, SungHoo — POSTECH
Seo, Boyeul — POSTECH
Park, Chang Hyun — POSTECH
Kim, Sang Woo — Pohang Univ. of Sicence And Tech.

10:30-12:30 MoA01.11
A 3-Axis 12-Bit CAN-Compatible MEMS Inertial Sensor Cluster for Vehicle Dynamics Control, pp. 83-84.
Ahn, Taedong — SML Electronics Inc.
Yoo, Kwangho — SML Electronics, Inc.
Ko, Hyoungho — Seoul National Univ.
Choi, Byoung-Doo — Seoul Univ.
Cho, Dong-il Dan — Seoul National Univ.
Han, Cheolkyu — SNU
Park, Minha — Hyundai autonet
Lee, Jeongpyo — Hyundai autonet
Jeong, Deog-kyoon — Seoul National Univ.

10:30-12:30 MoA01.12
Diagnosis of Engine Misfiring Based on the Adaptive Line Enhancer, pp. 85-89.
Kim, Ho-Wuk — Inha Univ.
Lee, Sang Kwon — Inha Univ.

10:30-12:30 MoA01.13
Optimal Velocity Control Method in Path Following Control Problem, pp. 90-95.
Okajima, Hiroshi — Kumamoto Univ.
Asai, Toru — Osaka Univ.
Kawaji, Shigeyasu — Kumamoto Univ.

10:30-12:30 MoA01.14
Suitable Two Wheeled Vehicle Dynamics Synthesis for Interactive Motorcycle Simulator, pp. 96-101.
Hima, Salim — IBISC Lab. Evry val d'essone Univ.
Nehaoua, Lamri — Evry Univ.
Séguy, Nicolas — Evry Val d'Essonne Univ.
Arioui, Hichem — Evry Val d'Essonne Univ.

10:30-12:30 MoA01.15
An Adaptive Sub-Optimal Energy Management Strategy for Hybrid Drive-Trains, pp. 102-107.
van Keulen, Thijs Adriaan Cornelis — Tech. Univ. Eindhoven
Steinbuch, Maarten — Eindhoven Univ. of Tech.
de Jager, Bram — Tech. Univ. Eindhoven

10:30-12:30 MoA01.16
Performance Indices Based Self Tuning for Si-Engine Control Optimization, pp. 108-110.
Jeinsch, Torsten — IAV GmbH
Yang, Guojun — Univ. of Duisburg-Essen
Ding, Steven X. — Univ. of Duisburg-Essen
Weinhold, Nick — IAV GmbH
Schultalbers, Matthias — IAV GmbH, Ingenieurgesellschaft Auto und Verkehr

10:30-12:30 MoA01.17
Initial State Iterative Learning for Final State Control in Motion Systems, pp. 111-116.
Xu, Jian-Xin — National Univ. of Singapore
Huang, Deqing — National Univ. of Singapore

10:30-12:30 MoA01.18
PWARX Traffic Network Hybrid Controller Based on 0-1 Classification, pp. 117-122.
Kim, YoungWoo — Nagoya Univ.
Kato, Tatsuya — Nagoya Univ.
Okuma, Shigeru — Nagoya Univ.
Narikiyo, Tatsuo — Toyota Tech. Inst.

10:30-12:30 MoA01.19

Control and Sensor Fault-Tolerance of Vehicle Lateral Dynamics, pp. 123-128.

Oudghiri-Bentaie, Mohammed — Univ. of Picardie Jules Verne
Chadli, Mohammed — Univ. de Picardie-Jules Verne
El Hajjaji, Ahmed — Univ. de Picardie-Jules Verne

10:30-12:30 MoA01.20

Robust Output H_; Fuzzy Control for Active Fault Tolerant Vehicle Stability, pp. 129-134.

Oudghiri-Bentaie, Mohammed — Univ. of Picardie Jules Verne
Chadli, Mohammed — Univ. de Picardie-Jules Verne
El Hajjaji, Ahmed — Univ. de Picardie-Jules Verne

10:30-12:30 MoA01.21

Performance Analysis of an Optical Distance Sensor for Roll Angle Estimation in Sport Motorcycles, pp. 135-140.

Boniolo, Ivo — Pol. di Milano
Norgia, Michele — Pol. di Milano
Tanelli, Mara — Pol. di Milano
Svelto, Cesare — Pol. di Milano
Savaresi, Sergio — Pol. di Milano

10:30-12:30 MoA01.22

Nonlinear Output Robust Regulation of Ground Vehicles in Presence of Disturbances and Parameter Uncertainties, pp. 141-146.

Di Gennaro, Stefano — Univ. di L'Aquila
Castillo-Toledo, Bernardino — CINVESTAV-GDL, Mexico
Acosta Lua, Cuauhtemoc — Centro de Investigación y Estudios Avanzados del I.P.N.

10:30-12:30 MoA01.23

Engine Simulator for ECMs Diagnosis, pp. 147-151.

Huertas Cardozo, José Ignacio — Inst. Tecnológico y de Estudios Superiores de Monterrey
Navarrete Alzate, Natalia Andrea — Inst. Tecnológico y de Estudios Superiores de Monterrey

10:30-12:30 MoA01.24

Estimation of Electropneumatic Clutch Actuator Load Characteristics, pp. 152-157.

Langjord, Hege — NTNU
Johansen, Tor Arne — Norwegian Univ. of Science and Tech.
Snare, Sten Roar — Kongsberg Automotive
Bratli, Christian — Kongsberg Automotive ASA

10:30-12:30 MoA01.25

Comprehensive Vehicle Motion Analysis Using Optical Flow Optimization Based on Pulse-Coupled Neural Network, pp. 158-163.

Cao, Yanpeng — Univ. of Manchester
Renfrew, Alasdair — Univ. of Manchester
Cook, Peter — The Univ. of Manchester

10:30-12:30 MoA01.26

Control of Steer-By-Wire Vehicles with Passivity Approach, pp. 164-169.

Im, Jaesung — Kumamoto Univ.
Ozaki, Fuminori — Omron Corp.
Matsunaga, Nobutomo — Kumamoto Univ.
Kawaji, Shigeyasu — Kumamoto Univ.

10:30-12:30 MoA01.27

Hardware Implementation of Aircraft Landing Controller by Evolutionary Computation and DSP, pp. 170-175.

Juang, Jih-Gau — National Taiwan Ocean Univ.
Chiou, Hou-Kai — National Taiwan Ocean Univ.

MoA02 304A

Nonlinear H_infty Control and Disturbance Rejection (Regular Session)

Chair: Anderson, Brian D.O. — Australian National Univ.
Co-Chair: Lim, Myo-Taeg — Korea Univ.

10:30-10:50 MoA02.1

Rejection of Fixed Direction Disturbances in Multivariable Electromechanical Motion Systems, pp. 176-181.

Boerlage, Matthijs — Tech. Univ. Eindhoven
Middleton, Rick — National Univ. of Ireland
Steinbuch, Maarten — Eindhoven Univ. of Tech.
de Jager, Bram — Tech. Univ. Eindhoven

10:50-11:10 MoA02.2

Clarification of Free Parameters of State-Dependent Coefficient Form: Effect on Solving State-Dependent Riccati Inequality, pp. 182-187.

Sakayanagi, Yoshihiro — Toyota Motor Corp. / Tokyo Inst. of Tech.
Nakayama, Daisuke — Tokyo Inst. of Tech.
Nakaura, Shigeki — Tokyo Inst. of Tech.
Sampei, Mitsuji — Tokyo Inst. of Tech.

11:10-11:30 MoA02.3

Nonlinear H-Infinity Control and the Hamilton-Jacobi-Isaacs Equation, pp. 188-193.

Ferreira, Henrique Cezar — Univ. of Sao Paulo
Rocha, Paulo Henrique da — Brazilian Navy Tech. Center.
Sales, Roberto Moura — Escola Pol. da USP

11:30-11:50 MoA02.4

Disturbance Attenuation in Hamiltonian Systems Via Direct Discrete-Time Design, pp. 194-199.

Yalcin, Yaprak — Istanbul Tech. Univ.
Goren-Sumer, Leyla — Istanbul Tech. Univ.

11:50-12:10 MoA02.5

An Iterative Procedure to Solve HJBI Equations in Nonlinear H Infinity Control, pp. 200-205.

Feng, Yantao — Australian National Univ.
Rotkowitz, Michael — The Univ. of Melbourne
Anderson, Brian D.O. — Australian National Univ.

12:10-12:30 MoA02.6

H_; Control for Singularly Perturbed Bilinear Systems with Parameter Uncertainties Using Successive Galerkin Approximation, pp. 206-211.

Kim, Young-Joong — Korea Univ.
Lim, Myo-Taeg — Korea Univ.

MoA03 304B

Geometric Control (Regular Session)

Chair: Celikovsky, Sergej — Inst. of Information Theory and Automation, Acad. of Science of the Czech Republic; Faculty of EE, Czech Tech. Univ.
Co-Chair: Yung, Chee-Fai — National Taiwan Ocean Univ.

10:30-10:50 MoA03.1

Gradient Based Discrete-Time Modeling and Control of Hamiltonian Systems, pp. 212-217.

Goren-Sumer, Leyla — Istanbul Tech. Univ.
Yalcin, Yaprak — Istanbul Tech. Univ.

10:50-11:10 MoA03.2

Distributed Geometric Control of Wave Equation, pp. 218-223.

Maidi, Ahmed — ENSIC
Diaf, Moussa — Univ. Mouloud MAMMERI
Corriou, Jean-Pierre — ENSIC

11:10-11:30 MoA03.3

On the Geometric Structure of the H-Infinity Central Controller, pp. 224-229.

Wu, Po-Feng — National Taiwan Ocean Univ.
Yung, Chee-Fai — National Taiwan Ocean Univ.

11:30-11:50 MoA03.4

H2 Preview Control: A Geometric Approach in the Discrete-Time Domain, pp. 230-235.

Zattoni, Elena — Univ. of Bologna

11:50-12:10 MoA03.5

Structural Properties of Inverse Models Represented by Bond Graph, pp. 236-241.

El Feki, Mariem — école centrale de lyon
Di Loreto, Michael — INSA de Lyon
Bideaux, Eric — INSA of Lyon
Thomasset, Daniel — INSA de Lyon
Ngwompo, Roger Fotsu — Univ. of Bath

12:10-12:30 MoA03.6

Control Design with Guaranteed Ultimate Bound for Feedback Linearizable Systems, pp. 242-247.

Kofman, Ernesto — UNR
Fontenla, Fernando — FCEIA - Univ. Nacional de Rosario
Haimovich, Hernan — Univ. Nacional de Rosario
Seron, Maria — The Univ. of Newcastle

MoA04	308
Time Delay Systems (Regular Session)	
Chair: Ge, Shuzhi Sam	National Univ. of Singapore
Co-Chair: de Souza, Carlos E.	Lab. Nac. de Comp. Cientifica - LNCC

10:30-10:50 MoA04.1
Adaptive Neural Control of SISO Time-Delay Nonlinear Systems with Unknown Hysteresis Input, pp. 248-253.

Lee, Tong Heng	National Univ. of Singapore
Ren, Beibei	National Univ. of Singapore
Ge, Shuzhi Sam	National Univ. of Singapore

10:50-11:10 MoA04.2
New Delay-Dependent Stability Criteria for T-S Fuzzy Systems with a Time-Varying Delay, pp. 254-258.

Liu, Fang	Central South Univ.
Wu, Min	Central South Univ.
He, Yong	Central South Univ.
Zhou, Yicheng	TEPCO SYSTEMS Corp.
Yokoyama, Ryuichi	Waseda Univ.

11:10-11:30 MoA04.3
Control of Unstable Delayed Systems with Input Saturations and Measurement Constraints: An Electrical Cart Application, pp. 259-264.

Sanahuja, Guillaume	Univ. de Tech. de Compičgne
Garcia Gil, Pedro José	Univ. Pol. de Valencia
Castillo, Pedro	Univ. De Tech. De Compiegne
Albertos, Pedro	Univ. Pol. de Valencia

11:30-11:50 MoA04.4
Delay-Dependent Regional Stability of a Class of Uncertain Nonlinear State-Delayed Systems, pp. 265-270.

de Souza, Carlos E.	Lab. Nac. de Comp. Cientifica - LNCC
Coutinho, Daniel F	Pont. Uni. Cat. do Rio Grande do Sul

11:50-12:10 MoA04.5
Delay-Range-Dependent Exponential Stability of Singular Systems with Multiple Time-Varying Delays, pp. 271-276.

Haidar, Ahmad	Ec. Olytechnique de Montreal
Boukas, El-Kebir	Ec. Pol. de Montreal

12:10-12:30 MoA04.6
Dynamic Non-Rational Anti-Windup for Time-Delay Systems with Saturating Inputs, pp. 277-282.

Ghiggi, Ilca Maria	UFRGS
Bender, Fernando Augusto	Univ. Federal do Rio Grande do Sul
Gomes Da Silva Jr., Joao Manoel	Univ. Federal do Rio Grande do Sul (UFRGS)

MoA05	307
Identification in Systems Biology: Methods and Applications (Invited Session)	
Chair: Bullinger, Eric	Univ. of Strathclyde
Co-Chair: Ferrari-Trecate, Giancarlo	Univ. degli Studi di Pavia
Organizer: Bullinger, Eric	Univ. of Strathclyde
Organizer: Ferrari-Trecate, Giancarlo	Univ. degli Studi di Pavia
Organizer: Findeisen, Rolf	Univ. of Stuttgart

10:30-10:50 MoA05.1
Identifiability Problems of Time-Delay HIV Models (I), pp. 283-288.

Zhang, Jiangfeng	Univ. of Pretoria
Xia, Xiaohua	Univ. of Pretoria

10:50-11:10 MoA05.2
Identification of Intra-Cellular Feedback Loops by Intermittent Step Perturbation Method (I), pp. 289-294.

Dong, Chaoyi	1.Korea Univ. Seoul, 136-713, Korea 2.InnerMongoliaUnivers
Cho, Kwang-Hyun	Korea Advanced Inst. of Science and Tech.
Yoon, Tae-Woong	Korea Univ.

11:10-11:30 MoA05.3
Identification of Optimality and Robustness in Dictyostelium External Signal Receptors (I), pp. 295-300.

Kim, Jongrae	Univ. of Glasgow
Heslop-Harrison, J. S.	Univ. of Leicester
Postlethwaite, Ian	the Univ. of Leicester
Bates, Declan G.	Univ. of Leicester

11:30-11:50 MoA05.4
Identification of Genetic Regulatory Networks: A Stochastic Hybrid Approach (I), pp. 301-306.

Cinquemani, Eugenio	ETH Zurich
Milias-Argeitis, Andreas	ETH Zürich
Lygeros, John	ETH Zurich

11:50-12:10 MoA05.5
Identification of PieceWise Affine Models of Genetic Regulatory Networks: The Data Classification Problem (I), pp. 307-312.

Porreca, Riccardo	Univ. di Pavia
Ferrari-Trecate, Giancarlo	Univ. degli Studi di Pavia

12:10-12:30 MoA05.6
Parameter Estimation in Kinetic Reaction Models Using Nonlinear Observers Facilitated by Model Extensions, pp. 313-318.

Fey, Dirk	Univ. of Strathclyde
Findeisen, Rolf	Univ. of Stuttgart
Bullinger, Eric	Univ. of Strathclyde

MoA06	310A
Plug and Play Process Control (Invited Session)	
Chair: Stoustrup, Jakob	Aalborg Univ.
Co-Chair: De Persis, Claudio	Sapienza Univ. of Rome
Organizer: Stoustrup, Jakob	Aalborg Univ.
Organizer: De Persis, Claudio	Sapienza Univ. of Rome

10:30-10:50 MoA06.1
Proportional and Proportional-Integral Controllers for a Nonlinear Hydraulic Network (I), pp. 319-324.

De Persis, Claudio	Sapienza Univ. of Rome
Kallesře, Carsten Skovmose	Grundfos Management A/S

10:50-11:10 MoA06.2
Plug and Play Process Control Applied to a District Heating System (I), pp. 325-330.

Knudsen, Torben	Aalborg Univ.
Trangbaek, Klaus	Aalborg Univ.
Kallesře, Carsten Skovmose	Grundfos Management A/S

11:10-11:30 MoA06.3
Stable Controller Reconfiguration through Terminal Connections (I), pp. 331-335.

Trangbaek, Klaus	Aalborg Univ.
Stoustrup, Jakob	Aalborg Univ.
Bendtsen, Jan Dimon	Aalborg Univ.

11:30-11:50 MoA06.4
Plug-And-Play Process Control: Improving Control Performance through Sensor Addition and Pre-Filtering (I), pp. 336-341.

Bendtsen, Jan Dimon	Aalborg Univ.
Trangbaek, Klaus	Aalborg Univ.
Stoustrup, Jakob	Aalborg Univ.

11:50-12:10 MoA06.5
Towards Automatic Model Based Controller Design for Reconfigurable Plants (I), pp. 342-346.

Michelsen, Axel Gottlieb	Aalborg Univ.
Stoustrup, Jakob	Aalborg Univ.
Izadi-Zamanabadi, Roozbeh	Aalborg Univ.

12:10-12:30 MoA06.6
On Propagating Requirements and Selecting Fuels for a Benson Boiler (I), pp. 347-352.

Kragelund, Martin	Aalborg Univ.
Wisniewski, Rafal	Aalborg Univ.
Mřlbak, Tommy	DONG Energy
Nielsen, Rene Just	DONG Energy A/S
Edlund, Kristian	Dong Energy

MoA07	310B
Control of Time Invariant Linear Systems (Regular Session)	
Chair: Ozbay, Hitay	Bilkent Univ.
Co-Chair: Davison, Edward J.	Univ. of Toronto

10:30-10:50 MoA07.1
The Servomechanism Problem for Unknown SISO Positive LTI Systems Via Tuning Regulators and Clamping, pp. 353-358.

Roszak, Bartek	Univ. of Toronto
Davison, Edward J.	Univ. of Toronto

10:50-11:10 MoA07.2
Strongly Stabilizing Controller Synthesis for a Class of MIMO Plants,

pp. 359-363.
Ozbay, Hitay — Bilkent Univ.
Gundes, A. Nazli — Univ. of California

11:10-11:30 — MoA07.3
Necessary and Sufficient Conditions for Perfect Command Following and Disturbance Rejection in Fractional Order Systems, pp. 364-369.
Merrikh-Bayat, Farshad — Sharif Uni. of Tech.
Karimi-Ghartemani, Masoud — Univ. of Toronto

11:30-11:50 — MoA07.4
Stability Analysis and Controller Design of Repetitive Control System Based on 2D Hybrid Model, pp. 370-375.
Wu, Min — Central South Univ.
Lan, Yong-Hong — Central South Univ.
She, Jin-Hua — Tokyo Univ. of Tech.
He, Yong — Central South Univ.

11:50-12:10 — MoA07.5
Hit-And-Run: New Design Technique for Stabilization, Robustness and Optimization of Linear Systems, pp. 376-380.
Polyak, Boris T. — Moscow Inst. of Control Sciences
Gryazina, Elena — Moscow Inst. of Physics and Tech.

MoA08 — 310C
Probabilistic Robustness (Regular Session)
Chair: Tempo, Roberto — Pol. di Torino
Co-Chair: Campi, Marco — Univ. of Brescia

10:30-11:10 — MoA08.1
The Scenario Approach for Systems and Control Design, pp. 381-389.
Campi, Marco — Univ. of Brescia
Garatti, Simone — Pol. di Milano
Prandini, Maria — Pol. di Milano

11:10-11:30 — MoA08.2
RACT: Randomized Algorithms Control Toolbox for MATLAB, pp. 390-395.
Tremba, Andrey — Inst. of Control Sciencies
Calafiore, Giuseppe — Pol. di Torino
Dabbene, Fabrizio — Pol. di Torino
Gryazina, Elena — Moscow Inst. of Physics and Tech.
Polyak, Boris T. — Moscow Inst. of Control Sciences
Shcherbakov, P.S. — Moscow Inst. of Control Sciences
Tempo, Roberto — Pol. di Torino

11:30-11:50 — MoA08.3
Stochastic Ellipsoid Methods with Multiple Cuts, pp. 396-401.
Wada, Takayuki — Kobe Univ.
Fujisaki, Yasumasa — Kobe Univ.

11:50-12:10 — MoA08.4
Probabilistic Sorting and Stabilization of Switched Systems, pp. 402-407.
Ishii, Hideaki — Tokyo Inst. of Tech.
Tempo, Roberto — Pol. di Torino

12:10-12:30 — MoA08.5
A Robust Approach to Markov Decision Problems with Uncertain Transition Probabilities, pp. 408-413.
Paschalidis, Ioannis — Boston Univ.
Kang, Seong-Cheol — Boston Univ.

MoA09 — 311C
Identification of Dynamic Errors-In-Variables Models (Invited Session)
Chair: Garnier, Hugues — Univ. Henri Poincaré, Nancy 1
Co-Chair: Wang, Liuping — RMIT Univ.
Organizer: Garnier, Hugues — Univ. Henri Poincaré, Nancy 1
Organizer: Gilson, Marion — Univ. Henri Poincaré, Nancy 1
Organizer: Wang, Liuping — RMIT Univ.

10:30-10:50 — MoA09.1
Comparison of Three Frisch Methods for Errors-In-Variables Identification (I), pp. 414-419.
Hong, Mei — Uppsala Univ.
Soderstrom, Torsten — Uppsala Univ.
Soverini, Umberto — Univ. of Bologna
Diversi, Roberto — Univ. of Bologna

10:50-11:10 — MoA09.2
Statistical Analysis of a Third-Order Cumulants Based Algorithm for Discrete-Time Errors-In-Variables Identification (I), pp. 420-425.
Thil, Stéphane — Nancy-Univ.
Hong, Mei — Uppsala Univ.
Soderstrom, Torsten — Uppsala Univ.
Gilson, Marion — Univ. Henri Poincaré, Nancy 1
Garnier, Hugues — Univ. Henri Poincaré, Nancy 1

11:10-11:30 — MoA09.3
On Instrumental Variable-Based Methods for Errors-In-Variables Model Identification (I), pp. 426-431.
Thil, Stéphane — Nancy-Univ.
Gilson, Marion — Univ. Henri Poincaré, Nancy 1
Garnier, Hugues — Univ. Henri Poincaré, Nancy 1

11:30-11:50 — MoA09.4
Identification of ARARX Models in Presence of Additive Noise (I), pp. 432-437.
Diversi, Roberto — Univ. of Bologna
Guidorzi, Roberto — Univ. of Bologna
Soverini, Umberto — Univ. of Bologna

11:50-12:10 — MoA09.5
Application of Non-Stationary EIV Methods to Transient Electromagnetic Mineral Exploration (I), pp. 438-443.
Lau, Katrina — The Univ. of Newcastle
Braslavsky, Julio H. — The Univ. of Newcastle
Aguero, Juan C — The Univ. of Newcastle
Goodwin, Graham C. — Univ. of Newcastle

12:10-12:30 — MoA09.6
Identifiability of EIV Dynamic Systems with Non-Stationary Data (I), pp. 444-449.
Aguero, Juan C — The Univ. of Newcastle
Goodwin, Graham C. — Univ. of Newcastle

MoA10 — 311B
Prediction, Filtering and Smoothing I (Regular Session)
Chair: Van den Hof, Paul M.J. — Delft Univ. of Tech.
Co-Chair: McKelvey, Tomas — Chalmers Univ. of Tech.

10:30-10:50 — MoA10.1
Robust H_infty Filtering by Means of Lead-Lag Controller, pp. 450-455.
Neveux, Philippe — Univ. d'Avignon et des Pays de Vaucluse
Blanco, Eric — AMPERE Lab.

10:50-11:10 — MoA10.2
Robust Kalman Filter and Smoother for Errors-In-Variables Model with Observation Outliers, pp. 456-461.
ALMutawa, Jaafar — King Fahd Univ. of Petroleum & Minerals

11:10-11:30 — MoA10.3
Direct Design of Optimal Filters from Data, pp. 462-467.
Novara, Carlo — Pol. di Torino
Ruiz, Fredy — Pol. di Torino
Milanese, Mario — Pol. di Torino

11:30-11:50 — MoA10.4
Estimating Cutting Forces in Micromilling by Input Estimation from Closed-Loop Data, pp. 468-473.
Blom, Rogier S. — Delft Univ. of Tech.
Van den Hof, Paul M.J. — Delft Univ. of Tech.

11:50-12:10 — MoA10.5
UKF Based Nonlinear Filtering for Parameter Estimation in Linear Systems with Correlated Noise, pp. 474-479.
Xu, Jiahe — Northeastern Univ.
Kolemisevska-Gugulovska, Tatjana — SS Cyril and Methodius Univ.
Zheng, Xiuping — Northeastern Univ.
Jing, Yuanwei — Northeastern Univ.
Dimirovski, Georgi Marko — Dogus Univ. of Istanbul

12:10-12:30 — MoA10.6
Multi-Sensor Distributed Fusion Filter for Discrete Stochastic Multi-Delayed Systems with Correlated Noise, pp. 480-484.
Sun, Shuli — Heilongjiang Univ.
Lv, Nan — Heilongjiang Univ.

MoA11 — 311A
Nonlinear Systems I (Regular Session)
Chair: Nakamura, Nami — Nara Inst. of Science and Tech.

Co-Chair: Morin, Pascal — INRIA Sophia Antipolis

10:30-10:50 MoA11.1
Extended Moore-Spence Equations Based Reduced Method for Computing Bifurcation Points of Power System Model, pp. 485-490.
An, Yichun — Northeastern Univ.
Zhang, Qingling — Northeastern Univ.
Li, Qin — Northeastern Univ.
Zhang, Daqing — Northeastern Univ.
Duan, Xiao-dong — Dalian Nationalities Univ.
Zheng, Meng — Northeastern Univ.

10:50-11:10 MoA11.2
On Convergence Rate of Second-Order Sliding Mode Control Algorithms, pp. 491-497.
Boiko, Igor — IMB Controls

11:10-11:30 MoA11.3
Nonlinear Modeling of Double-Loop Hysteretic Systems, pp. 498-502.
Pozo, Francesc — Univ. Pol. de Catalunya
Acho, Leonardo — EUETIB-Univ. Pol. of Catalunya
Rodriguez Tsouroudkdissian, Arturo — Pol. Univ. of Catalunya

11:30-11:50 MoA11.4
Transformation from Real Homogeneous Systems of Degree L to Complex Homogeneous Systems of Degree (l, 0), pp. 503-507.
Nakamura, Nami — Nara Inst. of Science and Tech.
Nakamura, Hisakazu — Nara Inst. of Science &Tech.

11:50-12:10 MoA11.5
Stabilization of Trajectories for Systems on Lie Groups. Application to the Rolling Sphere, pp. 508-513.
Morin, Pascal — INRIA Sophia Antipolis
Samson, Claude — INRIA Sophia Antipolis

12:10-12:30 MoA11.6
Stability Analysis on Kuramoto Model of Coupled Oscillators, pp. 514-518.
Wang, Wenxue — Texas Tech. Univ.
Ghosh, Bijoy — Texas Tech. Univ.

MoA12 313
Discrete Event Systems and Petri Nets (Regular Session)
Chair: Cao, Xi-Ren — Hong Kong Univ. of Sci. & Tech.
Co-Chair: Giua, Alessandro — Univ. di Cagliari

10:30-10:50 MoA12.1
Observability of Timed Continuous Petri Nets: A Class of Hybrid Systems, pp. 519-524.
Mahulea, Cristian — Univ. of Zaragoza
Recalde, Laura — Univ. De Zaragoza
Silva, Manuel — Univ. De Zaragoza

10:50-11:10 MoA12.2
The Verification of Real Time Systems Using the TINA Tool, pp. 525-530.
González del Foyo, Pedro Manuel — Univ. de São Paulo
Silva, José Reinaldo — Univ. of São Paulo

11:10-11:30 MoA12.3
Some New Results on Supervisory Control of Petri Nets with Decentralized Monitor Places, pp. 531-536.
Basile, Francesco — Univ. Degli Studi Di Salerno
Giua, Alessandro — Univ. di Cagliari
Seatzu, Carla — Univ. of Cagliari

11:30-11:50 MoA12.4
Predictability of Sequence Patterns in Discrete Event Systems, pp. 537-543.
Jeron, Thierry — INRIA
Marchand, Herve — IRISA/INRIA Rennes
Genc, Sahika — Univ. of Michigan
Lafortune, Stephane — Univ. of Michigan

11:50-12:10 MoA12.5
Modeling of Asynchronous Discrete-Event Systems As Networks of Input-Output Automata, pp. 544-549.
Drueppel, Sebastian — Robert Bosch GmbH, Corp. Sector Res. and Advance Enginee
Lunze, Jan — Ruhr-Univ. Bochum
Fritz, Martin — Robert Bosch GmbH

12:10-12:30 MoA12.6
A Simulation Study of a Reconfigurable Database, pp. 550-555.
Metzler, James — Air Force Res. Lab.
Wu, Neng Eva — Binghamton Univ.

MoA13 314
Distributed Control and Coordination (Regular Session)
Chair: Jumar, Ulrich — ifak - Inst. f. Automation u. Kommunikation
Co-Chair: Hu, Xiaoming — Royal Inst. of Tech.

10:30-10:50 MoA13.1
Systematic Design of Distributed Controllers for Sewer Networks, pp. 556-561.
Alex, Jens — ifak Inst. für Automation und Kommunikation e.V.
Schuetze, Manfred — ifak Magdeburg
Ogurek, Michael — ifak Inst. für Automation und Kommunikation e.V. Magdeburg
Jumar, Ulrich — ifak - Inst. f. Automation u. Kommunikation

10:50-11:10 MoA13.2
Boundedness of Multi-Dimensional Systems Over a Prescribed Frequency Domain, pp. 562-567.
Zhou, Tong — Tsinghua Univ.

11:10-11:30 MoA13.3
A Robust Control Method for Electrostatic Microbeam Dynamic Shaping with Capacitive Detection, pp. 568-573.
Kharrat, Chady — CEA
Colinet, Eric — CEA
Besancon-Voda, Alina — LAG-ENSIEG

11:30-11:50 MoA13.4
Distributed Control with Integral Quadratic Constraints, pp. 574-580.
Fang, Hui — Univ. of Notre Dame
Antsaklis, Panos J. — Univ. of Notre Dame

11:50-12:10 MoA13.5
Connectivity Constrained Multi-UGV Surveillance, pp. 581-586.
Anisi, David A. — Royal Inst. of Tech. (KTH)
Hu, Xiaoming — Royal Inst. of Tech.
Ogren, Petter — Swedish Defence Res. Agency (FOI)

12:10-12:30 MoA13.6
Cooperative Surveillance of a Moving Target Using a Formation Framework, pp. 587-592.
Woo, Sangbum — Univ.
Jayasuriya, Suhada — Texas A&M Univ.

MoA14 318
Networked Systems: Sensing, Estimation, Consensus and Control Over Networks (Invited Session)
Chair: Shi, Ling — California Inst. of Tech.
Co-Chair: Johansson, Karl Henrik — Royal Inst. of Tech.
Organizer: Shi, Ling — California Inst. of Tech.
Organizer: Johansson, Karl Henrik — Royal Inst. of Tech.
Organizer: Murray, Richard M. — California Inst. of Tech.

10:30-10:50 MoA14.1
Biologically-Inspired Navigation Strategies for Swarm Intelligence Using Spatial Gaussian Processes (I), pp. 593-598.
Choi, Jongeun — Michigan State Univ.
Lee, Joonho — Michigan State Univ.
Oh, Songhwai — Univ. of California, Berkeley

10:50-11:10 MoA14.2
Stabilizing Sampled-Data Linear Systems with Markovian Packet Losses and Random Sampling (I), pp. 599-604.
Xie, Li — Beijing Inst. of Thchnology
Xie, Lihua — Nanyang Tech. Univ.

11:10-11:30 MoA14.3
Estimation Over Wireless Sensor Networks: Tradeoff between Communication, Computation and Estimation Qualities (I), pp. 605-611.
Shi, Ling — California Inst. of Tech.
Johansson, Karl Henrik — Royal Inst. of Tech.
Murray, Richard M. — California Inst. of Tech.

11:30-11:50 MoA14.4
Using Hierarchical Decomposition to Speed up Average Consensus

(I), pp. 612-618.
Epstein, Michael — Caltech
Lynch, Kevin M. — Northwestern Univ.
Johansson, Karl Henrik — Royal Inst. of Tech.
Murray, Richard M. — California Inst. of Tech.

11:50-12:10 — MoA14.5
Experimental Evaluation of Power Control Algorithms for Wireless Sensor Networks (I), pp. 619-624.
Park, Pan Gun — School of Electrical Engineering, KTH
Fischione, Carlo — Royal Inst. of Tech.
Johansson, Karl Henrik — Royal Inst. of Tech.

12:10-12:30 — MoA14.6
Networked Stabilization of Multi-Input Systems with Channel Resource Allocation (I), pp. 625-630.
Gu, Guoxiang — Louisiana State Univ.
Qiu, Li — Hong Kong Univ. of Sci. & Tech.

MoA15 — 317
Monitoring & Sensing in Agriculture (Regular Session)
Chair: Blanke, Mogens — Tech. Univ. of Denmark
Co-Chair: Kaizu, Yutaka — Hokkaido Univ.

10:30-10:50 — MoA15.1
On-Line Microwave Measurement of the Moisture Content of Wheat, pp. 631-635.
Mellmann, Jochen — Leibniz-Inst. für Agrartechnik Potsdam-Bornim e.V. (ATB)

10:50-11:10 — MoA15.2
Potential of Vis/NIR Spectroscopy in Estimating ATP Content Per Protoplast As an Indicator of Freshness of Spinach, pp. 636-640.
Ye, Xujun — The Univ. of Tokyo
Oshita, Seiichi — The Univ. of Tokyo
Jin, Xiannu — The Univ. of Tokyo
Makino, Yoshio — The Univ. of Tokyo
Kawagoe, Yoshinori — The Univ. of Tokyo

11:10-11:30 — MoA15.3
Image Processing and Roughness Analysis As a Tool for Quantification of Physiological Well-Being in Plants: Results for Sunagoke Moss, pp. 641-646.
Ondimu, Stephen Nyarindo — Osaka Prefecture Unversity (Phd-student)

11:30-11:50 — MoA15.4
Incorporating Artificial Human Mentality (Kansei) in Intelligent Monitoring of Production Scheme for Customized Agro-Industrial Produce, pp. 647-652.
Ushada, Mirwan — Osaka Prefecture Univ. Japan, Graduate School of Lifeand En

11:50-12:10 — MoA15.5
Spatial Information Analysis of Grass-Land Using Information Technology, pp. 653-657.
Kang, Tae-Hwan — Hokkaido Univ.
Hayami, Atsuro — Hokkaido Univ.
Kaizu, Yutaka — Hokkaido Univ.
Noguchi, Noboru — Hokkaido Univ.

12:10-12:30 — MoA15.6
Oestrus Detection in Dairy Cows Using Likelihood Ratio Tests, pp. 658-663.
Jónsson, Ragnar Ingi — Tech. Univ. of Denmark
Björgvinsson, Trausti — Tech. Univ. of Denmark
Blanke, Mogens — Tech. Univ. of Denmark
Poulsen, Niels K. — The Tech. Univ. of Denmark
Hřjsgaard, Sřren — Aarhus Univ.
Munksgaard, Lene — Univ. of Aarhus

MoA16 — 316
Economic and Management Systems I (Regular Session)
Chair: Iggidr, Abderrahman — INRIA & Univ. of Metz
Co-Chair: Miyamoto, Toshiyuki — Osaka Univ.

10:30-10:50 — MoA16.1
An Energy Distribution Decision Method in Distributed Energy Management Systems with Several Agents, pp. 664-669.
Sugimoto, Yohei — Osaka Univ.
Miyamoto, Toshiyuki — Osaka Univ.
Kumagai, Sadatoshi — Osaka Univ.
Mori, Kazuyuki — Mitsubishi Electric Corp.
Kitamura, Shoichi — Mitsubishi Electric Corp.
Yamamoto, Takaya — Mitsubishi Electric Corp.

10:50-11:10 — MoA16.2
Hierarchical Nash-Cournot Q-Learning in Electricity Markets, pp. 670-675.
Sahraei Ardakani, Mostafa — CIPCE, School of Ec. Coll. of Engineering, Univ. of Tehr
Rahimi-Kian, Ashkan — Univ. of Tehran
Nili Ahmadabadi, Majid — Tehran Univ.

11:10-11:30 — MoA16.3
A Nonlinear Observer for a Fishery Model, pp. 676-681.
Guiro, Aboudramane — Univ. of Ouagadougou
Iggidr, Abderrahman — INRIA & Univ. of Metz
Ngom, Diene — Univ. Gaston Berger
Toure, Hamidou — Univ. of Ouagadougou

11:30-11:50 — MoA16.4
Investigation into the Use of Autoencoder Neural Networks, Principal Component Analysis and Support Vector Regression in Estimating Missing HIV Data, pp. 682-689.
Marivate, Vukosi Ntsakisi — Univ. of the Witwatersrand
Nelwamondo, Fulufhelo Vincent — Univ. of the Witwatersrand
Marwala, Tshilidzi — The Univ. of the Witwatersrand

11:50-12:10 — MoA16.5
Modelling of Business System Development on the Bases of Petri Nets and Graphs of Increments, pp. 690-694.
Yuditskiy, Semen — Inst. of Control Sciences RAS
Zheltova, Ludmila — Case Western Res. Univ.
Muradyan, Igor — Inst. of Control Sciences

12:10-12:30 — MoA16.6
Some Models of Dynamic Cognitive Maps with Qualitative Scales of Factors Values, pp. 695-699.
Markovskii, Alexei — Trapeznikov Inst. of Control Sciences, Russian Acad.

MoA17 — 320A
Steel Making (Highlight Session)
Chair: Asano, Kazuya — JFE R&D Corp.
Co-Chair: Lee, Dukman — POSCO

10:30-10:50 — MoA17.1
Control Issues in Continuous Casting of Steel (I), pp. 700-705.
Furtmueller, Christian — Johannes Kepler Univ. Linz
Del Re, Luigi — Johannes Kepler Univ.

10:50-11:10 — MoA17.2
Study on Mold Level Stabilization Techniques in Continuous Casting Machine (I), pp. 706-707.
Lee, Dukman — POSCO
Kim, GooHwa — POSCO
Park, Haedoo — POSCO

11:10-11:30 — MoA17.3
Rapid Oxide Inclusion Determination Method for Steel (I), pp. 708-709.
Shin, Yong_Tae — Tech. Res. Lab. POSCO

11:30-11:50 — MoA17.4
A Novel Flow Rate Estimation Method Using Extended Kalman Filter and Sensor Dynamics Compensation with Automatic Casting Pouring Process (I), pp. 710-715.
Noda, Yoshiyuki — Toyohashi Univ. of Tech.
Matsuo, Yusuke — Toyohashi Univ. of Tech.
Terashima, Kazuhiko — Toyohashi Univ. of Tech.
Zheng, Yufan — Univ. of Melbourne

11:50-12:10 — MoA17.5
Modeling of Critical Carbon Content in Decarburization in BOF and Its Application to Dynamic Control Model (I), pp. 716-717.
Iwamura, Ken — Sumitomo Metal IndustriesLtd.
Sakai, Kouichi — Sumitomo Metal IndustriesLtd
Kikuchi, Jun — Sumitomo Metal IndustriesLtd.
Kitada, Hiroshi — Sumitomo Metal Ind., Ltd.

12:10-12:30 — MoA17.6
Advanced Process Manipulation of Magnesia Sintering, pp. 718-723.
Kostial, Imrich — Tech. Univ. of Kosice
Mikula, Jan — Tech. Univ. of Kosice
Spisak, Jan — Tech. Univ. of Kosice

Glocek, Jan — Tech. Univ. of Kosice
Nemcovsky, Pavol — Tech. Univ. of Kosice
Terpak, Jan — Tech. Univ. of Kosice

MoA18 320B
Ubiquitous Robotic Companion (Highlight Session)
Chair: You, Bum-Jae — Korea Inst. of Science and Tech. (KIST)
Co-Chair: Yu, Wonpil — ETRI
Organizer: You, Bum-Jae — Korea Inst. of Science and Tech. (KIST)

10:30-10:50 MoA18.1
Network-Based Humanoids 'MAHRU' As Ubiquitous Robotic Companion (I), pp. 724-729.
You, Bum-Jae — Korea Inst. of Science and Tech. (KIST)
Kim, ChangHwan — Korea Inst. of Science and Tech.
Oh, Yonghwan — Korea Inst. of Science & Tech. Korea
Jeong, Mun-Ho — Korea Inst. of Science and Tech.
Kim, Doik — Korea Inst. of Science and Tech. (KIST)
Oh, Sang-Rok — Korea Inst. of Science and Tech.

10:50-11:10 MoA18.2
Imitation Learning of Robot Movement Using Evolutionary Algorithm (I), pp. 730-735.
Park, Galam — 1) korea Univ. seoul 2) Korea Inst. ofScienceandTechno
Ra, Syungkwon — Korea Inst. of Science and Tech.
Kim, ChangHwan — Korea Inst. of Science and Tech.
Song, Jae-Bok — Korea Univ.

11:10-11:30 MoA18.3
An Online Optimal Path Decoder for HMM towards Connected Hand Gesture Recognition (I), pp. 736-741.
Mazumdar, Monalisa — Korea Inst. of Science and Tech.
Jeong, Mun-Ho — Korea Inst. of Science and Tech.
You, Bum-Jae — Korea Inst. of Science and Tech. (KIST)

11:30-11:50 MoA18.4
Localization Algorithm for a Mobile Robot Using Igs (I), pp. 742-747.
Seo, DaeGeun — Pusan National Univ.
Lee, JangMyung — Pusan National Univ.

11:50-12:10 MoA18.5
Development of Industrial Autonomous Mobile Robot for Part Handling in Machine Tool Industry (I), pp. 748-749.
Won, Jong Beom — SMEC Co. LTD
Byun, Kyung Seok — Mokpo National Univ.
Lee, Sung-uk — Korea Atomic Energy Res. Inst.
Choi, Jong Kap — SMEC Co. LTD

MoA19 320C
Robotic Mechanism I (Regular Session)
Chair: Marchand, Nicolas — GIPSA-Lab. CNRS
Co-Chair: Hoshi, Yoshikatsu — Musashi Inst. of Tech.

10:30-10:50 MoA19.1
Motion Control of a Three-Dimensional Eel-Like Robot without Pectoral Fins, pp. 750-755.
El Rafei, Maher — GIPSA-Lab.
Alamir, Mazen — Gipsa-Lab. (CNRS-Univ. of Grenoble)
Marchand, Nicolas — GIPSA-Lab. CNRS
Porez, Mathieu — IRCCyN
Boyer, Frederic — Ec. des Mines de Nantes

10:50-11:10 MoA19.2
Analysis and Control of a Capsubot, pp. 756-761.
Liu, Yang — Staffordshire Univ.
Yu, Hongnian — Staffordshire Univ.
Yang, T. C. — Univ. of Sussex

11:10-11:30 MoA19.3
A Marsupial Robotic Fish System, pp. 762-766.
Zhou, Chao — Inst. of Automation,Chinese Acad. of Sciences
Cao, Zhiqiang — Inst. of Automation,Chinese Acad. of Sciences
Wang, Shuo — Chinese Acad. of Sciences
Tan, Min — Inst. of Automation, Chinese Acad. of Sciences

11:30-11:50 MoA19.4
Analysis of Coupled Van Der Pol Oscillators and Implementation to a Myriapod Robot, pp. 767-772.
Kuwata, Naoki — Musashi Inst. of Tech.
Hoshi, Yoshikatsu — Musashi Inst. of Tech.
Nohara, Ben T. — Musashi Inst. of Tech.

11:50-12:10 MoA19.5
The Artificial Muscle As an Innovative Actuator in Rehabilitation Robotics, pp. 773-778.
Knestel, Markus — Univ. of Ulm

12:10-12:30 MoA19.6
An Aerostat Positioning System with Cable Control, pp. 779-784.
Lambert, Casey — Tokyo Univ.
Nahon, Meyer — McGill Univ.

MoA20 321C
Flying Robot I (Regular Session)
Chair: Sasiadek, Jurek Z — Carleton Univ.
Co-Chair: Kendoul, Farid — Univ. of Tech. of Compičgne

10:30-10:50 MoA20.1
Yaw Control of RUAVs _; an Adaptive Robust H_; Control Method, pp. 785-790.
Zhao, Xingang — Shenyang Inst. of Automation,CAS
Han, Jianda — Shenyang Inst. of Automation

10:50-11:10 MoA20.2
Nonlinear Control for UAV Formation Flying, pp. 791-796.
Sasiadek, Jurek Z — Carleton Univ.
Necsulescu, Dan Sorin — Univ. of Ottawa

11:10-11:30 MoA20.3
Adaptive Vision-Based Controller for Small Rotorcraft UAVs Control and Guidance, pp. 797-802.
Kendoul, Farid — Univ. of Tech. of Compičgne
Fantoni, Isabelle — Univ. de Tech. de Compiegne
Lozano, Rogelio — Univ. de Tech. de Compiegne

11:30-11:50 MoA20.4
Autonomous Hovering of a Noncyclic Tiltrotor UAV: Modeling, Control and Implementation, pp. 803-808.
Sanchez, Anand — Univ. de Tech. de Compiegne
Escareńo-Castro, Juan — Univ. of Compiegne
Garcia-Salazar, Octavio — Univ. de Tech. de Compičgne
Lozano, Rogelio — Univ. de Tech. de Compiegne

11:50-12:10 MoA20.5
Tail-Sitter UAV Having One Tilting Rotor: Modeling, Control and Real-Time Experiments, pp. 809-814.
Garcia-Salazar, Octavio — Univ. de Tech. de Compičgne
Sanchez, Anand — Univ. de Tech. de Compiegne
Escareńo-Castro, Juan — Univ. of Compiegne
Lozano, Rogelio — Univ. de Tech. de Compiegne

12:10-12:30 MoA20.6
Dynamic-Fuzzy-Neural-Networks-Based Control of an Unmanned Aerial Vehicle, pp. 815-820.
Tang, Zhe — Nanyang Tech. Univ.
Er, Meng Joo — NTU
Zhou, Yi — Singapore Pol.

MoA21 321B
Servo Control for Storage Systems and Precision Devices I (Invited Session)
Chair: Yamaguchi, Takashi — Hitachi Global Storage Tech.
Co-Chair: Messner, William — Carnegie Mellon Univ.
Organizer: Yamaguchi, Takashi — Hitachi Global Storage Tech.

10:30-11:10 MoA21.1
HDD Servo Control Technologies - What We Have Done and Where We Should Go - (I), pp. 821-826.
Yamaguchi, Takashi — Hitachi Global Storage Tech.
Atsumi, Takenori — Hitachi, Ltd.

11:10-11:30 MoA21.2
Disturbance Suppression Beyond Nyquist Frequency in Hard Disk Drives (I), pp. 827-832.
Atsumi, Takenori — Hitachi, Ltd.

11:30-11:50 MoA21.3

A μ-Synthesis Approach to Guaranteed Cost Control of Track-Following Servos (I), pp. 833-838.
Conway, Richard — Univ. of California, Berkeley
Horowitz, Roberto — Univ. of California at Berkeley

11:50-12:10 MoA21.4
An Iterative Learning Control Design for Self-Servowriting in Hard Disk Drives (I), pp. 839-844.
Wu, Shang-Chen — Univ. of California at Berkeley
Tomizuka, Masayoshi — Univ. of California, Berkeley

12:10-12:30 MoA21.5
Position Error Signal Based Control Designs for Control of Self-Servo Track Writer (I), pp. 845-850.
Oh, Sehoon — the Univ. of Tokyo
Hori, Yoichi — Univ. of Tokyo

MoA22 321A
Design and Control of Mechatronic Machines (Regular Session)
Chair: Singhose, William E. — Georgia Inst. of Tech.
Co-Chair: Lee, Ju-Il — Seagate Res.

10:30-10:50 MoA22.1
Educational Strategy Based on Active Learning for Mechatronics Labs, pp. 851-856.
Ramirez-Cadena, Miguel — Monterrey Inst. of Tech. (ITESM)
Vargas-Rodrigez, Rodrigo — Tecnológico de Monterrey
Morales-Menendez, Ruben — Tecnologico de Monterrey, Campus Monterrey
Guedea, Federico — Univ. of Waterloo, ITESM

10:50-11:10 MoA22.2
Design and Control of an Electromagnetically Actuated Punch, pp. 857-862.
Dagen, Matthias — Leibniz Univ. Hannover
Heimann, Bodo — Univ. of Hannover
Javadi, Mohsen — Univ. of Hannover
Behrens, Bernd-Arno — Inst. of Metal Forming and Metal-Forming Machines

11:10-11:30 MoA22.3
A Mechatronic System Architecture for the Development of Flexible Materials Handling Systems, pp. 863-868.
Walker, Anthony John — Univ. of KwaZulu-Natal
Bright, Glen — Univ. of KwaZulu Natal

11:30-11:50 MoA22.4
A New Control Strategy for Trajectory Tracking of Fire-Rescue Turntable Ladders, pp. 869-874.
Zimmert, Nico — Univ. of Stuttgart
Kharitonov, Alexander — Univ. of Stuttgart
Sawodny, Oliver — Univ. of Stuttgart

11:50-12:10 MoA22.5
Passivity Based Control and Time Optimal Trajectory Planning of a Single Mast Stacker Crane, pp. 875-880.
Staudecker, Martin — Johannes Kepler Univ. Linz
Schlacher, Kurt — Johannes Kepler Univ. of Linz
Hansl, Rudolf — TGW Transportgeraete GmbH

12:10-12:30 MoA22.6
A Multi-Operational-Mode Anti-Sway and Positioning Control for an Industrial Bridge Crane, pp. 881-888.
Sorensen, Khalid — Georgia Inst. of Tech.
Fisch, Hannes — Zurich Univ. of applied Sciences
Dickerson, Stephen L. — Georgia Inst. of Tech.
Singhose, William E. — Georgia Inst. of Tech.
Glauser, Urs — Zurich Univ. of Applied Sciences

MoA23 323
Large Scale and Complex Systems: Applications I (Regular Session)
Chair: Borne, Pierre — Lail
Co-Chair: Dourado, Antonio — Univ. of Coimbra

10:30-10:50 MoA23.1
Transfer Functions for Natural Gas Pipeline Systems, pp. 889-894.
Aalto, Hans Rauno Mikael — Neste Jacobs Oy

10:50-11:10 MoA23.2
Coordination of Cooperative Search and Rescue Robots for Disaster Relief, pp. 895-900.
Lau, Henry — The Univ. of Hong Kong

11:10-11:30 MoA23.3
Proposition of Completeness Property to Perform the Plant Modelling for Manufacturing Applications, pp. 901-906.
Rohee, Benoit — Univ. de Reims
Carre-Menetrier, Veronique — UFR SCIENCES EXACTES ET NATURELLES DE REIMS - Univ. DE REIM
Riera, Bernard — Reims Univ.

11:30-11:50 MoA23.4
Maintenance Decision Making Tool Reaching a Compromise between Maintainability and Reliability Performances, pp. 907-912.
Thomas, Edouard — Univ.
Levrat, Eric — Univ.
Iung, Benoît — Nancy Univ.

11:50-12:10 MoA23.5
Real Time Balancing of Complex Disassembly Lines, pp. 913-918.
Duta, Luminita — Valahia State Univ.
Filip, Florin Gheorghe — Romanian Acad.
Caciula, Ion — Valahia State Univ.

12:10-12:30 MoA23.6
Dealing with Mutual Exclusion Sections in Production Systems: From Shared Resources to Parallel TEG's, pp. 919-924.
Boutin, Olivier — École Centrale de Nantes
Cottenceau, Bertrand — Univ. of Angers, FRANCE
L'Anton, Anne — IUT de Nantes

MoA24 324
Control and Monitoring of Semiconductor Manufacturing (Invited Session)
Chair: Ho, Weng Khuen — National Univ. of Singapore
Co-Chair: Adomaitis, Raymond — Univ. of Maryland
Organizer: Ho, Weng Khuen — National Univ. of Singapore
Organizer: Qin, S. Joe — Univ. of Southern California

10:30-10:50 MoA24.1
Critical Dimension and Real-Time Temperature Control for Warped Wafers (I), pp. 925-930.
Ho, Weng Khuen — National Univ. of Singapore
Tay, Arthur — National Univ. of Singapore
Fu, Jun — National Univ. of Singapore
Chen, Ming — National Univ. of Singapore
Feng, Yong — National Univ. of Singapore

10:50-11:10 MoA24.2
Uniformity Control in Planetary Chemical Vapor Deposition Reactor Systems (I), pp. 931-935.
Adomaitis, Raymond — Univ. of Maryland

11:10-11:30 MoA24.3
EWMA Controller Tuning and Performance Evaluation in a High Mixed System (I), pp. 936-939.
Ma, Mingda — Harbin Inst. of Tech.
Chang, Chun-Cheng — National Tsing-Hua Univ.
Wong, David, S.H. — National Tsing-Hua Univ.
Jang, Shi-Shang — National Tsing-Hua Univ.

11:30-11:50 MoA24.4
Information Flow Based Decomposition of Decision-Making Problems Involving Partial Observability (I), pp. 940-945.
Agrawal, Rakshita — Georgia Inst. of Tech.
Lee, Jay — Georgia Tech.
Realff, Matthew J. — Georgia Inst. of Tech.

11:50-12:10 MoA24.5
Temperature Cycling for Photoresist Processing (I), pp. 946-951.
Wang, Yuheng — National Univ. of Singapore
Chua, HuiTong — The Univ. of Western Australia
Tay, Arthur — National Univ. of Singapore
Fang, Zhong Ping — Singapore Insititute of Manufacturing Tech.

MoA25 328
Applications of Nonlinear Optimization Based and Predictive Control (Invited Session)
Chair: Engell, Sebastian — Univ. of Dortmund
Co-Chair: Findeisen, Rolf — Univ. of Stuttgart
Organizer: Findeisen, Rolf — Univ. of Stuttgart
Organizer: Engell, Sebastian — Univ. of Dortmund

10:30-10:50 MoA25.1
Hybrid Predictive Control of a Solar Air Conditioning Plant (I), pp. 952-957.

Rodriguez, Miguel — Univ. of Valladolid
de Prada, Cesar — Univ. of Valladolid
Capraro, Flavio — Univ. Nacional de San Juan (UNSJ)
Cristea, Smaranda — Univ. of Valladolid
De Keyser, Robin M.C. — Ghent Univ.

10:50-11:10 MoA25.2
Robust Control of the Distributed Solar Collector Field ACUREX Using MPC for Tracking. (I), pp. 958-963.
Alvarado, Ignacio — Univ. of Seville
Limon, Daniel — Univ. de Sevilla
Alamo, Teodoro — Univ. de Sevilla
Arahal, Manuel R. — Univ. de Sevilla
Camacho, Eduardo — Univ. of Seville

11:10-11:30 MoA25.3
Engineering of Online Optimizing Control - a Case Study: Reactive SMB Chromatography (I), pp. 964-969.
Kuepper, Achim — Biochemical anc Chemical Engineering, Univ. Dortmund
Engell, Sebastian — Univ. of Dortmund

11:30-11:50 MoA25.4
Model Based Control Approach for Batch Crystallization Product Design (I), pp. 970-975.
Nagy, Zoltan K. — Loughborough Univ.

11:50-12:10 MoA25.5
On Useful Redundancy in Dynamic Inverse Problems Related Optimization (I), pp. 976-981.
Alamir, Mazen — Gipsa-Lab. (CNRS-Univ. of Grenoble)

12:10-12:30 MoA25.6
An Industrial Implementation of a Generic NMPC Controller with Application to a Batch Process (I), pp. 982-987.
Pluymers, Bert — IPCOS
Ludlage, Jobert — IPCOS B.V.
Ariaans, Leon — IPCOS
Van Brempt, Wim — IPCOS

MoA26 327
Cold Rolling and Tension Control (Regular Session)
Chair: Craig, Ian — Univ. of Pretoria
Co-Chair: Knittel, Dominique — IPST - Univ. Strasbourg I

10:30-10:50 MoA26.1
Optimum Feedback Controller Design for Tandem Cold Metal Rolling, pp. 988-993.
Pittner, John — Univ. of Pittsburgh
Simaan, Marwan A. — Univ. of Pittsburgh

10:50-11:10 MoA26.2
Modelling and Control of Consumable Double-Electrode Gas Metal Arc Welding Process, pp. 994-999.
Li, Kehai — Univ. of Kentucky
Zhang, Y. M. — Univ. of Kentucky

11:10-11:30 MoA26.3
Grinding Mill Circuits - a Survey of Control and Economic Concerns, pp. 1000-1005.
Wei, Donghui — Univ. of Pretoria, South Africa
Craig, Ian — Univ. of Pretoria

11:30-11:50 MoA26.4
Improved Drive Control for Multi-Stand Cold Rolling Mills, pp. 1006-1011.
Soler, Nicolas — Univ. of Tech. Darmstadt
Isermann, Rolf — Univ. of Tech. Darmstadt
Feldmann, Frank — ABB Automation GmbH

11:50-12:10 MoA26.5
Modeling and H-Infinty Low Order Control of Web Handling Systems with a Pendulum Dancer, pp. 1012-1017.
Vedrines, Marc — INSA Strasbourg
Knittel, Dominique — IPST - Univ. Strasbourg I

12:10-12:30 MoA26.6
H-Infinity-Based PI-Observers for Web Tension Estimation in Industrial Unwinding - Winding Systems, pp. 1018-1023.
Gassmann, Vincent — Univ. of Strasbourg
Knittel, Dominique — IPST - Univ. Strasbourg I

MoA28 330A
Benchmark for Engine Cold Start (Invited Session)
Chair: Shen, Tielong — Sophia Univ.
Co-Chair: Jimbo, Tomohiko — Toyota Central R&D Lab. inc.
Organizer: Shen, Tielong — Sophia Univ.
Organizer: Ohata, Akira — Toyota Motor Corp.

10:30-10:50 MoA28.1
Physical-Model-Based Control of Engine Cold Start Via Role State Variables (I), pp. 1024-1029.
Jimbo, Tomohiko — Toyota Central R&D Lab. inc.
Hayakawa, Yoshikazu — Nagoya Univ.

10:50-11:10 MoA28.2
The Cold Starting Control of Engine Using Large Scale Database-Based Online Modelling (I), pp. 1030-1035.
Ogawa, Masatoshi — Waseda Univ.
Ogai, Harutoshi — Professor (Waseda Univ.

11:10-11:30 MoA28.3
Starting Speed Control of SI Engine Based on Extremum Seeking Control (I), pp. 1036-1041.
Sugihira, Shigehiro — Keio Univ.
Kitazono, Shinya — Keio Univ.
Ohmori, Hiromitsu — Keio Univ.

11:30-11:50 MoA28.4
Model-Based Cold-Start Speed Control Design for SI Engines (I), pp. 1042-1047.
Zhang, Jiangyan — Sophia Univ.
Shen, Tielong — Sophia Univ.
Marino, Riccardo — Univ. di Roma Tor Vergata

11:50-12:10 MoA28.5
Introduction to the Benchmark Challenge on SICE Engine Start Control Problem (I), pp. 1048-1053.
Ohata, Akira — Toyota Motor Corp.
Shen, Tielong — Sophia Univ.
Ito, Kazuhisa — Tottori Univ.
Kako, Junichi — Toyota Motor Corp.

MoA29 330B
Model-Based Development for Automotive Control Systems (Invited Session)
Chair: Ohata, Akira — Toyota Motor Corp.
Co-Chair: Oho, Shigeru — Hitachi Ltd.
Organizer: Ohata, Akira — Toyota Motor Corp.

10:30-10:50 MoA29.1
High-Level Physical Modeling Description and Symbolic Computing (I), pp. 1054-1055.
Bakus, Jan — Maplesoft
Bernardin, Laurent — Maplesoft
Gerhard, Juergen — Maplesoft
Kowalska, Kaska — Maplesoft
Léger, Mathieu — Maplesoft
Wittkopf, Allan — Maplesoft

10:50-11:10 MoA29.2
Verification and Validation Integrated within Processes Using Model-Based Design (I), pp. 1056-1061.
Hayhurst, Chris — The MathWorks
Murphy, Brett — The MathWorks
Anderson, Richard — The MathWorks
Mohtadi, Coourous — The MathWorks
Friedman, Jon — The MathWorks
Mosterman, Pieter — The MathWorks, Inc.

11:10-11:30 MoA29.3
Improving Model-Based Design for Automotive Control Systems Development (I), pp. 1062-1065.
Ohata, Akira — Toyota Motor Corp.
Butts, Kenneth R. — Toyota Tech. Center, USA

11:30-11:50 MoA29.4
Excitation Signals for Nonlinear Dynamic Modeling of Combustion Engines (I), pp. 1066-1067.
Baumann, Wolf — IAV
Schaum, Steffen — IAV GmbH
Roepke, Karsten — IAV GmbH
Knaak, Mirko — IAV GmbH

11:50-12:10 MoA29.5
Model-Based Implementation Design of Automotive Controllers (I), pp. 1068-1069.
Oho, Shigeru — Hitachi Ltd.

MoA30 330C
Low Altitude Flight and Landing Control (Invited Session)

Chair: Nebylov, Alexander — State Univ. of Aerospace Inst.
Co-Chair: Silvestre, Carlos — Inst. Superior Tecnico
Organizer: Nebylov, Alexander — State Univ. of Aerospace Inst.

10:30-10:50 MoA30.1
Wig-Craft Marine Landing Control at Rough Sea (I), pp. 1070-1075.
Nebylov, Vladimir — State Univ. of Aerospace Inst.
Nebylov, Alexander — State Univ. of Aerospace Inst.

10:50-11:10 MoA30.2
Terrain Avoidance Model Predictive Control for Autonomous Rotorcraft (I), pp. 1076-1081.
Guerreiro, Bruno Joao Nogueira — Inst. Superior Tecnico
Silvestre, Carlos — Inst. Superior Tecnico
Cunha, Rita — Inst. Superior Técnico, Inst. for Systems and

11:10-11:30 MoA30.3
Wing-In-Ground Effect Flight Control: New Role of Automatic Systems (I), pp. 1082-1087.
Nebylov, Alexander — State Univ. of Aerospace Inst.

11:30-11:50 MoA30.4
Development of an Automatic Height Control System for Wig Crafts (I), pp. 1088-1092.
Davila, Daniel — National Armed Forces Univ. of Venezuela

11:50-12:10 MoA30.5
Glidepath Command Generation and Tracking for Longitudinal Autolanding, pp. 1093-1098.
Ju, Hann-Shing — National Chung-Hsing Univ.
Tsai, Ching-Chih — National Chung-Hsing Univ.

12:10-12:30 MoA30.6
Sliding Mode Control of Pitch-Rate of an F-16 Aircraft, pp. 1099-1104.
Promtun, Ekprasit — San Diego State Univ.
Seshagiri, Sridhar — San Diego State Univ.

MoB02 304A
Stability Analysis (Regular Session)

Chair: Monnigmann, Martin — Tech. Univ. Braunschweig
Co-Chair: Kim, Kyung-Soo — Korea Advanced Inst. of Science and Tech.

14:00-14:20 MoB02.1
French Champagne and Belgian Chocolate Problems in Simultaneous Stabilization of Linear Systems, pp. 1105-1110.
He, Guannan — Chinese Acad. of Sciences
Wang, Long — Peking Univ.
Yu, Wensheng — Chinese Acad. of Sciences

14:20-14:40 MoB02.2
Polynomial Lyapunov Functions for Exponential Stability of Nonlinear Systems on Bounded Regions, pp. 1111-1116.
Peet, Matthew M — INRIA - Rocquencourt
Bliman, Pierre-Alexandre J — INRIA-Rocquencourt

14:40-15:00 MoB02.3
Positive Invariance Tests with Efficient Hessian Matrix Eigenvalue Bounds, pp. 1117-1122.
Monnigmann, Martin — Tech. Univ. Braunschweig

15:00-15:20 MoB02.4
On Stability Properties of Nonlinear Time-Varying Systems by Semi-Definite Time-Varying Lyapunov Candidates, pp. 1123-1128.
Wang, Zhi Ming — East China Normal Univ.
Tan, Ying — The Univ. of Melbourne
Wang, Gexia — East China Normal Univ.
Nesic, Dragan — Univ. of Melbourne

15:20-15:40 MoB02.5
A Lyapunov Approach for Discrete-Time Sliding Hyperplane Design and Robust Sliding Mode Control Using MROF, pp. 1129-1134.
Kim, Kyung-Soo — Korea Advanced Inst. of Science and Tech.
Bandyopadhyay, Bijnan — IIT Bombay

15:40-16:00 MoB02.6
Design of ISS-Lyapunov Functions for Discrete-Time Linear Uncertain Systems, pp. 1135-1140.
Muńoz de la Peńa, David — Univ. de Sevilla
Alamo, Teodoro — Univ. de Sevilla
Lazar, Mircea — Eindhoven Univ. of Tech.
Heemels, Maurice — Tech. Univ. Eindhoven

MoB03 304B
Control of Constrained Systems I (Regular Session)

Chair: Turner, Matthew C. — Univ. of Leicester
Co-Chair: Akasaka, Noriyuki — Kurume National Coll. of Tech.

14:00-14:20 MoB03.1
Design of Piecewise Linear LQ Control for Linear Systems with Rate Saturations Using LMI Optimization, pp. 1141-1146.
Akasaka, Noriyuki — Kurume National Coll. of Tech.

14:20-14:40 MoB03.2
Probabilistic Assurance of Constraint Fulfillment against Model Uncertainties and Disturbances, pp. 1147-1152.
Hatanaka, Takeshi — Tokyo Inst. of Tech.
Takaba, Kiyotsugu — Kyoto Univ.

14:40-15:00 MoB03.3
Robust Control for Uncertain Linear Systems with State and Control Constraints, pp. 1153-1158.
Ayad, Hassan — Univ. caddi ayyad Faculty of Sciences and Tech.
Mesquine, Fouad — Cadi Ayyad Univ.
Ait Rami, Mustapha — Facultad de Ciencias, Univ. de Valladolid

15:00-15:20 MoB03.4
Stabilizing Reduced Order Model Predictive Control for Constrained Linear Systems, pp. 1159-1164.
Hara, Naoyuki — Tokyo Metropolitan Univ.
Kojima, Akira — Tokyo Metropolitan Univ.

15:20-15:40 MoB03.5
Practical Considerations for Override Compensator Synthesis and Implementation, pp. 1165-1170.
March, Phil — Univ. of Leicester
Turner, Matthew C. — Univ. of Leicester

15:40-16:00 MoB03.6
Geometric Analysis of a Class of Constrained Mechanical Control Systems in the Nonzero Velocity Setting, pp. 1171-1176.
Nightingale, Jason — Univ. of Notre Dame
Hind, Richard — Univ. of Notre Dame
Goodwine, Bill — California Inst. of Tech.

MoB04 308
Applications of Nonlinear Control I (Regular Session)

Chair: Back, Juhoon — Korea Univ.
Co-Chair: Moberg, Stig — ABB AB - Robotics

14:00-14:20 MoB04.1
Trajectory Stabilization of Wheeled System, pp. 1177-1182.
Matiukhin, Vladimir — Russian Acad. of sciences

14:20-14:40 MoB04.2
Variable Speed Control of Wind Turbines: A Robust Backstepping Approach, pp. 1183-1188.
Sivrioglu, Selim — Gebze Inst. of Tech.
Ozbay, Ufuk — Gebze Inst. of Tech.
Zergeroglu, Erkan — Gebze Inst. of Tech.

14:40-15:00 MoB04.3
Torque Multiplication and Singularity Avoidance in the Control of Electrostatic Torsional Micro-Mirrors, pp. 1189-1194.
Zhu, Guchuan — Ec. Pol. de Montreal
Agudelo, Carlos Gustavo — École Pol.
Saydy, Lahcen — Ec. Pol. of Montreal
Packirisamy, Muthukumaran — Concordia Univ.

15:00-15:20 MoB04.4
Operator Based Nonlinear Control Design for a Water Level Process System, pp. 1195-1199.
Jiang, Changan — Okayama Univ.
Deng, Mingcong — Okayama Univ.
Inoue, Akira — Okayama Univ.

15:20-15:40 MoB04.5
Aircraft Automatic Maneouvering System Using Energy-Based Control Technique, pp. 1200-1205.
Jones, Lim Jen Nee — Monash Univ. Sunway Campus Malaysia
Akmeliawati, Rini — International Islamic Univ.

Tan, Chee Pin — Monash Univ.

15:40-16:00 MoB04.6

A Benchmark Problem for Robust Control of a Multivariable Nonlinear Flexible Manipulator, pp. 1206-1211.

Moberg, Stig — ABB AB - Robotics
Öhr, Jonas — Optimation AB
Gunnarsson, Svante — Linkoping Univ.

MoB05 307

Fault-Tolerant Control I (Regular Session)

Chair: Sánchez-Peńa, Ricardo S. — Univ. Pol. de Catalunya
Co-Chair: Krokavec, Dusan — Tech. Univ. of Kosice, Faculty of Electrical

14:00-14:20 MoB05.1

Fault-Tolerant Switching Scheme with Multiple Sensor-Controller Pairs, pp. 1212-1217.

Martinez-Molina, John Jairo — INP-Grenoble, Gipsa-Lab.
Seron, Maria — The Univ. of Newcastle
De Dona, Jose Adrian — The Univ. of Newcastle

14:20-14:40 MoB05.2

Fault Accommodation for Discrete Event Systems Using Petri Nets with Application to Traffic Light Control, pp. 1218-1223.

Yang, Hao — Nanjing Univ. of Aeronautics and Astronautics
Jiang, Bin — Nanjing Univ. of Aeronautics and Astronautics
Cocquempot, Vincent — Univ. des Sciences et Tech. de Lille

14:40-15:00 MoB05.3

Positive Invariant Sets for Fault Tolerant Multisensor Control Schemes, pp. 1224-1229.

Olaru, Sorin — Supelec
De Dona, Jose Adrian — The Univ. of Newcastle
Seron, Maria — The Univ. of Newcastle

15:00-15:20 MoB05.4

Sensor Fault Tolerant Control of Induction Motors, pp. 1230-1235.

Seron, Maria — The Univ. of Newcastle
Romero, Monica E. — Univ. Nacional de Rosario
De Dona, Jose Adrian — The Univ. of Newcastle

15:20-15:40 MoB05.5

Using the Unfalsified Control Concept to Achieve Fault Tolerance, pp. 1236-1242.

Ingimundarson, Ari — Tech. Univ. of Catalonia
Sánchez-Peńa, Ricardo S. — Univ. Pol. de Catalunya

15:40-16:00 MoB05.6

Performance of Reconfiguration Structures Based on the Constrained Control, pp. 1243-1248.

Krokavec, Dusan — Tech. Univ. of Kosice, Faculty of Electrical
Filasova, Anna — Tech. Univ. of Kosice

MoB06 310A

Tools and Methods in Time-Delay System Theory and Control (Invited Session)

Chair: Conte, Giuseppe — Univ. di Ancona
Co-Chair: Perdon, Anna Maria — Univ. Pol. delle Marche
Organizer: Conte, Giuseppe — Univ. di Ancona
Organizer: Perdon, Anna Maria — Univ. Pol. delle Marche

14:00-14:20 MoB06.1

Minimal Representations for Delay Systems (I), pp. 1249-1254.

Yamamoto, Yutaka — Kyoto Univ.

14:20-14:40 MoB06.2

A Notion of Zero Dynamics for Linear, Time-Delay System (I), pp. 1255-1260.

Conte, Giuseppe — Univ. Pol. delle Marche
Perdon, Anna Maria — Univ. Pol. delle Marche

14:40-15:00 MoB06.3

Observers and State Reconstructions for Linear Neutral Time-Delay Systems (I), pp. 1261-1266.

Perdon, Anna Maria — Univ. Pol. delle Marche
Anderlucci, Maria — Univ. Pol. delle Marche

15:00-15:20 MoB06.4

Delay-Scheduled State-Feedback Design for Time-Delay Systems with Time-Varying Delays (I), pp. 1267-1272.

Briat, Corentin — INPG/ENSIEG
Sename, Olivier — INPG
Lafay, JeanFrancois — Ec. Centrale Nantes

15:20-15:40 MoB06.5

Design of Fault-Tolerant Controllers for Guaranteed H2-Performance Over Digital Networks with Time-Varying Communication Delays (I), pp. 1273-1278.

Yame, Joseph Julien — Univ. Henri Poincaré, Nancy 1
Sauter, Dominique D.J. — Univ. Henri Poincare, Nancy 1

15:40-16:00 MoB06.6

Transfer Matrix Approach to the Triangular Decoupling of General Neutral Multi-Delay Systems, pp. 1279-1286.

Koumboulis, Fotis N. — Halkis Inst. of Tech.
Panagiotakis, George — HIT

MoB07 310B

Linear Systems Analysis (Regular Session)

Chair: Willems, Jan C. — K.U. Leuven
Co-Chair: Malabre, Michel — UMR CNRS 6597

14:00-14:20 MoB07.1

A Period-Specific Realization of Linear Continuous-Time Systems, pp. 1287-1292.

Hodaka, Ichijo — Univ. of Miyazaki
Jikuya, Ichiro — Nagoya Univ.

14:20-14:40 MoB07.2

Singularly Perturbed Derivative Coupling-Filter, pp. 1293-1298.

Mendez Delgadillo, Hugo — CINVESTAV - IPN
Bonilla, Moises E. — CINVESTAV-IPN
Malabre, Michel — UMR CNRS 6597
Pacheco Martínez, Jaime — CINVESTAV - IPN

14:40-15:00 MoB07.3

A Factorization Approach for the L-Infinity-Gain of Discrete-Time Linear Systems, pp. 1299-1304.

Picasso, Bruno — Univ. di Pisa and Pol. di Milano
Colaneri, Patrizio — Pol. di Milano

15:00-15:20 MoB07.4

Averaging and Stability of Time-Varying Discrete-Time Linear Systems, pp. 1305-1310.

Vargas, Alessandro N. — UNICAMP
Do Val, Joao B.R. — UNICAMP - FEEC

15:20-15:40 MoB07.5

On Rational Quadratic Differential Forms, pp. 1311-1318.

Takaba, Kiyotsugu — Kyoto Univ.
Trentelman, Harry L. — Univ. of Groningen
Willems, Jan C. — K.U. Leuven

15:40-16:00 MoB07.6

Analysis and Improvements of a Systematic Componentwise Ultimate-Bound Computation Method, pp. 1319-1324.

Haimovich, Hernan — Univ. Nacional de Rosario
Kofman, Ernesto — UNR
Seron, Maria — The Univ. of Newcastle

MoB08 310C

LMIs and Algebraic Methods in Control (Invited Session)

Chair: Ebihara, Yoshio — Kyoto Univ.
Co-Chair: Oishi, Yasuaki — Nanzan Univ.
Organizer: Ebihara, Yoshio — Kyoto Univ.
Organizer: Oishi, Yasuaki — Nanzan Univ.

14:00-14:20 MoB08.1

Robust Controller Synthesis for Disturbance Filter Uncertainty Described by Dynamic Integral Quadratic Constraints., pp. 1325-1330.

Dietz, Sjoerd — Delft Univ. of Tech.
Scherer, Carsten W. — Delft Univ. of Tech.
Koroglu, Hakan — Delft Univ. of Tech.

14:20-14:40 MoB08.2

Sum-Of-Squares Approximations to Robust Semidefinite Programs with Functional Variables: A Region-Dividing Approach (I), pp. 1331-1336.

Jennawasin, Tanagorn — The Univ. of Tokyo
Oishi, Yasuaki — Nanzan Univ.

14:40-15:00 MoB08.3

Modeling and Solving Uncertain Optimization Problems in YALMIP (I), pp. 1337-1341.

Löfberg, Johan — Linköping Univ.

15:00-15:20 MoB08.4
Sum of Roots Characterization for Parametric State Feedback H_infty Control (I), pp. 1342-1347.
Kanno, Masaaki — Japan Science and Tech. Agency
Hara, Shinji — The Univ. of Tokyo

15:20-15:40 MoB08.5
Robust H2 Perfomance of Discrete-Time Periodic Systems: LMIs with Reduced Dimensions (I), pp. 1348-1353.
Peaucelle, Dimitri — LAAS-CNRS
Ebihara, Yoshio — Kyoto Univ.
Arzelier, Denis — LAAS-CNRS

15:40-16:00 MoB08.6
LMI-Based Periodically Time-Varying Dynamical Controller Synthesis for Discrete-Time Uncertain Linear Systems (I), pp. 1354-1359.
Ebihara, Yoshio — Kyoto Univ.
Peaucelle, Dimitri — LAAS-CNRS
Arzelier, Denis — LAAS-CNRS

MoB09 311C
Errors in Variables Identification (Regular Session)
Chair: Aguero, Juan C — The Univ. of Newcastle
Co-Chair: Malti, Rachid — Univ. Bordeaux1

14:00-14:20 MoB09.1
Bias-Compensation Based Method for Errors-In-Variables Model Identification, pp. 1360-1365.
Ikenoue, Masato — Ariake National Coll. of Tech.
Kanae, Shunshoku — Kyushu Univ.
Yang, Zi-Jiang — Kyushu Univ.
Wada, Kiyoshi — Kyushu Univ.

14:20-14:40 MoB09.2
Recursive Identification of EIV ARMA Processes, pp. 1366-1371.
Chen, Han Fu — AMSS, Chinese Acad. of Sciences

14:40-15:00 MoB09.3
Accuracy Analysis of Time-Domain Maximum Likelihood Method and Sample Maximum Likelihood Method for Errors-In-Variables Identification, pp. 1372-1377.
Hong, Mei — Uppsala Univ.
Soderstrom, Torsten — Uppsala Univ.
Schoukens, Johan — Vrije Univ. Brussel
Pintelon, Rik — Vrije Univ. Brussel

15:00-15:20 MoB09.4
Identification of Errors-In-Variables Models Using the EM Algorithm, pp. 1378-1383.
ALMutawa, Jaafar — King Fahd Univ. of Petroleum & Minerals

15:20-15:40 MoB09.5
Efficient Estimation of Errors-In-Variables Models, pp. 1384-1389.
Vajk, Istvan — Budapest Univ. of Tech. and Ec.
Hetthessy, Jeno — Budapest Univ. of Tech. and Ec.

15:40-16:00 MoB09.6
Gradient-Based Approaches for Recursive Frisch Scheme Identification, pp. 1390-1395.
Linden, Jens G. — Coventry Univ.
Vinsonneau, Benoit — Coventry Univ.
Burnham, Keith J. — Coventry Univ.

MoB10 311B
Prediction, Filtering and Smoothing II (Regular Session)
Chair: Novara, Carlo — Pol. di Torino
Co-Chair: Chen, Tongwen — Univ. of Alberta

14:00-14:20 MoB10.1
Switched IMM-EV Algorithms for State Estimation of Some Jump Markov Systems, pp. 1396-1401.
Ho, Tan-Jan — Chung Yuan Christian Univ.

14:20-14:40 MoB10.2
A New Parameter-Dependent Approach to Discrete-Time Robust H_{2} Filtering, pp. 1402-1407.
Gao, Huijun — Harbin Inst. of Tech.
Meng, Xiangyu — Harbin Inst. of Tech.
Chen, Tongwen — Univ. of Alberta

14:40-15:00 MoB10.3
High-Gain Observer-Based Parameter Identification with Application in a Gas Turbine Engine, pp. 1408-1413.
Gao, Zhiwei — The Univ. of Manchester
Dai, Xuewu — Univ. of Manchester
Breikin, Tim — Univ. of manchester
Wang, Hong — the Univ. of Manchester

15:00-15:20 MoB10.4
Stability of Signal Reconstruction Filters Via Cardinal Exponential Splines, pp. 1414-1419.
Nagahara, Masaaki — Kyoto Univ.
Yamamoto, Yutaka — Kyoto Univ.
Khargonekar, Pramod P. — Univ. of Florida

15:20-15:40 MoB10.5
Multiple-Level Quantized Innovation Kalman Filter, pp. 1420-1425.
You, Keyou — Nanyang Tech. Univ.
Xie, Lihua — Nanyang Tech. Univ.
Sun, Shuli — Heilongjiang Univ.
Xiao, Wendong — Inst. for Infocomm Res.

15:40-16:00 MoB10.6
A Level Measurement Method Based on Acoustic Resonance Using Unscented Kalman Filter, pp. 1426-1431.
Deghat, Mohammad — Shiraz Univ.
Karimaghaee, Paknosh — Shiraz Univ.

MoB11 311A
Nonlinear Systems II (Regular Session)
Chair: Xia, Xiaohua — Univ. of Pretoria
Co-Chair: Sun, Jing — Univ. of Michigan

14:00-14:20 MoB11.1
Counteracting the Effects of Adversarial Inputs on Asynchronous Sequential Machines, pp. 1432-1437.
Yang, Jung Min — Catholic Univ. of Daegu
Hammer, Jacob — Univ. of Florida

14:20-14:40 MoB11.2
Flatness-Based Pre-Compensation of Laser Diodes, pp. 1438-1441.
Abichou, Azgal — Tunisia Pol. School
El Asmi, Sadok — Univ. du 7 Novembre, SUPCOM
Rouchon, Pierre — ENSMP

14:40-15:00 MoB11.3
Partial Semi-Stability for a Class of Nonlinear Systems, pp. 1442-1447.
Costa, Eduardo F. — Univ. de São Paulo
Astolfi, Alessandro — Imperial Col. London & Univ. of Rome Tor Vergata

15:00-15:20 MoB11.4
State Estimation Based Model Predictive Control for LHD Vehicles, pp. 1448-1453.
Nuńez, Felipe — Pontificia Univ. Catolica de Chile
Navarro, Sergio — Pontificia Univ. Catolica de Chile
Aguado, Alberto — Inst. of Cybernetics, Mathemtics and Physics.
Cipriano, Aldo — Pontificia Univ. Catolica de Chile

15:20-15:40 MoB11.5
Overcoming Singularity and Degeneracy in Neighboring Extremal Solutions of Discrete-Time Optimal Control Problem with Mixed Input-State Constraints, pp. 1454-1459.
Ghaemi, Reza — Univ. of Michigan (Ann Arbor)
Sun, Jing — Univ. of Michigan
Kolmanovsky, Ilya V. — Ford Motor Co.

15:40-16:00 MoB11.6
Stabilization for a Class of Nonlinear Systems: A Fuzzy Logic Approach, pp. 1460-1465.
Di Gennaro, Stefano — Univ. di L'Aquila
Castillo-Toledo, Bernardino — CINVESTAV-GDL, Mexico

MoB12 313
Iterative Learning Control I (Regular Session)
Chair: Rogers, Eric — Univ. of Southampton
Co-Chair: Karimi, Alireza — Ec. Pol. Federale de Lausanne

14:00-14:20 MoB12.1
Performance Assessment Measures of Batch Processes for Iterative Learning Control, pp. 1466-1471.
Chen, Junghui — Chung-Yuan Christian Univ.
Kong, Cho-Kai — Chung-Yuan Christian Univ.

14:20-14:40 MoB12.2
Design and Stability Discussion of a Hybrid Intelligent Controller, pp. 1472-1477.
Mohammadzaheri, Morteza — Univ. of Adelaide
Chen, Lei — Adelaide Univ.

14:40-15:00 MoB12.3
Iterative Learning Control Based on Stochastic Approximation, pp. 1478-1483.
Butcher, Mark Edward John — Ec. Pol. Federal de Lausanne
Karimi, Alireza — Ec. Pol. Federale de Lausanne
Longchamp, Roland — Ec. Pol. Federale De Lausanne

15:00-15:20 MoB12.4
A Design Method of Robust Stabilizing Simple Multi-Period Repetitive Controllers, pp. 1484-1489.
Yamada, Kou — Gunma Univ.
Hagiwara, Takaaki — Graduate School of Engineering, Gunma Univ.
Takenaga, Hiroshi — Graduate school of Engineering, Gunma Univ.
Kobayashi, Masahiko — Gunma Univ.

15:20-15:40 MoB12.5
Perfect Tracking of Repetitive Signals for a Class of Nonlinear Systems, pp. 1490-1495.
Yang, Zaiyue — Univ. of Hong Kong
Chan, Che Wai — Univ. of Hong Kong

15:40-16:00 MoB12.6
Strong Practical Stability and Stabilization of Uncertain Discrete Linear Repetitive Processes, pp. 1496-1501.
Dabkowski, Pawel — Nikolaus Copernicus Univ. in Torun
Galkowski, Krzysztof — Univ. of Zielona Gora
Rogers, Eric — Univ. of Southampton
Kummert, Anton — Univ. of Wuppertal

MoB13 314
Distributed Estimation and Consensus I (Regular Session)
Chair: Mareels, Iven — The Univ. of Melbourne
Co-Chair: Keviczky, Tamas — Delft Univ. of Tech.

14:00-14:20 MoB13.1
Algebraic Criteria for Consensus Problem of Discrete-Time Networked Systems, pp. 1502-1509.
Li, Zonggang — Beihang Univ.
Jia, Yingmin — Beihang Univ.
Du, Junping — Beijing Univ. of Posts and Telecommunications
Yu, Fashan — Henan Pol. Univ.

14:20-14:40 MoB13.2
Robustness of Distributed Multi-Agent Consensus, pp. 1510-1515.
Wang, Jinzhi — Peking Univ.
Mareels, Iven — The Univ. of Melbourne
Tan, Ying — The Univ. of Melbourne

14:40-15:00 MoB13.3
A Study on Distributed Model Predictive Consensus, pp. 1516-1521.
Keviczky, Tamas — Delft Univ. of Tech.
Johansson, Karl Henrik — Royal Inst. of Tech.

15:00-15:20 MoB13.4
Nonlinear Multi-Agent System Consensus with Time-Varying Delays, pp. 1522-1527.
Muenz, Ulrich — Univ. of Stuttgart
Papachristodoulou, Antonis — Univ. of Oxford
Allgower, Frank — Univ. of Stuttgart

15:20-15:40 MoB13.5
Leader-Following Consensus Control for Multi-Agent Systems under Measurement Noises, pp. 1528-1533.
Ma, Cui-Qin — Chinese Acad. of Sciences
Li, Tao — Chinese Acad. of Sciences
Zhang, Ji-Feng — Chinese Acad. of Sciences

15:40-16:00 MoB13.6
Switching Control of a Modified Leader-Follower Team of Agents under the Leader and Network Topological Changes, pp. 1534-1540.
semsar Kazerooni, Elham — Concordia Univ.
Khorasani, Khashayar — Concordia Univ.

MoB14 318
Control and Synchronization of Networks (Regular Session)
Chair: Hill, David J. — The Australian National Univ.
Co-Chair: Wieland, Peter — Univ. of Stuttgart

14:00-14:20 MoB14.1
On Consensus in Multi-Agent Systems with Linear High-Order Agents, pp. 1541-1546.
Wieland, Peter — Univ. of Stuttgart
Kim, Jung-Su — Univ. of Stuttgart
Scheu, Holger — Univ. of Stuttgart
Allgower, Frank — Univ. of Stuttgart

14:20-14:40 MoB14.2
Master Stability Equations of Complex Dynamical Networks with General Topology, pp. 1547-1552.
Sun, Hongfei — Xiamen Univ.
Hill, David J. — The Australian National Univ.

14:40-15:00 MoB14.3
Transition to Complex Behavior in Networks of Coupled Dynamical Systems, pp. 1553-1558.
Barajas-Ramirez, Juan Gonzalo — IPICYT Res. Center
Femat, Ricardo — IPICYT

15:00-15:20 MoB14.4
Synchronization of a Complex Network with Switched Coupling, pp. 1559-1564.
Kim, Sehjeong — Australian National Univ.
Hill, David J. — The Australian National Univ.

15:20-15:40 MoB14.5
Synchronization in a Network of Chaotic Solid-State Nd: YAG Lasers, pp. 1565-1570.
Posadas-Castillo, Cornelio — Nuevo León Autonomous Univ. (UANL)
Cruz-Hernandez, Cesar — CICESE
Lopez-Gutierrez, Rosa Martha — Baja California Autonomous Univ.

15:40-16:00 MoB14.6
Stabilizing Interconnection Characterization for Multi-Agent Systems with Dissipative Properties, pp. 1571-1577.
Hirche, Sandra — Tech. Univ. Muenchen
Hara, Shinji — The Univ. of Tokyo

MoB15 317
Mechatronics in Agriculture (Regular Session)
Chair: Blanke, Mogens — Tech. Univ. of Denmark
Co-Chair: Visala, Arto — Helsinki Univ. of Tech.

14:00-14:20 MoB15.1
XML Based Graphical User Interface Editor and Runtime Parser for ISO 11783 Machine Automation Systems, pp. 1578-1583.
Ohman, Matti — Helsinki Univ. of Tech.
Kalmari, Jouko — Helsinki Univ. of Tech.
Visala, Arto — Helsinki Univ. of Tech.

14:20-14:40 MoB15.2
Estimating Hay Bale Position with Stereo Vision Technique Using an Omnidirectional Camera, pp. 1584-1589.
Farrokhi Teimourlou, Rahman — Hokkaido Univ.
Noguchi, Noboru — Hokkaido Univ.

14:40-15:00 MoB15.3
Natural Environment Modeling and Fault-Diagnosis for Automated Agricultural Vehicle., pp. 1590-1595.
Blas, Morten Rufus — Tech. Univ. of Denmark
Blanke, Mogens — Tech. Univ. of Denmark

15:00-15:20 MoB15.4
Calibration Method for 2-Dimensional Laser Scanner Attached on a Robot Vehicle, pp. 1596-1601.
Barawid, Oscar Jr. — Hokkaido Univ.
Noguchi, Noboru — Hokkaido Univ.
Ishii, Kazunobu — Hokkaido Univ.

15:20-15:40 MoB15.5
Development of the Biogas Tractor with Two Biogas Feeding Algorithms, pp. 1602-1607.
Jaber, Nizar — Hokkaido Univ.
Tsukamoto, Takayuki — Hokkaido Univ.
Noguchi, Noboru — Hokkaido Univ.

15:40-16:00 MoB15.6
Analysis of Grain Mass Flow Experiments in a Mixed-Flow Dryer, pp. 1608-1612.

Gottschalk, Klaus — Leibniz-Inst. für Agrartechnik Potsdam-Bornim e.V. (ATB)
Mellmann, Jochen — Leibniz-Inst. für Agrartechnik Potsdam-Bornim e.V. (ATB)

MoB16 316
Economic and Management Systems II (Regular Session)
Chair: Wang, Dingwei — Northeastern Univ.
Co-Chair: Barmish, B. Ross — Univ. of Wisconsin

14:00-14:40 MoB16.1
Cognitive Approach in Simulation and Control, pp. 1613-1620.
Avdeeva, Zinaida — Inst. of Control Sciences of the Russian Acad.
Kovriga, Svetlana — Inst. of Control Sciences of the Russian Acad. of Sciences

14:40-15:00 MoB16.2
On Trading of Equities: A Robust Control Paradigm, pp. 1621-1626.
Barmish, B. Ross — Univ. of Wisconsin

15:00-15:20 MoB16.3
A Mean-Variance Model for Optimal Portfolio Selection with Transaction Costs, pp. 1627-1632.
Peng, Hui — Central South Univ.

15:20-15:40 MoB16.4
Team Building under Pareto Uncertainty, pp. 1633-1638.
Novikov, Dmitry — Inst. of Control Sciences of Russian Acad. ofSciences

15:40-16:00 MoB16.5
Modelling and Analysis of Bargaining Process for E-Procurement of Large Enterprise Group, pp. 1639-1644.
Wang, Dingwei — Northeastern Univ.
Kaku, Ikou — Akita Prefectural Univ.

MoB17 320A
Hot Rolling (Highlight Session)
Chair: Park, Cheol Jae — POSCO
Co-Chair: Choi, IlSeop — POSCO

14:00-14:20 MoB17.1
Model–based Control of Front–end Bending in Hot Rolling Processes, pp. 1645-1650.
Kiefer, Thomas — Vienna Univ. of Tech.
Kugi, Andreas — Vienna Univ. of Tech.

14:20-14:40 MoB17.2
Start-Up Control of a Hot Strip Mill Tension/Looper System: An Approach Based on Model Predictive Control (I), pp. 1651-1656.
Kojima, Akira — Tokyo Metropolitan Univ.
Morooka, Nobuyuki — JFE Steel Corp.

14:40-15:00 MoB17.3
Tension Control with ARHC Scheme for Hot Strip Finishing Mills (I), pp. 1657-1658.
Park, Cheol Jae — POSCO
Hwang, I Cheol — Dong-Eui Univ.

15:00-15:20 MoB17.4
Nonlinear Looper-Tension Control for Hot Strip Finishing Mill Using Feedback Linearization. (I), pp. 1659-1660.
Hwang, I Cheol — Dong-Eui Univ.
Park, Cheol Jae — POSCO

15:20-15:40 MoB17.5
An MPC Strategy for Hot Rolling Mills and Applications to Strip Threading Control Problems. (I), pp. 1661-1662.
Choi, IlSeop — POSCO
Rossiter, J. Anthony — Univ. of Sheffield
Chung, Jea Sook — POSCO
Fleming, P.J. — Univ. of Sheffield

MoB18 320B
Recent Development of Intelligent Robots I: Navigation (Highlight Session)
Chair: Song, Jae-Bok — Korea Univ.
Co-Chair: Chung, Woojin — Korea Univ.

14:00-14:20 MoB18.1
Upward Monocular Camera Based SLAM Using Corner and Door Features (I), pp. 1663-1668.
Hwang, Seo-Yeon — Korea Univ.
Song, Jae-Bok — Korea Univ.

14:20-14:40 MoB18.2
Use of Range Sensor Information for Improving Positioning Accuracy (I), pp. 1669-1674.
Cho, Seong Ho — Hongik Univ.
Lee, Sooyong — Hongik Univ.
Yu, Wonpil — ETRI

14:40-15:00 MoB18.3
High Accurate Two-Dimensional Geo-Location System for Social Safety Robot (I), pp. 1675-1678.
Kim, Sujin — Information and Communications Univ.
Kim, Jaehwan — Electronics and Telecommunications Res. Inst. (ETRI)
Kang, Joonhyuk — Information and Communications Univ.
Kim, Gon-Woo — Korea Inst. of Industrial Tech. (KITECH)
Nam, Kyung-Tae — Kitech(Korea Inst. of Industrial Tech.
Lee, Sang-Moo — Korea Inst. of Industrial Tech. (KITECH)
Shon, Woong-Hee — Korea Inst. of Industrial Tech. (KITECH)

15:00-15:20 MoB18.4
Multi-Agent Coordinated Motion Planning for Monitoring and Controlling the Observed Space in a Security Zone (I), pp. 1679-1684.
Kim, Jimin — Seoul National Univ.
Choi, Jeong Sik — Seoul National Univ.
Lee, Beom Hee — Seoul National Univ.

15:20-15:40 MoB18.5
Safe and High Speed Navigation of a Patrol Robot in Occluded Dynamic Obstacles (I), pp. 1685-1690.
Choi, Min-Ki — Korea Univ.
Chung, Woojin — Korea Univ.

15:40-16:00 MoB18.6
An Intelligent Navigation Method for Service Robots in the Smart Environment (I), pp. 1691-1696.
Park, Jae-Han — KITECH
Baeg, Seung-Ho — KITECH
Ryu, Ho-Sun — LG Electronics
Baeg, Moon-Hong — KITECH

MoB19 320C
Robotic Mechanism II (Regular Session)
Chair: Iwasaki, Tetsuya — Univ. of Virginia
Co-Chair: Zhu, Wen-Hong — Canadian Space Agency

14:00-14:20 MoB19.1
Virtual Decomposition Control of a Planar Flexible-Link Robot, pp. 1697-1702.
Zhu, Wen-Hong — Canadian Space Agency
Lange, Christian — Canadian Space Agency
Callot, Mathilde — Canadian Space Agency

14:20-14:40 MoB19.2
Optimal Protraction of a Three-Joint Robot Leg, pp. 1703-1710.
Erden, Mustafa Suphi — Delft Univ. of Tech.
Leblebicioglu, Kemal — Middle Esat Tech. Univ.

14:40-15:00 MoB19.3
Vibration Suppression and Balance Control for Biped Humanoid Walking, pp. 1711-1716.
Chang, Young-Hwan — Korea Inst. of Science and Tech. (KIST)
Oh, Yonghwan — Korea Inst. of Science & Tech. Korea
Kim, Doik — Korea Inst. of Science and Tech. (KIST)
Hong, Seokmin — UST, KIST

15:00-15:20 MoB19.4
Dynamic Control Algorithm for Biped Walking Based on Policy Gradient Fuzzy Reinforcement Learning, pp. 1717-1722.
Katic, Dusko — Mihailo Pupin Inst.
Rodic, Aleksandar — Mihailo Pupin Inst.

15:20-15:40 MoB19.5
On the Optimal Harmonic Gait for Locomotion of Mechanical

Rectifier Systems, pp. 1723-1728.
Blair, Justin — UVA
Iwasaki, Tetsuya — Univ. of Virginia

15:40-16:00 — MoB19.6
Biped Gait Generation Via Iterative Learning Control Including Discrete State Transitions, pp. 1729-1734.
Satoh, Satoshi — Nagoya Univ.
Fujimoto, Kenji — Nagoya Univ.
Hyon, Sang-Ho — JST-ICORP/ATR

MoB20 — 321C
Flying Robot II (Regular Session)
Chair: Ollero, Anibal Ollero — Escuela Superior de Ingenieros - Univ. de Sevilla
Co-Chair: Tayebi, Abdelhamid — Lakehead Univ.

14:00-14:20 — MoB20.1
A Two Step Velocity Planning Method for Real-Time Collision Avoidance of Multiple Aerial Robots in Dynamic Environments, pp. 1735-1740.
Rebollo, J.J. — Univ. of Seville
Maza, Ivan — Univ. of Seville
Ollero, Anibal Ollero — Escuela Superior de Ingenieros - Univ. de Sevilla

14:20-14:40 — MoB20.2
Asymptotic Stability of Hierarchical Inner-Outer Loop-Based Flight Controllers, pp. 1741-1746.
Kendoul, Farid — Univ. of Tech. of Compičgne
Fantoni, Isabelle — Univ. de Tech. de Compiegne
Lozano, Rogelio — Univ. de Tech. de Compiegne

14:40-15:00 — MoB20.3
Global Discrete Time Stabilization of the PVTOL Aircraft Based on Fast Predictive Control, pp. 1747-1752.
Chemori, Ahmed — UM2
Marchand, Nicolas — GIPSA-Lab. CNRS

15:00-15:20 — MoB20.4
Discrete-Time Dynamic Feedback Linearization of a VTOL Using Observed States, pp. 1753-1759.
Rejón, Victor — CINVESTAV
Aranda-Bricaire, Eduardo — CINVESTAV

15:20-15:40 — MoB20.5
A Simple Time-Varying Observer for Speed Estimation of UAV, pp. 1760-1765.
Boutayeb, Mohamed — Nancy Univ.
Richard, Edouard — nancy Univ.
Rafaralahy, Hugues — Univ. Henri Poincaré, Nancy I
Souley Ali, Harouna — Univ. Henri Poincaré
Zaloylo, Guy — Nancy Univ.

15:40-16:00 — MoB20.6
Decentralized Attitude Alignment Control of Spacecraft within a Formation without Angular Velocity Measurements, pp. 1766-1771.
Abdessameud, Abdelkader — Univ. of Western Ontario
Tayebi, Abdelhamid — Lakehead Univ.

MoB21 — 321B
Servo Control for Storage Systems and Precision Devices II (Invited Session)
Chair: Yamaguchi, Takashi — Hitachi Global Storage Tech.
Co-Chair: Horowitz, Roberto — Univ. of California at Berkeley
Organizer: Yamaguchi, Takashi — Hitachi Global Storage Tech.

14:00-14:20 — MoB21.1
Friction Compensation in Servo Systems Using a Local Control Design Approach (I), pp. 1772-1777.
Mostefai, Lotfi — The Univ. of Tokyo, Inst. of Industrial science
Danai, Mouloud — Univ. of Sheffield
Hori, Yoichi — Univ. of Tokyo

14:20-14:40 — MoB21.2
Discrete-Time Exact and Approximate Dynamic Inversion for Settle Performance (I), pp. 1778-1784.
Rigney, Brian — Univ. of Colorado at Boulder
Pao, Lucy Y. — Univ. of Colorado at Boulder
Lawrence, Dale A. — Univ. of Colorado

14:40-15:00 — MoB21.3
An Operator Based Modeling and Compensation of VCM Actuator Pivot Friction in a 1.8-Inch HDD (I), pp. 1785-1790.
Du, Chunling — Data Storage Inst.
Xie, Lihua — Nanyang Tech. Univ.
Zhang, Jingliang — Data Storage Inst.

15:00-15:20 — MoB21.4
Design Approach for Hard Disk Drive Settle Performance Optimization (I), pp. 1791-1796.
Stoev, Julian — Samsung Electronics
Lee, Ho Seong — Samsung Electronics

15:20-15:40 — MoB21.5
A Hybrid Modeling Method for Precise Positioning Systems (I), pp. 1797-1802.
Hirata, Mitsuo — Utsunomiya Univ.
Noguchi, Sakae — Utsunomiya Univ.
Adachi, Shuichi — Keio Univ.

15:40-16:00 — MoB21.6
Design of Seeking Control Based on Two-Degree-Of-Freedom Controller Using Frequency Shaped Final-State Control (I), pp. 1803-1808.
Kang, Hyun Jae — Hanyang Univ.
Lee, Choong Woo — Hanyang Univ.
Chung, Chung Choo — Hanyang Univ.
Lee, Ho Seong — Samsung Electronics

MoB22 — 321A
Control Methods for Mechatronic Systems (Regular Session)
Chair: Jezernik, Karel — Univ. of Maribor
Co-Chair: Nguyen, Tu Duc — Norwegian Univ. of Science and Tech.

14:00-14:20 — MoB22.1
The Control and Identification Algorithm for Devices with Differential Inductive Sensors, pp. 1809-1814.
Kochetkov, Sergey — Togliatti State Univ.
Shavrin, Pavel — Togliatti State Univ.
Kiselyov, Sergey — Togliatti State Univ.

14:20-14:40 — MoB22.2
Vss Speed Sensorless Control of PMSM, pp. 1815-1820.
Jezernik, Karel — Univ. of Maribor

14:40-15:00 — MoB22.3
Frequency Locking of an Optical Cavity Using LQG Integral Control, pp. 1821-1826.
Sayed Hassen, Sayed Zahiruddeen — Univ. of New South Wales
Huntington, Elanor — Univ. of New South Wales
James, Matthew R. — Australian National Univ.
Petersen, Ian Richard — Univ. of New South Wales - ADFA

15:00-15:20 — MoB22.4
Nonlinear Passivity Based Control Law with Application to Electropneumatic System, pp. 1827-1832.
Turki, Karima — INSA de Lyon
Smaoui, Mohamed — INSA de Lyon
Thomasset, Daniel — INSA de Lyon
Mnif, Faical — Sultan Qaboos Univ.
Derbel, Nabil — Professor

15:20-15:40 — MoB22.5
Tracking Control for Port-Hamiltonian Systems Using Feedforward and Feedback Control and a State Observer, pp. 1833-1838.
Stadlmayr, Richard — Linz Center of Mechatronics GmbH
Schlacher, Kurt — Johannes Kepler Univ. of Linz

15:40-16:00 — MoB22.6
Boundary Stabilization of Marine Structure, pp. 1839-1844.
Nguyen, Tu Duc — Norwegian Univ. of Science and Tech.

MoB23 — 323
Large Scale and Complex Systems: Applications II (Regular Session)
Chair: Díez, José Luis — Univ. Pol. de Valencia
Co-Chair: Filip, Florin Gheorghe — Romanian Acad.

14:00-14:20 — MoB23.1
Knowledge Based Approach to Project Prototyping, pp. 1845-1850.
Tomczuk-Pirog, Izabela — Aalborg Univ.
Nielsen, Peter — Aalborg Univ.

MuszyD;ski, Wojciech — WrocB;aw Univ. of Tech.
Banaszak, Zbigniew — Tech. Univ. of Koszalin

14:20-14:40 MoB23.2
Operating-State-Based Intelligent Control of Combustion Process of Coke Oven, pp. 1851-1856.
Lei, Qi — Central South Univ.
Wu, Min — Central South Univ.
Cao, Weihua — Central South Univ.
She, Jin-Hua — Tokyo Univ. of Tech.

14:40-15:00 MoB23.3
Applying Dynamic Data Mining on Multi-Agent Systems, pp. 1857-1862.
Benítez Sánchez, Ignacio — Pol. Univ. of Valencia
Díez, José Luis — Univ. Pol. de Valencia
Albertos, Pedro — Univ. Pol. de Valencia

15:00-15:20 MoB23.4
Production Process Efficiency Analysis: An Approach Based on Colored Petri Nets, pp. 1863-1868.
Bastos Jr, Nilson — Pontifical Catholic Univ. of Parana
Santos, Eduardo Alves Portela — Pontifical Catholic Univ. of Parana
Rocha Loures, Eduardo — Pontifical Catholic Univ. of Paraná
Busetti, Marco Antonio — Pontifical Catholic Univ. of Parana

15:20-15:40 MoB23.5
Control of a Production-Inventory System Using a PID Controller and Demand Prediction, pp. 1869-1874.
Tosetti, Santiago — Univ. Nacional de San Juan
Patino, H. Daniel — Univ. Nacional de San Juan
Capraro, Flavio — Univ. Nacional de San Juan (UNSJ)
Gambier, Adrian — Univ. of Heidelberg

15:40-16:00 MoB23.6
Advances in the Control of Sheet Metal Forming, pp. 1875-1883.
Lim, Yongseob — Univ. of Michigan
Venugopal, Ravinder — Intellicass Inc.
Ulsoy, A. Galip — Univ. of Michigan

MoB24 324
Fault Detection and Accommodation for Nonlinear Systems (Invited Session)
Chair: Jiang, Bin — Nanjing Univ. of Aeronautics and Astronautics
Co-Chair: Cocquempot, Vincent — LAGIS - LILLE 1 Univ.
Organizer: Jiang, Bin — Nanjing Univ. of Aeronautics and Astronautics
Organizer: Cocquempot, Vincent — Univ. des Sciences et Tech. de Lille

14:00-14:20 MoB24.1
Algebraic Approach to the Problem of Fault Accommoation in Nonlinear Systems (I), pp. 1884-1889.
Shumsky, Alexey — Inst. for Marine Tech. Problems

14:20-14:40 MoB24.2
Design of Sensor Fault Diagnosis Method for Non Linear Systems Described by Linear Polynomial Matrices Formulation: Application to a Winding Machine (I), pp. 1890-1895.
Theilliol, Didier — Univ. Henri Poincare, Nancy 1
Ponsart, Jean-Christophe — Univ. Henri Poincare, Nancy I
Rodrigues, Mickael — Univ. OF LYON 1; LAGEP UMR CNRS 5007
Aberkane, Samir — UHP, NANCY 1
Yame, Joseph Julien — Univ. Henri Poincaré, Nancy 1

14:40-15:00 MoB24.3
Fault Estimation for Single Output Nonlinear Systems Using an Adaptive Sliding Mode Observer (I), pp. 1896-1901.
Yan, Xing-Gang — Univ. of Leicester
Edwards, Christopher — Univ. of Leicester

15:00-15:20 MoB24.4
Observer-Based Fault Estimation for Networked Control Systems with Transfer Delays (I), pp. 1902-1907.
Mao, Ze hui — Nanjing Univ. of Aeronautics and Astronautics
Jiang, Bin — Nanjing Univ. of Aeronautics and Astronautics
Cocquempot, Vincent — Univ. des Sciences et Tech. de Lille
Shi, Peng — Faculty of Advanced Tech.

15:20-15:40 MoB24.5
Fault Detection and Isolation Applied to a Ship Propulsion Benchmark (I), pp. 1908-1913.
Zhang, Youmin — Concordia Univ.
Wu, Neng Eva — Binghamton Univ.
Jiang, Bin — Nanjing Univ. of Aeronautics and Astronautics

15:40-16:00 MoB24.6
Fault Detection, Isolation and Accommodation Using the Generalized Parity Vector Technique, pp. 1914-1921.
Taylor, James H. — Univ. of New Brunswick
Omana, Maira — Univ. of New Brunswick

MoB25 328
New Theoretical Results and Numerical Methods in Optimization Based Control (Invited Session)
Chair: Findeisen, Rolf — Univ. of Stuttgart
Co-Chair: Engell, Sebastian — Univ. of Dortmund
Organizer: Findeisen, Rolf — Univ. of Stuttgart
Organizer: Engell, Sebastian — Univ. of Dortmund

14:00-14:20 MoB25.1
NCO Tracking for Singular Control Problems Using Neighboring Extremals (I), pp. 1922-1927.
Gros, Sebastien — Doctoral Student
Chachuat, Benoit — Ec. Pol. Federale de Lausanne (EPFL)
Bonvin, Dominique — EPFL

14:20-14:40 MoB25.2
An Efficient Strategy for Real-Time Dynamic Optimization Based on Parametric Sensitivities (I), pp. 1928-1933.
Würth, Lynn — RWTH Aachen
Hannemann, Ralf — RWTH Aachen Univ.
Marquardt, Wolfgang — RWTH Aachen Univ.

14:40-15:00 MoB25.3
An Adjoint-Based Numerical Method for Fast Nonlinear Model Predictive Control (I), pp. 1934-1939.
Wirsching, Leonard — Univ. of Heidelberg
Albersmeyer, Jan — Uni Heidelberg
Kühl, Peter — Univ. of Heidelberg
Diehl, Moritz — Univ. of Heidelberg
Bock, Georg — Univ. of Heidelberg

15:00-15:20 MoB25.4
A Hidden Markov Disturbance Model for Offset-Free Linear Model Predictive Control (I), pp. 1940-1945.
Wong, Wee Chin — Georgia Inst. of Tech.
Lee, Jay — Georgia Tech.

15:20-15:40 MoB25.5
Adaptive Model Predictive Control for Constrained Nonlinear Systems (I), pp. 1946-1951.
Guay, Martin — Queen's Univ.
Adetola, Veronica — Queen's Univ.

15:40-16:00 MoB25.6
Avoidance of Poorly Observable Trajectories: A Predictive Control Perspective (I), pp. 1952-1957.
Böhm, Christoph — Univ. of Stuttgart
Findeisen, Rolf — Otto-von-Guericke-Univ. Magdeburg
Allgower, Frank — Univ. of Stuttgart

MoB26 327
Furnace Control (Regular Session)
Chair: Chai, Tianyou — Northeastern Univ.
Co-Chair: Salas-Cabrera, Ruben — Inst. Tecnologico de Cd. Madero

14:00-14:20 MoB26.1
Outlier Detection for 2D Temperature Data, pp. 1958-1963.
Leiviska, Kauko — Univ. of Oulu/
Ruuska, Jari — Univ. of Oulu

14:20-14:40 MoB26.2
Control and Optimization for Steel Plant Preheating Installations, pp. 1964-1969.
Popescu, Dumitru — Pol. Univ. of Bucharest
Dimon, Catalin — Univ. Pol. of Bucharest

Petrescu, Catalin — Pol. Univ. of Bucharest

14:40-15:00 MoB26.3

Temperature Control of a Tube Furnace: An Experimental Approach, pp. 1970-1975.

Salas-Cabrera, Ruben — Inst. Tecnologico de Cd. Madero
Joers Delgado, Carlos Alberto — Inst. Tecnologico de Ciudad Madero
Medellin-Marsuez, Reyna — Inst. Tecnologico de Cd. Madero

15:00-15:20 MoB26.4

Intelligent Integrated Model for Predicting Burn-Through Point Based on Gas Temperature Distribution, pp. 1976-1981.

Xu, Chen-Hua — Central South Univ.
Wu, Min — Central South Univ.
She, Jin-Hua — Tokyo Univ. of Tech.
Ding, Lei — Central South Univ.
Yokoyama, Ryuichi — Waseda Univ.

15:20-15:40 MoB26.5

Optimizing Control of Hot Blast Stoves in Staggered Parallel Operation, pp. 1982-1987.

Sahin, Akin — ETH Zurich
Morari, Manfred — Swiss Federal Inst. of Tech.

15:40-16:00 MoB26.6

Hybrid Intelligent Control for Optimal Operation of Shaft Furnace Process, pp. 1988-1995.

Chai, Tianyou — Northeastern Univ.
Ding, Jinliang — Northeastern Univ.
Wu, Fenghua — Northeastern Univ.

MoB27 326
Precision Systems and Friction Modeling/Control (Regular Session)

Chair: Alvarez-Icaza, Luis — Univ. Nacional Autónoma de México
Co-Chair: Babuska, Robert — Delft Univ. of Tech.

14:00-14:20 MoB27.1

Robust H Infinity Control of Hysteresis in a Piezoelectric Stack Actuator, pp. 1996-2001.

Chuang, Ning — Australian Defence Force Acad.
Petersen, Ian Richard — Univ. of New South Wales - ADFA

14:20-14:40 MoB27.2

A Practical Loop Shaping Design Procedure with Classical Control Criteria and Its Application to Hard Disk Drives, pp. 2002-2007.

Ohno, Keitaro — The Univ. of Tokyo
Hara, Shinji — The Univ. of Tokyo
Yamahira, Naoshi — The Univ. of Tokyo
Kawabe, Takayuki — Fujitsu Lab. Ltd.
Maruyama, Tsugito — Fujitsu Lab. Ltd.

14:40-15:00 MoB27.3

Wind Turbine Modeling by Friction Effects, pp. 2008-2013.

Villanueva, Juvenal — Univ. Nacional Autónoma de México
Alvarez-Icaza, Luis — Univ. Nacional Autónoma de México

15:00-15:20 MoB27.4

Friction Identification and Compensation on Nanometer Scale, pp. 2014-2019.

Amthor, Arvid — TU Ilmenau
Ament, Christoph — Tech. Univ. Ilmenau
Li, Pu — Tech. Univ. of Ilmenau

15:20-15:40 MoB27.5

Adaptive Friction Compensation: Application to a Robotic Manipulator, pp. 2020-2024.

Susanto, Witono — TU Delft
Babuska, Robert — Delft Univ. of Tech.
Liefhebber, Freek — TNO Science and Industry
van der Weiden, Ton — TU Delft

15:40-16:00 MoB27.6

Stability of a Class of Relay Feedback Systems Arising in Controlled Mechanical Systems with Ideal Coulomb Friction, pp. 2025-2030.

Jeon, Soo — Univ. of California at Berkeley
Tomizuka, Masayoshi — Univ. of California, Berkeley

MoB28 330A
Engine Modeling, Diagnostics and Control (Invited Session)

Chair: Rizzo, Gianfranco — Univ. of Salerno
Co-Chair: Isermann, Rolf — Univ. of Tech. Darmstadt
Organizer: Rizzo, Gianfranco — Univ. of Salerno

14:00-14:20 MoB28.1

Model-Based Fault Detection and Diagnosis with Special Input Excitation Applied to a Modern Diesel Engine (I), pp. 2031-2036.

Clever, Sebastian — Tech. Univ. Darmstadt
Isermann, Rolf — Univ. of Tech. Darmstadt

14:20-14:40 MoB28.2

A Modeling Approach for Engine Dynamics Based on Electrical Analogy (I), pp. 2037-2042.

Palma, Antonio — Elasis SPA
Palladino, Angelo — Univ. degli Studi del Sannio
Fiengo, Giovanni — Univ. degli Studi del Sannio
De Cristofaro, Ferdinando — Elasis
Garofalo, Fabio — Elasis S.C.p.A.
Glielmo, Luigi — Univ. of Sannio

14:40-15:00 MoB28.3

Observer Design and Model Augmentation for Bias Compensation Applied to an Engine (I), pp. 2043-2048.

Höckerdal, Erik — Linköping Univ.
Frisk, Erik — Linkoping Univ.
Eriksson, Lars — Linköping Univ.

15:00-15:20 MoB28.4

Closed-Loop Individual Cylinder Air-Fuel Ratio Control Via UEGO Signal Spectral Analysis (I), pp. 2049-2056.

Cavina, Nicolo — Univ. of Bologna
Moro, Davide — Univ. of Bologna
Corti, Enrico — Univ. of Bologna

15:20-15:40 MoB28.5

Robust Nonlinear EGR and VGT Control with Integral Action for Diesel Engines (I), pp. 2057-2062.

Wahlström, Johan — Linköping Univ.
Eriksson, Lars — Linköping Univ.

15:40-16:00 MoB28.6

Time to Surge Concept and Surge Control for Acceleration Performance (I), pp. 2063-2068.

Leufven, Oskar — Linköping Univ.
Eriksson, Lars — Linköping Univ.

MoB29 330B
New Trends in Chassis Control and Supervision (Invited Session)

Chair: Gissinger, Gerard — Univ. of Mulhouse
Co-Chair: Yi, Kyongsu — Seoul National Univ.
Organizer: Gissinger, Gerard — Univ. of Mulhouse

14:00-14:20 MoB29.1

Navigation and Speed Signs Recognition Fusion for Enhanced Vehicle Location (I), pp. 2069-2074.

Lauffenburger, Jean-Philippe — Univ. of Haute-Alsace
Bradai, Benazouz — Valeo
Basset, Michel — Univ. de Haute-Alsace
Nashashibi, Fawzi — Ec. des Mines de Paris

14:20-14:40 MoB29.2

Attitude and Handling Improvements through Gain-Scheduled Suspensions and Brakes Control (I), pp. 2075-2080.

Poussot, Charles — INPG/ENSIEG
Sename, Olivier — INPG
Dugard, Luc — CNRS-INPG-UJF
Gaspar, Peter — Computer & Automation Inst. of HAS
Szabo, Zoltan — Hungarian Acad. of Sciences
Bokor, Jozsef — Hungarian Acad. of Sciences

14:40-15:00 MoB29.3

Optimization of Global Chassis Control Variables (I), pp. 2081-2086.

Kasac, Josip — Faculty of Mechanical Engineering and Naval Architecture
Deur, Josko — Univ. of Zagreb
Novakovic, Branko — Faculty of Mechanical Engineering and Naval Architecture
Assadian, Francis — Jaguar Cars Ltd
Hancock, Matthew — Jaguar Cars Ltd

15:00-15:20 MoB29.4

An Integrated Vehicle Control with Actuator Reconfiguration (I), pp.

2087-2092.
Gaspar, Peter — Computer & Automation Inst. of HAS
Szabo, Zoltan — Hungarian Acad. of Sciences
Bokor, Jozsef — Hungarian Acad. of Sciences

15:20-15:40 MoB29.5
Design and Tests of a Controller for Autonomous Vehicle Path Tracking Using GPS/INS Sensors, pp. 2093-2098.
Kang, Juyong — Seoul National Univ.
Hindiyeh, Rami Y. — Stanford Univ.
Moon, Seung-Wuk — Seoul National Univ.
Yi, Kyongsu — Seoul National Univ.
Gerdes, J. Christian — Stanford Univ.

15:40-16:00 MoB29.6
Anti-Lock Braking System Using Predictive Control and On-Line Tire/Road Characteristics Estimation, pp. 2099-2104.
Jacquet, Arnaud — Messier-Bugatti
Chamaillard, Y. — LME
Basset, Michel — Univ. de Haute-Alsace
Gissinger, Gerard — Univ. of Mulhouse
Franck, David — Messier-Bugatti
Garcia, Jean-Pierre — messier bugatti

MoB30 330C
Formation Flight (Invited Session)
Chair: de Lafontaine, Jean — Univ. de Sherbrooke / NGC Aerospace Ltd
Co-Chair: Lovera, Marco — Pol. di Milano
Organizer: de Lafontaine, Jean — Univ. de Sherbrooke / NGC Aerospace Ltd
Organizer: Kron, Aymeric — Univ. of Sherbrooke

14:00-14:20 MoB30.1
An LTP/LPV Approach to Orbit Control of Spacecraft on Elliptical Orbits (I), pp. 2105-2110.
Vigano', Luca — Pol. di Milano
Lovera, Marco — Pol. di Milano
Drai, Rémi — ESA-ESTEC

14:20-14:40 MoB30.2
Relative State Estimation of Satellite Formation Flying Using Kalman Filter (I), pp. 2111-2116.
Lee, Young Gu — Korea Advanced Inst. of Science and Tech.
Bang, Hyochoong — KAIST

14:40-15:00 MoB30.3
Robust Multi-Objective Control for the Station Keeping of the Interferometric Cartwheel (I), pp. 2117-2122.
Arzelier, Denis — LAAS-CNRS
Theron, Alain — Univ. de Toulouse
Peaucelle, Dimitri — LAAS-CNRS
Fourcade, Jean — CNES

15:00-15:20 MoB30.4
Distributed Estimation for Spacecraft Formations Over Time-Varying Sensing Topologies (I), pp. 2123-2130.
Acikmese, Behcet — Jet Propulsion Lab.
Scharf, Daniel — Jet Propulsion Lab.
Carson, John M. — California Inst. of Tech. Jet Propulsion Lab.
Hadaegh, Fred Y. — California Inst. of Tech.

15:20-15:40 MoB30.5
Formation Flying Guidance Navigation and Control Design for Science Missions (I), pp. 2131-2136.
Villien, Anthony — ASTRIUM SAS
Morand, Julien — ASTRIUM SAS
Borde, Jacques — ASTRIUM SAS
Cavel, Cyril — ASTRIUM SAS

15:40-16:00 MoB30.6
Output Attitude Tracking of a Formation of Spacecraft, pp. 2137-2143.
Grřtli, Esten Ingar — Norwegian Univ. of Science and Tech.
Gravdahl, Jan Tommy — Norwegian Univ. of Science & Tech.

MoBCC 401
Milestone Report by IFAC Coordinating Committee on Design Methods (CC2) (Milestone Session)
Chair: Bars, Ruth — Budapest Univ. of Tech. and Ec.

14:00-16:00 MoBCC.1
Trends in Theory of Control System Design - Status Report by the IFAC Coordinating Committee on Design Methods, pp. 2144-2155.
Bars, Ruth — Budapest Univ. of Tech. and Ec.
Colaneri, Patrizio — Pol. di Milano
Dugard, Luc — CNRS-INPG-UJF
Allgower, Frank — Univ. of Stuttgart
Kleimenov, Anatolii — Inst. of Mathematics and Mechanics of Ural Branch of the Rus
Scherer, Carsten W. — Delft Univ. of Tech.

MoC01 Atlantic Hall
Mechatronics & Computers (Poster Session)
Chair: Wang, Wei — Dalian Univ. of Tech.
Co-Chair: Boverie, Serge — Continental Automotive France

16:30-18:30 MoC01.1
LQ Control Problem Based on Numerical Computation with Guaranteed Accuracy, pp. 2156-2161.
Yano, Kentaro — Kyushu Inst. of Tech.
Koga, Masanobu — Kyushu Inst. of Tech.

16:30-18:30 MoC01.2
Design of Intelligent Information Support Systems for Human-Operators of Complex Plants, pp. 2162-2167.
Jharko, Elena — V.A. Trapeznikov Inst. of Control Sciences

16:30-18:30 MoC01.3
Model Parameter Estimation by Tracking Simulator for the Innovation of Plant Operation, pp. 2168-2173.
Nakaya, Makoto — Yokogawa Electric Corp.
Seki, Tatenobu — Yokogawa Electric Corp.
Kawaguchi, Kyojiro — Yokogawa Electric Corp.
Onoe, Yasushi — Yokogawa Electric Corp.
Ohtani, Tetsuya — Yokogawa Electric Corp.

16:30-18:30 MoC01.4
Design on Odd-Even Steps Third Order Approach Interpolation Algorithm for Logarithmic Curve, pp. 2174-2179.
Jiang, Xinhua — Central South Univ.
Chen, Xingwu — Fujian Univ. of Tech.

16:30-18:30 MoC01.5
Hybrid System Approach to On-Line Testing of Mixed Signal VLSI Circuits: A Case Study of DC-DC Buck Converters, pp. 2180-2187.
Biswas, Santosh — IIT Kharagpur INDIA
Samanta, Susovan — IIT Kharagpur
Mukhopadhyay, Siddhartha — IIT KGP
Patra, Amit — IIT Kharagpur
Sarkar, Dipankar — IIT,Kharagpur

16:30-18:30 MoC01.6
A Fuel-Cell-Battery Hybrid Platform for Portable Embedded Systems, pp. 2188-2193.
Lee, Kyungsoo — SEOUL NATIONAL Univ.
Cho, Youngjin — seoul national Univ.
Park, Jaehyun — SEoul national Univ.
Kim, Younghyun — Seoul National Univ.
Kim, Jihun — seoul national Univ.
Chang, Naehyuck — Seoul national Univ.

16:30-18:30 MoC01.7
Home Network Infrastructure Based on Corba Event Channel, pp. 2194-2199.
Binugroho, Eko Henfri — Pusan National Univ.
Seo, Young Bong — Pusan National Univ.
Choi, Jae Weon — Pusan National Univ.

16:30-18:30 MoC01.8
A Soar-Based Planning Agent for Gas-Turbine Engine Control and Health Management, pp. 2200-2205.
Gunetti, Paolo — Univ. of Sheffield
Thompson, Haydn — Univ. of Sheffield

16:30-18:30 MoC01.9
Fuzzy Logic Application to Drying Kinetics Modelling, pp. 2206-2211.
Vaquiro, Henry A. — Univ. of Tolima
Bon, Jose — Pol. Univ. of Valencia
Díez, José Luis — Univ. Pol. de Valencia

16:30-18:30 MoC01.10

Reinforcement Learning for Elevator Control, pp. 2212-2217.

Yuan, Xu	ASML Netherlands B.V.
Busoniu, Lucian	Delft Univ. of Tech.
Babuska, Robert	Delft Univ. of Tech.

16:30-18:30 MoC01.11

A Novel Multi-Source Classification Approach Based on Evidence Combination, pp. 2218-2223.

Han, Deqiang	Xi'an Jiaotong Univ.
Han, Chongzhao	Xi'an Jiaotong Univ.
Yang, Yi	Xi'an Jiaotong Univ.

16:30-18:30 MoC01.12

Neural Network-Based Intelligent Compaction Analyzer for Estimating Compaction Quality of Hot Asphalt Mixes, pp. 2224-2229.

Commuri, Sesh	Univ. of Oklahoma
Mai, Anh	Univ. of Oklahoma
Zaman, Musharraf	Univ. of Oklahoma

16:30-18:30 MoC01.13

ANN for Interpolating Instability Trends in WEDM, pp. 2230-2235.

Portillo Perez, Eva	Univ. of the Basque Country
Marcos, Marga	Univ. del País Vasco
Cabanes, Itziar	Univ. of the Basque Country
Zubizarreta, Asier	Univ. of the Basque Country
Sánchez, José Antonio	Univ. of the Basque Country

16:30-18:30 MoC01.14

Radio-Frequency Transducers and Algorithms for Determining the Volumetric Content of the Components of Emulsion and Stratified Flows, pp. 2236-2241.

Lunkin, Boris V.	Inst. of Control Sciences, Russian Acad. of Sciences

16:30-18:30 MoC01.15

Motion Planning and Trajectory Tracking of Underactuated Three-Link Robots, pp. 2242-2247.

Liu, Qingbo	Beijing Univ. of Tech.
Yu, Yueqing	Beijing Univ. of Tech.
Xu, Zihong	Jiang Su Univ.
Su, Liying	Beijing Univ. of Tech.
Liu, Shanzeng	Beijing Univ. of Tech.

16:30-18:30 MoC01.16

Monitoring Phase Transition in Polymer Using a Quartz Crystal Resonator, pp. 2248-2251.

Kim, Young Han	Dong-A Univ.
Kim, Byoung Chul	Dong-A Univ.

16:30-18:30 MoC01.17

On the Implementation of a Wavelet-Based Iterative Learning Controller Using CPLD/FPGA, pp. 2252-2257.

Chen, Jian-Shiang	National Tsing Hua Univ.
Tzeng, Kune-Shiang	National United Univ.

16:30-18:30 MoC01.18

Modeling and Precison Control of Permanent Magnet Linear Motors, pp. 2258-2263.

Zhang, Dailin	The Chinese Univ. of Hong Kong

16:30-18:30 MoC01.19

On the Importance of Tailorable Processes in the Development of Embedded Industrial Automation Systems, pp. 2264-2269.

Nenninger, Philipp	ABB
Streitferdt, Detlef	ABB

16:30-18:30 MoC01.20

Feedforward Design for a Mechanical System with Marginally Stable Inverse, pp. 2270-2275.

Naucler, Peter	Uppsala Univ.
Soderstrom, Torsten	Uppsala Univ.

16:30-18:30 MoC01.21

Robust Trajectory Control of Robot Manipulators Using Time Delay Control with Adaptive Compensator, pp. 2276-2281.

Han, Dong Ki	Korea Advanced Inst. of Science and Tech. (KAIST)
Chang, Pyung Hun	Korea Adv. Inst. of Sci. & Tech.
Jin, Maolin	Korea Advanced Inst. of Science and Tech.

16:30-18:30 MoC01.22

Adaptive Sliding-Mode Control for a Precision Positioner with Hybrid Mechanism, pp. 2282-2287.

Huang, Sheng-Chih	National Taiwan Univ.
Hung, Shao-Kang	National Taiwan Univ.
Chen, Mei-Yung	National Taiwan Normal Univ.
Lin, Chih-Hsien	National Taiwan Univ.
Fu, Li-Chen	National Taiwan Univ.

16:30-18:30 MoC01.23

Stress-Dependent Hysteresis Modeling and Tracking Control of Giant Magnetostrictive Actuator for Periodic Reference Input, pp. 2288-2293.

Zhang, Zhen	Beijing Univ. of Aero & Astro, Beijing
Mao, Jianqin	Beijing Univ. of Aeronautics and Astronautics
Chen, Wenli	Beijing Univ. of Aero & Astro

16:30-18:30 MoC01.24

Macroscopic Drive Chain Efficiency Modeling Using State Machines, pp. 2294-2299.

Al Assad, Omar	GE healthcare/ SUPELEC
Godoy, Emmanuel	Supelec
Croulard, Vincent	GEMS

16:30-18:30 MoC01.25

Multi-Scale Distributed Port-Hamiltonian Representation of Ionic Polymer-Metal Composite, pp. 2300-2305.

Nishida, Gou	RIKEN
Takagi, Kentaro	Nagoya Univ.
Maschke, Bernhard	Univ. Claude Bernard of Lyon
Luo, Zhiwei	Bio-mimetic Control Res. Ctr.

16:30-18:30 MoC01.26

Identification and Control of a Hydraulic Forestry Crane, pp. 2306-2311.

Miranda La Hera, Pedro Xavier	Umeĺ Univ.
Mettin, Uwe	Umeĺ Univ.
Manchester, Ian	Umeĺ Univ.
Shiriaev, Anton	Umea Univ.

16:30-18:30 MoC01.27

On Modeling and Parameter Estimation of Brushless DC Servoactuators for Position Control Tasks, pp. 2312-2317.

Campa, Ricardo	Inst. Tecnologico de la Laguna
Torres, Elio	Inst. Tecnologico de la Laguna
Salas, Francisco	Inst. Tecnologico de la Laguna
Santibanez, Victor	Inst. Tecnologico De La Laguna

16:30-18:30 MoC01.28

High-Fidelity Tracking Control of Electric Shaking Tables, pp. 2318-2323.

Sawada, Yuichi	Kyoto Inst. of Tech.
Ohgawara, Naoto	Kyoto Inst. of Tech.

16:30-18:30 MoC01.29

Backstepping Technique for Tracking Control of an Underactuated Surface Vessel with Unmeasured Thruster Dynamic, pp. 2324-2329.

Ghommam, Jawhar	MECA
Mnif, Faical	Sultan Qaboos Univ.
El-Metwally, K.A	Cairo Univ.

16:30-18:30 MoC01.30

Reducing Effect of Outliers in Landmark-Based Spatial Localization Using MLESAC, pp. 2330-2335.

Choi, Sunglok	Electronics and Telecommunications Res. Inst.
Kim, Jong-Hwan	Korea Advanced Inst. of Science and Tech.

16:30-18:30 MoC01.31

A Virtual Range Finder Based on Monocular Vision System in Simultaneous Localization and Mapping, pp. 2336-2341.

Zhang, Xinzheng	The Hong Kong Pol. Univ.
Rad, A. B.	Simon Fraser Univ.
Wong, Y. K.	Hong Kong Pol. Univ.

16:30-18:30 MoC01.32

Plan Planning of Mobile Robot in Irregular Environment Using Immune Evolutionary Algorithm, pp. 2342-2346.

Cai, Zixing	Central South Univ.
Yu, Lingli	Central South Univ.
Xiao, Chang	Central South Univ.
Liu, Lijue	Central South Univ.

16:30-18:30 MoC01.33

Model Algorithm Tracking Control of Wheeled Mobile Robots, pp. 2347-2352.

Zhang, Yuanliang — Chonbuk National Univ.
Chong, Kil To — Chon Buk National Univ.

16:30-18:30 — MoC01.34
Speeded-Up Algorithm for Human/Vehicle Classification Using Hilbert Scanning Distance, pp. 2353-2358.
Baek, Young Min — Seoul National Univ.
Choi, Jeong Hwan — Seoul National Univ.
Choi, Jin Young — Seoul National Univ.

16:30-18:30 — MoC01.35
Color-Based Visual Servoing of a Mobile Manipulator with Stereo Vision, pp. 2359-2364.
Lee, Hyun-Jeong — Pusan National Univ.
Lee, Min Cheol — Pusan National Univ.

16:30-18:30 — MoC01.36
Delayed Inverse Depth Monocular SLAM, pp. 2365-2370.
Munguia, Rodrigo — Tech. Univ. of Catalonia, UPC
Grau, Antoni — Tech. Univ. of Catalonia, UPC

16:30-18:30 — MoC01.37
Robust Salient Moving Object Detection with Light-Computational Load, pp. 2371-2376.
Choi, Jeong Hwan — Seoul National Univ.
Baek, Young Min — Seoul National Univ.
Choi, Jin Young — Seoul National Univ.

16:30-18:30 — MoC01.38
Automatic Segmentation for Emotional Feature Extraction from Spoken Sentence, pp. 2377-2381.
Hyun, Kyung Hak — KAIST
Kim, Eun Ho — KAIST
Kwak, Yoon Keun — KAIST

16:30-18:30 — MoC01.39
Adaptive Neural Network Tracking Control for Manipulators with Uncertainties, pp. 2382-2387.
Cheng, Long — Inst. of Automation, Chinese Acad. of Sciences
Hou, Zeng-Guang — Chinese Acad. of Science
Tan, Min — Inst. of Automation, Chinese Acad. of Sciences
Wang, Hong-Ming — Inst. of Automation, Chinese Acad. of Sciences

16:30-18:30 — MoC01.40
Direct Method of Manipulator Endpoint Control Synthesis, pp. 2388-2393.
Krasnova, Svetlana — ICS
Utkin, Victor — ICS
Utkin, Anton — ICS

16:30-18:30 — MoC01.41
Humanoid Gait Synthesis Using Trajectory Plot and Relative-ZMP (R-ZMP) Concept, pp. 2394-2399.
Er, Meng Joo — NTU
Weng, Soon Khor — Nanyang Tech. Univ.
Tang, Zhe — Nanyang Tech. Univ.

16:30-18:30 — MoC01.42
Development of a Foot Mechanism for Landing Experiment, pp. 2400-2405.
Cheon, Seyoung — 1.Yonsei Univ. Republic of Korea 2.The Centerfor Co
Oh, Yonghwan — Korea Inst. of Science & Tech. Korea
Chang, Young-Hwan — Korea Inst. of Science and Tech. (KIST)
Park, Youngpil — Yonsei Univ. 134 Sinchon-dong, Seodaemun-gu, Seoul 120-749,

16:30-18:30 — MoC01.43
Data Fusion and Efficient Algorithm for Moving Target Tracking, pp. 2406-2411.
Liu, Guocheng — Coll. of Power and Mechanical Engineering, WuhanUniversity
Wang, Yongji — Hauzhong Univ. of Science And Tech.

16:30-18:30 — MoC01.44
Explanation-Based Manipulator Learning: Acquisition of Assembling Technique through Observation, pp. 2412-2417.
Wang, Lei — Kyoto Univ.
Tian, Yajie — Kyoto Univ.
Sawaragi, Tetsuo — Kyoto Univ.

16:30-18:30 — MoC01.45
Timed Petri Nets Model on Bell-Type Batch Annealing Process and Its Simulation Using SystemC Platform, pp. 2418-2423.
Zhang, Xiaoping — Dalian Univ. of Tech.
Liu, Quanli — Dalian Univ. of Tech.
Wang, Wei — Dalian Univ. of Tech.
Zhao, Jun — Dalian Univ. of Tech.
Wang, Zhigang — Dalian Univ. of Tech.

16:30-18:30 — MoC01.46
Human-Robot Cooperation in Precise Positioning of a Flat Object, pp. 2424-2429.
Wojtara, Tytus — Bio-Mimetic Control Res. Center
Uchihara, Masafumi — Toyota Motor Corp.
Murayama, Hideyuki — Toyota Motor Corp.
Shimoda, Shingo — Riken
Sakai, Satoshi — Nagoya Inst. of Tech.
Fujimoto, Hideo — Nagoya Inst. of Tech.
Kimura, Hidenori — The Inst. of Physical and Chemical Res. (RIKEN)

16:30-18:30 — MoC01.47
Tele-Operation between Human and Robot Arm Using Wearable Electronic Device, pp. 2430-2435.
Song, HeeBae — KIST
Kim, Doik — Korea Inst. of Science and Tech. (KIST)
Park, Mignon — Yonsei Univ.
Park, JoonByung — KIST

16:30-18:30 — MoC01.48
Ubiquitous Display for Human Centered Interface -Fixed Shape Projection and Parameter Optimization, pp. 2436-2441.
Miyashita, Satoshi — Ritsumeikan Univ.
Lee, Joo-Ho — Ritsumeikan Univ.

16:30-18:30 — MoC01.49
Impedance Compensation of Flexible Joint Actuator for Ideal Force Mode Control, pp. 2442-2447.
Kong, Kyoungchul — Univ. of California, Berkeley
Bae, Joonbum — Univ. of California at Berkeley
Tomizuka, Masayoshi — Univ. of California, Berkeley

16:30-18:30 — MoC01.50
Advanced Control Structure for Energy Management in Ground Coupled Heat Pump HVAC System, pp. 2448-2453.
Pardo, Nicolas — Univ. Pol. de Valencia
Sala, Antonio — Univ. Pol. de Valencia
Montero, Alvaro — Univ.
Urchueguia, Javier — Univ. Pol. de Valencia
Martos, Julio — Univ. de Valencia

MoC02 — 304A
Stability of Nonlinear Systems (Regular Session)
Chair: Jiang, Zhong-Ping — Pol. Univ.
Co-Chair: Ito, Hiroshi — Kyushu Inst. of Tech.

16:30-16:50 — MoC02.1
Remarks on ISS and Integral-ISS Stabilization with Positive Controls, pp. 2454-2459.
Lin, Yuandan — Florida Atlantic Univ.
Wang, Yuan — Florida Atlantic Univ.
Jiang, Zhong-Ping — Pol. Univ.

16:50-17:10 — MoC02.2
Bilaterally Flexible Lyapunov Inequalities for Nonlinear Small-Gain Method Covering Iiss Systems, pp. 2460-2465.
Ito, Hiroshi — Kyushu Inst. of Tech.

17:10-17:30 — MoC02.3
Finite-Time Input-To-State Stability and Applications to Finite-Time Control, pp. 2466-2471.
Hong, Yiguang — Chinese Acad. of Sciences
Jiang, Zhong-Ping — Pol. Univ.
Feng, Gang — City Univ. of Hong Kong

17:30-17:50 — MoC02.4
Novel Delay-Dependent Exponential Stability of a Class of Fuzzy Cellular Neural Networks with Time-Varying Delays, pp. 2472-2477.
Liu, Zhenwei — Northeastern Univ.
Zhang, Huaguang — Northeastern Univ.
Liu, Derong — Univ. of Illinois at Chicago

17:50-18:10 — MoC02.5
Improved Delay-Dependent Stability for a Class of Linear Systems

with Time-Varying Delay and Nonlinear Perturbations, pp. 2478-2483.
Yan, Xianbo — TIANJIN Univ.
Wang, Yijing — Tianjin Univ.
Zuo, Zhiqiang — Tianjin Univ.
Zhao, Huimin — Tianjin Univ.
Zhang, Guoshan — Tianjin Univ.

18:10-18:30 — MoC02.6
New Delay-Dependent Criteria for Robust Stability of Uncertain Singular Systems, pp. 2484-2489.
Gao, J. F. — Zhejiang Univ. Zhejiang Sci-Tech. Univ.
Su, Hongye — Zhejiang Univ.
Ji, Xiaofu — Zhejiang Univ.
Chu, Jian — Zhejiang Univ.

MoC03 — 304B
Control of Constrained Systems II (Regular Session)
Chair: Utkin, Victor — ICS
Co-Chair: Lin, Zongli — Univ. of Virginia

16:30-16:50 — MoC03.1
Analysis and Design of Switched Linear Systems in the Presence of Actuator Saturation and L2 Disturbances, pp. 2490-2495.
Lv, Liang — Shanghai Jiao Tong Univ.
Lin, Zongli — Univ. of Virginia
Fang, Haijun — MKS Inst.

16:50-17:10 — MoC03.2
Dynamic Linear System Synthesis with Account of Phase and Control Restrictions Via Sigma-Function Feedback, pp. 2496-2501.
Utkin, Victor — ICS

17:10-17:30 — MoC03.3
Constrained Stabilization of Bilinear Discrete-Time Systems Using Polyhedral Lyapunov Functions, pp. 2502-2507.
Bitsoris, Georges — Univ. of Patras
Athanasopoulos, Nikolaos — Univ. of Patras, Greece

17:30-17:50 — MoC03.4
Output Variance-Constrained LQG Control of Discrete-Time Systems, pp. 2508-2513.
Lee, Ji-Woong — Pennsylvania State Univ.
Khargonekar, Pramod P. — Univ. of Florida

17:50-18:10 — MoC03.5
A New Output Feedback Control for Nonlinear Differential-Algebraic-Equation Systems, pp. 2514-2519.
Zang, Qiang — Southeast Univ.
Dai, Xianzhong — Southeast Univ.
Zhang, Kaifeng — Southeast Univ.

18:10-18:30 — MoC03.6
Off-Line Robustification of Explicit Control Laws, pp. 2520-2525.
Rodriguez-Ayerbe, Pedro — Supelec
Olaru, Sorin — Supelec

MoC04 — 308
Applications of Nonlinear Control II (Regular Session)
Chair: Chiu, George T.-C. — Purdue Univ.
Co-Chair: Bates, Declan G. — Univ. of Leicester

16:30-16:50 — MoC04.1
Acceleration Feedback Control of Hysteretic Base-Isolated Structures: Application to a Benchmark Case, pp. 2526-2531.
Pozo, Francesc — Univ. Pol. de Catalunya (UPC)
Rodellar, Jose — Tech. Univ. of Catalonia
Acho, Leonardo — EUETIB-Univ. Pol. of Catalunya

16:50-17:10 — MoC04.2
Multiobjective Worst-Case Analysis of a Re-Entry Vehicle Control Law, pp. 2532-2537.
Menon, Prathyush P — Univ. of Leicester
Postlethwaite, Ian — the Univ. of Leicester
Bennani, Samir — European Space Agency
Marcos, Andres — Deimos Space S.L.
Bates, Declan G. — Univ. of Leicester

17:10-17:30 — MoC04.3
Robust Adaptive Control of Hard Disk Drives with Hysteresis Friction Nonlinearity in Mobile Applications, pp. 2538-2543.
Ren, Beibei — National Univ. of Singapore
San, Phyo Phyo — National Univ. of Singapore
Ge, Shuzhi Sam — National Univ. of Singapore
Lee, Tong Heng — National Univ. of Singapore

17:30-17:50 — MoC04.4
A New Nonlinear Control Methodology for Irrigation Canals Based on a Delayed Input Model, pp. 2544-2549.
Benayache, Zohra — INPG
Besancon, Gildas — ENSIEG-INPG
Georges, Didier — ENSIEG - INPG

17:50-18:10 — MoC04.5
System Analysis of a Hybrid Two-Component Development Process for Xerography, pp. 2550-2555.
Liu, Feng — Purdue Univ.
Chiu, George T.-C. — Purdue Univ.
Hamby, Eric S. — Xerox Corp.
Eun, Yongsoon — Xerox

18:10-18:30 — MoC04.6
Power-Based Control of Physical Systems: Two Case Studies, pp. 2556-2562.
Garcia-Canseco, Eloisa — Univ. of Groningen
Jeltsema, Dimitri — Delft Univ. of Tech.
Scherpen, Jacquelien M.A. — Univ. of Groningen
Ortega, Romeo — LSS-SUPELEC

MoC05 — 307
Fault-Tolerant Control II (Regular Session)
Chair: Yang, Soo Siang — Univ. of Malaya
Co-Chair: Feng, Chieh-Chuan — I-Shou Univ.

16:30-16:50 — MoC05.1
On-Line References Reshaping and Control Reconfiguration for Non-Minimum Phase Nonlinear Fault Tolerant Control, pp. 2563-2569.
Benosman, Mouhacine — TL@National Univ. of Singapore
Lum, Kai-Yew — National Univ. of Singapore

16:50-17:10 — MoC05.2
Output Selection with Fault Tolerance Via Dynamic Controller Design, pp. 2570-2575.
Li, Zhenhai — Loughborough Univ.
Zolotas, Argyrios — Loughborough Univ.
Jaimoukha, Imad M. — Imperial Coll. London
Grigoriadis, Karolos M. — Univ. of Houston

17:10-17:30 — MoC05.3
Latent and Small Fault Detection and Diagnosis for Dynamic Processes, pp. 2576-2581.
Ge, Zhiqiang — Zhejiang Univ.
Song, Zhi-Huan — Zhejiang Univ.

17:30-17:50 — MoC05.4
Robust Fault-Tolerant Control for Systems with Extended Bounded-Sensor-Faults, pp. 2582-2587.
Feng, Chieh-Chuan — I-Shou Univ.

17:50-18:10 — MoC05.5
Sensor Fault Tolerant Controller for a Double Inverted Pendulum System, pp. 2588-2594.
Yang, Soo Siang — Univ. of Malaya
Chen, Jie — Brunel Univ.
Mohamed, Haider Abbas F. — Univ. of Malaya
Moghavvemi, Mahmoud — Univ. of Malaya

18:10-18:30 — MoC05.6
Adaptive Neural-Based Fault Tolerant Control for Nonlinear Systems, pp. 2595-2600.
De La Fuente, Maria Jesus — Univ. De Valladolid. Q4718001C
Mateo, Victor — Univ. de Valladolid
Sainz, Gregorio — Univ. de Valladolid
Saludes, Sergio — Fundación Cartif

MoC06 — 310A
Time Delay Systems: Stability Analysis (Regular Session)
Chair: Keel, Lee H. — Tennessee State Univ.
Co-Chair: Fridman, Emilia — Tel-Aviv Univ.

16:30-16:50 — MoC06.1
Delay-Dependent Exponential Stability of Linear Distributed Parameter Systems, pp. 2601-2606.
Fridman, Emilia — Tel-Aviv Univ.
Orlov, Yury — CICESE

16:50-17:10 — MoC06.2
A Delay Decomposition Approach to Stability of Linear Neutral Systems, pp. 2607-2612.

Han, Qing-Long Central Queensland Univ.

17:10-17:30 MoC06.3

Necessary and Sufficient Conditions for Delay-Dependent Asymptotic Stability of Linear Discrete Time Delay Autonomous Systems, pp. 2613-2618.

Debeljkovic, Dragutin, LJ. Univ. of Belgrade
Stojanovic, Sreten assistant prof.

17:30-17:50 MoC06.4

Some Necessary and Sufficient Conditions of Stability on the Approximation of a Distributed Delay Control Law, pp. 2619-2624.

Cardelli, Michel IRCCyN
Boudey, Julien IRCCyN

17:50-18:10 MoC06.5

Delay-Dependent Stability Criteria for Markovian Switching Networks with Time-Varying Delay, pp. 2625-2630.

Sathananthan, Sivapragasam Tennessee State Univ.
Beane, Carlos Tennessee State Univ.
Keel, Lee H. Tennessee State Univ.

18:10-18:30 MoC06.6

Fast Step-Response Evaluation of Linear Continuous-Time Systems with Time Delay in the Feedback Loop, pp. 2631-2636.

Piguet, Yves Calerga Sarl
Muellhaupt, Philippe Ec. Pol. Fed. de Lausanne

MoC07 310B

Control Problems under Conflict or Uncertainties (Regular Session)

Chair: Turnau, Andrzej AGH Univ. of Science and Tech.
Co-Chair: Cruz, Jose B The Ohio State Univ.

16:30-16:50 MoC07.1

Enhancements for Contractive Receding Horizon Control, pp. 2637-2642.

Chung, Hoam Univ. of California, Berkeley
Polak, Elijah Univ. of California
Sastry, Shankar Univ. of California at Berkeley

16:50-17:10 MoC07.2

Game of Defending a Target: A Linear Quadratic Differential Game Approach, pp. 2643-2648.

Li, Dongxu Ohio State Univ.
Cruz, Jose B The Ohio State Univ.

17:10-17:30 MoC07.3

Robust Filter Design for Sigma-Delta Modulators with One-Bit Quantizer and Analog Mismatch, pp. 2649-2654.

Chou, Yung-Shan Tamkang Univ.
Lin, Chun-Chen Tamkang Univ.

17:30-17:50 MoC07.4

Model Identification Dedicated to the Time-Optimal Control, pp. 2655-2660.

Turnau, Andrzej AGH Univ. of Science and Tech.

17:50-18:10 MoC07.5

A Probabilistic Algorithm for Mode Based Motion Planning of Agile Unmanned Air Vehicles in Complex Environments, pp. 2661-2668.

Koyuncu, Emre Istanbul Tech. Univ.
Üre, Naz1;m Kemal Istanbul Tech. Univ.
Inalhan, Gokhan Istanbul Tech. Univ.

18:10-18:30 MoC07.6

Asymptotic Disturbance Attenuation Properties for Continuous-Time Uncertain Switched Linear Systems, pp. 2669-2674.

Lin, Hai National Univ. of Singapore
Antsaklis, Panos J. Univ. of Notre Dame

MoC08 310C

Observer and Robust Estimator Synthesis (Regular Session)

Chair: Allgower, Frank Univ. of Stuttgart
Co-Chair: Geromel, Jose C. UNICAMP

16:30-16:50 MoC08.1

Robust H2 Filtering for Continuous Time Systems with Linear Fractional Representation, pp. 2675-2680.

Korogui, Rubens H. Univ. of Campinas
Geromel, Jose C. UNICAMP

16:50-17:10 MoC08.2

H2 and Hoo Filtering of Discrete-Time Markov Jump Linear Systems through Linear Matrix Inequalities, pp. 2681-2686.

Fioravanti, André R. UNICAMP
Gonçalves, Alim P. C. UNICAMP
Geromel, Jose C. UNICAMP

17:10-17:30 MoC08.3

Robust H_; Filtering for Uncertain Discrete-Time Singular Systems, pp. 2687-2692.

Lee, Ching-Min I-Shou Univ.
Wang, Wei-Sheng I-Shou Univ.

17:30-17:50 MoC08.4

An Observer That Converges in Finite Time Due to Measurement-Based State Updates, pp. 2693-2695.

Raff, Tobias Univ. of Stuttgart
Allgower, Frank Univ. of Stuttgart

17:50-18:10 MoC08.5

A Construction of Disturbance Observer to Cope with Frequency Variation and Its Application to Vibration Suppression Control System, pp. 2696-2701.

Fuwa, Katsuhiko Nagaya Inst. of Tech.
Narikiyo, Tatsuo Toyota Tech. Inst.
Kandoh, Hisashi Nagaya Inst. of Tech.

18:10-18:30 MoC08.6

Implementation of Disturbance Attenuation System Based on Frequency Estimation, pp. 2702-2707.

Narikiyo, Tatsuo Toyota Tech. Inst.
Fuwa, Katsuhiko Nagaya Inst. of Tech.
Murano, Takeshi Toyota Tech. Inst.

MoC09 311C

Nonlinear System Identification I (Regular Session)

Chair: Wills, Adrian George Univ. of Newcastle
Co-Chair: Schön, Thomas, Bo Linköping Univ.

16:30-16:50 MoC09.1

Blind Maximum Likelihood Identification of Hammerstein Systems, pp. 2708-2713.

Vanbeylen, Laurent Vrije Univ. Brussel
Pintelon, Rik Vrije Univ. Brussel
Schoukens, Johan Vrije Univ. Brussel

16:50-17:10 MoC09.2

Maximum Likelihood Identification of Wiener Models, pp. 2714-2719.

Hagenblad, Anna Linkoping Univ.
Ljung, Lennart Linköping Univ.
Wills, Adrian George Univ. of Newcastle

17:10-17:30 MoC09.3

Optimal Precision of Quantum System Parameter Estimation Subject to Instrumentation Constraints, pp. 2720-2725.

Kosut, Robert SC Solutions

17:30-17:50 MoC09.4

NARX Model Identification with Error Filtering, pp. 2726-2731.

Piroddi, Luigi Pol. di Milano
Lovera, Marco Pol. di Milano

17:50-18:10 MoC09.5

Piecewise Linear Solution Paths for Parametric Piecewise Quadratic Programs, pp. 2732-2737.

Roll, Jacob Linköping Univ.

18:10-18:30 MoC09.6

Identification of Non-Parametric Nonlinear Systems with Low Degree Interactive Terms, pp. 2738-2743.

Bai, Er-Wei Univ. of Iowa

MoC10 311B

Prediction, Filtering and Smoothing III (Regular Session)

Chair: Stepanov, Oleg A. Central Scientific Res. Inst. Elektropribor
Co-Chair: Broersen, Piet M.T. Delft Univ. of Tech.

16:30-16:50 MoC10.1

Finite-Sample Bias Propagation in the Yule-Walker Method of Autoregressive Estimation, pp. 2744-2749.

Broersen, Piet M.T. Delft Univ. of Tech.

16:50-17:10 MoC10.2

Investigation of Linear Optimal Estimator, pp. 2750-2755.

Stepanov, Oleg A. Central Scientific Res. Inst. Elektropribor
Toropov, Anton Central Scientific Res. Inst. Elektropribor

17:10-17:30 MoC10.3
Design of Robust Hinf Observers for Nonlinear Systems Using a Multiple Model, pp. 2756-2761.
Orjuela, Rodolfo — CRAN-INPL
Marx, Benoit — Centre de Recherche en Automatique de Nancy
Ragot, Jose — CRAN-INPL
Maquin, Didier — Inst. National Pol. de Lorraine

17:30-17:50 MoC10.4
Robust State Estimation for Multi-Delayed Neural Networks: An LMI Approach, pp. 2762-2767.
Yu, Li — Zhejiang Univ. of Tech.
Zheng, Ke — Zhejiang Univ. of Tech.
Zhang, Wen-An — Zhejiang Univ. of Tech.

17:50-18:10 MoC10.5
Design of Observers for Takagi-Sugeno Systems with Immeasurable Premise Variables : An L2 Approach, pp. 2768-2773.
Ichalal, Dalil — CRAN (CENTRE DE RECHERCHE EN AUTOMATIQUE DE NANCY)
Marx, Benoit — Centre de Recherche en Automatique de Nancy
Ragot, Jose — CRAN-INPL
Maquin, Didier — Inst. National Pol. de Lorraine

18:10-18:30 MoC10.6
A Result on State Estimation of Nonlinear Systems with Application to Fuel Cell Stacks., pp. 2774-2778.
Benallouch, Mohamed — Louis Pasteur Univ.
Outbib, Rachid — Univ. of Aix-Marseille III
Boutayeb, Mohamed — Nancy Univ.
Laroche, Edouard — LSIIT

MoC11 — 311A
Nonlinear Systems III (Regular Session)
Chair: Sakai, Satoru — Chiba Univ.

16:30-16:50 MoC11.1
Limitations of Nonlinear Periodic Sampled-Data Control for Robust Stabilization, pp. 2779-2784.
Schmid, Robert — The Univ. of Melbourne

16:50-17:10 MoC11.2
Robust Observer-Based Output Tracking Control of Nonlinear Systems with Sensor Measurement Delays, pp. 2785-2790.
Pan, Ya-Jun — Dalhousie Univ.

17:10-17:30 MoC11.3
Partial Stabilization of a Class of Hydraulic Mechanical Systems with Casimir Functions, pp. 2791-2796.
Sakai, Satoru — Chiba Univ.

17:30-17:50 MoC11.4
Asymptotic Rejection of General Periodic Disturbances in Nonminimum-Phase Nonlinear Output-Feedback Systems, pp. 2797-2802.
Ding, Zhengtao — The Univ. of Manchester

17:50-18:10 MoC11.5
A High Gain Observer Based LMI Approach, pp. 2803-2807.
Rodrigues, Mickael — Univ. OF LYON 1; LAGEP UMR CNRS 5007
Hammouri, Hassan — Univ. Claude Bernard
Mechmeche chokri, Chokri — Ec. supérieure des sciences et Tech. de Tunis
Benhadj Braiek, Naceur — Ec. Pol. de Tunisie

18:10-18:30 MoC11.6
Lyapunov Function Design Using Quantization of Markov Process, pp. 2808-2813.
Nishimura, Yuki — Hokkaido Univ.
Yamashita, Yuh — Hokkaido Univ.

MoC12 — 313
Iterative Learning Control II (Regular Session)
Chair: Galkowski, Krzysztof — Univ. of Zielona Gora
Co-Chair: Sogo, Takuya — Chubu Univ.

16:30-16:50 MoC12.1
Model-Free Based Optimal Iterative Learning Control for a Class of Discrete-Time Nonlinear Systems, pp. 2814-2819.
Jin, Shangtai — Beijing Jiaotong Univ.
Hou, Zhongsheng — Beijing Jiaotong Univ.
Zhao, Ming — Beijing Jiaotong Univ.

16:50-17:10 MoC12.2
An Algebraic Expression of Stable Inversion for Nonminimum Phase Systems and Its Applications, pp. 2820-2825.
Sogo, Takuya — Chubu Univ.

17:10-17:30 MoC12.3
Iterative Learning Control Based Ramp Metering Tracking Various Trajectories, pp. 2826-2831.
Yan, Jingwen — Beijing Jiaotong Univ.
Hou, Zhongsheng — Beijing Jiaotong Univ.
Zhao, Ming — Beijing Jiaotong Univ.

17:30-17:50 MoC12.4
A 2D Systems Approach to Iterative Learning Control with Experimental Validation, pp. 2832-2837.
Hladowski, Lukasz — Univ. of Zielona Gora
Galkowski, Krzysztof — Univ. of Zielona Gora
Cai, Zhonglun — Univ. of Southampton
Rogers, Eric — Univ. of Southampton
Freeman, Christopher Thomas — Univ. of Southampton
Lewin, Paul — Univ. of Southampton

17:50-18:10 MoC12.5
Asymptotic Stability of Uncalibrated Eye-In-Hand Visual Servoing: An Affine Invariance Perspective, pp. 2838-2843.
Hao, Miao — Tsinghua Univ.
Sun, Zengqi — Tsinghua Univ.
Masakazu, Fujii — IHI Corp.

18:10-18:30 MoC12.6
A Fast Iterative Learning Control Approach to Rejection of Periodic Disturbances, pp. 2844-2849.
Ha, In-Joong — Seoul National Univ.
Jang, Jung-Kook — Seoul National Univ.
Park, Jin-Won — Seoul National Univ.

MoC13 — 314
Distributed Estimation and Consensus II (Regular Session)
Chair: Lee, Jin S. — Pohang Univ. of Science & Tech.
Co-Chair: Johansson, Mikael — Royal Inst. of Tech.

16:30-16:50 MoC13.1
Distributed Maximum Likelihood Estimation with Time-Varying Network Topology, pp. 2850-2855.
Calafiore, Giuseppe — Pol. di Torino
Abrate, Fabrizio — Pol. di Torino

16:50-17:10 MoC13.2
Data Fusion of Unknown Correlations Using Internal Ellipsoidal Approximation, pp. 2856-2860.
Zhou, Yan — Shanghai Jiao Tong Univ.
Li, Jianxun — Shanghai Jiao Tong Univ.

17:10-17:30 MoC13.3
Faster Linear Iterations for Distributed Averaging, pp. 2861-2866.
Johansson, Björn — Royal Inst. of Tech.
Johansson, Mikael — Royal Inst. of Tech.

17:30-17:50 MoC13.4
Asymptotically Unbiased Average Consensus under Measurement Noises and Fixed Topologies, pp. 2867-2873.
Li, Tao — Chinese Acad. of Sciences

17:50-18:10 MoC13.5
Multi-Agent Consensus Using Both Current and Outdated States, pp. 2874-2879.
Cao, Yongcan — Utah State Univ.
Ren, Wei — Utah State Univ.
Chen, YangQuan — Utah State Univ.

18:10-18:30 MoC13.6
Observability Analysis for Networked Control Systems: A Graph Theoretic Approach, pp. 2880-2885.
Boukhobza, Taha — Univ. Henri Poincaré Nancy 1
Hamelin, Hamelin — Nancy Univ.

MoC14 — 318
Control of Networks (Regular Session)
Chair: Zampieri, Sandro — Univ. di Padova
Co-Chair: Pavel, Lacra — Univ. of Toronto

16:30-16:50 MoC14.1
Trends in Networked Control Systems, pp. 2886-2894.

Zampieri, Sandro Univ. di Padova

16:50-17:10 MoC14.2

A Distributed Optimization Approach to Constrained OSNR Problem, pp. 2895-2900.

Pan, Yan Univ. of Toronto
Alpcan, Tansu Deutsche Telekom Lab.
Pavel, Lacra Univ. of Toronto

17:10-17:30 MoC14.3

Primal-Dual Power Control of Optical Networks with Time-Delay, pp. 2901-2906.

Stefanovic, Nem Univ. of Toronto
Pavel, Lacra Univ. of Toronto

17:30-17:50 MoC14.4

Dynamic Network Utility Maximization with Delivery Contracts, pp. 2907-2912.

Trichakis, Nikolaos Massachusetts Inst. of Tech.
Zymnis, Argyrios Stanford Univ.
Boyd, Stephen P. Stanford Univ.

17:50-18:10 MoC14.5

Global Stability Analysis of Primal Internet Congestion Control Schemes with Heterogeneous Delays, pp. 2913-2918.

Papachristodoulou, Antonis Univ. of Oxford
Peet, Matthew M INRIA - Rocquencourt

18:10-18:30 MoC14.6

A Novel AQM Scheme for Wireless Networks with BER Estimation, pp. 2919-2924.

Wen, Tingting Univ. of Manchester
Chen, Cailian The Univ. of Manchester
Ding, Zhengtao The Univ. of Manchester
Yang, T. C. Univ. of Sussex

MoC15 317

Greenhouses and Controlled Agricultural Production (Regular Session)

Chair: Camacho, Eduardo Univ. of Seville
Co-Chair: van Straten, G Wageningen Univ.

16:30-16:50 MoC15.1

A Volterra Model of the Greenhouse Temperature Using Natural Ventilation, pp. 2925-2930.

Gruber, Jorn Klaas Univ. de Sevilla
Rodríguez-Díaz, Francisco Univ. of Almería
Bordons, Carlos Univ. de Sevilla
Guzman, Jose Luis Univ. of Almeria
Berenguel, Manuel Univ. of Almeria
Camacho, Eduardo Univ. of Seville

16:50-17:10 MoC15.2

Effect of Innaccurate Measurements on Energy Consumption in Greenhouse Horticulture, pp. 2931-2936.

Bontsema, Jan Wageningen Univ. and Res. Centre
Gieling, Theo H. Wageningen Univ. and Res. Centre
Kornet, Jan George Wageningen Univ. and Res. Centre
Swinkels, Gert-Jan Wageningen Univ. and Res. Centre
Van Henten, Eldert Jan Wageningen Univ.

17:10-17:30 MoC15.3

Discrete Model Based Greenhouse Environmental Control Using the Branch & Bound Algorithm, pp. 2937-2943.

Ferreira, Pedro Unilever R&D Port Sunlight
Ruano, Antonio Univ. of Algarve

17:30-17:50 MoC15.4

On Evaluating Optimality Losses of Greenhouse Climate Controllers, pp. 2944-2949.

van Straten, G Wageningen Univ.
Van Willigenburg, L.G. Wageningen Univ.

17:50-18:10 MoC15.5

Intelligent Irrigation in Grapevines: A Way to Obtain Different Wine Characteristics, pp. 2950-2955.

Capraro, Flavio Univ. Nacional de San Juan (UNSJ)
Schugurensky, Carlos Univ. Nacional de San Juan
Vita, Facundo INTA San Juan
Tosetti, Santiago Univ. Nacional de San Juan
Lage, Andres Univ. Nac. San Juan
Patino, H. Daniel Univ. Nacional de San Juan

18:10-18:30 MoC15.6

Water Irrigation Control for Sunagoke Moss Using Intelligent Image Analysis, pp. 2956-2961.

Hendrawan, Yusuf Osaka Prefecture Univ. Japan, GraduateSchoolofLifeandEnvir

MoC16 316

Economic and Management Systems III (Regular Session)

Chair: Andreeski, Cvetko Faculty of Tourism and Hospitality
Co-Chair: Goubko, Mikhail Inst. of Control Sciences of Russian Acad. of Sciences

16:30-16:50 MoC16.1

Optimal Hierarchies in Firms: A Theoretical Model, pp. 2962-2967.

Goubko, Mikhail Inst. of Control Sciences of Russian Acad. of Sciences
Mishin, Sergey Inst. of Control Sciences of Russian Acad. of Sciences

16:50-17:10 MoC16.2

Combined Gesture-Speech Recognition and Synthesis Using Neural Networks, pp. 2968-2973.

Roncancio, Catalina CARTIF
Gomez Garcia-Bermejo, Jaime CARTIF Foudation
Zalama, Eduardo Fundación Cartif

17:10-17:30 MoC16.3

Leadership Approach for Managing in Distributed Team, pp. 2974-2979.

Koednok, Sukumarl Vongchavalitkul Univ.

17:30-17:50 MoC16.4

Simplified Azbel Model for Fitting Mortality Tables (I), pp. 2980-2983.

Andreeski, Cvetko Faculty of Tourism and Hospitality
Vasant, Pandian Univ. Tech. Petronas

17:50-18:10 MoC16.5

Quality Based Model for Reverse Logistics: A KM View, pp. 2984-2989.

Wadhwa, S Indian Inst. of Tech. New Delhi
Madaan, Jitendra Indian Inst. of Tech. New Delhi

MoC17 320A

Recent Automation Technologies in Shipbuilding Industry I (Highlight Session)

Chair: Kim, Jae-Hoon Samsung Heavy Industries
Co-Chair: Park, Youngjun Samsung Haevy Industries, Co., Ltd.
Organizer: Kim, Jae-Hoon Samsung Heavy Industries
Organizer: Park, Youngjun Samsung Haevy Industries, Co., Ltd.

16:30-16:50 MoC17.1

Study of the Spray Gun Trajectory for Inner Hull Block Structures (I), pp. 2990-2991.

Kim, Sangwhee Samsung Heavy Industry
Park, Youngjun Samsung Haevy Industries, Co., Ltd.
Eun, Jong-Ho Samsung Heavy Industry

16:50-17:10 MoC17.2

A Study on Operating Strategy for Automated Painting System in Inner Double Hull Blocks (I), pp. 2992-2995.

Kim, Byung-Su Samsung Heavy Industries co.,Ltd
Park, Youngjun Samsung Haevy Industries, Co., Ltd.
Eun, Jong-Ho Samsung Heavy Industry

17:10-17:30 MoC17.3

The State of the Sprayed Paint Measuring System: Through Monitoring the Spray Cone Profile (I), pp. 2996-2997.

Kim, Joon kil Samsung Heavy Industry
Kim, Sangwhee Samsung Heavy Industry
Ji, Sang gi Samsung Heavy Industry.Co.Ltd
Park, Youngjun Samsung Haevy Industries, Co., Ltd.

17:30-17:50 MoC17.4

Development of Semi-Automatic Painting System for Longitudinal

Stiffeners in Double Hull Blocks (I), pp. 2998-3003.

Lee, Dong Hoon	stx shipbuilding co.,ltd.
Kim, Ho Kyeong	stx shipbuilding co.,ltd.
Lim, Rae Soo	stx shipbuilding co.,ltd.
Kim, Eun Tae	stx shipbuilding co.,ltd.
Leem, Hyo Kwan	STX shipbuilding

17:50-18:10 MoC17.5

Design of a Four Legged Parallel Walking Robot to Go through a Narrow Hole (I), pp. 3004-3008.

Park, Kun-Woo — Changwon Nat'l Univ.

18:10-18:30 MoC17.6

Environment Measurement and Object Recognition for Autonomous Mobile Robot's Navigation in Automated Shipbuilding (I), pp. 3009-3010.

Hong, Jin IL	Samsung Heavy Industry.Co.Ltd
Lee, Hyunki	KAIST
Park, Youngjun	Samsung Haevy Industries, Co., Ltd.

MoC18 320B

Recent Development of Intelligent Robots II: Mobility (Highlight Session)

Chair: Park, Sangdeok	Korea Inst. of Industrial Tech. (KITECH)
Co-Chair: So, ByungRok	Korea Inst. of Industrial Tech. (KITECH)

16:30-16:50 MoC18.1

Biomimetic Locomotion Control of a Quadruped Walking Robot (I), pp. 3011-3016.

Choi, Hyoukryeol	Sungkyunkwan Univ.
Koo, Igmo	Sungkyunkwan Univ.
Kang, Tae Hun	Phohang Inst. of Intelligent Robotics
Vo, GiaLoc	Sungkyunkwan Univ.
Trong, Tran Duc	Sungkyunkwan Univ.
Song, Young Kuk	Sungkyunkwan Univ.

16:50-17:10 MoC18.2

QuadTrack-II: A Remotely Operated Mobile Robot with Four Articulated Tracks (I), pp. 3017-3020.

Choi, Youngsoo	Korea Atomic Energey Res. Inst.
Jeong, Kyungmin	Korea Atomic Energey Res. Inst.
Seo, Youngchil	Korea Atomic Energey Res. Inst.
Lee, Sung-uk	Korea Atomic Energy Res. Inst.
Cho, Jaiwan	Korea Atomic Energey Res. Inst.
Jung, Seungho	Korea Atomic Energey Res. Inst.
Kim, Seungho	Korea Atomic Energey Res. Inst.

17:10-17:30 MoC18.3

Foot Trajectory Generation of Hydraulic Quadruped Robots on Uneven Terrain (I), pp. 3021-3026.

Kim, HyoungKwon	Korea Inst. of Industrial Tech.
Kwon, Ohung	Hanyang Univ.
Won, Daehee	Korea Inst. of Industrial Tech.
Park, Sangdeok	Korea Inst. of Industrial Tech. (KITECH)
Kim, Tae Ju	KITECH
Kim, Sang-Seok	Div. for Applied Robot Tech. Korea Inst. of Indust

17:30-17:50 MoC18.4

Walking Pattern Generation for Planar Biped Walking Using Q-Learning (I), pp. 3027-3032.

Lee, Jungho	KAIST
Oh, Jun Ho	KAIST

17:50-18:10 MoC18.5

Subminiature Surveillance Robots for Socail Safety (I), pp. 3033-3034.

Kim, Eun Seok	Convex Co.,Ltd.
Han, Man Gi	Convex Co.,Ltd.
Kim, Hyun Joo	Convex Co.,Ltd.
Yim, Choong Hyuk	Convex Co.,Ltd.
Song, Jae-Bok	Korea Univ.
Kim, Byeong Sang	Korea Univ.

18:10-18:30 MoC18.6

Educational Robotic Construction Kit: Bioloid (I), pp. 3035-3036.

Han, Jea-Kweon	ROROTIS Co., LTD.
Ha, In-Yong	ROBOTIS Co., LTD.
Kim, Byoung-Soo	ROBOTIS Co., LTD.

MoC19 320C

Control of Cooperative, Mobile Minirobots – Robotsoccer (Invited Session)

Chair: Kopacek, Peter	Vienna Univ. of Tech.
Co-Chair: Han, Man-Wook	Vienna Univ. of Tech.
Organizer: Han, Man-Wook	Vienna Univ. of Tech.
Organizer: Kopacek, Peter	Vienna Univ. of Tech.

16:30-16:50 MoC19.1

Robotsoccer (I), pp. 3037-3041.

Kopacek, Peter — Vienna Univ. of Tech.

16:50-17:10 MoC19.2

Humanoid Robot System, HanSaRam-VII for RoboMarathon in HuroCup (I), pp. 3042-3047.

Yoo, Jeong-Ki	Korea Advanced Inst. of Science and Tech.
Kim, Yong-Duk	Korea Advanced Inst. of Science and Tech. (KAIST)
Lee, Bum-Joo	Korea Advanced Inst. of Science and Tech.
Park, In-Won	Korea Advanced Inst. of Science and Tech.
Kim, Jong-Hwan	Korea Advanced Inst. of Science and Tech.

17:10-17:30 MoC19.3

Active Balancing Reflexes for Small Humanoid Robots (I), pp. 3048-3053.

McGrath, Sara	Univ. of Manitoba
Baltes, Jacky	Univ. of Manitoba
Anderson, John E	Univ. of Manitoba

17:30-17:50 MoC19.4

Towards MiroSot Robots with PFGA and DSP-Based Image Processing On-Board (I), pp. 3054-3058.

Jesse, Norbert — Univ. of Dortmund

17:50-18:10 MoC19.5

Quantitative Comparison of Color Systems for Robot Soccer Applications (I), pp. 3059-3064.

Weiss, Norman	Vienna Univ. of Tech.
Jesse, Norbert	Univ. of Dortmund

18:10-18:30 MoC19.6

Control of a Humanoid Robot Based on the ZMP Method (I), pp. 3065-3069.

Han, Man-Wook	Vienna Univ. of Tech.
Timofte, Gabriel	Tech. Univ. "Gheorghe Asachi", Romania

MoC20 321C

Latest Development in Mobile Machines (Invited Session)

Chair: Chen, Xiaoqi	Univ. of Canterbury
Co-Chair: Virk, Gurvinder	Massey Univ.
Organizer: Chen, Xiaoqi	Univ. of Canterbury
Organizer: Virk, Gurvinder	Massey Univ.

16:30-16:50 MoC20.1

Unmanned Marine Vehicles at CNR-ISSIA (I), pp. 3070-3075.

Caccia, Massimo — CNR-ISSIA

16:50-17:10 MoC20.2

System Identification and Modelling of Front Wheel Drive Electric Wheelchairs (I), pp. 3076-3081.

Chen, Xiaoqi	Univ. of Canterbury
Chase, J. Geoffrey	Univ. of Canterbury
Patrick, Wolm	Univ. of Canterbury

17:10-17:30 MoC20.3

Analysis and Implementation of Swimming Backward for Biomimetic Carangiform Robot Fish (I), pp. 3082-3086.

Zhou, Chao	Inst. of Automation,Chinese Acad. of Sciences
Nahanvandi, Saeid	Deakin Univ.
Gu, Nong	Deakin Univ.
Cao, Zhiqiang	Inst. of Automation,Chinese Acad. of Sciences
Wang, Shuo	Chinese Acad. of Sciences
Tan, Min	Inst. of Automation, Chinese Acad. of Sciences

17:30-17:50 MoC20.4

Dynamic Target Tracking Control for a Wheeled Mobile Robots

Constrained by Limited Inputs (I), pp. 3087-3091.
Huang, Loulin — Massey Univ.
Tang, Liqiong — Massey Univ.

17:50-18:10 MoC20.5
Constrained Control Allocation for Linear Systems with Internal Dynamics (I), pp. 3092-3097.
Liao, Fang — National Univ. of Singapore
Lum, Kai-Yew — National Univ. of Singapore
Wang, Jian Liang — Nanyang Tech. Univ.

18:10-18:30 MoC20.6
Mobile Robotic Issues for Urban Search and Rescue (I), pp. 3098-3103.
Virk, Gurvinder — Massey Univ.
Gatsoulis, Yiannis — Univ. of Leeds
Parack, Muddassir — Biogene Ltd
Kherada, Afsha — Biogene Ltd

MoC21 321B
Servo Control for Storage Systems and Precision Devices III (Invited Session)
Chair: Yamaguchi, Takashi — Hitachi Global Storage Tech.
Co-Chair: Hori, Yoichi — Univ. of Tokyo
Organizer: Yamaguchi, Takashi — Hitachi Global Storage Tech.

16:30-16:50 MoC21.1
Time-Varying Compensation for Mid-Frequency Repeatable Runout in Hard Disk Drives Via a Linear Feedback Scheme (I), pp. 3104-3109.
Thum, Chin Kwan — A*STAR Data Storage Inst.
Du, Chunling — Data Storage Inst.
Chen, Ben M. — National Univ. of Singapore
Ong, Eng Hong — A*STAR Data Storage Inst.
Tan, Kim Piew — A*STAR Data Storage Inst.

16:50-17:10 MoC21.2
Robust and Quick Response Tracking Servo System for High Rotational Speed Optical Disk System (I), pp. 3110-3115.
Ohishi, Kiyoshi — Nagaoka Univ. of Tech.
Miyazaki, Toshimasa — Nagaoka National Coll. of Tech.
Yoshida, Yasuharu — Nagaoka Univ. of Tech.
Kamigaki, Yoshiya — Nagaoka Univ. of Tech.
Koide, Daiichi — JAPAN BROADCASTING Corp.
Tokumaru, Haruki — JAPAN BROADCASTING Corp.

17:10-17:30 MoC21.3
High-Gain Servo Controller for Optical Disk Drives and the Initial Value Compensation (I), pp. 3116-3117.
Urakawa, Yoshiyuki — Sony Corp.
Yuichi, Suzuki — SONY

17:30-17:50 MoC21.4
Active Tape Steering Control System (I), pp. 3118-3123.
Xia, Lu — Carnegie Mellon Univ.
Messner, William — Carnegie Mellon Univ.

17:50-18:10 MoC21.5
Positioning of Large-Scale High-Precision Stage with Vibration Suppression PTC (I), pp. 3124-3129.
Sakata, Koichi — Yokohama National Univ.
Fujimoto, Hiroshi — Yokohama National Univ.
Saiki, Kazuaki — Nikon Corp.

18:10-18:30 MoC21.6
Nano-Positioning of an Electromagnetic Scanner with a MEMS Capacitive Sensor (I), pp. 3130-3135.
Huang, Xinghui — Seagate Tech.
Lee, Ju-Il — Seagate Res.
Ramakrishnan, Narayanan — Seagate Tech.
Bedillion, Mark — Seagate Tech.
Chu, Patrick B. — Seagate Tech.

MoC22 321A
Control of Mechanical Systems (Regular Session)
Chair: Fradkov, Alexander L. — Acad. of Sciences of Russia
Co-Chair: Chang, Dong Eui — Univ. of Waterloo

16:30-16:50 MoC22.1
Control of Wave Motion in the Chain of Pendulums, pp. 3136-3141.
Fradkov, Alexander L. — Acad. of Sciences of Russia
Andrievsky, Boris — Inst. for Problems of Mechanical Engin.

16:50-17:10 MoC22.2
Control of Interconnected Mechanical Systems, pp. 3142-3147.
Sabanovic, Asif — Sabanci Univ.
Sabanovic, Nadira — Sabanci Univ.
Ohnishi, Kouhei — Keio Univ.

17:10-17:30 MoC22.3
Jet-Scheduling Control for SpiderCrane: Experimental Results (I), pp. 3148-3154.
Buccieri, Davide — Ec. Pol. Fed. de Lausanne
Salzmann, Christophe — Ec. Pol. Fédérale de Lausanne
Muellhaupt, Philippe — Ec. Pol. Fed. de Lausanne
Bonvin, Dominique — EPFL

17:30-17:50 MoC22.4
Stabilization of a 2D-SpiderCrane Mechanism Using Damping Assignment Passivity-Based Control (I), pp. 3155-3160.
Kazi, Faruk — Indian Inst. of Tech. Bombay
Banavar, Ravi N. — Indian Inst. of Tech.
Muellhaupt, Philippe — Ec. Pol. Fed. de Lausanne
Bonvin, Dominique — EPFL

17:50-18:10 MoC22.5
Some Results on Stabilizability of Controlled Lagrangian Systems by Energy Shaping (I), pp. 3161-3166.
Chang, Dong Eui — Univ. of Waterloo

18:10-18:30 MoC22.6
Bounded Attitude Stabilization: Real-Time Application on Four-Rotor Mini-Helicopter, pp. 3167-3173.
Guerrero Castellanos, Jose Fermi — GIPSA-Lab. INPG-UJF-CNRS
Marchand, Nicolas — GIPSA-Lab. CNRS
Lesecq, Suzanne — INPG/UJF/CNRS
Delamare, Jérôme — INPG-LEG

MoC23 323
Large Scale Complex Systems: Theory (Regular Session)
Chair: Brdys, Mietek M.A. — Univ. of Birmingham
Co-Chair: Bakule, Lubomir — Acad. of Sciences of Czech Republic

16:30-16:50 MoC23.1
Fast and Accurate Modeling of Distributed RLC Interconnect and Transmission Line in Time and Frequency Domains, pp. 3174-3179.
Wang, Sheng-Guo — Univ. of North Carolina – Charlotte
Wang, Ben — IBM

16:50-17:10 MoC23.2
Expert-Statistical Processing of Data and the Method of Analogs in Solution of Applied Problems in Control Theory, pp. 3180-3185.
Mandel', Alexander Solomonovich — Trapeznikov Inst. of Control Sciences of RussianAcademy of S
Belyakov, Alexei Gennadievich — Trapeznikov Inst. of Control Sciences of Russian Acad. of
Semenov, Dmitry Andreevich — Trapeznikov Inst. of Control Sciences

17:10-17:30 MoC23.3
Timing and Deadlock-Freeness in Continuous Petri Nets, pp. 3186-3191.
Vazquez, Carlos Renato — Univ. de Zaragoza
Mangini, Agostino Marcello — Pol. di Bari
Mihalache, Ana — Univ. tehnica Gh. Asachi
Recalde, Laura — Univ. De Zaragoza
Silva, Manuel — Univ. De Zaragoza

17:30-17:50 MoC23.4
Tracking Control of Timed Continuous Petri Net Systems under Infinite Servers Semantics, pp. 3192-3197.
Xu, Jing — National Univ. of Singapore
Recalde, Laura — Univ. De Zaragoza
Silva, Manuel — Univ. De Zaragoza

17:50-18:10 MoC23.5
Moment Matching Model Order Reduction in Time-Domain Via Laguerre Series, pp. 3198-3203.
Eid, Rudy — Tech. Univ. München
Lohmann, Boris — Tech. Univ. München

18:10-18:30 MoC23.6
Communication and State Realization in Decentralized Supervisory Control of Discrete-Event Systems, pp. 3204-3209.

Mannani, Amin — Concordia Univ.
Gohari, Peyman — Concordia Univ.

MoC24 — 324
Fault Tolerant Control (Invited Session)

Chair: Kinnaert, Michel — Univ. Libre de Bruxelles
Co-Chair: Dixon, Roger — Loughborough Univ.
Organizer: Kinnaert, Michel — Univ. Libre de Bruxelles
Organizer: Dixon, Roger — Loughborough Univ.

16:30-16:50 — MoC24.1
Reconfigurable Control of Hammerstein Systems after Actuator Faults (I), pp. 3210-3215.
Richter, Jan — Ruhr-Univ. Bochum
Lunze, Jan — Ruhr-Univ. Bochum

16:50-17:10 — MoC24.2
Closed-Loop Subspace Predictive Control for Fault Tolerant MPC Design (I), pp. 3216-3221.
Dong, Jianfei — Delft Univ. of Tech.
Verhaegen, Michel — Delft Univ. of Tech.
Holweg, Edward — SKF

17:10-17:30 — MoC24.3
Sensor Fault Diagnosis of Wind Turbines for Fault Tolerant (I), pp. 3222-3227.
Wei, Xiukun — Delft Univ. of Tech.
Verhaegen, Michel — Delft Univ. of Tech.
van Engelen, Tim — Energy Res. Centre of the Netherlands (Ec.

17:30-17:50 — MoC24.4
Modelling of High Redundancy Actuation Utilising Multiple Moving Coil Actuators (I), pp. 3228-3233.
Davies, Jessica — Loughborough Univ.
Steffen, Thomas — Loughborough Univ.
Dixon, Roger — Loughborough Univ.
Goodall, R.M. — Loughborough Univ.
Zolotas, Argyrios — Loughborough Univ.
Pearson, John — BAE Systems

17:50-18:10 — MoC24.5
Failure Modes and Probabilities of a High Redundancy Actuator (I), pp. 3234-3239.
Steffen, Thomas — Loughborough Univ.
Davies, Jessica — Loughborough Univ.
Dixon, Roger — Loughborough Univ.
Goodall, R.M. — Loughborough Univ.
Pearson, John — BAE Systems
Zolotas, Argyrios — Loughborough Univ.

18:10-18:30 — MoC24.6
Threshold Selection Based on Closed-Loop Performance for Fault Detection Schemes (I), pp. 3240-3245.
Aberkane, Samir — UHP, NANCY 1
Kinnaert, Michel — Univ. Libre de Bruxelles

MoC25 — 328
Model Reduction and Realtime Optimization and Control (Regular Session)

Chair: Van den Hof, Paul M.J. — Delft Univ. of Tech.
Co-Chair: Lee, Jong Min — Univ. of Alberta

16:30-16:50 — MoC25.1
Real-Time Dynamic Optimization of Batch Crystallization Processes, pp. 3246-3251.
Mesbah, Ali — TU Delft
Kalbasenka, Alex — TU Delft
Huesman, Adrie — Delft Univ. of Tech.
Kramer, Herman — TU Delft
Van den Hof, Paul M.J. — Delft Univ. of Tech.

16:50-17:10 — MoC25.2
Parametric Approximation of Piecewise Quadratic Value Functions for the Control of Complex Systems, pp. 3252-3257.
Nosair, Hussam — Univ. of Alberta
Lee, Jong Min — Univ. of Alberta

17:10-17:30 — MoC25.3
Evolutionary Improvement Algorithm with Statistical Learning Method for Process Real-Time Optimization, pp. 3258-3262.
Choi, Seungjune — Seoul National Univ.
Kim, Seunghyok — Seoul National Univ.
Yoon, En Sup — Seoul National Univ.

17:30-17:50 — MoC25.4
On-Line Optimizing Control for a Class of Batch Reactive Distillation Columns, pp. 3263-3268.
Pérez-Correa, Sandra — Univ. Autónoma Metropolitana
González, Pablo — Univ. Autónoma Metropolitana - Iztapalapa
Alvarez, Jesus — Univ. Auto. Metropolitanta-Iztapal

17:50-18:10 — MoC25.5
A Balancing Approach to Model Reduction of Polynomial Nonlinear Systems, pp. 3269-3273.
Siahaan, Hardy B. — International Res. Inst. of Stavanger (IRIS)

18:10-18:30 — MoC25.6
Model Reduction of Systems with Traveling Waves Using Projection Methods, pp. 3274-3279.
Nauta, Maarten — Eindhoven Univ. of Tech.
Weiland, Siep — Eindhoven Univ. of Tech.
Backx, Ton — Eindhoven Univ. of Tech.

MoC26 — 327
Separation Control (Regular Session)

Chair: Ozgen, Canan — Middle East Tech. Univ.
Co-Chair: Koivo, Heikki — Helsinki Univ. of Tech.

16:30-16:50 — MoC26.1
Prediction of Concentrate Grade in Industrial Gravity Separation Plant – Comparison of Rpls and Neural Network, pp. 3280-3285.
Remes, Antti Juhani — Helsinki Univ. of Tech.
Vaara, Niina — Outokumpu
Saloheimo, Kari — Outotec
Koivo, Heikki — Helsinki Univ. of Tech.

16:50-17:10 — MoC26.2
Hierachical Intelligent Optimization Blending System Based on Production Indices for Lead-Zinc Sintering Process, pp. 3286-3291.
Wang, Yalin — Central South Univ.
Yang, Chunhua — Central South Univ.
Gui, Weihua — Central South Univ.
Ling, Xiang — Central South Univ.

17:10-17:30 — MoC26.3
Utilizing 3D Height Measurement in Particle Size Analysis, pp. 3292-3297.
Kaartinen, Jani — Helsinki Univ. of Tech.
Tolonen, Antti — Helsinki Univ. of Tech.

17:30-17:50 — MoC26.4
Computer Vision Based Interface Level Control in a Separation Cell, pp. 3298-3303.
Jampana, Phanindra — Univ. of Alberta
Shah, Sirish — Univ. of Alberta
Kadali, Ramesh — Suncor Energy Inc.

17:50-18:10 — MoC26.5
State Estimation for a Reactive Batch Distillation Column, pp. 3304-3309.
Bahar, Alm1;la — Middle East Tech. Univ.
Ozgen, Canan — Middle East Tech. Univ.

18:10-18:30 — MoC26.6
State and Ore Hardness Estimation in Semiautogenous Grinding, pp. 3310-3315.
Cuevas, Alejandro — Pontificia Univ. Católica de Chile
Cipriano, Aldo — Pontificia Univ. Catolica de Chile

MoC27 — 326
Power Electronics Applications (Invited Session)

Chair: Albea, Carolina — Univ. of Seville
Co-Chair: Xu, Jian-Xin — National Univ. of Singapore
Organizer: Albea, Carolina — Univ. of Seville

16:30-16:50 — MoC27.1
Adaptive Control of the Boost Inverter with Load RL (I), pp. 3316-3321.
Albea, Carolina — Univ. of Seville
Gordillo, Francisco — Univ. de Sevilla
Canudas de Wit, Carlos — CNRS-GIPSA-Lab.

16:50-17:10 — MoC27.2
Direct Torque Tracking PI-Controller Design for Switched Reluctance Motor Drive Using Singular Perturbation Method (I), pp. 3322-3327.
Sahoo, Sanjib — National Univ. of Singapore

Panda, Sanjib — National Univ. of Singapore
Xu, Jian-Xin — National Univ. of Singapore
Yurkevich, Valery D. — Novosibirsk State Tech. Univ.

17:10-17:30 MoC27.3
Inter Power Electronic Building Blocks Communication Over Two Optical Rings (I), pp. 3328-3332.
Cucej, Zarko — Univ. of Maribor
Truntic, Mitja — Univ. of Maribor
Milanovic, Miro — Univ. of Maribor
Benki — Univ. of Maribor
;, Karl

17:30-17:50 MoC27.4
Frequency Domain Based Repetitive Control of Three Phase Boost PWM Rectifier under Distorted Supply Voltage Conditions (I), pp. 3333-3338.
Wu, Xinhui — National Unversity of Singapore
Panda, Sanjib — National Univ. of Singapore
Xu, Jian-Xin — National Univ. of Singapore

17:50-18:10 MoC27.5
Implementation of Fuzzy-Logic State Controller in FPGA for Step-Down Converter (I), pp. 3339-3343.
Truntic, Mitja — Univ. of Maribor
Milanovic, Miro — Univ. of Maribor
Cucej, Zarko — Univ. of Maribor

18:10-18:30 MoC27.6
High Performance Repetitive Control of an Active Filter under Varying Network Frequency (I), pp. 3344-3349.
Costa-Castelló, Ramon — Univ. Pol. de Catalunya
Malo, Shane — Univ. Pol. de Catalunya (UPC)
Grino, Robert — Univ. Pol. De Catalunya

MoC28 330A
Automotive Control and Estimation Using Look-Ahead Road Information (Invited Session)
Chair: Johansson, Karl Henrik — Royal Inst. of Tech.
Co-Chair: Nielsen, Lars — Linköping Univ.
Organizer: Johansson, Karl Henrik — Royal Inst. of Tech.
Organizer: Nielsen, Lars — Linköping Univ.

16:30-16:50 MoC28.1
Design of a Well-Behaved Algorithm for On-Board Look-Ahead Control (I), pp. 3350-3355.
Hellström, Erik — Linköping Univ.
Aaslund, Jan — Linköping Univ.
Nielsen, Lars — Linköping Univ.

16:50-17:10 MoC28.2
Real Time Control of Hybrid Electric Vehicle on a Prescribed Road (I), pp. 3356-3361.
Kermani, Saďda — INRETS
Delprat, Sebastien — Univ. of Valenciennes et Hainaut Cambresis
Guerra, Thierry Marie — Univ. of Valenciennes
Trigui, Rochdi — INRETS

17:10-17:30 MoC28.3
Energy Management for a Hybrid Solar Vehicle with Series Structure (I), pp. 3362-3367.
Arsie, Ivan — Univ. of Salerno
Di Martino, Raffaele — Univ. of Salerno
Rizzo, Gianfranco — Univ. of Salerno
Sorrentino, Marco — Univ. of Salerno

17:30-17:50 MoC28.4
Optimal Speed on Small Gradients - Consequences of a Non-Linear Fuel Map (I), pp. 3368-3373.
Ivarsson, Maria — Scania
Aaslund, Jan — Linköping Univ.
Nielsen, Lars — Linköping Univ.

17:50-18:10 MoC28.5
Approximate Dynamic Programming Applied to Parallel Hybrid Powertrains (I), pp. 3374-3379.
Johannesson, Lars — Chalmers
Egardt, Bo S. — Chalmers Univ. of Tech.

18:10-18:30 MoC28.6
Road Grade Estimation for Look-Ahead Vehicle Control (I), pp. 3380-3385.
Sahlholm, Per — Scania CV AB
Johansson, Karl Henrik — Royal Inst. of Tech.

MoC29 330B
Active Suspension (Regular Session)
Chair: Bokor, Jozsef — Hungarian Acad. of Sciences
Co-Chair: Gaspar, Peter — Computer & Automation Inst. of HAS

16:30-16:50 MoC29.1
The Design of a Two-Level Controller for Suspension Systems, pp. 3386-3391.
Gaspar, Peter — Computer & Automation Inst. of HAS
Szederkenyi, Gabor — Computer and Automation Res. Inst. Hungarian
Szabo, Zoltan — Hungarian Acad. of Sciences
Bokor, Jozsef — Hungarian Acad. of Sciences

16:50-17:10 MoC29.2
Potential of Low Bandwidth Active Suspension Control with Continuously Variable Damper, pp. 3392-3397.
Koch, Guido — Tech. Univ. München
Fritsch, Oliver — Tech. Univ. München
Lohmann, Boris — Tech. Univ. München

17:10-17:30 MoC29.3
Multi-Objective Preview Control of Active Vehicle Suspensions, pp. 3398-3403.
Akbari, Ahmad — Tech. Univ. of Munich
Lohmann, Boris — Tech. Univ. München

17:30-17:50 MoC29.4
Nonlinear Control of Full-Vehicle Active Suspensions with Backstepping Design Scheme, pp. 3404-3409.
Hu, Jia-Wei — National Chi Nan Univ.
Lin, Jung-Shan — National Chi Nan Univ.

17:50-18:10 MoC29.5
A Self Tuning Suspension Controller for Multi-Body Quarter Vehicle Model, pp. 3410-3415.
Poussot, Charles — INPG/ENSIEG
Drivet, Aline — TEC de Monterrey
Sename, Olivier — INPG
Dugard, Luc — CNRS-INPG-UJF
Ramírez-Mendoza, Ricardo A. — ITESM Campus Monterrey

18:10-18:30 MoC29.6
Sliding Mode Controllers for Active Suspensions, pp. 3416-3421.
Koshkouei, Ali — Coventry Univ.
Burnham, Keith J. — Coventry Univ.

MoC30 330C
Guidance and Robust Control of Information Spacecraft (Invited Session)
Chair: Somov, Yevgeny — Samara Scientific Center, Russian Acad. of Sciences
Co-Chair: Çimen, Tayfun — ROKETSAN Missiles Industries Inc.
Organizer: Somov, Yevgeny — Samara Scientific Center, Russian Acad. of Sciences

16:30-16:50 MoC30.1
Guidance and Robust Gyromoment Precise Attitude Control of Agile Observation Spacecraft (I), pp. 3422-3427.
Somov, Yevgeny — Samara Scientific Center, Russian Acad. of Sciences
Butyrin, Sergey — Samara Scientific Center, Russian Acad. of Sciences
Somov, Sergey — Samara Scientific Center, Russian Acad. of Sciences

16:50-17:10 MoC30.2
Local Orbital Frame Predictor for LEO Drag-Free Satellites (I), pp. 3428-3433.
Canuto, Enrico — Pol. di Torino
Massotti, Luca — ESA - ESTEC

17:10-17:30 MoC30.3
Design and Implementation of Robust Symmetric Attitude Controller for ETS-VIII Spacecraft (I), pp. 3434-3439.
Nagashio, Tomoyuki — Univ. of Electro-Communications
Kida, Takashi — Univ. of Electro-Communications
Ohtani, Takashi — Japan Aerospace Exploration Agency

Hamada, Yoshiro — Japan Aerospace Exploration Agency

17:30-17:50 MoC30.4

Modeling and Adaptive Attitude Control of Large Spacecrafts in View of Flexible Structure (I), pp. 3440-3445.

Rutkovsky, Vladislav Yu. — Inst. OF CONTROL SCIENCES
Zemlyakov, Stanislav — Inst. of Control Sciences of RAS
Sukhanov, Victor — Inst. OF CONTROL SCIENCES
Glumov, Victor — Inst. OF CONTROL SCIENCES

17:50-18:10 MoC30.5

A Landmark Based Nonlinear Observer for Attitude and Position Estimation with Bias Compensation, pp. 3446-3451.

Vasconcelos, José Fernandes — Inst. Superior Técnico
Cunha, Rita — Inst. Superior Técnico, Inst. for Systems and
Silvestre, Carlos — Inst. Superior Tecnico
Oliveira, Paulo Jorge — Inst. Superior Técnico

18:10-18:30 MoC30.6

Spacecraft Parameter Estimation by Using Predictive Filter Algorithm (I), pp. 3452-3457.

Myung, Hyunsam — KAIST
Bang, Hyochoong — KAIST

MoCCC 401

Milestone Report by IFAC Coordinating Committee on Bio and Ecological Systems (CC8) (Milestone Session)

Chair: Feng, David Dagan — Hong Kong Pol. Univ.

16:30-18:30 MoCCC.1

Bio and Ecological Systems: Challenges, Accomplishments and Forecasts, pp. 3458-3469.

Carson, Ewart — City Univ.
Feng, David Dagan — Hong Kong Pol. Univ.
Pons, Marie-Noelle — ENSIC
Soncini-Sessa, Rodolfo — Pol. di Milano
van Straten, G — Wageningen Univ.

TuPL1 Auditorium (301)

Robust Control in Biology: From Genes to Cells to Systems by Francis J. Doyle III, (Plenary Session)

Chair: Cho, Dong-il Dan — Seoul National Univ.

08:00-09:00 TuPL1.1

Robust Control in Biology: From Genes to Cells to Systems, pp. 3470-3479.

Doyle III, Francis Joseph — Univ. of California at Santa Barbara

TuPL2 Auditorium (301)

Stochastic Learning and Optimization - a Sensitivity-Based Approach by Xi-Ren Cao (Plenary Session)

Chair: Kucera, Vladimir — Czech Tech. Univ. in Prague

09:00-10:00 TuPL2.1

Stochastic Learning and Optimization - a Sensitivity-Based Approach, pp. 3480-3492.

Cao, Xi-Ren — Hong Kong Univ. of Sci. & Tech.

TuA01 Atlantic Hall

Systems and Signals I (Poster Session)

Chair: Zaytoon, Janan — Univ. of Reims
Co-Chair: Veres, Sandor M — Univ. of Southampton

10:30-12:30 TuA01.1

Robust H-Infinity Control for Neutral Uncertain Switched Nonlinear Systems Using Multiple Lyapunov Functions, pp. 3493-3498.

Li, Li-li — Northeastern Univ. China
Dimirovski, Georgi Marko — Dogus Univ. of Istanbul
Zhao, Jun — The Australian National Univ.

10:30-12:30 TuA01.2

Effect Output Noise in Iterative Learning Control, pp. 3499-3502.

Liu, Shaojie — The Univ. of sheffield
Owens, David H. — The Univ. of Sheffield

10:30-12:30 TuA01.3

An Improved Clonal Selection Algorithm Based Optimization Method for Iterative Learning Control Systems, pp. 3503-3508.

Li, Hengjie — Lanzhou Univ. of Tech.
Hao, Xiaohong — Lanzhou Univ. of Tech.
Owens, David — the Univ. of Sheffield
Zhang, Lei — lanzhou Univ. of Tech.

10:30-12:30 TuA01.4

Model-Free Adaptive Control for a Class of Nonlinear Discrete-Time Systems Based on the Partial Form Linearization, pp. 3509-3514.

Hou, Zhongsheng — Beijing Jiaotong Univ.
Jin, Shangtai — Beijing Jiaotong Univ.

10:30-12:30 TuA01.5

A Neural Network Observer-Based Approach for Synchronization of Discrete-Time Chaotic Systems, pp. 3515-3520.

Naghavi, S.Vahid — Shiraz Univ.
Safavi, Ali Akbar — Shiraz Univ.

10:30-12:30 TuA01.6

Robust Adaptive Control of Time-Delay Nonlinear Systems Via TS Recurrent Fuzzy CMAC Approach, pp. 3521-3526.

Chiu, Chian-Song — Chung-Yuan Christian Univ.

10:30-12:30 TuA01.7

Disturbance Rejection in Neural Network Model Predictive Control, pp. 3527-3532.

Jazayeri Moghadas, Seyed Ali — K. N. Toosi Univ. of Tech.
Fatehi, Alireza — K.N. Toosi Univ. of Tech.
Sadjadian, Houman — K. N. Toosi Univ. of Tech.
Khaki Sedigh, Ali — K.N. Toosi Univ. of Tech.

10:30-12:30 TuA01.8

Iterative Identification and Control Satisfying Classical Robustness Measures, pp. 3533-3538.

Berger, Marcus A. R. — Univ. Federal de Campina Grande
Barros, Péricles R. — Univ. Federal de Campina Grande

10:30-12:30 TuA01.9

Adaptive FIR Filtering under Minimum Error/Input Information Criterion, pp. 3539-3543.

Chen, Badong — Tsinghua Univ.
Hu, Jinchun — Tsinghua Univ.
Li, HongBo — Tsinghua Univ.
Sun, Zengqi — Tsinghua Univ.

10:30-12:30 TuA01.10

Fast-Array Implementation of Adaptive IIR Filter in Feed-Forward Active Noise and Vibration Control Systems, pp. 3544-3549.

Montazeri, Allahyar — Iran Univ. of Science and Tech.
Zavari, Keivan — Iran Univ. of Science and Tech.
Poshtan, Javad — Iran Univ. of Science and Tech.
Roosta, Alireza — Shiraz Univ. of Tech.

10:30-12:30 TuA01.11

Computationally Efficient Sub-Optimal Mid Course Guidance Using Model Predictive Static Programming (MPSP), pp. 3550-3555.

Dwivedi, Prasiddha Nath — DRDO
Bhattacharyaa, Abhijit — DRDO
Padhi, Radhakant — Indian Inst. of Science

10:30-12:30 TuA01.12

Sliding Sector Design for Nonlinear Systems, pp. 3556-3561.

Korondi, Peter — Budapest Univ. of Tech. and Ec.
Hashimoto, Hideki — Univ. of Tokyo
Sziebig, Gabor — Budapest Univ. of Tech. and Ec.

10:30-12:30 TuA01.13

Repetitive and Iterative Learning Controllers Designed by Duality with Experimental Verification, pp. 3562-3567.

Ali Alsubaie, Muhammad — Univ. of Southampton
Cai, Zhonglun — Univ. of Southampton
Freeman, Christopher Thomas — Univ. of Southampton
Lewin, Paul — Univ. of Southampton
Rogers, Eric — Univ. of Southampton

10:30-12:30 TuA01.14

Intelligent Control, Based on Reinforcement Learning, for Batch Thermal Sterilization of Canned Foods, pp. 3568-3573.

Syam, Syafiie — Univ. of Valladolid
Garcia, Miriam — CSIC
Vilas, Carlos — CSIC
Tadeo, Fernando — Univ. of Valladolid Q4718001C
Alonso, Antonio A. — IIM-CSIC
Martinez, Ernesto — Ingar

10:30-12:30 TuA01.15

Closed Reentrant Queueing Networks under Affine Index Policies: Throughput Bounds, Examples and Asymptotic Loss, pp.

3574-3579.
Morrison, James R. KAIST
Juen, Joshua Central Michigan Univ.

10:30-12:30 TuA01.16
Control Synthesis Approach for DES Modelled by Petri Nets, pp. 3580-3585.
Bekrar, Rebiha Reims Univ.
Messai, Nadhir Univ. de Reims Champagne-Ardenne
Essounbouli, Najib Reims Univ.
Hamzaoui, Abdelaziz Professor
Riera, Bernard Reims Univ.

10:30-12:30 TuA01.17
Toward an Intelligent Distributed Safety Instrumented Systems : Dependability Evaluation, pp. 3586-3591.
Mkhida, Abdelhak ENSAM Meknes
Thiriet, Jean-Marc CNRS-INPG-UJF
Aubry, Jean-François INPL

10:30-12:30 TuA01.18
Robust Tasking of Airborne Sensing Nodes for Network Availability (I), pp. 3592-3597.
Wu, Neng Eva Binghamton Univ.
Guo, Yan Binghamton Univ.
Ruschmann, Matthew Binghamton Univ.

10:30-12:30 TuA01.19
Designing Dependable Dynamic Workflows through a Reflective PN-Based Approach (I), pp. 3598-3605.
Capra, Lorenzo Univ. of milan

10:30-12:30 TuA01.20
Hierarchical Modelling and Verification Based on Petri Net Components with Multiple Import Interfaces, pp. 3606-3611.
Kuessel, Uwe RWTH Aachen
Padberg, Julia Tech. Univ. Berlin
Abel, Dirk RWTH-Aachen Univ.

10:30-12:30 TuA01.21
Response-Time Control of a Processor-Sharing System Using Virtualized Server Environments, pp. 3612-3618.
Kjćr, Martin Ansbjerg Lund Univ. LTH
Kihl, Maria Lund Inst. of Tech. Lund Univ.
Robertsson, Anders LTH, Lund Univ.

10:30-12:30 TuA01.22
Algorithms for Online Implementations of Explicit MPC Solutions, pp. 3619-3622.
Sui, Dan NUS
Feng, Le The Norwegian Univ. of Science and Tech.
Hovd, Morten Norwegian Univ. of Tech. and Science

10:30-12:30 TuA01.23
Predictive Control of Nonlinear Hybrid Systems Using Generalized Outer Approximation, pp. 3623-3628.
Nandola, Naresh IIT Bombay
Bhartiya, Sharad IIT Bombay

10:30-12:30 TuA01.24
Flood Prevention of the Demer River Using Model Predictive Control, pp. 3629-3634.
Barjas Blanco, Toni KULeuven
De Moor, Bart L.R. Katholieke Univ. Leuven

10:30-12:30 TuA01.25
An Interpretation of Concurrent Hybrid Time Systems Over Multi-Clock Systems, pp. 3635-3640.
Bujorianu, Manuela Univ. of Twente
Bujorianu, Marius Constantin Univ. of Twente
Langerak, Romanus Univ. of Twente

10:30-12:30 TuA01.26
A Hybrid Predictive Control Scheme for Hygrothermal Process, pp. 3641-3646.
Oliveira, Gustavo Henrique da Costa PUCPR
Ushijima, Luiz Henrique PUCPR

10:30-12:30 TuA01.27
On Input-To-Output Stability of Switched Nonlinear Systems, pp. 3647-3652.
Efimov, Denis Inst. for Problems of Mechanical Eng.
Panteley, Elena V. CNRS
Loria, Antonio CNRS

10:30-12:30 TuA01.28
Synchronization of Complex Dynamical Networks with Switching Topology: A Switched System Point of View, pp. 3653-3658.
Zhao, Jun The Australian National Univ.
Hill, David J. The Australian National Univ.

10:30-12:30 TuA01.29
Global Asymptotic Stability of the Limit Cycle in Piecewise Linear Versions of the Goodwin Oscillator, pp. 3659-3664.
Salinas-Varela, Adrian Alberto Univ. of Cambridge
Stan, Guy-Bart Univ. of Cambridge
Goncalves, Jorge M. Univ. of Cambridge

10:30-12:30 TuA01.30
Method for Analysis of Synchronization Applied to Supermarket Refrigeration System, pp. 3665-3670.
Wisniewski, Rafael Danfoss A/S
Larsen, Lars Finn Sloth Danfoss A/S

10:30-12:30 TuA01.31
Square-Root Algorithms of Recursive Least-Squares Wiener Estimators in Linear Discrete-Time Stochastic Systems, pp. 3671-3676.
Nakamori, Seiichi Kagoshima Univ.

10:30-12:30 TuA01.32
Linear Least-Squares Estimation Based on Covariances from Multiple Correlated Uncertain Observations, pp. 3677-3682.
Caballero-Águila, Raquel Jaén Univ.
Hermoso-Carazo, Aurora Granada Univ.
Jiménez-López, José Domingo Jaén Univ.
Linares-Pérez, Josefa Granada Univ.
Nakamori, Seiichi Kagoshima Univ.

10:30-12:30 TuA01.33
Access and Service Rate Control in Queuing System, pp. 3683-3688.
Miller, Boris Monash Univ.

10:30-12:30 TuA01.34
Estimation of State and Measurement Noise Covariance Matrices by Multi-Step Prediction, pp. 3689-3694.
Dunik, Jindrich Univ. of West Bohemia in Pilsen
Simandl, Miroslav Univ. of West Bohemia

10:30-12:30 TuA01.35
Analysis on Behaviors of Controlled Quantum Systems Via Quantum Entropy, pp. 3695-3700.
Abe, Tomonari The Univ. of Tokyo
Sasaki, Tomotake The Univ. of Tokyo
Hara, Shinji The Univ. of Tokyo
Tsumura, Koji Univ. of Tokyo

10:30-12:30 TuA01.36
FIR Filters for Stationary State Space Signal Models, pp. 3701-3706.
Park, Jung Hun Seoul National Univ.
Kwon, Wook Hyun Seoul National Univ.

10:30-12:30 TuA01.37
Depth Control of Autonomous Underwater Vehicle Based on Open Control Platform, pp. 3707-3712.
Syahroni, Nanang Pusan National Univ.
Seo, Young Bong Pusan National Univ.
Choi, Jae Weon Pusan National Univ.

10:30-12:30 TuA01.38
Compromises between Feasibility and Performance within Linear MPC, pp. 3713-3718.
Ding, Yihang Univ. of Sheffield
Rossiter, J. Anthony Univ. of Sheffield

10:30-12:30 TuA01.39
Observer-Based Synchronization of Discrete-Time Chaotic Systems under Communication Constraints, pp. 3719-3724.
Fradkov, Alexander L. Acad. of Sciences of Russia
Andrievsky, Boris Inst. for Problems of Mechanical Engin.
Andrievsky, Alexey IPME RAS

10:30-12:30 TuA01.40
Coordinated Control of Multiple Mobile Agents with Connectivity Preserving, pp. 3725-3730.

Su, Housheng — Shanghai Jiao Tong Univ.
Wang, Xiaofan — Shanghai JiaoTong Univ.

10:30-12:30 — TuA01.41
Stochastic Switching Approach of Bilateral Teleoperation Systems: Part I - Theory, pp. 3731-3736.
Walker, Kevin — Dalhousie Univ.
Pan, Ya-Jun — Dalhousie Univ.
Gu, Jason — Dalhousie Univ.

10:30-12:30 — TuA01.42
Stochastic Switching Approach of Bilateral Teleoperation Systems: Part II - Experiment, pp. 3737-3742.
Walker, Kevin — Dalhousie Univ.
Pan, Ya-Jun — Dalhousie Univ.
Gu, Jason — Dalhousie Univ.

10:30-12:30 — TuA01.43
Synchronization of a Class of Multi-Agent Systems with Large Population, pp. 3743-3748.
Liu, Zhixin — Acad. of Mathematics and Systems Sciences
Guo, Lei — Chinese Acad. of Sciences

10:30-12:30 — TuA01.44
Stochastic Observer-Based Guaranteed Cost Control for Networked Control Systems with Packet Dropouts, pp. 3749-3754.
Fang, Xiaosheng — Shanghai Jiaotong Univ.
Wang, Jingcheng — Shanghai JiaoTong Univ.

10:30-12:30 — TuA01.45
Set-Valued State Estimation for Uncertain Continuous-Time Systems Via Limited Capacity Communication Channels, pp. 3755-3760.
Cheng, Teddy M. — Univ. of New South Wales
Malyavej, Veerachai — The Mahanakorn Univ. of Tech.
Savkin, Andrey V. — Univ. of New South Wales

TuA02 — 304A
Stabilization of Nonlinear Systems I (Regular Session)
Chair: Isidori, Alberto — Univ. of Rome "La Sapienza"
Co-Chair: Loria, Antonio — CNRS

10:30-11:10 — TuA02.1
State-Dependent Riccati Equation (SDRE) Control: A Survey, pp. 3761-3775.
Çimen, Tayfun — ROKETSAN Missiles Industries Inc.

11:10-11:30 — TuA02.2
A Note on Robust Output Feedback Stabilization of Nonlinear Nonminimum Phase Systems, pp. 3776-3780.
Isidori, Alberto — Univ. of Rome
Marconi, Lorenzo — Univ. di Bologna

11:30-11:50 — TuA02.3
Feedback Stabilization of the TORA System Via Interconnection and Damping Assignment Control, pp. 3781-3786.
Morillo, Atilio — Univ. del Zulia
Ríos-Bolívar, Miguel — Univ. de Los Andes
Acosta, Vivian — Univ. de Los Andes

11:50-12:10 — TuA02.4
Control under Quantization, Saturation and Delay: An LMI Approach, pp. 3787-3792.
Fridman, E. M. — Tel-Aviv Univ.
Dambrine, Michel — Univ. de Valenciennes et du Hainaut-Cambrésis

12:10-12:30 — TuA02.5
An Inner-Loop Controller Guaranteeing Robust Transient Performance for Uncertain MIMO Linear Systems, pp. 3793-3798.
Back, Juhoon — Korea Univ.
Shim, Hyungbo — Seoul National Univ.
Joo, Young Jun — Seoul National Univ.

TuA03 — 304B
Advances in Higher Order Sliding Mode Control (Invited Session)
Chair: Shtessel, Yuri B. — Univ. of Alabama at Huntsville
Co-Chair: Levant, Arie — Tel - Aviv Univ.
Organizer: Shtessel, Yuri B. — Univ. of Alabama at Huntsville
Organizer: Levant, Arie — Tel - Aviv Univ.
Organizer: Fridman, Leonid M. — Univ. of Mexico

10:30-11:10 — TuA03.1
Homogeneous High-Order Sliding Modes (I), pp. 3799-3810.
Levant, Arie — Tel - Aviv Univ.

11:10-11:30 — TuA03.2
Blood Glucose Regulation Via Double Loop Higher Order Sliding Mode Control and Multiple Sampling Rate (I), pp. 3811-3816.
Kaveh, Parisa — Univ. of Alabama in Huntsville
Shtessel, Yuri B. — Univ. of Alabama at Huntsville

11:30-11:50 — TuA03.3
Observation and Separation Principle for the Chattering-Free Control of Multi-Input Systems with Simplex Sliding Mode (I), pp. 3817-3822.
Bartolini, Giorgio — Univ. of Cagliari
Punta, Elisabetta — National Res. Council of Italy - CNR
Zolezzi, Tullio — Univ. of Genoa

11:50-12:10 — TuA03.4
On the Transfer Properties of Second-Order Sliding Mode Control Systems (I), pp. 3823-3829.
Pisano, Alessandro — Univ. di Cagliari
Fridman, Leonid M. — Univ. of Mexico
Boiko, Igor — IMB Controls
Usai, Elio — Univ. degli Studi di Cagliari

12:10-12:30 — TuA03.5
On ZOH Discretization of Higher-Order Sliding Mode Control Systems (I), pp. 3830-3835.
Wang, Bin — Royal Melbourne Inst. of Tech.
Yu, Xinghuo — RMIT Univ.

TuA04 — 308
Applications of Nonlinear Control III (Regular Session)
Chair: Hammouri, Hassan — Univ. Claude Bernard
Co-Chair: Laila, Dina Shona — Imperial Coll. London

10:30-10:50 — TuA04.1
Control of Oriented Mechanical Systems: A Method Based on Dual Quaternion, pp. 3836-3841.
Han, Dapeng — National Univ. of Defense Tech.
Wei, Qing — National Univ. of Defense Tech.
Li, Zexiang — Hong Kong Univ. of Science & Tech.
Sun, Weimeng — National Univ. of Defense Tech.

10:50-11:10 — TuA04.2
Nonlinear Observer and Output Feedback Design for a Combustion Engine Test Bench, pp. 3842-3847.
Laila, Dina Shona — Imperial Coll. London
Gruenbacher, Engelbert — Linz Center of Mechatronics

11:10-11:30 — TuA04.3
Adaptive Backstepping Control for Vibration Reduction in a Structure with Frictional and Hysteretic Actuators, pp. 3848-3853.
Zapateiro, Mauricio — Univ. of Girona
Karimi, Hamid Reza — Univ. of Girona
Luo, Ningsu — Univ. of Girona

11:30-11:50 — TuA04.4
Lyapunov Based Control for Non Isothermal Continuous Stirred Tank Reactor, pp. 3854-3858.
Hoang, Ngoc Ha — Univ. Claude Bernard Lyon 1
Couenne, Francoise — Univ. of Lyon 1
Jallut, Christian — Univ. Claude Bernard Lyon 1
Le Gorrec, Yann — Univ. of Lyon, Lyon 1

11:50-12:10 — TuA04.5
Nonlinear Implicit On-Line Observer : Application to the Estimation in Binary Distillation Columns, pp. 3859-3864.
Mota Grajales, Rafael — Inst. Tecnologico de Tuxtla Gutiérrez
Nadri, Madiha — Univ. Claude Bernard Lyon 1
Hammouri, Hassan — Univ. Claude Bernard

12:10-12:30 — TuA04.6
Adaptive Observer and Kalman Filtering, pp. 3865-3870.
Benzemrane, Khadidja — CNRS / Evry Univ.
Damm, Gilney — IBISC Lab. CNRS/Evry Univ.
Santosuosso, Giovanni L. — Univ. di Roma Tor Vergata

TuA05 — 307
Switching Stability and Control I (Regular Session)
Chair: Fikar, Miroslav — STU in Bratislava

Co-Chair: Yoon, Tae-Woong — Korea Univ.

10:30-10:50 TuA05.1
On Stability of Switched Differential Algebraic Systems -- Conditions and Applications, pp. 3871-3876.
Pendharkar, Ishan — Indian Inst. of Tech. Bombay, India.
Wulff, Kai — Tech. Univ. of Berlin
Raisch, Joerg — Tech. Univ. Berlin

10:50-11:10 TuA05.2
Polynomial Approximation of Closed-Form MPC for Piecewise Affine Systems, pp. 3877-3882.
Kvasnica, Michal — Slovak Univ. of Tech. in Bratislava
Christophersen, Frank J. — ETH - Swiss Federal Inst. of Tech.
Herceg, Martin — Slovak Univ. of Tech. in Bratislava
Fikar, Miroslav — STU in Bratislava

11:10-11:30 TuA05.3
Stabilization of Switched Discrete-Time Systems with Time-Varying Delay, pp. 3883-3888.
Leite, Valter J. S. — CEFET/MG - Campus Div.
Miranda, Marcio Fantini — Federal Univ. of Minas Gerais

11:30-11:50 TuA05.4
Robust Tracking Control for Switched Linear Systems with Time-Delay: An Average Dwell Time Approach, pp. 3889-3894.
Li, Qing-Kui — Northeastern Univ.
Dimirovski, Georgi Marko — Dogus Univ. of Istanbul
Zhao, Jun — The Australian National Univ.

11:50-12:10 TuA05.5
Asymptotic Tracking of Non-Sinusoidal Periodic References: A Switched Linear Internal Model Approach, pp. 3895-3900.
Rossi, Carlo — Univ. of Bologna
Tilli, Andrea — Univ. of Bologna
Toniato, Manuel — Univ. of Bologna

12:10-12:30 TuA05.6
Tracking Control for Switched Linear Systems with Time-Delay, pp. 3901-3906.
Li, Qing-Kui — Northeastern Univ.
Dimirovski, Georgi Marko — Dogus Univ. of Istanbul
Zhao, Jun — The Australian National Univ.

TuA06 — 310A
Time Delay Systems: Stabilisation and Control (Regular Session)
Chair: Kucera, Vladimir — Czech Tech. Univ. in Prague
Co-Chair: Arunsawatwong, Suchin — Chulalongkorn Univ.

10:30-10:50 TuA06.1
Affine Parameterization of Cascade Control with Time Delays, pp. 3907-3912.
Zitek, Pavel — Czech Tech. Univ.
Kucera, Vladimir — Czech Tech. Univ. in Prague
Vyhlidal, Tomas — Czech Tech. Univ. in Prague

10:50-11:10 TuA06.2
Asymptotic Sensitivity Properties of Davison Type Integral Controllers for Time-Delay Plants, pp. 3913-3918.
Ishihara, Tadashi — Fukushima Univ.
Zheng, Liang An — National Kaohsiung Univ. of Applied Sciences
Guo, Hai-jiao — Tohoku Gakuin Univ.

11:10-11:30 TuA06.3
Rejection of Persistent Bounded Disturbance for a Class of Time-Delay Systems, pp. 3919-3922.
Sun, Man — Beihang Univ.
Jia, Yingmin — Beihang Univ.
Du, Junping — Beijing Univ. of Posts and Telecommunications
Yu, Fashan — Henan Pol. Univ.

11:30-11:50 TuA06.4
H_{infty} Output Feedback Control for Singular Systems with Time-Varying Delay, pp. 3923-3927.
Li, Lin — BeiHang Univ.
Jia, Yingmin — Beihang Univ.
Du, Junping — Beijing Univ. of Posts and Telecommunications
Yu, Fashan — Henan Pol. Univ.

11:50-12:10 TuA06.5
Stability and Stabilization of Retarded Fractional Delay Differential Systems, pp. 3928-3933.
Nguyen, Van Quang — Chulalongkorn Univ.
Arunsawatwong, Suchin — Chulalongkorn Univ.

12:10-12:30 TuA06.6
Memoryless Control to Drive States of Delayed Continuous-Time Systems within the Nonnegative Orthant, pp. 3934-3939.
Hmamed, Abdelaziz — Faculty of Science Dhar Elmhraz
Benzaouia, Abdellah — Faculty of Science Semlalia
Rami, Mustapha Ait — Chinese Univ. of Hong Kong
Tadeo, Fernando — Univ. of Valladolid Q4718001C

TuA07 — 310B
Dynamic Games and Applications (Invited Session)
Chair: Freiling, Gerhard — Univ. Duisburg-Essen
Co-Chair: Abou-Kandil, Hisham — Ec. Normale Sup. Cachan
Organizer: Abou-Kandil, Hisham — Ec. Normale Sup. Cachan
Organizer: Jungers, Marc — CNRS - Nancy Univ. ENSEM

10:30-10:50 TuA07.1
A Stackelberg Game Approach to Mixed H2/H_infinity Control (I), pp. 3940-3945.
Jungers, Marc — CNRS - Nancy Univ. ENSEM
Trelat, Emmanuel — Univ. of Paris Sud (Orsay)
Abou-Kandil, Hisham — Ec. Normale Sup. Cachan

10:50-11:10 TuA07.2
Coupled Riccati Differential Equations Arising in Connection with Nash Differential Games (I), pp. 3946-3951.
Freiling, Gerhard — Univ. Duisburg-Essen

11:10-11:30 TuA07.3
The Open-Loop Linear Quadratic Differential Game for Index One Descriptor Systems (I), pp. 3952-3957.
Engwerda, Jacob — Tilburg Univ.
Salmah, Salmah — Gadjah Mada Univ.

11:30-11:50 TuA07.4
Robust Stackelberg Equilibrium for a Multi-Scenario Two Players Linear Affine-Quadratic Differential Game (I), pp. 3958-3963.
Jimenez-Lizarraga, Manuel — Autonomous Univ. of Nuevo León, México.
Poznyak, Alexander S. — CINVESTAV-IPN

11:50-12:10 TuA07.5
Solutions in Nonantagonistic Positional Differential Games with Vector Payoff Functionals (I), pp. 3964-3969.
Kleimenov, Anatolii — Inst. of Mathematics and Mechanics of Ural Branch of the Rus

12:10-12:30 TuA07.6
Asymptotic Epsilon-Nash Equilibrium for 2nd Order Two-Player Nonzero-Sum Singular LQ Games with Decentralized Control, pp. 3970-3975.
Wang, Xu — Ohio State Univ.
Cruz, Jose B — The Ohio State Univ.

TuA08 — 310C
Robust Controller Synthesis I (Regular Session)
Chair: Scherer, Carsten W. — Delft Univ. of Tech.
Co-Chair: Polyak, Boris T. — Moscow Inst. of Control Sciences

10:30-10:50 TuA08.1
Invariant Ellipsoids Approach to Robust Rejection of Persistent Disturbances, pp. 3976-3981.
Shcherbakov, P.S. — Moscow Inst. of Control Sciences
Topunov, Michael — Inst. for Control Science
Polyak, Boris T. — Moscow Inst. of Control Sciences

10:50-11:10 TuA08.2
Calculation of All $H_{\∞}$ Robust Stabilizing Gains for SISO LTI Systems, pp. 3982-3987.
Söylemez, Mehmet Turan — Istanbul Tecnical Univ.
Bayhan, Nevra — Istanbul Univ.

11:10-11:30 TuA08.3
Continuous and Discrete-Time Path-Following Design of Mixed H2/Hinf State-Feedback Controllers, pp. 3988-3993.
Ostertag, Eric — Univ. of Strasbourg I

11:30-11:50 TuA08.4
H_{infty} Tracking with Preview for Linear Systems with Impulsive

Effects-State Feedback and Full Information Cases, pp. 3994-3999.
Nakura, Gou — Osaka Univ.

11:50-12:10 — TuA08.5
H_{infty} Tracking with Preview by Output Feedback for Linear Systems with Impulsive Effects, pp. 4000-4005.
Nakura, Gou — Osaka Univ.

12:10-12:30 — TuA08.6
Reduced Complexity Existence Conditions for Robust L2-Gain Feedforward Controllers for Uncertain Systems Using Dynamic IQCs, pp. 4006-4011.
Kose, Emre — Bogazici Univ.
Scherer, Carsten W. — Delft Univ. of Tech.

TuA09 — 311C
Nonlinear System Identification II (Regular Session)
Chair: Schön, Thomas, Bo — Linköping Univ.
Co-Chair: Wills, Adrian George — Univ. of Newcastle

10:30-10:50 — TuA09.1
Parameter Estimation for Discrete-Time Nonlinear Systems Using EM, pp. 4012-4017.
Wills, Adrian George — Univ. of Newcastle
Schön, Thomas, Bo — Linköping Univ.
Ninness, Brett — Univ. of Newcastle

10:50-11:10 — TuA09.2
On the Consistency of Certain Identification Methods for Linear Parameter Varying Systems, pp. 4018-4023.
Butcher, Mark Edward John — Ec. Pol. Federal de Lausanne
Karimi, Alireza — Ec. Pol. Federale de Lausanne
Longchamp, Roland — Ec. Pol. Federale De Lausanne

11:10-11:30 — TuA09.3
Identification of Nonlinear Volterra Models by Means of Diffusive Representation, pp. 4024-4029.
Casenave, Céline — LAAS-CNRS
Montseny, Gerard — LAAS-CNRS

11:30-11:50 — TuA09.4
Nolinear System Identification Based on Local Sub-Model Networks, pp. 4030-4035.
Sun, Lianming — The Univ. of Kitakyushu
Sano, Akira — Keio Univ.

11:50-12:10 — TuA09.5
Adaptive Hinging Hyperplanes, pp. 4036-4041.
Xu, Jun — Tsinghua Univ.
Huang, Xiaolin — Tsinghua Univ.
Wang, Shuning — Tsinghua Univ.

12:10-12:30 — TuA09.6
A Neuro-Based EM-Particle Smoothing Algorithm for Identification of Nonlinear State Space Models, pp. 4042-4047.
Gorji daronkolaei, Aliakbar — Amirkabir Univ. of Tech.
Menhaj, Mohammad Bagher — Amirkabir Univ. of Tech.

TuA10 — 311B
Identification Algorithms and Applications (Regular Session)
Chair: Malti, Rachid — Univ. Bordeaux1
Co-Chair: Li, Li — The Univ. of Melbourne

10:30-10:50 — TuA10.1
Model Reduction for Linear Parameter-Dependent Systems, pp. 4048-4053.
Li, Li — The Univ. of Melbourne

10:50-11:10 — TuA10.2
Input-Adaptive Models Based Multiple-Model Algorithm for Maneuvering Target Tracking, pp. 4054-4059.
Lan, Jian — Tsinghua Univ. P. R. China
Mu, Chundi — Tsinghua Univ.

11:10-11:30 — TuA10.3
Simple Altitude Estimator Using Air-Data and GPS Measurements, pp. 4060-4065.
Whang, Ick Ho — The Agency For Defense Development
Ra, Won-Sang — Agency for Defense Development

11:30-11:50 — TuA10.4
Wavelet Based OE Model Identification with Random Missing Data, pp. 4066-4071.
Geng, Lihui — Tsinghua Univ.
Zhang, Tao — Tsinghua Univ.
Xiao, Deyun — Tsinghua Univ.
Song, Jingyan — Tsinghua Univ.

11:50-12:10 — TuA10.5
Channel Equalization Using Dynamic Fuzzy Neural Networks, pp. 4072-4077.
Li, Ming-Bin — Nanyang Tech. Univ.
Er, Meng Joo — NTU

12:10-12:30 — TuA10.6
Set Membership Estimation of Fractional Models in the Frequency Domain, pp. 4078-4083.
Khemane, Firas — Univ. Bordeaux 1
Malti, Rachid — Univ. Bordeaux 1
Thomassin, Magalie — Univ. Bordeaux 1
Raissi, Tarek — Univ. Bordeaux 1

TuA11 — 311A
Adaptive Control of Systems I (Regular Session)
Chair: Bittanti, Sergio — Pol. di Milano
Co-Chair: Sugimoto, Kenji — Nara Inst. of Science and Tech.

10:30-10:50 — TuA11.1
Can a Two-Link Manipulator Learn How to Write?, pp. 4084-4089.
Alali, Basel — Nara Inst. of Science and Tech.
Hirata, Kentaro — NAIST, Nara Inst. of Sciense and Tech.
Sugimoto, Kenji — Nara Inst. of Science and Tech.

10:50-11:10 — TuA11.2
Nonlinear Adaptive H-Infinity Control of Robotic Manipulators under Constraint, pp. 4090-4095.
Miyasato, Yoshihiko — The Inst. of Statistical Mathematics

11:10-11:30 — TuA11.3
Adaptive Control of a Scalar Linear Stochastic System with a Fractional Brownian Motion, pp. 4096-4101.
Duncan, Tyrone E. — Univ. of Kansas
Pasik-Duncan, Bozenna — Univ. of Kansas

11:30-11:50 — TuA11.4
Regulation of Linear Systems with Unknown Additive Sinusoidal Sensor Disturbances, pp. 4102-4107.
Marino, Riccardo — Univ. di Roma Tor Vergata
Santosuosso, Giovanni L. — Univ. di Roma Tor Vergata
Tomei, Patrizio — Univ. of Roma Tor Vergata

11:50-12:10 — TuA11.5
Adaptive Visual Servoing of Robot Manipulators without Measuring the Image Velocity, pp. 4108-4113.
Lizarralde, Fernando — Federal Univ. of Rio de Janeiro
Hsu, Liu — COPPE - Federal Univ. of Rio de Janeiro
Costa, Ramon R. — COPPE - Federal Univ. of Rio de Janeiro

12:10-12:30 — TuA11.6
Direct and Indirect Stable Adaptive Control for Suspension Systems with MR Damper, pp. 4114-4119.
Nilkhamhang, Itthisek — Keio Univ.
Mori, Tomoaki — Keio Univ.
Sano, Akira — Keio Univ.

TuA12 — 313
Dependable Control of Discrete Event Systems I (Invited Session)
Chair: Faure, Jean-Marc — ENS Cachan
Co-Chair: Lesage, Jean-Jacques — ENS de Cachan
Organizer: Faure, Jean-Marc — ENS Cachan
Organizer: Lesage, Jean-Jacques — ENS de Cachan
Organizer: Frey, Georg — Univ. of Kaiserslautern

10:30-10:50 — TuA12.1
Optimal Control of Multi-Layer Discrete Event Systems with Real-Time Constraint Guarantees (I), pp. 4120-4125.
Mao, Jianfeng — Boston Univ.
Cassandras, Christos G. — Boston Univ.

10:50-11:10 — TuA12.2
Reliable and Safe Operation of Distributed Discrete-Event Controllers: A Networked Implementation with Real-Time

Guarantees (I), pp. 4126-4131.
Schmidt, Klaus — Univ. of Erlangen - Nuremberg
Schmidt, Ece G. — Middle East Tech. Univ.
Zaddach, Jorgos-Johannes — Siemens AG

11:10-11:30 TuA12.3
Algebraic Synthesis of Dependable Logic Controllers (I), pp. 4132-4137.
Hietter, Yann — ENS de Cachan
Roussel, Jean-Marc — ENS de Cachan
Lesage, Jean-Jacques — ENS de Cachan

11:30-11:50 TuA12.4
Non-Coherent Modelling in Compositional Fault Tree Analysis (I), pp. 4138-4143.
Sharvia, Septavera — Univ. of Hull
Papadopoulos, Yiannis Ioannis — Univ. of Hull

11:50-12:10 TuA12.5
Agent Oriented Software-Development for Networked Embedded Systems with Real Time and Dependability Requirements in the Domain of Automation (I), pp. 4144-4149.
Wannagat, Andreas — Univ. of Kassel, Faculty of Electrical EngineeringandComput
Vogel-Heuser, Birgit — Univ. of Kassel

TuA13 314
Sensor Networks (Regular Session)
Chair: Mareels, Iven — The Univ. of Melbourne
Co-Chair: Park, Chan Gook — Seoul National Univ.

10:30-10:50 TuA13.1
Model Based Information Fusion in Sensor Networks, pp. 4150-4155.
Alriksson, Peter — Lund Univ.
Rantzer, Anders — Lund Univ.

10:50-11:10 TuA13.2
Region Coverage for Planar Sensor Network Via Sensing Sectors, pp. 4156-4161.
Shi, Guodong — Chinese Acad. of Sciences
Hong, Yiguang — Chinese Acad. of Sciences

11:10-11:30 TuA13.3
Distributed Coverage Control in Sensor Network Environments with Polygonal Obstacles, pp. 4162-4167.
Cassandras, Christos G. — Boston Univ.
Zhong, Minyi — Boston Univ.

11:30-11:50 TuA13.4
Optimal Power Analysis for Network Lifetime Balance in Hierarchy Networks, pp. 4168-4173.
Wen, Rongrong — The Univ. of Melbourne
Mareels, Iven — The Univ. of Melbourne
Krongold, Brian Scott — Univ. of Melbourne

11:50-12:10 TuA13.5
Reformulating Kalman Filter Based Optimal Dynamic Coverage Control, pp. 4174-4179.
Chen, Lingji — Scientific Systems Company Inc.
Mehra, Raman K. — Scientific Systems Co. Inc.

12:10-12:30 TuA13.6
Coverage Control with Information Decay in Dynamic Environments, pp. 4180-4185.
Hübel, Nico — Univ. Stuttgart
Hirche, Sandra — Tech. Univ. Muenchen
Gusrialdi, Azwirman — Tokyo Inst. of Tech.
Hatanaka, Takeshi — Tokyo Inst. of Tech.
Fujita, Masayuki — Tokyo Inst. of Tech.
Sawodny, Oliver — Univ. of Stuttgart

TuA14 318
Control Over Networks I (Regular Session)
Chair: Yu, Li — Zhejiang Univ. of Tech.
Co-Chair: Guan, Zhi-Hong — Huazhong Univ. of Science & Tech.

10:30-10:50 TuA14.1
H-Infinite Filtering of Network-Based Systems with Random Delays, pp. 4186-4191.
Song, HongBo — Zhejiang Univ. of Tech.
Yu, Li — Zhejiang Univ. of Tech.
Zhang, Wen-An — Zhejiang Univ. of Tech.

10:50-11:10 TuA14.2
Measurement Delay Estimation for Kalman Filter in Networked Control Systems, pp. 4192-4197.
Pohjola, Mikael — Helsinki Univ. of Tech.
Koivo, Heikki — Helsinki Univ. of Tech.

11:10-11:30 TuA14.3
Passivity of Infinite--Dimensional Linear Systems with State, Input and Output Delays, pp. 4198-4203.
Hadd, Said — The Univ. of Liverpool
Zhong, Qing-Chang — The Univ. of Liverpool

11:30-11:50 TuA14.4
Stabilization of Networked Control Systems with Random Delays: A New Multirate Method, pp. 4204-4209.
Guan, Zhi-Hong — Huazhong Univ. of Science & Tech.
Yang, Chun-Xi — Huazhong Univ. of Science and Tech.
Huang, Jian — Huazhong Univ. of Science and Tech.

11:50-12:10 TuA14.5
Stability Analysis for a Class of Networked/Embedded Control Systems: Output Feedback Case, pp. 4210-4215.
Fujioka, Hisaya — Kyoto Univ.

12:10-12:30 TuA14.6
Controllability and Observability of Linear Discrete-Time Systems with Network Induced Variable Delay, pp. 4216-4221.
Ionete, Catalin Cosmin — Univ. of Craiova
Cela, Arben — Groupe ESIEE
Ben Gaid, Mongi — IFP
Reama, Abdellatif — Univ.

TuA15 317
Artificial Pancreas: Novel Applications of Modeling and Control in Biomedical Systems (Invited Session)
Chair: Vehi, Josep — Univ. de Girona
Co-Chair: Doyle, Francis — Univ. of California at Santa Barbara
Organizer: Vehi, Josep — Univ. de Girona
Organizer: Doyle, Francis — Univ. of California at Santa Barbara

10:30-10:50 TuA15.1
Prediction of Dynamic Glycemic Trends Using Optimal State Estimation (I), pp. 4222-4227.
Percival, Matthew W. — Univ. of California
Bevier, Wendy C. — Sansum Diabetes Res. Inst.
Zisser, Howard — Sansum Diabetes Res. Inst.
Jovanovic, Lois — Sansum Diabetes Res. Inst.
Seborg, Dale — Univ. of California
Doyle, Francis — Univ. of California at Santa Barbara

10:50-11:10 TuA15.2
Implications of Meal Library & Meal Detection to Glycemic Control of Type I Diabetes Mellitus through MPC Control (I), pp. 4228-4233.
Dassau, Eyal — Univ. of California Santa Barbara
Herrero, Pau — Univ. de Girona
Zisser, Howard — Sansum Diabetes Res. Inst.
Buckingham, Bruce — Stanford
Jovanovic, Lois — Sansum Diabetes Res. Inst.
Dalla Man, Chiara — Univ. of Padova
Cobelli, Claudio — Univ. of Padova
Vehi, Josep — Univ. de Girona
Doyle, Francis — Univ. of California at Santa Barbara

11:10-11:30 TuA15.3
In Silico Testing and in Vivo Experiments with Closed-Loop Control of Blood Glucose in Diabetes (I), pp. 4234-4239.
Kovatchev, Boris — Univ. of Virginia
Raimondo, Davide Martino — Univ. of Pavia
Breton, Marc — Univ. of Virginia
Patek, Stephen D. — Univ. of Virginia
Cobelli, Claudio — Univ. of Padova

11:30-11:50 TuA15.4
Robust Sliding Mode Closed-Loop Glucose Control with Meal Compensation in Type 1 Diabetes Mellitus (I), pp. 4240-4245.
Garcia-Gabin, Winston — Univ. of Girona

Vehi, Josep — Univ. de Girona
Bondia Company, Jorge — Tech. Univ. of Valencia
Tarin, Cristina — Tech. Univ. of Valencia
Calm, Remei — Univ. de Girona

11:50-12:10 TuA15.5
Model Predictive Control of Glucose Concentration in Subjects with Type 1 Diabetes: An in Silico Trial (I), pp. 4246-4251.
Magni, Lalo — Univ. of Pavia
Raimondo, Davide Martino — Univ. of Pavia
Dalla Man, Chiara — Univ. of Padova
De Nicolao, Giuseppe — Univ. di Pavia
Kovatchev, Boris — Univ. of Virginia
Cobelli, Claudio — Univ. of Padova

12:10-12:30 TuA15.6
A Closed-Loop Artificial Pancreas Based on MPC: Human-Friendly Identification and Automatic Meal Disturbance Rejection (I), pp. 4252-4257.
Lee, Hyunjin — Rensselaer Pol. Inst.
Bequette, B. Wayne — Rensselaer Pol. Inst.

TuA16 316
National and Regional Economies (Regular Session)
Chair: Neck, Reinhard — Klagenfurt Univ.
Co-Chair: Wang, Long — Peking Univ.

10:30-11:10 TuA16.1
The Contribution of Control Theory to the Analysis of Economic Policy, pp. 4258-4269.
Neck, Reinhard — Univ. of Klagenfurt

11:10-11:30 TuA16.2
Collusion Helps Abate Environmental Externalities: A Dynamic Approach, pp. 4270-4273.
Lambertini, Luca — Univ. of Bologna
Mantovani, Andrea — Univ. of Bologna

11:30-11:50 TuA16.3
Cooperation in Networked Prisoner's Dilemma with Individual Learning Feedback, pp. 4274-4279.
Chen, Xiaojie — Coll. of Engineering, Peking Univ.
Fu, Feng — Coll. of Engineering, Peking Univ.
Wang, Long — Peking Univ.

11:50-12:10 TuA16.4
Assosiative Search Models in Trading, pp. 4280-4284.
Bakhtadze, Natalia — Inst. of Control Sciences of Russian Acad. ofSciense s
Lototsky, Vladimir — Inst. of control Science of Russian Acad. of Science

TuA17 320A
Recent Automation Technologies in Shipbuilding Industry II (Highlight Session)
Chair: Lee, Kyu-Yeul — Seoul National Univ.
Co-Chair: Lee, Ji-Hyoung — Hyundai Heavy Industries Co., Ltd.
Organizer: Lee, Kyu-Yeul — Seoul National Univ.

10:30-10:50 TuA17.1
Active Compliant Motion Control for Grinding Robot (I), pp. 4285-4289.
Park, Juyi — Daewoo Shipbuilding and Marine Engineering
Kim, Soo Ho — Daewoo Shipbuilding & Marine Engineering co., KPU
Kim, Sungkwun — Korea Pol. Univ.

10:50-11:10 TuA17.2
Development of Automatic Welding System for Multi-Layer and Multi-Pass Welding (I), pp. 4290-4291.
Kim, Yong-Baek — Hyundai Heavy Industries CO.,LTD
Kim, Jeom-Goo — Hyundai Heavy Industries CO.,LTD
Jang, Won-Taek — Hyundai Heavy Industries CO.,LTD
Park, Jong-ryon — Hyundai Heavy Industries Co., Ltd.
Moon, Hyung-Soon — Hyundai Heavy Industries CO.,LTD
Kim, Ji-On — Hyundai Heavy Industries CO.,LTD

11:10-11:30 TuA17.3
Rail Running Mobile Welding Robot 'RRX3' for the Double Hull Ship Structure (I), pp. 4292-4297.
Kim, Jongwon — Seoul National Univ. Mechanical and AerospaceEngineering
Lee, Kyu-Yeul — Seoul National Univ.
Kim, Tae-Wan — Seoul National Univ.
Lee, Donghun — Seoul National Univ.
Lee, Sungcheul — Seoul National Univ. Mechanical and AerospaceEngineering
Lim, Chaemook — Seoul National Univ. Mechanical and AerospaceEngineering
Kang, Sung-Won — Daewoo Shipbuilding & Marine Engineering co.

11:30-11:50 TuA17.4
Modularized Control Architecture of an Embedded Controller for Mobile Welding Robot in the Shipyard (I), pp. 4298-4303.
Lee, Kyu-Yeul — Seoul National Univ.
Kim, Tae-Wan — Seoul National Univ.
Kim, Jongwon — Seoul National Univ. Mechanical and Aerospace Engineering
Ku, Nam-Kug — Seoul National Univ.
Hounyoung, Lim — Seoul National Univ.
Jongjin, Woo — Seoul National Univ.
Lee, Sang-Moo — Korea Inst. of Industrial Tech. (KITECH)
Kim, Soo Ho — Daewoo Shipbuilding & Marine Engineering co., KPU

11:50-12:10 TuA17.5
Wireless Teaching Pendant for Mobile Welding Robot in Shipyard (I), pp. 4304-4309.
Kim, Tae-Wan — Seoul National Univ.
Lee, Kyu-Yeul — Seoul National Univ.
Kim, Jongwon — Seoul National Univ. Mechanical and Aerospace Engineering
Oh, Min-Jae — Seoul National Univ.
Lee, Jie Hyeung — Daewoo Shipbuilding & Marine Engineering co., KPU

12:10-12:30 TuA17.6
Development of Carriage-Type Welding Robot for Double Hull Assembly Line in Shipbuilding (I), pp. 4310-4311.
Lee, Ji-Hyoung — Hyundai Heavy Industries Co., Ltd.
Kim, Jong-jun — Hyundai Heavy Industries Co., Ltd.
Kim, Jae-kwon — Hyundai Heavy Industries Co., Ltd.
Park, Jong-ryon — Hyundai Heavy Industries Co., Ltd.

TuA18 320B
Recent Development of Intelligent Robots III: Vision & HRI (Highlight Session)
Chair: Choi, Jin Young — Seoul National Univ.
Co-Chair: Kim, Hong-Seok — Korea Inst. of Industrial Tech. (KITECH)

10:30-10:50 TuA18.1
Motion Planning for Non-Holonomic Mobile Manipulator Based Visual Servo under Large Platform Movement Errors at Low Velocity (I), pp. 4312-4317.
Le Minh, Phuoc — Sungkyunkwan Univ.
Martinet, Philippe — Blaise Pascal Univ.
Kim, Hun Mo — Sungkyunkwan Univ.
Lee, Sukhan — Sungkyunkwan Univ.

10:50-11:10 TuA18.2
Adaptive Visual Tracking for Surveillance Systems (I), pp. 4318-4323.
Yun, Seok Min — SNU
Na, Jin Hee — SNU
Choi, Jin Young — Seoul National Univ.

11:10-11:30 TuA18.3
Sensor Guided Laser Welding Robot System (I), pp. 4324-4329.
Kim, Chang-Hyun — Korea Advanced Inst. of Science and Tech.
Choi, Tae-Yong — Korea Advanced Inst. of Science and Tech.

Lee, Ju-Jang — Korea Advanced Inst. of Science and Tech.
Suh, Jeong — Korea Inst. of Machinery and Materials
Park, Kyoung-Taik — Korea Inst. of Machinery and Materials
Kang, Hee-Shin — Korea Inst. of Machinery and Materials
Lee, Moon-Yong — Sungwoo Hitech Co., LTD
Kim, Sung-rak — Hyundai Heavy Industries Co., LTD.

11:30-11:50 TuA18.4
Emotional Exchange of a Socially Interactive Robot (I), pp. 4330-4335.
Kwon, Dong-Soo — KAIST
Kim, Young-Min — KAIST

11:50-12:10 TuA18.5
Development of an Android for Emotional Expression and Human Interaction (I), pp. 4336-4337.
Lee, Dong-Wook — Korea Inst. of Industrial Tech. (KITECH)
Lee, Tae-Geun — Korea Inst. of Industrial Tech. (KITECH)
So, ByungRok — Korea Inst. of Industrial Tech. (KITECH)
Choi, Moosung — Korea Inst. of Industrial Tech.
Shin, Eun-Cheol — KITECH
Yang, KwangWoong — KITECH
Baeg, Moon-Hong — KITECH
Kim, Hong-Seok — Korea Inst. of Industrial Tech. (KITECH)
Lee, Ho-Gil — Korea Inst. of Industrial Tech. (KITECH)

TuA19 320C
Robot Manipulators I (Regular Session)
Chair: Gillet, Denis — Ec. Pol. Fédérale de Lausanne (EPFL)
Co-Chair: Lee, Joo-Ho — Ritsumeikan Univ.

10:30-10:50 TuA19.1
Decoupling Neural Sliding Mode Control for Multi-Link Robots, pp. 4338-4342.
Mu, Xiaojiang — Beijing Univ. of Tech.
Chen, Yangzhou — Beijing Univ. of Tech. Beijing, 100022,P.R.China

10:50-11:10 TuA19.2
Adaptive Tracking Control of Coordinated Nonholonomic Mobile Manipulators, pp. 4343-4348.
Fang, Mu — Shanghai Jiaotong Univ.
Chen, Weidong — Shanghai Jiaotong Univ.
Li, Zhijun — Shanghai Jiao Tong Univ.

11:10-11:30 TuA19.3
Considering Passive Joints in Cooperative Manipulation As Functional Redundancy, pp. 4349-4354.
From, PÍl Johan — Norwegian Univ. of Science and Tech.
Gravdahl, Jan Tommy — Norwegian Univ. of Science & Tech.

11:30-11:50 TuA19.4
On Achieving Periodic Joint Motion for Redundant Robots, pp. 4355-4360.
Michellod, Yvan — Ec. Pol. fédérale de Lausanne
Muellhaupt, Philippe — Ec. Pol. Fed. de Lausanne
Gillet, Denis — Ec. Pol. Fédérale de Lausanne (EPFL)

11:50-12:10 TuA19.5
Dynamic Modeling and Identification of a Complex-Structured Parallel Robot, pp. 4361-4366.
Kroneis, Jens — Univ. of Kaiserslautern
Müller, Peter Andreas — Univ. of Kaiserslautern
Liu, Steven — Tech. Univ. Kaiserslautern

12:10-12:30 TuA19.6
Passive Decomposition of Multiple Nonholonomic Mechanical Systems under Motion Coordination Requirements, pp. 4367-4373.
Lee, Dongjun — Univ. of Tennessee-Knoxville

TuA20 321C
Mobile Robot Control I (Regular Session)
Chair: Velasco-Villa, Martin — CINVESTAV-IPN
Co-Chair: Trächtler, Ansgar — Univ. of Paderborn

10:30-10:50 TuA20.1
Inverse Optimal Velocity Field Control of an Outdoor Blimp Robot, pp. 4374-4379.
Fukao, Takanori — Kobe Univ.
Yuzuriha, Akito — Kobe Univ.
Suzuki, Takafumi — Kobe Univ.
Kanzawa, Takeshi — Kobe Univ.
Oshibuchi, Takashi — Kobe Univ.
Osuka, Koichi — Kobe Univ.
Kohno, Takashi — Japan Aerospace Exploration Agency
Okuyama, Masahiro — Japan Aerospace Exploration Agency
Tomoi, Yasuhito — Japan Aerospace Exploration Agency
Nakadate, Masaaki — Japan Aerospace Exploration Agency

10:50-11:10 TuA20.2
Multiobjective Optimization of Control Trajectories for the Guidance of a Rail-Bound Vehicle, pp. 4380-4386.
Geisler, Jens — Univ. of Paderborn
Witting, Katrin — Univ. of Paderborn, Germany
Trächtler, Ansgar — Univ. of Paderborn
Dellnitz, Michael — Univ. of Paderborn

11:10-11:30 TuA20.3
A Method for Guidance of a Wheeled Mobile Robot Based on Received Radio Signal Strength Measurements, pp. 4387-4392.
Teimoori Sangani, Hamid — The Univ. of New South Wales (UNSW)
Savkin, Andrey V. — Univ. of New South Wales

11:30-11:50 TuA20.4
Real-Time Sliding-Mode Adaptive Control of a Mobile Platform Wheeled Mobile Robot, pp. 4393-4399.
Filipescu, Adrian — Univ. Dunarea de Jos of Galati
Stancu, Alexandru — Univ. Pol. de Catalunya (UPC)
Filipescu, Silviu — Univ. Dunarea de Jos of Galati
Stamatescu, Grigore — Pol. Univ. of Bucharest

11:50-12:10 TuA20.5
A Receding-Horizon Formation Tracking Controller with Leader-Follower Strategies, pp. 4400-4405.
Chen, Jian — Lab. for Mechatronics and Controls; JointAdvancedResearch
Sun, Dong — City Univ. of Hong Kong
Yang, Jie — Department of Precision Machinery and Inst. Univ.

12:10-12:30 TuA20.6
Bank-To-Turn Control for a Small UAV Using Backstepping and Parameter Adaptation, pp. 4406-4411.
Jung, Dongwon — Georgia Inst. of Tech.
Tsiotras, Panagiotis — Georgia Inst. of Tech.

TuA21 321B
Low-Cost, High-Performance Sensor Technologies for Robotic and Consumer Applications (Invited Session)
Chair: Lee, In Ock — Ninety System Co.
Co-Chair: Kim, Byung-Geuk — Hagisonic Co., Ltd.
Organizer: Choi, Byoung-Doo — Seoul Univ.
Organizer: Cho, Dong-il Dan — Seoul National Univ.

10:30-10:50 TuA21.1
Improving Igs Ultrasonic Receiver Circuit of Low Cost Positioning Sensor for Ubiquitous Robotic Companion (I), pp. 4412-4417.
Jin, JoCheol — Ninety system co.
Lee, In Ock — Ninety System Co.
Lim, Hyung Joon — Ninety System Co.
Shin, Joon Gyou — Ninety System Co.
Lee, Won Bok — Ninety System Co.
Lee, Chang Jin — Ninety System Co.

10:50-11:10 TuA21.2
Wafer-Level Vacuum Packaged X and Y Axis Gyroscope Using the Extended SBM Process for Ubiquitous Robot Applications (I), pp. 4418-4423.

Choi, Byoung-Doo — Seoul Univ.
Paik, Seung-Joon — SML electronics
Lee, Sangmin — Seoul National Univ.
Ko, Hyoungho — Seoul National Univ.
Yoo, Kwangho — SML Electronics, Inc.
Kim, Namkuk — Seoul National Univ.
Cho, Dong-il Dan — Seoul National Univ.

11:10-11:30 TuA21.3
Robust Control Design for Resonance Damping of a Directional Microphone, pp. 4424-4429.
Vargas, Henik — Binghamton Univ.
Wu, Neng Eva — Binghamton Univ.
Miles, Ron — Binghamton Univ.
Qu, Jinli — Binghamton Univ.

11:30-11:50 TuA21.4
Development of an Automatic Recharging System for Intelligent Robots Using an Anisotropic Ultrasonic Sensor (I), pp. 4430-4431.
Kim, Byung-Geuk — Hagisonic Co., Ltd.
Jang, Seung-Jin — Hagisonic Co., Ltd.
Park, Seon-Hong — Hagisonic Co., Ltd.
Choi, Duck-Hee — Hagisonic Co., Ltd.
Ahn, Youn-Kuk — Hagisonic Co., Ltd.

TuA22 321A
Design and Development Tools for Mechatronic Systems (Regular Session)
Chair: Falcon, Jeannie — National Inst.
Co-Chair: Danielsson, Fredrik — Univ. West

10:30-10:50 TuA22.1
Design of Hybrid Systems with Real-Time Processor and FPGA Targets, pp. 4432-4433.
Falcon, Jeannie — National Inst.

10:50-11:10 TuA22.2
New Mechatronics Development Techniques for FPGA-Based Control and Simulation of Electromechanical Systems, pp. 4434-4439.
Kassas, Zaher — National Inst.
MacCleery, Brian — National Inst.

11:10-11:30 TuA22.3
General Time Synchronisation Method for PLC Programs Aiming at Virtual Verification and Development with CAPE Tools, pp. 4440-4445.
Carlsson, Henrik — Univ. West
Danielsson, Fredrik — Univ. West
Lennartson, Bengt — Chalmers Univ. of Tech.

11:30-11:50 TuA22.4
A New Hardware-In-The-Loop Platform for the Evaluation of Adaptive Lighting Systems, pp. 4446-4451.
Opfermann, Alexander — TU Dortmund
Bertram, Torsten — TU Dortmund
Baum, Dietmar — Hella KGaA Hueck & Co.
Karas, Peter — Hella KGaA Hueck & Co.

11:50-12:10 TuA22.5
A New Motorcycle Simulator Platform: Mechatronics Design, Dynamics Modeling and Control, pp. 4452-4457.
Nehaoua, Lamri — Evry Univ.
Hima, Salim — IBISC Lab. Evry val d'essone Univ.
Arioui, Hichem — Evry Val d'Essonne Univ.
Séguy, Nicolas — Evry Val d'Essonne Univ.

12:10-12:30 TuA22.6
Model-Free Control of Shape Memory Alloys Antagonistic Actuators, pp. 4458-4463.
Gédouin, Pierre-Antoine — Ec. nationale d'ingénieurs de Brest
Join, Cédric — UHP-Nancy & ALIEN INRIA-Futurs
Delaleau, Emmanuel — Ec. nationale d'ingénieurs de Brest
Bourgeot, Jean-Matthieu — Ec. nationale d'ingenieurs de Brest
Arbab Chirani, Shabnam — ENIB
Calloch, Sylvain — ENSIETA

TuA23 323
Radio Frequency Identification (RFID) Technology in Supply Chain Management I (Invited Session)
Chair: Dolgui, Alexandre — Ec. des Mines de Saint Etienne
Co-Chair: Monostori, Laszlo — Budapest Univ. of Tech. and
Organizer: Dolgui, Alexandre — Ec. des Mines de Saint Etienne
Organizer: Monostori, Laszlo — Budapest Univ. of Tech. and

10:30-11:10 TuA23.1
RFID Technology in Supply Chain Management: State of the Art and Perspectives (I), pp. 4464-4475.
Dolgui, Alexandre — Ec. des Mines de Saint Etienne
Proth, Jean-Marie — INRIA

11:10-11:30 TuA23.2
Direct Neural Network Based Service Level Control in RFID-Enabled Supply Chain (I), pp. 4476-4480.
Hong, Seong Rok — Yonsei Univ.
Yoo, Jang Sun — Yonsei Univ.
Ko, Jong Myoung — Yonsei Univ.
Kim, Chang Ouk — Yonsei Univ.

11:30-11:50 TuA23.3
Model Predictive Control for Scheduling and Routing in a Solid Waste Management System (I), pp. 4481-4486.
Johansson, Ola M. — Lund Univ.
Johansson, Rolf — Lund Univ.

11:50-12:10 TuA23.4
Repair-Control of Enterprise Systems Using RFID Sensory Data (I), pp. 4487-4492.
Kohn, Wolf — Univ. of Washington
Brayman, Vladimir — Univ. of Washington

12:10-12:30 TuA23.5
TRASER: An Open-Source Solution Platform for Cross-Company Transparency in Tracking and Tracing (I), pp. 4493-4498.
Monostori, Laszlo — Computer and Automation Res. Inst. Hungarian
Ilie-Zudor, Elisabeth — Computer and Automation Res. Inst. HungarianAcademy of
Szathmári, Marcell — MTA SZTAKI
Kemény, Zsolt — MTA SZTAKI

TuA24 324
Statistical and Parameter Estimation Based Methods (Regular Session)
Chair: Gao, Furong — Hong Kong Univ. of Sci & Tech.
Co-Chair: Shah, Sirish — Univ. of Alberta

10:30-11:10 TuA24.1
Stage-Oriented Statistical Batch Process Monitoring, Quality Prediction and Improvement, pp. 4499-4510.
Yao, Yuan — Hong Kong Univ. of Science and Tech.
Gao, Furong — Hong Kong Univ. of Sci & Tech.

11:10-11:30 TuA24.2
A Polyreference Least Square Complex Frequency Domain Based Statistical Test for Damage Detection, pp. 4511-4516.
Canales, Gilles Olivier — Univ. de Rennes I
Mevel, Laurent — IRISA/INRIA
Basseville, Michele — IRISA/CNRS

11:30-11:50 TuA24.3
Application of Bicoherence Analysis on Vibration Data for Condition Based Monitoring of Rotating Machinery, pp. 4517-4522.
Halim, Enayet — Univ. of Alberta
Shah, Sirish — Univ. of Alberta
Choudhury, Md. Ali — Bangladesh Univ. of Engineering Tech.
Kadali, Ramesh — Suncor Energy Inc.

11:50-12:10 TuA24.4
Passive Robust Fault Detection Using Interval MA Parity Equations: Inverse vs Direct Image Tests, pp. 4523-4528.
Guerra, Pedro — Tech. Univ. of Catalonia (UPC)
Puig, Vicenc — Univ. Pol. de Catalunya

12:10-12:30 TuA24.5
An Adaptive DISSIM Algorithm for Statistical Process Monitoring, pp. 4529-4534.
Zhao, Chunhui — Northeastern Univ.
Wang, Fuli — Northeastern Univ.
Mao, Zhizhong — Northeastern Univ.
Jia, Mingxing — Northeastern Univ.
Wang, Shu — Northeastern Univ.

TuA25 328

Process Modeling, Identifcation, and Estimation (Regular Session)

Chair: Moreno, Jaime A. — Univ. Nacional Autonoma de Mexico-UNAM
Co-Chair: Patton, Ron J. — Univ. of Hull

10:30-10:50 TuA25.1
Integrated Design of Robust Controller and Fault Estimator for Linear Parameter Varying Systems, pp. 4535-4539.
Weng, Zhengxin — Shanghai Jiaotong Univ.
Patton, Ron J. — Univ. of Hull
Cui, Ping — Shanghai Jiaotong Univ.

10:50-11:10 TuA25.2
Oil and Gas Production Optimization; Lost Potential Due to Uncertainty, pp. 4540-4547.
Elgsćter, Steinar Morisbak — Norwegian Uni. Science & Tech.
Slupphaug, Olav — ABB
Johansen, Tor Arne — Norwegian Univ. of Science and Tech.

11:10-11:30 TuA25.3
Dynamic Modelling and Optimal Control of a Multicomponent Batch Packed Distillation Column, pp. 4548-4553.
Ceylan, Hatice — Middle East Tech. Univ.
Ozgen, Canan — Middle East Tech. Univ.

11:30-11:50 TuA25.4
Dissipativity-Based Globally Convergent Observer Design for a Class of Tubular Reactors, pp. 4554-4559.
Schaum, Alexander — Univ. Autónoma de México
Moreno, Jaime A. — Univ. Nacional Autonoma de Mexico-UNAM
Alvarez, Jesus — Univ. Auto. Metropolitanta-Iztapal

11:50-12:10 TuA25.5
Principal Component Analysis Based Support Vector Machine for the End Point Detection of the Metal Etch Process, pp. 4560-4565.
Han, Kyounghoon — Seoul National Univ.
Kim, Seunghyok — Seoul National Univ.
Park, Kun Joo — DMS Co., Ltd.
Yoon, En Sup — Seoul National Univ.
Chae, Heeyeop — Sungkyunkwan Univ.

TuA26 327

Modeling, Operation and Control of Power Systems I (Regular Session)

Chair: Weber, Harald — Univ. of Rostock
Co-Chair: Havel, Petr — Czech Tech. Univ.

10:30-10:50 TuA26.1
Design of Supplementary Controller for HVDC Using Memetic Algorithm, pp. 4566-4570.
Haidari, Saeid — Electrical Engineering Department of
Farsangi, Malihe Maghfoori — Electrical Engineering Department ofShahidBahonarUniversity, Ker
Nezamabadi-pour, Hossein — Electrical Engineering Department of ShahidBahonarUniversity, Ke
Lee, Kwang Y. — Baylor Univ.

10:50-11:10 TuA26.2
Adaptive Feed-Forward Cancellation Control of a Full-Bridge DC-AC Voltage Inverter, pp. 4571-4576.
Malo, Shane — Univ. Pol. de Catalunya (UPC)
Grino, Robert — Univ. Pol. De Catalunya

11:10-11:30 TuA26.3
Discrete-Time Observer for Induction Machine in Presence Magnetic Saturation, pp. 4577-4582.
Giri, Fouad — GREYC - Univ. de Caen
Elfadili, Abderrahim — Univ. Mohammed V, EMI , Rabat
Ouadii, Hamid — Ismra
Dugard, Luc — CNRS-INPG-UJF
Buche, Gabriel — INPG

11:30-11:50 TuA26.4
Design of a Supplementary Controller for SVC Using Immune Algorithm, pp. 4583-4587.
Kyanzadeh, Saeid — Electrical Engineering Department of Shahid Bahonar
Farsangi, Malihe Maghfoori — Electrical Engineering Department ofShahidBahonarUniversity, Ker
Nezamabadi-pour, Hossein — Electrical Engineering Department of ShahidBahonarUniversity, Ke
Lee, Kwang Y. — Baylor Univ.

11:50-12:10 TuA26.5
Monte-Carlo Simulation of Electricity Transmission System Operation, pp. 4588-4593.
Cerny, Vaclav — Univ. of West Bohemia
Janecek, Petr — Univ. of West Bohemia
Fialova, Andrea — Univ. of West Bohemia
Fantik, Josef — CEPS a.s.

12:10-12:30 TuA26.6
Decentralized Nonlinear Control Method of Components in Power Systems Based on Differential-Algebraic Sub-System Models, pp. 4594-4599.
Zhang, Kaifeng — Southeast Univ.
Dai, Xianzhong — Southeast Univ.
Zang, Qiang — Southeast Univ.

TuA27 326

Computational Intelligence Approach in Modeling and Control (Invited Session)

Chair: Kuroe, Yasuaki — Kyoto Inst. of Tech.
Co-Chair: Watanabe, Keigo — Saga Univ.
Organizer: Kuroe, Yasuaki — Kyoto Inst. of Tech.

10:30-10:50 TuA27.1
A Fuzzy Kalman Filter Approach to the SLAM Problem of Nonholonomic Mobile Robots (I), pp. 4600-4605.
Watanabe, Keigo — Saga Univ.
Dedduwa Pathiranage, Chandima — Saga Univ.
Izumi, Kiyotaka — Saga Univ.

10:50-11:10 TuA27.2
Nonlinear System Modeling by Hybrid Genetic Programming (I), pp. 4606-4611.
Hashimoto, Nozomi — Osaka Univ.
Kondo, Nobuhiko — Osaka Univ.
Hatanaka, Toshiharu — Osaka Univ.
Uosaki, Katsuji — Fukui Univ. of Tech.

11:10-11:30 TuA27.3
Robust Autonomous Flight Control of an UAV by Use of Neural Networks (I), pp. 4612-4617.
Nakanishi, Hiroaki — Kyoto Univ.
Inoue, Koichi — Osaka Sangyo Univ.

11:30-11:50 TuA27.4
Identification of a Class of Discrete Event Systems by Neural Networks - Sparse Realization - (I), pp. 4618-4624.
Kuroe, Yasuaki — Kyoto Inst. of Tech.
Mori, Yoshihiro — Kyoto Inst. of Tech.

11:50-12:10 TuA27.5
Neurofuzzy Modelling and Pattern Matching for Online Fault Detection and Isolation of Nonlinear DC Motors, pp. 4625-4630.
Mok, Hing Tung — The Univ. of Hong Kong
Chan, Che Wai — Univ. of Hong Kong

12:10-12:30 TuA27.6
Real-Time Level Plant Control Using Improved BELBIC, pp. 4631-4635.
Masoudinejad, Mojtaba — K.N. Toosi Univ. of Tech.
Khorsandi, Rahman — Univ.
Fatehi, Alireza — K.N. Toosi Univ. of Tech.
Lucas, Caro — Prof.
Fakhimi, Siavash — Univ.
Jamali, Mohammad Reza — Univ. of Tehran

TuA28 330A

Hybrid Vehicle I (Regular Session)

Chair: Guzzella, Lino — ETH Zurich
Co-Chair: Peng, Huei — Univ. of Michigan

10:30-10:50 TuA28.1
Modelling of a PEM Fuel Cell System, pp. 4636-4641.
Thanapalan, Kary — Univ. of Glamorgan

Williams, Jonathan Univ. of Glamorgan
Liu, Guoping Univ. of Glamorgan
Rees, David Univ. of Glamorgan

10:50-11:10 TuA28.2
Optimal Hybridization in Two Parallel Hybrid Electric Vehicles Using Dynamic Programming, pp. 4642-4647.
Sundström, Olle ETH Zurich / Empa
Guzzella, Lino ETH Zurich
Soltic, Patrik Empa

11:10-11:30 TuA28.3
Automated Modeling of Power-Split Hybrid Vehicles, pp. 4648-4653.
Liu, Jinming Univ. of Michigan, Ann Arbor
Peng, Huei Univ. of Michigan

11:30-11:50 TuA28.4
Modeling of Voltage Hysteresis and Relaxation of HEV NiMH Battery, pp. 4654-4658.
Ota, Yutaka Nagoya Inst. of Tech.
Hashimoto, Yoshihiro Nagoya Inst. of Tech.
Sakamoto, Masaru Nagoya Inst. of Tech.
Kiriake, Rei Nagoya Inst. of Tech.
Kobe, Takashi Nagoya Inst. of Tech.

11:50-12:10 TuA28.5
Statistical Learning Applied to the Energy Management in a Fuel Cell Electric Vehicle, pp. 4659-4664.
Cavalletti, Matteo Univ. Pol. delle Marche
Piovesan, Jorge Univ. of New Mexico
Abdallah, Chaouki T. Univ. of New Mexico
Longhi, Sauro Univ. Pol. delle Marche
Dorato, Peter Univ. of New Mexico
Ippoliti, Gianluca Univ. Pol. delle Marche

12:10-12:30 TuA28.6
Trip Based Nearly Global Optimal Power Management of Plug-In Hybrid Electric Vehicles Using Gas-Kinetic Traffic Flow Model, pp. 4665-4670.
Gong, Qiuming Univ. of Wisconsin-Milwaukee
Li, Yaoyu Univ. of Wisconsin-Milwaukee

TuA29 330B
Semi-Active Suspension and Roll-Over Prevention (Regular Session)
Chair: Savaresi, Sergio Pol. di Milano
Co-Chair: Hong, Keum-Shik Pusan National Univ.

10:30-10:50 TuA29.1
Performance Analysis and Simulation of a New Industrial Semi-Active Damper, pp. 4671-4676.
Aubouet, Sébastien SOBEN SAS
Sename, Olivier INPG
Talon, Benjamin SOBEN SAS
Poussot, Charles INPG/ENSIEG
Dugard, Luc CNRS-INPG-UJF

10:50-11:10 TuA29.2
Vehicle Chassis Control Using Adaptive Semi-Active Suspension, pp. 4677-4682.
Velupillai, Sankaranarayanan Postdoctoral Res.
Guvenc, Levent Istanbul Tech. Univ.
Oncu, Sinan Graduate student
Ozcan, Dincer Graduate student

11:10-11:30 TuA29.3
Control of a Semi-Active MR-Damper Suspension System: A New Polynomial Model, pp. 4683-4688.
Turnip, Arjon PhD Student
Hong, Keum-Shik Pusan National Univ.
Park, Seonghun Pusan National Univ.

11:30-11:50 TuA29.4
Semi-Active Control Strategies for High-Performance Motorcycles, pp. 4689-4694.
Savaresi, Sergio Pol. di Milano
Spelta, Cristiano Univ. degli studi di Bergamo
Moneta, Andrea Pol. di Milano
Tosi, Filippo Pol. di Milano
Fabbri, Luca Piaggio Group
Nardo, Lorenzo Aprilia
Previdi, Fabio Univ. degli Studi di Bergamo

11:50-12:10 TuA29.5
Adaptive Rollover Prevention for Automotive Vehicles with Differential Braking, pp. 4695-4700.
Solmaz, Selim National Univ. of Ireland, Maynooth
Akar, Mehmet Bogazici Univ.
Shorten, Robert Nat. Univ. of Ireland

12:10-12:30 TuA29.6
Energy Saving Actuator Arrangements in an Actively Damped Engine Suspension System, pp. 4701-4706.
Paschedag, Jörg Tech. Univ. München
Koch, Guido Tech. Univ. München
Lohmann, Boris Tech. Univ. München

TuA30 330C
Satellite Navigation (Invited Session)
Chair: Jee, Gyu-In Konkuk Univ.
Co-Chair: Krauss, Peter A. Astrium GmbH
Organizer: Jee, Gyu-In Konkuk Univ.
Organizer: Lee, Jang Gyu Seoul National Univ.

10:30-10:50 TuA30.1
Modernized Spaceborne GNSS Receivers (I), pp. 4707-4712.
Krauss, Peter A. Astrium GmbH
Kühl, Christopher Astrium GmbH
Mittnacht, Michael Astrium GmbH
Heim, Jens Astrium GmbH
Gottzein, Eveline EADS

10:50-11:10 TuA30.2
Preliminary Experiments of GPS/INS Based Integrity Monitoring Using MSAS Differential Correction Data (I), pp. 4713-4718.
Tsujii, Toshiaki Japan Aerospace Exploration Agency
Tomita, Hiroshi Japan Aerospace Exploration Agency
Fujiwara, Takeshi Japan Aerospace Exploration Agency
Harigae, Masatoshi JAXA

11:10-11:30 TuA30.3
Fully Automatic Taxiing, Takeoff and Landing of a UAV Based on a Single-Antenna GNSS Receiver (I), pp. 4719-4724.
Cho, Am Seoul National Univ.
Kim, Jihoon Seoul National Univ.
Lee, Sanghyo Seoul National Univ.
Kim, Bosung Seoul National Univ.
Park, Noha Seoul National Univ.
Kim, DongKeon Seoul National Univ.

11:30-11:50 TuA30.4
Comparative Performance Analyses of GPS Receivers under High-Dynamic Conditions (I), pp. 4725-4730.
Kwon, Byung-Moon Korea Aerospace Res. Inst.

11:50-12:10 TuA30.5
Realization of Initial Alignment Algorithm for Strapdown Inertial Navigation System Using Central Difference Filter, pp. 4731-4736.
Ali, Jamshaid NESCOM
Nzar, Muhammad NESCOM

12:10-12:30 TuA30.6
Lateral Guidance & Control Design for an Unmanned Aerial Vehicle, pp. 4737-4742.
Samar, Raza National Engineering & Scientific Commission
Ahmed, Shakil NESCOM
Nzar, Muhammad NESCOM

TuB02 304A
Stabilization of Nonlinear Systems II (Regular Session)
Chair: Khalil, Hassan K. Michigan State Univ.
Co-Chair: Farza, Mondher Univ. DE CAEN, ENSICAEN

14:00-14:20 TuB02.1
Global Set Stabilization of the Spacecraft Attitude Control Problem Based on Quaternion, pp. 4743-4748.
Ding, Shihong Southeast Univ.
Li, Shihua Southeast Univ.
Li, Qi Southeast Univ.

14:20-14:40 TuB02.2
Approximate Feedback Linearization Using Multivariable Legendre Polynomials, pp. 4749-4754.

Deutscher, Joachim — Univ. Erlangen-Nürnberg
Bäuml, Markus — Univ. Erlangen-Nürnberg

14:40-15:00 — TuB02.3
Averaging of Zero Dynamics for Systems Controlled by the Vertically Transverse Function Approach, pp. 4755-4760.
Sosa Zúńiga, José Miguel — IPICYT, México
Lizárraga Navarro, David A. — IPICYT, México

15:00-15:20 — TuB02.4
Switched Feedback Control for a Class of First-Order Nonholonomic Driftless Systems, pp. 4761-4766.
Ishikawa, Masato — Kyoto Univ.

15:20-15:40 — TuB02.5
Observer-Based Output Feedback Controller for a Class of Nonlinear Systems, pp. 4767-4772.
Hajji, Sofien — GREYC Caen France, ENIS Sfax Tunisia
Farza, Mondher — Univ. DE CAEN, ENSICAEN
M'Saad, Mohammed — GREYC CNRS UMR 6072
Kamoun, Mohamed — ENIS, SFAX, TUNISIA

15:40-16:00 — TuB02.6
Robust Output Feedback Control for a Class of Uncertain Switching Fuzzy Systems, pp. 4773-4778.
Liu, Yi — Northeastern Univ.
Dimirovski, Georgi Marko — Dogus Univ. of Istanbul
Zhao, Jun — The Australian National Univ.

TuB03 — 304B
Advances in Higher Order Sliding Mode Observation and Estimation (Invited Session)
Chair: Shtessel, Yuri B. — Univ. of Alabama at Huntsville
Co-Chair: Spurgeon, Sarah K. — Univ. of Leicester
Organizer: Shtessel, Yuri B. — Univ. of Alabama at Huntsville
Organizer: Spurgeon, Sarah K. — Univ. of Leicester
Organizer: Fridman, Leonid M. — Univ. of Mexico

14:00-14:40 — TuB03.1
High-Order Sliding-Mode Observation for Systems with Unknown Inputs (I), pp. 4779-4790.
Fridman, Leonid M. — Univ. of Mexico
Davila Montoya, Jorge Angel — Univ. of Mexico (Univ. Nacional Autonoma de Mexico)
Levant, Arie — Tel - Aviv Univ.

14:40-15:00 — TuB03.2
Second Order Sliding Mode and Adaptive Observers for a Chaotic System: A Comparative Study (I), pp. 4791-4796.
Bejarano, Francisco — ENSEA
Ghanes, Malek — ENSEA
Barbot, Jean Pierre — ENSEA
Fridman, Leonid M. — Univ. of Mexico

15:00-15:20 — TuB03.3
HOSM Observer for a Class of Non-Minimum Phase Causal Nonlinear MIMO Systems (I), pp. 4797-4802.
Baev, Simon — Univ. of Alabama in Huntsville (UAH)
Shtessel, Yuri B. — Univ. of Alabama at Huntsville
Edwards, Christopher — Univ. of Leicester

15:20-15:40 — TuB03.4
The Robustness of a Second Order Sliding Mode Approach to Human Gait Simulation (I), pp. 4803-4808.
Steve, Lister — Univ. of Leicester
Spurgeon, Sarah K. — Univ. of Leicester
Jon, Scott — Univ. of Leicester

15:40-16:00 — TuB03.5
Actuator Fault Diagnosis Using High-Order Sliding Mode Differentiator (HOSMD) and Its Application to a Laboratory 3D Crane (I), pp. 4809-4814.
Chen, Wei-tian — Simon Fraser Univ.
Wu, Qing — Simon Fraser Univ.
Taffazoli, Esmaeil — Simon Fraser Univ.
Saif, Mehrdad — Simon Fraser Univ.

TuB04 — 308
Applications of Nonlinear Control IV (Regular Session)
Chair: Xia, Xiaohua — Univ. of Pretoria
Co-Chair: Xin, Xin — Okayama Prefectural Univ.

14:00-14:20 — TuB04.1
Constructive Invariant Manifolds to Stabilize Pendulum--Like Systems Via Immersion and Invariance, pp. 4815-4819.
Acosta, José Ángel — Univ. de Sevilla
Ortega, Romeo — LSS-SUPELEC
Astolfi, Alessandro — Imperial Col. London & Univ. of Rome Tor Vergata
Sarras, Ioannis — Univ. Paris-Sud XI

14:20-14:40 — TuB04.2
Numerical Methods Based Controller Design for Mobile Robots, pp. 4820-4827.
Scaglia, Gustavo — Univ. Nacional de San Juan
Quintero Montoya, Olga Lucia — Univ. Nacional de San Juan
Mut, Vicente — Univ. Nacional de San Juan (UNSJ), Argentina
di Sciascio, Fernando — Univ. Nacional de San Juan

14:40-15:00 — TuB04.3
Analysis of the Energy Based Swing-Up Control for a Double Pendulum on a Cart, pp. 4828-4833.
Xin, Xin — Okayama Prefectural Univ.

15:00-15:20 — TuB04.4
Model-Following Control of Nonlinear Systems Based on Virtual Constraints, pp. 4834-4839.
Sawamura, Yoshihiro — Tokyo Denki Univ.
Kojima, Shingo — Tokyo Denki Univ.
Iwase, Masami — Tokyo Denki Univ.
Hatakeyama, Shoshiro — Tokyo Denki Univ.

15:20-15:40 — TuB04.5
Control of Pendulum-Like System with Multiple Nonlinearities, pp. 4840-4845.
Ouyang, Hua — Univ. of New South Wales at Australian Defence Force
Petersen, Ian Richard — Univ. of New South Wales - ADFA
Ugrinovskii, Valery — Univ. of New South Wales

15:40-16:00 — TuB04.6
Computing Guaranteed Bounds for Uncertain Cooperative and Monotone Nonlinear Systems, pp. 4846-4851.
Gennat, Marc — Univ. of Wuppertal
Tibken, Bernd — Univ. of Wuppertal

TuB05 — 307
Switching Stability and Control II (Regular Session)
Chair: Kurzhanski, A.B. — Univ. of California, Berkeley
Co-Chair: Junco, Sergio — Univ. Nacional de Rosario

14:00-14:20 — TuB05.1
A Novel Method of Stability Analysis for Networked Control Systems, pp. 4852-4856.
Sun, Xi-Ming — Glamorgan Univ.
Liu, Guoping — Univ. of Glamorgan
Rees, David — Univ. of Glamorgan
Wang, Wei — Dalian Univ. of Tech.

14:20-14:40 — TuB05.2
Stability Guaranteed Predictive Control of Constrained Continuous-Time PWL Systems, pp. 4857-4862.
Zou, Yuanyuan — Shanghai Jiao Tong Univ.
Li, Shaoyuan — Shanghai Jiao Tong Univ.

14:40-15:00 — TuB05.3
A Model Reference Robust Control with Unknown High Frequency Gain Sign : General Case, pp. 4863-4868.
Jiang, Xu — Beijing Univ. of Aeronautics and Astronautics
Lin, Yan — Beijing Univ. of Aeronautics and

15:00-15:20 — TuB05.4
Impulse Control Inputs and the Theory of Fast Feedback Control, pp. 4869-4874.
Daryin, Alexander — Moscow State (Lomonosov) Univ.
Kurzhanski, A.B. — Univ. of California, Berkeley

15:20-15:40 — TuB05.5
A Case Study on Multiple Controller Adaptive Control, pp. 4875-4880.
Felicio, Paulo, A.S.A. — Inst. Pol. de Setubal
Lourtie, Pedro — Inst. Superior T Cnico

15:40-16:00 — TuB05.6
A Lie Algebraic Approach to Design of Stable Feedback Control

Systems with Varying Sampling Rate, pp. 4881-4886.
Felicioni, Flavia — Univ. Nacional de Rosario
Junco, Sergio — Univ. Nacional de Rosario

TuB06 310A
Time Delay Systems: Robust Control (Regular Session)
Chair: Karimi, Hamid Reza — Univ. of Bremen
Co-Chair: Parlakci, Alpaslan — Istanbul Bilgi Univ.

14:00-14:20 TuB06.1
Design of Robust Delay-Dependent Guaranteed Cost Controller for Uncertain Nonlinear Neutral Systems: An LMI Descriptor Approach, pp. 4887-4892.
Parlakci, Alpaslan — Istanbul Bilgi Univ.

14:20-14:40 TuB06.2
Delay-Dependent Robust Control of Time-Delay Systems with Polytopic Uncertainty, pp. 4893-4898.
Sun, Man — Beihang Univ.
Jia, Yingmin — Beihang Univ.
Du, Junping — Beijing Univ. of Posts and Telecommunications
Yuan, Shiying — Henan Pol. Univ.

14:40-15:00 TuB06.3
Robust Mixed H2/Hinf Control of Uncertain Neutral Systems with Time-Varying Delays, pp. 4899-4904.
Karimi, Hamid Reza — Univ. of Bremen
Luo, Ningsu — Univ. of Girona

15:00-15:20 TuB06.4
Robust Adaptive Sliding Mode Control for a Class of Uncertain Hybrid Linear Systems with Markovian Jump Parameters, pp. 4905-4909.
He, Youguo — Northeastern Univ.
Stankovski, Mile — SS Cyril and Methodius Univ.
Jing, Yuanwei — Northeastern Univ.
Dimirovski, Georgi Marko — Dogus Univ. of Istanbul

15:20-15:40 TuB06.5
Optimal Fractional Order Proportional Integral Controller for Varying Time-Delay Systems, pp. 4910-4915.
Bhambhani, Varsha — Utah State Univ.
Chen, YangQuan — Utah State Univ.
Xue, Dingyu — Northeastern Univ.

15:40-16:00 TuB06.6
Delay-Dependent Robust H_infinity Control of Uncertain Stochastic Delayed Systems, pp. 4916-4921.
Chen, Yun — Hangzhou Dianzi Univ.
Xue, Anke — Hangzhou Dianzi Univ.
Lu, Renquan — Zhejiang Univ.
Zhou, ShaoSheng — Hangzhou Dianzi Univ.
Wang, JunHong — Hangzhou Dianzi Univ.

TuB07 310B
Linear Parameter-Varying Systems (Regular Session)
Chair: Koroglu, Hakan — Delft Univ. of Tech.
Co-Chair: Jetto, L. — Univ. di Ancona

14:00-14:20 TuB07.1
Gain Scheduled Observer State Feedback Controllers for Rational LPV Systems, pp. 4922-4927.
Bouali, Anis — Ec. des Mines de Nantes / Inst. de Recherche en communicati
Yagoubi, Mohamed — Ec. des Mines de Nantes (IRCCyN)
Chevrel, Philippe — IRCCyN / Ec. des Mines de Nantes

14:20-14:40 TuB07.2
LPV Control for Robust Attenuation of Non-Stationary Sinusoidal Disturbances with Measurable Frequencies, pp. 4928-4933.
Koroglu, Hakan — Delft Univ. of Tech.
Scherer, Carsten W. — Delft Univ. of Tech.

14:40-15:00 TuB07.3
Gain Scheduling Using Time-Varying Kalman Filter for a Class of LPV Systems, pp. 4934-4939.
Cha, Sung Han — RSISE, The Australian National Univ.
Anderson, Brian D.O. — Australian National Univ.
Rotkowitz, Michael — The Univ. of Melbourne

15:00-15:20 TuB07.4
LMI Based Stabilization of a Class of Switching LPV Systems, pp. 4940-4945.
Jetto, L. — Univ. di Ancona
Orsini, Valentina — Univ. Pol. delle Marche

15:20-15:40 TuB07.5
Parameter Dependent State-Feedback Control of LPV Time Delay Systems with Time Varying Delays Using a Projection Approach, pp. 4946-4951.
Briat, Corentin — INPG/ENSIEG
Sename, Olivier — INPG
Lafay, JeanFrancois — Ec. Centrale Nantes

15:40-16:00 TuB07.6
Crucial Aspects of Zero-Order Hold LPV State-Space System Discretization, pp. 4952-4957.
Tóth, Roland — Delft Univ. of Tech.
Heuberger, Peter — Delft Univ. of Tech.
Van den Hof, Paul M.J. — Delft Univ. of Tech.
Felici, Federico — EPFL

TuB08 310C
Robust Controller Synthesis II (Regular Session)
Chair: Wik, Torsten — Chalmers Univ. of Tech.
Co-Chair: Saeki, Masami — Hiroshima Univ.

14:00-14:20 TuB08.1
Model-Free PID Controller Optimization for Loop Shaping, pp. 4958-4963.
Saeki, Masami — Hiroshima Univ.

14:20-14:40 TuB08.2
Single-Parameter Tuning of PI Controllers: From Theory to Practice, pp. 4964-4969.
Matusu, Radek — Tomas Bata Univ. in Zlin
Prokop, Roman — Tomas Bata Univ. in Zlin

14:40-15:00 TuB08.3
Tank Reactor Temperature Control Using Quantitative Feedback Theory, pp. 4970-4975.
Olesen, Veronica — Chalmers Univ. of Tech.
Breitholtz, Claes — Chalmers Univ. of Tech.
Wik, Torsten — Chalmers Univ. of Tech.

15:00-15:20 TuB08.4
Automated Synthesis of Fixed Structure QFT Controller Using Interval Constraint Satisfaction Techniques, pp. 4976-4981.
Nataraj, P.S.V. — Indian Inst. of Tech.
Deshpande, Manoj — Indian Inst. of Tech. Bombay, Mumbai , INDIA

15:20-15:40 TuB08.5
Fixed-Order Controller Design for Polytopic Systems Using Rank Deficiency in a Sylvester Matrix, pp. 4982-4987.
Khatibi, Hamid — EPFL
Karimi, Alireza — Ec. Pol. Federale de Lausanne
Longchamp, Roland — Ec. Pol. Federale De Lausanne

15:40-16:00 TuB08.6
Regularization of the Limiting Optimal Controller in Robust Stabilization, pp. 4988-4992.
Iantchenko, Svetlana — Lunds Univ.
Ghulchak, Andrey — Lund Univ.

TuB09 311C
Nonlinear System Identification III (Regular Session)
Chair: Bai, Er-Wei — Univ. of Iowa
Co-Chair: Medvedev, Alexander V. — Uppsala Univ.

14:00-14:20 TuB09.1
A Recursive Method of Identification of Hammerstein Model Based on Least Squares Support Vector Machines, pp. 4993-4998.
Chen, Kun — Zhejiang Univ.
Wang, Haiqing — Zhejiang Univ.
Song, Zhi-Huan — Zhejiang Univ.

14:20-14:40 TuB09.2
Identification of NARX Hammerstein Models Based on Support Vector Machines, pp. 4999-5004.
Al-Dhaifallah, Mujahed — Univ. of Calgary
Westwick, David — Univ. of Calgary

14:40-15:00 TuB09.3
Parametric Identification of Nonlinear Hysteretic Systems, pp. 5005-5010.

Rochdi, Youssef — Ec. D'INGENIEURS MOHAMMEDIA RABAT
Giri, Fouad — GREYC - Univ. de Caen
Chaoui, Fatima-Zahra — ENSET
Ikhouane, Faycal — Univ. Pol. de Catalunya
Rodellar, Jose — Tech. Univ. of Catalonia
Mohamed, Haloua — Ec. Mohammadia d'Ingénieurs, Univ. Mohammed V Agdal

15:00-15:20 TuB09.4
Gyro-Bias Estimation Filter Design for the Stabilization Accuracy Enhancement of Two Axes Gimbaled Sighting Systems, pp. 5011-5017.
Atesoglu, Ozgur — Aselsan Inc.
Nalbantoglu, Volkan — Aselsan Inc.
Seymen, Burak — ASELSAN INC.

15:20-15:40 TuB09.5
A Method of LPV Model Identification for Control, pp. 5018-5023.
Zhu, Yucai — Eindhoven Univ. of Tech.
Xu, Zuhua — Zhajiang Univ.

TuB10 311B
Estimation Error Quantification (Regular Session)
Chair: Ljung, Lennart — Linköping Univ.
Co-Chair: Campi, Marco — Univ. of Brescia

14:00-14:20 TuB10.1
Finite Sample Confidence Regions for Parameters in Prediction Error Identification Using Output Error Models, pp. 5024-5029.
den Dekker, Arnold J. — Delft Univ. of Tech.
Bombois, Xavier — Delft Univ. of Tech.
Van den Hof, Paul M.J. — Delft Univ. of Tech.

14:20-14:40 TuB10.2
New Convergence Results for the Least Squares Identification Algorithm, pp. 5030-5035.
Hu, Xiao-Li — AMSS, Chinese Acad. of Sciences
Ljung, Lennart — Linköping Univ.

14:40-15:00 TuB10.3
On Identification of Cascade Systems, pp. 5036-5040.
Wahlberg, Bo — Royal Inst. of Tech. (KTH)
Hjalmarsson, HÍkan — KTH
MÍrtensson, Jonas — KTH

15:00-15:20 TuB10.4
Non-Asymptotic Model Quality Assessment of Transfer Functions at Multiple Frequency Points, pp. 5041-5046.
Ko, Sangho — Korea Aerospace Univ.
Weyer, Erik — Univ. of Melbourne
Campi, Marco — Univ. of Brescia

15:20-15:40 TuB10.5
Relative Error Issues in Sampled Data Models, pp. 5047-5052.
Goodwin, Graham C. — Univ. of Newcastle
Yuz, Juan I. — Univ. Técnica Federico Santa María
Aguero, Juan C — The Univ. of Newcastle

15:40-16:00 TuB10.6
Index Reduction of Index 1 DAE under Uncertainty, pp. 5053-5058.
Tidefelt, Henrik — Linköping Univ.
Glad, Torkel — Linkoping Univ.

TuB11 311A
Adaptive Control of Systems II (Regular Session)
Chair: Brown, Lyndon J. — Univ. of Western Ontario
Co-Chair: Do, Duc — The Univ. of Western Australia

14:00-14:20 TuB11.1
High Performance Control of an Active Heave Compensation System, pp. 5059-5064.
Do, Duc — The Univ. of Western Australia
Pan, Jie — The Univ. of Western Australia

14:20-14:40 TuB11.2
Adaptive Control Design Based on Adaptive Optimization Principles, pp. 5065-5070.
Kosmatopoulos, Elias — Tech. Univ. of Crete
Papageorgiou, Markos — Tech. Univ. of Crete

14:40-15:00 TuB11.3
An Efficient Adaptive Optimization Scheme, pp. 5071-5076.
Kosmatopoulos, Elias — Tech. Univ. of Crete
Papageorgiou, Markos — Tech. Univ. of Crete

15:00-15:20 TuB11.4
FPGA-Based Implementation of an Active Vibration Controller, pp. 5077-5082.
Leva, Alberto — Pol. di Milano
Piroddi, Luigi — Pol. di Milano

15:20-15:40 TuB11.5
A New Critical Case for Adaptive Nonlinear Stabilization, pp. 5083-5088.
Li, Chanying — Acad. of Mathematic and System Science, CAS
Guo, Lei — Chinese Acad. of Sciences

15:40-16:00 TuB11.6
Identification of Exponentially Damped Sinusoidal Signals, pp. 5089-5094.
Lu, Jin — The Univ. of Western Ontario
Brown, Lyndon J. — Univ. of Western Ontario

TuB12 313
Dependable Control of Discrete Event Systems II (Invited Session)
Chair: Papadopoulos, Yiannis Ioannis — Univ. of Hull
Co-Chair: Stursberg, Olaf — Tech. Univ. Muenchen
Organizer: Faure, Jean-Marc — ENS Cachan
Organizer: Lesage, Jean-Jacques — ENS de Cachan
Organizer: Frey, Georg — Univ. of Kaiserslautern
Organizer: Papadopoulos, Yiannis Ioannis — Univ. of Hull

14:00-14:20 TuB12.1
Verification of Fault Tolerance of Discrete-Event Object-Oriented Models Using Model Checking (I), pp. 5095-5100.
Bonfe, Marcello — Univ. di Ferrara
Fantuzzi, Cesare — Univ. of Modena and Reggio Emilia
Secchi, Cristian — Univ. of Modena and Reggio Emilia

14:20-14:40 TuB12.2
Improving Large-Sized PLC Programs Verification Using Abstractions (I), pp. 5101-5106.
Gourcuff, Vincent — Lurpa - ENS de Cachan
Faure, Jean-Marc — ENS Cachan
de Smet, Olivier — Lurpa - ENS de Cachan

14:40-15:00 TuB12.3
Property Patterns for the Formal Verification of Automated Production Systems (I), pp. 5107-5112.
Campos, José Creissac — Univ. of Minho
Machado, José — Univ. of Minho
Seabra, Eurico — Univ. of Minho

15:00-15:20 TuB12.4
Comparing Simulative and Formal Methods for the Analysis of Response Times in Networked Automation Systems (I), pp. 5113-5118.
Greifeneder, Jürgen — Univ. of Kaiserslautern
Liu, Liu — Univ. of Kaiserslautern
Frey, Georg — Univ. of Kaiserslautern

15:20-15:40 TuB12.5
Efficient Representation for Formal Verification of Time Performances of Networked Automation Architectures (I), pp. 5119-5124.
Ruel, Silvain — ENS de Cachan
de Smet, Olivier — Lurpa - ENS de Cachan
Faure, Jean-Marc — ENS Cachan

15:40-16:00 TuB12.6
Verification of Uncertain Embedded Systems by Computing Reachable Sets Based on Zonotopes (I), pp. 5125-5130.
Althoff, Matthias — Tech. Univ. München
Stursberg, Olaf — Tech. Univ. Muenchen
Buss, Martin — Tech. Univ. Muenchen

TuB13 314
Coordination of Multiagent Systems (Regular Session)
Chair: Xi, Yugeng — Shanghai Jiao Tong Univ.
Co-Chair: Namerikawa, Toru — Kanazawa Univ.

14:00-14:20 TuB13.1
Particle Swarms in Optimization and Control, pp. 5131-5136.
van Ast, Jelmer Marinus — Delft Univ. of Tech.
Babuska, Robert — Delft Univ. of Tech.
De Schutter, Bart — Delft Univ. of Tech.

14:20-14:40 TuB13.2
Distributed Formation Algorithm for Multi-Agent Systems with a Relaxed Connectivity Condition, pp. 5137-5142.
Li, Xiaoli — Shanghai Jiao Tong Univ.
Xi, Yugeng — Shanghai Jiao Tong Univ.

14:40-15:00 TuB13.3
Stable Swarming by Mutual Interactions of Attraction/Alignment/Repulsion: Fixed Topology, pp. 5143-5148.
Li, Xiaohai — City Univ. of New York
Cai, Zhijun — Univ. of Iowa

15:00-15:20 TuB13.4
Formation Control of Nonholonomic Multi-Vehicle Systems Based on Virtual Structure, pp. 5149-5154.
Yoshioka, Chika — Kanazawa Univ.
Namerikawa, Toru — Kanazawa Univ.

15:20-15:40 TuB13.5
Rigid Formation Keeping and Formation Reconfiguration of Multi-Agent Systems, pp. 5155-5160.
Maithripala, D.H.A. — Texas A&M Univ.
Jayasuriya, Suhada — Texas A&M Univ.

15:40-16:00 TuB13.6
Control of Formations of UAVs for Surveillance and Reconnaissance Missions, pp. 5161-5166.
Kopfstedt, Thomas — Diehl BGT Defence GmbH und Co. KG
Mukai, Masakazu — Kyushu Univ.
Fujita, Masayuki — Tokyo Inst. of Tech.
Ament, Christoph — Tech. Univ. Ilmenau

TuB14 318
Control Over Networks II (Regular Session)
Chair: De Persis, Claudio — Sapienza Univ. of Rome
Co-Chair: Middleton, Rick — National Univ. of Ireland

14:00-14:20 TuB14.1
Optimal Controller Design for Networked Control Systems, pp. 5167-5172.
Silva, Eduardo I — The Univ. of Newcastle
Quevedo, Daniel E. — The Univ. of Newcastle
Goodwin, Graham C. — Univ. of Newcastle

14:20-14:40 TuB14.2
Infimal Feedback Capacity for a Class of Additive Coloured Gaussian Noise Channels, pp. 5173-5178.
Rojas, Alejandro J. — The Univ. of Newcastle
Middleton, Rick — National Univ. of Ireland
Freudenberg, James S. — Univ. of Michigan

14:40-15:00 TuB14.3
Repeated Poles in Feedback Over a Class of Signal-To-Noise Ratio Constrained Channels, pp. 5179-5184.
Rojas, Alejandro J. — The Univ. of Newcastle
Yuz, Juan I. — Univ. Técnica Federico Santa María

15:00-15:20 TuB14.4
Characterization of a Complementary Sensitivity Property in Feedback Control: An Information Theoretic Approach, pp. 5185-5190.
Okano, Kunihisa — The Univ. of Tokyo
Hara, Shinji — The Univ. of Tokyo
Ishii, Hideaki — Tokyo Inst. of Tech.

15:20-15:40 TuB14.5
Robust Stabilization of Nonlinear Systems by Quantized and Ternary Control, pp. 5191-5196.
De Persis, Claudio — Sapienza Univ. of Rome

15:40-16:00 TuB14.6
Internal Stability of Dynamically Quantised Control for Stochastic Scalar Plants, pp. 5197-5202.
Gurt, Assaf — Univ. of Melbourne
Nair, Girish — Univ. of Melbourne

TuB15 317
Biosignals Analysis and Interpretation (Regular Session)
Chair: Johansson, Rolf — Lund Univ.
Co-Chair: Bequette, B. Wayne — Rensselaer Pol. Inst.

14:00-14:20 TuB15.1
Temporal Pattern Recognition Using Spiking Neural Networks for Cortical Neuronal Spike Train Decoding, pp. 5203-5208.
Fang, Huijuan — Huazhong Univ. of Science and Tech.
Wang, Yongji — Hauzhong Univ. of Science And Tech.
He, Jiping — Arizona State Univ.
Liu, Shan — Huazhong Univ. of Science and Tech.

14:20-14:40 TuB15.2
Automatic EEG Arousals Detection for Obstructive Sleep Apnea Syndrome, pp. 5209-5214.
Sugi, Takenao — Saga Univ.
Kawana, Fusae — Toranomon Hospital
Nakamura, Masatoshi — Graduate School of Science and Engineering, Saga Univ.

14:40-15:00 TuB15.3
Analysis of Changes in the Beat-To-Beat P-Wave Morphology Using Clustering Techniques, pp. 5215-5220.
Herreros, Alberto — Univ. of Valladolid
Baeyens, Enrique — Univ. of Valladolid
Carlson, Jonas — Univ. of Lund
Johansson, Rolf — Lund Univ.
Perán, J. Ramón — Univ. of Valladolid
Olsson, Bertil — Univ. of Lund

15:00-15:20 TuB15.4
Comparison Study of Biosignal Based Computer Interfaces Based on Fitts' Law Paradigm, pp. 5221-5226.
Choi, Changmok — KAIST
Kim, Chunwoo — Seoul National Univ.
Kim, Jung — KAIST

15:20-15:40 TuB15.5
A Two-Steps Sleep/wake Stages Classifier Taking into Account Artefacts in the Polysomnographic Signals, pp. 5227-5232.
Zoubek, Lukáš — Univ. Joseph Fourier
Charbonnier, Sylvie — INPG/UJF
Lesecq, Suzanne — INPG/UJF/CNRS
Buguet, Alain — Univ. Claude Bernard Lyon 1
Chapotot, Florian — The Univ. of Chicago

15:40-16:00 TuB15.6
Chemotherapy Using Linear Analysis and Swarm Intelligence, pp. 5233-5238.
Bavafa, Elham — Univ. of Tehran
Yazdanpanah, M. J. — Univ. of Tehran
Kalaghchi, Bita — Univ. of tehran

TuB16 316
Systems and Control Sciences in Social Systems Applications (Invited Session)
Chair: Andreeski, Cvetko — Faculty of Tourism and Hospitality
Co-Chair: Mayer, Frédérique — Nancy Univ. - INPL
Organizer: Dimirovski, Georgi Marko — Dogus Univ. of Istanbul

14:00-14:40 TuB16.1
Applied System and Control Sciences to Social Systems: Globalization Age Paradigms (I), pp. 5239-5250.
Dimirovski, Georgi Marko — Dogus Univ. of Istanbul

14:40-15:00 TuB16.2
Social Impact of Automation Trends and Issues: An Human Centred Systems Engineering Perspective (I), pp. 5251-5256.
Mayer, Frédérique — Nancy Univ. - INPL

15:00-15:20 TuB16.3
Supplemental Ways for Improving International Stability Swiis (I), pp. 5257-5261.
Kopacek, Peter — Vienna Univ. of Tech.

15:20-15:40 TuB16.4
Fuzzy Optimization with Robust Logistic Membership Function: A Case Study in for Home Textile Industry (I), pp. 5262-5266.
Vasant, Pandian — Univ. Tech. Petronas
Andreeski, Cvetko — Faculty of Tourism and Hospitality

15:40-16:00 TuB16.5

Systems Approaches to Sustainable Advancement of Developing Countries: Recent Contributions (I), pp. 5267-5272.

Stankovski, Mile	SS Cyril and Methodius Univ.
Kolemisevska-Gugulovska, Tatjana	SS Cyril and Methodius Univ.
Dimirovski, Georgi Marko	Dogus Univ. of Istanbul

TuB17 320A

Recent Automation Technologies in Shipbuilding Industry III (Highlight Session)

Chair: Hur, Jong Sung	Hyundai Heavy Industries Co., Ltd.
Co-Chair: Choi, Ho-Woong	Hyundai Heavy Industries Co., Ltd.
Organizer: Lee, Choong Dong	Hyundai Heavy Industries Co., Ltd.
Organizer: Hur, Jong Sung	Hyundai Heavy Industries Co., Ltd.

14:00-14:20 TuB17.1

Development of Multi Welding Robot System for Sub Assembly in Shipbuilding (I), pp. 5273-5278.

Kang, Sung-Won	Daewoo Shipbuilding & Marine Engineering co.
Youn, Ho-Joong	Daewoo Shipbuilding & Marine Engineering Co.,Ltd.
Kim, Dong-Ho	Daewoo Shipbuilding & Marine Engineering Co., Ltd
Kim, Kang uk	Daewoo Shipbuilding & Marine Enineering Co. Ltd.,
Lee, Sang-Bum	Daewoo Shipbuilding & Marine Engineering Co.,Ltd.
Kim, Seong-Yeop	Daewoo Shipbuilding & Marine Engineering Co.,Ltd.
Kim, Soo Ho	Daewoo Shipbuilding & Marine Engineering co., KPU

14:20-14:40 TuB17.2

Development of Embedded Robot Controller for Shipbuilding (I), pp. 5279-5284.

Kim, Won-Bae	Inst. for Advanced Engineering
Lee, Young Seok	Inst. for Advanced Engineering
Lee, Kyoung Don	Inst. for Advanced Engineering
Lee, Seung Ho	DAEWOO Shipbuilding & Marine Engineering
Kim, Soo Ho	Daewoo Shipbuilding & Marine Engineering co., KPU

14:40-15:00 TuB17.3

A Dynamic Connection Scheme for User Interface of Process Control System in Offshore Plant (I), pp. 5285-5290.

Moon, Daekeun	Hyundai Heavy Industries Co., Ltd.
Kim, Hagbae	Yonsei Univ.
Park, Jinho	Hyundai Heavy Industries Co., Ltd.
Park, Dongho	Hyundai Heavy Industries Co., Ltd.

15:00-15:20 TuB17.4

Integrated Extension Alarm System for Machinery and Cargo Monitoring (I), pp. 5291-5292.

Moon, Daekeun	Hyundai Heavy Industries Co., Ltd.
Cho, Deokhwan	Hyundai Heavy Industries Co., Ltd.
Park, Jinho	Hyundai Heavy Industries Co., Ltd.
Park, Dongho	Hyundai Heavy Industries Co., Ltd.

15:20-15:40 TuB17.5

A Method of Reliability Improvement Based on IEC 61924 for the Integrated Navigation System (I), pp. 5293-5294.

Choe, Hangsoeb	Hyundai Heavy Industries Co., Ltd
Kim, Kicheol	Hyundai Heavy Industries Co., Ltd
Park, Jinho	Hyundai Heavy Industries Co., Ltd.
Park, Dongho	Hyundai Heavy Industries Co., Ltd.

15:40-16:00 TuB17.6

Development of a Ship Digital Relay Automated Evaluation Program (I), pp. 5295-5296.

Choi, Ho-Woong	Hyundai Heavy Industries Co., Ltd.
Min, Byoung-Woon	Hyundai Heavy Industries Co., Ltd.
Lee, Byeong-Ho	Hyundai Heavy Industries Co., Ltd.
Kim, Jung-Han	Hyundai Heavy Industries Co., Ltd.

TuB18 320B

Recent Development of Intelligent Robots IV: Architecture & Applications (Highlight Session)

Chair: Park, Sooyong	Sogang Univ.
Co-Chair: Fahmy, A. A.	Cardiff Univ.

14:00-14:20 TuB18.1

Software Architecture-Based Approach to Self-Adaptive Function for Intelligent Robots (I), pp. 5297-5302.

Kim, Dongsun	Sogang Univ.
Park, Sooyong	Sogang Univ.

14:20-14:40 TuB18.2

A System Architecture of Wireless Communication for Fire-Fighting Robots (I), pp. 5303-5307.

Park, Jung-Hyun	Advanced Inst. of Science and Tech. (KAIST)
Kim, Byung-Wook	Advanced Inst. of Science and Tech. (KAIST)
Park, Dong-Jo	Advanced Inst. of Science and Tech. (KAIST)
Kim, Moon-June	WIA Corp.

14:40-15:00 TuB18.3

Adaptive Fuzzy Neural Network for Inverse Modeling of Robot Manipulators, pp. 5308-5313.

Pham, D T	Cardiff Univ.
Fahmy, A. A.	Cardiff Univ.
Eldukhri, E. E.	Cardiff Univ.

15:00-15:20 TuB18.4

Concept and Scenarios of Intelligent Robotic Systems for Social Safety (I), pp. 5314-5315.

An, MyungSeok	Samsung Tech.
Cho, Hyun Woo	SAMSUNG Tech.
Yoo, MyungHo	Samsung Tech. Co., LTD.

15:20-15:40 TuB18.5

The Development of a Sevice Robot for Restaurant Serving and Guidance (I), pp. 5316-5317.

Kang, Bokhyun	YujinRobot Co., Ltd.
Stonier, Daniel	YujinRobot Co., Ltd.
Shin, Kyungchul	YujinRobot Co., Ltd.

15:40-16:00 TuB18.6

Healthcare Robot Technology Development (I), pp. 5318-5323.

Yi, Sungil	Korea Inst. of Industrial Tech.
Moon, Dongju	Korea Inst. of Industrial Tech.
Yang, Yongjoo	Korea Inst. of Industrial Tech.
Kim, Kangeun	Korea Inst. of Industrial Tech.

TuB19 320C

Robot Manipulators II (Regular Session)

Chair: Song, Jae-Bok	Korea Univ.
Co-Chair: Behera, Laxmidhar	Indian Inst. of Tech. Kanpur

14:00-14:20 TuB19.1

Dynamic Analysis and Robust Control Design for Stewart Platform with Moving Payloads, pp. 5324-5329.

Iqbal, Sohail	Muhammad Ali Jinnah Univ.
Bhatti, Aamer Iqbal	Muhammad Ali Jinnah Univ. Islamabad
Ahmed, Qadeer	Muhammad Ali Jinnah Univ.

14:20-14:40 TuB19.2

Fault Diagnosis in Robotic Manipulators Using Joint Torque Sensing, pp. 5330-5334.

Namvar, Mehrzad	Sharif Univ. of Tech.
Aghili, Farhad	Canadian Space Agency

14:40-15:00 TuB19.3

Closed-Loop Control in Image Processing for Improvement of Object Recognition, pp. 5335-5340.

Grigorescu, Sorin Mihai — Univ. Bremen
Ristic-Durrant, Danijela — Univ. Bremen
Vuppala, Sai Krishna — Univ. of Bremen
Graeser, Axel — Univ. of Bremen

15:00-15:20 TuB19.4
Predictive Visual Feedback Control with Eye-In/to-Hand Configuration Via Stabilizing Receding Horizon Approach, pp. 5341-5346.
Murao, Toshiyuki — Advanced Inst. of Industrial Tech.
Kawai, Hiroyuki — Kanazawa Inst. of Tech.
Fujita, Masayuki — Tokyo Inst. of Tech.

15:20-15:40 TuB19.5
Wall Juggling of One Ball by Robot Manipulator with Visual Servo, pp. 5347-5352.
Nakashima, Akira — Nagoya Univ.
Kobayashi, Yosuke — Nagoya Univ.
Hayakawa, Yoshikazu — Nagoya Univ.

15:40-16:00 TuB19.6
Inverse Kinematic Control Using Rotational and Joint Space Clustering with Visual Motor Coordination, pp. 5353-5358.
Ray, Anjan Kumar — Indian Inst. of Tech. Kanpur
Behera, Laxmidhar — Indian Inst. of Tech. Kanpur

TuB20 321C
Mobile Robot Control II (Regular Session)
Chair: Marchand, Nicolas — GIPSA-Lab. CNRS
Co-Chair: Pieri, Edson Roberto De — Federal Univ. of Santa Catarina

14:00-14:20 TuB20.1
Path Tracking Control of a Flapping Micro Aerial Vehicle (MAV), pp. 5359-5364.
Rifai, Hala — GIPSA-Lab.
Marchand, Nicolas — GIPSA-Lab. CNRS
Poulin, Guylaine — ENSIEG

14:20-14:40 TuB20.2
Path-Tracking Dynamic Model Based Control of an Omnidirectional Mobile Robot, pp. 5365-5370.
Vázquez, Alejandro — Centro de Investigación y de Estudios Avanzados del IPN
Velasco-Villa, Martin — CINVESTAV-IPN
Del-Muro-Cuellar, Basilio — ESIME-Culhuacán IPN

14:40-15:00 TuB20.3
Neurocontrollers for Trajectory Tracking Problem of a Nonholonomic Mobile Robot, pp. 5371-5376.
Martins, Nardęnio Almeida — UFSC - Univ. Federal de Santa Catarina
Bertol, Douglas Wildgrube — Federal Univ. of Santa Catarina
Lombardi, Warody C. — Federal Univ. of Santa Catarina
Pieri, Edson Roberto De — Federal Univ. of Santa Catarina
Castelan, Eugenio B. — Univ. Federal de Santa Catarina

15:00-15:20 TuB20.4
Trajectory Tracking Control of Skid-Steering Robot - Experimental Validation, pp. 5377-5382.
Pazderski, Dariusz — Poznan Univ. of Tech.
Kozlowski, Krzysztof R. — Poznan Univ. of Tech.

15:20-15:40 TuB20.5
Adaptive Trajectory Tracking and Stabilization for Omnidirectional Mobile Robot with Dynamic Effect and Uncertainties, pp. 5383-5388.
Huang, Hsu-Chih — National Chung-Hsing Univ.
Tsai, Ching-Chih — National Chung-Hsing Univ.

15:40-16:00 TuB20.6
A Mobile Robot Path-Planning Approach under Unknown Environments, pp. 5389-5392.
Cai, Zixing — Central South Univ.
Wen, Zhiqiang — Central South Univ.
Zou, Xiao-bing — Central South Univ.
Chen, Bai-fan — Central South Univ.

TuB21 321B
Measurement & Actuation (Regular Session)
Chair: Chase, J. Geoffrey — Univ. of Canterbury
Co-Chair: Tarn, Tzyh-Jong — Washington Univ.

14:00-14:20 TuB21.1
Event-Based Feedforward Control of a Drug Delivery System for Diabetes Care, pp. 5393-5398.
Yang, Ruoting — Washington Univ.
Tarn, Tzyh-Jong — Washington Univ.
Zhang, Mingjun — Agilent Tech.

14:20-14:40 TuB21.2
Mass Measurement under Weightless Conditions by Relay Feedback Systems, pp. 5399-5404.
Mizuno, Takeshi — Saitama Univ.
Takasaki, Masaya — Saitama Univ.
Ishino, Yuji — Saitama Univ.

14:40-15:00 TuB21.3
An Adaptive Depth of Field Imaging System for Visual Servoing, pp. 5405-5410.
Hong, Deokhwa — Korea Advanced Inst. of Science and Tech.
Janabi-Sharifi, Farrokh — Ryerson Univ.
Cho, Hyung Suck — KAIST

15:00-15:20 TuB21.4
Surface Reconstruction for a DIET Breast Cancer Screening System, pp. 5411-5416.
Brown, Richard G — Univ. of Canterbury
Hann, Christopher E — Univ. of Canterbury
Chase, J. Geoffrey — Univ. of Canterbury
Ray, Lawrence E — Carestream Health

15:20-15:40 TuB21.5
Combining PMD and Stereo Camera for Motion Estimation of a Mobile Robot, pp. 5417-5422.
Joochim, Chanin — Univ. of Siegen
Roth, Hubert — Univ. Siegen
Netramai, Chayakorn — Univ. Siegen
Melnychuk, Oleksandr — Univ. Siegen

15:40-16:00 TuB21.6
Robust PID Controller Design for a Micro-Actuator with Squeezed Gas Film Damping Effects, pp. 5423-5428.
Vagia, Marialena — Univ. of Patras
Tzes, Anthony — Univ. of Patras

TuB22 321A
Neural Network Based Control (Regular Session)
Chair: Jung, Seul — Chungnam National Univ.
Co-Chair: Han, Min — Dalian Univ. of Tech.

14:00-14:20 TuB22.1
Novel Delay-Dependent Stability Criterion for Delayed Neural Networks, pp. 5429-5432.
Yang, Bin — Dalian Univ. of Tech.
Wang, Hong — Dalian Univ. of Tech.
Jiang, Yanhong — Dalian Univ. of Tech.
Han, Min — Dalian Univ. of Tech.

14:20-14:40 TuB22.2
CPG Based Motion Control for an Underwater Thruster with Undulating Long-Fin, pp. 5433-5438.
Dong, Xiang — Inst. of Automation, Chinese Acad. of Sciences
Wang, Shuo — Chinese Acad. of Sciences
Cao, Zhiqiang — Inst. of Automation,Chinese Acad. of Sciences
Tan, Min — Inst. of Automation, Chinese Acad. of Sciences

14:40-15:00 TuB22.3
Implementation of a Neural Network Controller on a DSP for Controlling an Inverted Pendulum System on an X-Y Plane, pp. 5439-5443.
Kim, Sung-Su — Chungnam National Univ.
Jung, Seul — Chungnam National Univ.
Lee, Geunhyeong — Chungnam national Univ.

15:00-15:20 TuB22.4
Stability Criteria for Three-Layer Locally Recurrent Networks, pp. 5444-5449.
Patan, Krzysztof — Univ. of Zielona Gora

15:20-15:40 TuB22.5
Redundant Robot Kinematics Control with HCMAC Neural Network Manipulability Enhancement, pp. 5450-5455.
Rikovsky, Vladislav — Slovak Univ. of Tech.
Kozak, Stefan — Slovak Univ. of Tech. Faculty of Informatics and Info

15:40-16:00 TuB22.6

Linear Induction Motor Sensorless Speed Control Based on T-S Fuzzy Design, pp. 5456-5461.

Lian, Kuang-Yow — National Taipei Univ. of Tech.
Hung, Cheng-Yao — Chung-Yuan Christian Univ.
Chiu, Chian-Song — Chung-Yuan Christian Univ.

TuB23 323

Radio Frequency Identification (RFID) Technology in Supply Chain Management II (Regular Session)

Chair: Montreuil, Benoit — Faculté des sciences de l'administration, Univ. Laval
Co-Chair: Tsang, Albert H.C. — The Hong Kong Pol. Univ.
Organizer: Dolgui, Alexandre — Ec. des Mines de Saint Etienne
Organizer: Monostori, Laszlo — Budapest Univ. of Tech. and

14:00-14:20 TuB23.1

Optimized Sensor Network Design for Process Monitoring Based on Independent Component Analysis, pp. 5462-5469.

Salahshoor, Karim — petroleum Univ. of Tech.
Kiasi, Fariborz — petroleum Univ. of Tech.

14:20-14:40 TuB23.2

Contribution of Simulation in the Product Driven Systems Production Activity Control (I), pp. 5470-5475.

Cardin, Olivier — IRCCyN
Castagna, Pierre — Univ. of Nantes
Chove, Etienne — IRCCyN

14:40-15:00 TuB23.3

Impacts of RFID Deployment on Real Time Management of Retail Stores (I), pp. 5476-5481.

Hakimi, Driss — Faculté des sciences de l'administration, Univ. Laval
Montreuil, Benoit — Faculté des sciences de l'administration, Univ. Laval
Ruiz, Angel — Faculté des sciences de l'Administration, Univ. Laval

15:00-15:20 TuB23.4

An Intelligent RFID-Based Electronic Anti-Counterfeit System (InRECS) for the Manufacturing Industry (I), pp. 5482-5487.

Kwok, S. K. — The Hong Kong Pol. Univ.
Tsang, Albert H.C. — The Hong Kong Pol. Univ.
Ting, Siu Lun — The Hong Kong Pol. Univ.
Lee, W.B. — The Hong Kong Pol. Univ.
Cheung, Benny C.F. — The Hong Kong Pol. Univ.

15:20-15:40 TuB23.5

Implementing the Concept of Product-Driven Control Using Wireless Sensor Networks: Some Experiments and Issues, pp. 5488-5493.

Gouyon, David — Nancy Univ.
David, Michael — Nancy Univ.

15:40-16:00 TuB23.6

Structural Approach for Sensor Placement with Diagnosability Purpose, pp. 5494-5499.

Yassine, Abed Alrahim — Inst. National Pol. de Grenoble
Ploix, Stephane — Inst. National Pol. de Grenoble
Flaus, Jean-Marie — E.N.S.I.E.G.

TuB24 324

Applications of Process Supervision and Fault Tolerant Control (Regular Session)

Chair: Ding, Steven X. — Univ. of Duisburg-Essen
Co-Chair: Gentil, Sylviane — INPG

14:00-14:20 TuB24.1

Detection of Oscillatory Control Loops in Irrigation Channels, pp. 5500-5505.

Ooi, Su Ki — The Univ. of Melbourne
Weyer, Erik — Univ. of Melbourne

14:20-14:40 TuB24.2

Co-Design of a Safe Network Control Quadrotor, pp. 5506-5511.

Berbra, Cedric — CNRS-INPG-UJF
Lesecq, Suzanne — INPG/UJF/CNRS
Gentil, Sylviane — INPG
Thiriet, Jean-Marc — CNRS-INPG-UJF

14:40-15:00 TuB24.3

Robust Fault Detection Using Consistency Techniques with Application to an Automotive Engine, pp. 5512-5517.

Gelso, Esteban R. — Univ. of Girona
Frisk, Erik — Linkoping Univ.
Armengol Llobet, Joaquim — Univ. de Girona

15:00-15:20 TuB24.4

Optimal Guidance of Unmanned Aerial Vehicles for Emitter Location, pp. 5518-5522.

Huang, Kun — Binghamton Univ.
Wu, Neng Eva — Binghamton Univ.
Fowler, Mark L. — Binghamton Univ.

15:20-15:40 TuB24.5

A Note on Unknown Input Fault Detetection Filter Design, pp. 5523-5528.

Ding, Steven X. — Univ. of Duisburg-Essen
Khan, Abdul Qayyum — Univ. of Duisburg-Essen
Wang, Yongqiang — Tsinghua Univ.
Abid, Muhammad — Univ. of Duisburg-Essen, Germany

15:40-16:00 TuB24.6

Classification of Voltage Sags Based on MPCA an CBR, pp. 5529-5534.

Khosravi, Abbas — Amirkabir Uinversity
Melendez, Joaquim — Univ. de Girona
Zapateiro, Mauricio — Univ. of Girona
Colomer, Joan — Univ. de Girona

TuB25 328

Process Modeling and Identification (Regular Session)

Chair: Hahn, Juergen — Texas A&M Univ.
Co-Chair: Fradkov, Alexander L. — Acad. of Sciences of Russia

14:00-14:20 TuB25.1

Multiple Switching Relay for Identification of Frequency Responses, pp. 5535-5538.

Lee, Jietae — Kyungpook National Univ.
Je, Cheol Ho — Kyungpook National Univ.
Sung, Su Whan — Kyungpook National Univ.
Edgar, Thomas F. — Univ. of Texas at Austin

14:20-14:40 TuB25.2

A Time Delay Estimation Method for MIMO Systems, pp. 5539-5544.

Ni, Boyi — Tsinghua Univ.
Shah, Sirish — Univ. of Alberta
Xiao, Deyun — Tsinghua Univ.

14:40-15:00 TuB25.3

Selection of Parameter Sets and Design of Experiments for Estimation of Nonlinear Dynamic Systems, pp. 5545-5550.

Chu, Yunfei — Texas A&M Univ.
Hahn, Juergen — Texas A&M Univ.

15:00-15:20 TuB25.4

Application of Speed-Gradient Variational Principle to Modeling Transient Processes in Thermodynamics, pp. 5551-5556.

Fradkov, Alexander L. — Acad. of Sciences of Russia

15:20-15:40 TuB25.5

Robust Fault Detection with Unknown-Input Interval Observers Using Zonotopes, pp. 5557-5562.

Guerra, Pedro — Tech. Univ. of Catalonia (UPC)
Puig, Vicenc — Univ. Pol. de Catalunya
Witczak, Marcin — Univ. of Zielona Gora

15:40-16:00 TuB25.6

Cascade Process Modeling with Mechanism-Based Hierarchical Neural Networks, pp. 5563-5568.

Cong, QiuMei — Northeastern Univ. center of automation
Chai, Tianyou — Northeastern Univ.
Yu, Wen — CINVESTAV-IPN

TuB26 327

Modeling, Operation and Control of Power Systems II (Regular Session)

Chair: Horacek, Petr — Czech Tech. Univ. in Prague
Co-Chair: El-Metwally, K.A — Cairo Univ.

14:00-14:20 TuB26.1

Adaptive Nonlinear Control of Multiphase Synchronous Buck Power Converters, pp. 5569-5574.

El Fadil, Hassan — Ec. Mohammadia d'Ingénieurs

Giri, Fouad — GREYC - Univ. de Caen
Guerrero, Josep.M — EUETIB, Univ. Pol. de Catalunya (UPC)

14:20-14:40 TuB26.2
Passive P-Control of a Grid-Connected Photovoltaic Inverter, pp. 5575-5580.
Meza, Carlos — Tech. Univ. of Catalonia
Jeltsema, Dimitri — Delft Univ. of Tech.
Scherpen, Jacquelien M.A. — Univ. of Groningen
Biel, Domingo — Univ. Pol. de Catalunya

14:40-15:00 TuB26.3
Application of Passivity-Based Control to Stabilization of the SMIB System with Controllable Series Devices, pp. 5581-5586.
Manjarekar, Narayan — I.I.T. Bombay
Banavar, Ravi N. — Indian Inst. of Tech.
Ortega, Romeo — LSS-SUPELEC

15:00-15:20 TuB26.4
Individual Pitch Control of Wind Turbines Using Local Inflow Measurements, pp. 5587-5592.
Thomsen, Sven Creutz — Tech. Univ. of Denmark
Niemann, Henrik — Tech. Univ. of Denmark
Poulsen, Niels K. — The Tech. Univ. of Denmark

15:20-15:40 TuB26.5
Rate Bounded Linear Parameter Varying Control of a Wind Turbine in Full Load Operation, pp. 5593-5598.
Řstergaard, Kasper Zinck — Vestas Wind Systems A/S
Stoustrup, Jakob — Aalborg Univ.
Brath, Per — Vestas Wind Systems A/S

15:40-16:00 TuB26.6
Multi-Objective VAr Planning with SVC Using Immune Algorithmand and Guaranteed Convergence Particle Swarm Optimization, pp. 5599-5604.
Farsangi, Malihe Maghfoori — Electrical Engineering Department ofShahidBahonarUniversity, Ker
Nezamabadi-pour, Hossein — Electrical Engineering Department of ShahidBahonarUniversity, Ke
Lee, Kwang Y. — Baylor Univ.

TuB27 326
Fuzzy Systems and Control: Stability Analysis and Design (Regular Session)
Chair: Guerra, Thierry Marie — Univ. of Valenciennes
Co-Chair: Shoureshi, Rahmat — Univ. of Denver

14:00-14:20 TuB27.1
Stability Analysis of Fuzzy Systems: Membership-Shape and Polynomial Approaches, pp. 5605-5610.
Sala, Antonio — Univ. Pol. de Valencia
Guerra, Thierry Marie — Univ. of Valenciennes

14:20-14:40 TuB27.2
A Membership-Function-Dependent Stability Analysis of Takagi-Sugeno Models, pp. 5611-5616.
Bernal, Miguel — Univ. Valenciennes et Hainaut-Cambresis
Guerra, Thierry Marie — Univ. of Valenciennes
Kruszewski, Alexandre — Ec. Centrale de Lille

14:40-15:00 TuB27.3
Robust Stability of Systems with Fuzzy Parametric Uncertainty, pp. 5617-5622.
Husek, Petr — Czech Tech. Univ. in Prague

15:00-15:20 TuB27.4
Robust Chaotic Cryptosystems Based on T-S Fuzzy Model, pp. 5623-5628.
Yu, Gwo-Ruey — National Ilan Univ.

15:20-15:40 TuB27.5
Fuzzy Partition Optimization for Approximate Fuzzy Q-Iteration, pp. 5629-5634.
Busoniu, Lucian — Delft Univ. of Tech.
Ernst, Damien — Univ. of Ličge
De Schutter, Bart — Delft Univ. of Tech.
Babuska, Robert — Delft Univ. of Tech.

15:40-16:00 TuB27.6
Robust AQM Controller Design for DiffServ Network Using Sliding Mode Control, pp. 5635-5639.
Zhang, Nannan — Northeastern Univ.
Jing, Yuanwei — Northeastern Univ.
Yang, Muyi — Northeastern Univ.
Zhang, Siying — Northeastern Univ.

TuB28 330A
Hybrid Vehicle II (Regular Session)
Chair: Rizzo, Gianfranco — Univ. of Salerno
Co-Chair: Manzie, Chris — The Univ. of Melbourne

14:00-14:20 TuB28.1
Prediction of Power Demand for Hybrid Vehicles Operating in Fixed-Route Service, pp. 5640-5645.
Bartholomaeus, Ralf — Fraunhofer
Klingner, Matthias — Fraunhofer
Lehnert, Martin — Fraunhofer

14:20-14:40 TuB28.2
Fuel Economy Benefits of Look-Ahead Capability in a Mild Hybrid Configuration, pp. 5646-5651.
Kim, Tae Soo — The Univ. of Melbourne
Manzie, Chris — The Univ. of Melbourne
Watson, Harry — The Univ. of Melbourne

14:40-15:00 TuB28.3
Rule-Based Equivalent Fuel Consumption Minimization Strategies for Hybrid Vehicles, pp. 5652-5657.
Hofman, Theo — Tech. Univ. Eindhoven

15:00-15:20 TuB28.4
Effects of Spark Ignition Timing and Fuel Injection Strategy for Combustion Stability on HEV Powertrain During Engine Restart and Deceleration Driving, pp. 5658-5663.
Ohn, Hyungsuek — Seoul National Univ.
Yu, Seongeun — Seoul National Univ.
Min, Kyoung Doug — Seoul National Univ.

15:20-15:40 TuB28.5
Hardware in the Loop Simulation of Vehicle Stability Control Using Regenerative Braking and Electro Hydraulic Brake for Hybrid Electric Vehicle, pp. 5664-5669.
Kim, Donghyun — Sungkyunkwan Univ.
Kim, Chulsoo — Hyundai Motor Company
Hwang, Sung-Ho — Sungkyunkwan Univ.
Kim, Hyunsoo — Sungkyunkwan Univ.

TuB29 330B
Vehicle Dynamics (Regular Session)
Chair: Gerdes, J. Christian — Stanford Univ.
Co-Chair: El Hajjaji, Ahmed — Univ. de Picardie-Jules Verne

14:00-14:20 TuB29.1
An Output Feedback Controller Design for Lateral Vehicle Dynamic, pp. 5670-5675.
Bosche, Jerome — Univ. of Amiens
El Hajjaji, Ahmed — Univ. de Picardie-Jules Verne

14:20-14:40 TuB29.2
Steering Assist Torque Control Enhancing Vehicle Stabiliity, pp. 5676-5681.
Lee, Ahn Na — MANDO Corp.
Jung, JiHyun — MANDO Corp.

14:40-15:00 TuB29.3
Unified Chassis Control for Vehicle Rollover Prevention, pp. 5682-5687.
Yoon, Jangyeol — Seoul National Univ.
Cho, Wanki — Seoul National Univ. Korea
Yi, Kyongsu — Seoul National Univ.
Koo, Bongkyeong — MANDO Corp.

15:00-15:20 TuB29.4
Lateral Wind Force and Torque Estimation for a Driving Assistance, pp. 5688-5693.
Glaser, Sébastien — INRETS-LCPC
Mammar, Said — LSC-CNRS-FRE2494
Dakhlallah, Jamil — INRETS-LCPC
Netto, Mariana — LIVIC - LCPC/INRETS

15:20-15:40 TuB29.5
Detection of Critical Driving Situations Using Phase Plane Method for Vehicle Lateral Dynamics Control by Rear Wheel Steering, pp. 5694-5699.
von Vietinghoff, Anne — Univ. Karlsruhe (TH)
Lu, Haiyan — Univ. Karlsruhe (TH)

Kiencke, Uwe — Univ. of Karlsruhe

15:40-16:00 — TuB29.6
Vehicle Parameter Estimation and Stability Enhancement Using Sliding Modes Techniques, pp. 5700-5705.
Shraim, Hassan — LSIS, Univ. AIX marseille III
Ouladsine, Mustapha — Univ. d'aix marseille III
Fridman, Leonid M. — Univ. of Mexico

TuB30 — 330C
Guidance, Control & Navigation for Unmanned Air Vehicles (Invited Session)
Chair: Tsourdos, Antonios — Cranfield Univ.
Co-Chair: Siguerdidjane, Houria — SUPELEC
Organizer: Tsourdos, Antonios — Cranfield Univ.

14:00-14:20 — TuB30.1
Stability Analysis of an UAV Controller Using Singular Perturbation Theory (I), pp. 5706-5711.
Bertrand, Sylvain — ONERA
Hamel, Tarek — Univ. de Nice Sophia Antipolis
Piet-Lahanier, Helene — ONERA

14:20-14:40 — TuB30.2
Cooperative Task Assignment Using Dynamic Ranking (I), pp. 5712-5717.
Bracci, Andrea — Univ. of Pisa
Pollini, Lorenzo — Univ. of Pisa
Innocenti, Mario — Univ. of Pisa

14:40-15:00 — TuB30.3
Dubins Path Planning of Multiple UAVs for Tracking Contaminant Cloud (I), pp. 5718-5723.
Subchan, Subchan — Cranfield Univ.
White, Brian A. — Cranfield Univ.
Tsourdos, Antonios — Cranfield Univ.
Shanmugavel, Madhavan — Cranfield Univ.
Zbikowski, R — Cranfield Univ.

15:00-15:20 — TuB30.4
UAV Optimal Cooperative Target Tracking and Collision Avoidance of Moving Objects (I), pp. 5724-5729.
Prévost, Carole Gabrielle — Univ. Laval
Desbiens, Andre — Univ. Laval
Gagnon, Eric — Defence R&D Canada - Valcartier
Hodouin, Daniel — Laval Univ.

15:20-15:40 — TuB30.5
Robust Control and Visual Servoing of an Uav (I), pp. 5730-5735.
Dib, Alaa — Supelec
Siguerdidjane, Houria — SUPELEC
Zaidi, Nedjma — Supélec

15:40-16:00 — TuB30.6
Multi-Rate Path-Following Control for Unmanned Air Vehicles, pp. 5736-5741.
Antunes, Duarte — Inst. Superior Tecnico, Inst. forSystemsandRobotics
Silvestre, Carlos — Inst. Superior Tecnico
Cunha, Rita — Inst. Superior Técnico, Inst. for Systems and

TuBCC — 401
Milestone Report by IFAC Coordinating Committee on Manufacturing and Logistics Systems (CC5) (Milestone Session)
Chair: Nof, Shimon Y. — Purdue Univ.

14:00-16:00 — TuBCC.1
Advances in E-Manufacturing, E-Logistics, and E-Service Systems, pp. 5742-5750.
Nof, Shimon Y. — Purdue Univ.
Filip, Florin Gheorghe — Romanian Acad.
Molina, Arturo — Tecnologico de Monterrey
Monostori, Laszlo — Computer and Automation Res. Inst. Hungarian
Pereira, Carlos Eduardo — Federal Univ. of Rio Grande do Sol

TuC01 — Atlantic Hall
Design Methods (Poster Session)
Chair: Bars, Ruth — Budapest Univ. of Tech. and Ec.
Co-Chair: Colaneri, Patrizio — Pol. di Milano

16:30-18:30 — TuC01.1
Self-Tuning Continuous-Time Generalized Minimum Variance Control, pp. 5751-5755.
Hoshino, Ryota — Tokyo Metropolitan Univ.
Mori, Yasuchika — Tokyo Metropolitan Univ.

16:30-18:30 — TuC01.2
Designing PI Controller Based on Iterative Learning Control Using Adaptive Technique, pp. 5756-5761.
Gomma, H. W. — Univ. of Helwan
Thomas, Jean — Beni-Sueif Univ.

16:30-18:30 — TuC01.3
Adaptive Control of Three – Tank – System Using Polynomial Methods, pp. 5762-5767.
Kubalcik, Marek — Tomas Bata Univ.
Bobál, Vladimír — Tomas Bata Univ. in Zlin

16:30-18:30 — TuC01.4
A Virtual Prototyping Approach to the Design of Advanced Chiller Control Systems, pp. 5768-5769.
Albieri, Michele — Rhoss S.p.A.
Beghi, Alessandro — Univ. di Padova
Bodo, Cristian — Univ. di Padova
Cecchinato, Luca — Univ. di Padova

16:30-18:30 — TuC01.5
Scheduling of a LQ Control Algorithm for Efficient FPGA Implementation, pp. 5770-5775.
Sucha, Premysl — Czech Tech. Univ. in Prague
Hanzalek, Zdenek — Czech Tech. Univ. in Prague

16:30-18:30 — TuC01.6
Eigenstructure Assignment for Helicopter Hover Control, pp. 5776-5781.
Pomfret, Andrew James — Univ. of York
Griffin, Stuart J — Univ. of York
Clarke, Tim — Univ. of York

16:30-18:30 — TuC01.7
Control System Design for a New Servo Press, pp. 5782-5787.
Yeung, Wai Keung — The Chinese Univ. of Hong Kong
Li, Jian Ping — The Chinese Univ. of Hong Kong
He, Kai — The Chinese Univ. of Hong Kong
Luo, Yuanxin — Chinese Univ. of Hong Kong
Kong, Ching Tom — The Chinese Univ. of Hong Kong
Du, Ruxu — the Chinese Univ. of Hong Kong

16:30-18:30 — TuC01.8
Analysis of the Oil Film Effect in the Air Gap of an Electro-Hydraulic Compound Pump, pp. 5788-5795.
Hsieh, Sheng-Ping — Feng Chia Univ.
Hwang, Thong-Shing — FENG CHIA Univ.
Hwang, Min-Tzung — Chung-Shan Inst. of Science and Tech.

16:30-18:30 — TuC01.9
Optimal State Space Control of DC Motor, pp. 5796-5801.
Ruderman, Michael — Tech. Univ. Dortmund
Krettek, Johannes — Univ. of Dortmund
Hoffmann, Frank — Univ. of Dortmund
Bertram, Torsten — TU Dortmund

16:30-18:30 — TuC01.10
Calculating All Kp Admitting Stability of a PID Control Loop, pp. 5802-5807.
Hohenbichler, Norbert — RWTH Aachen Univ.
Abel, Dirk — RWTH-Aachen Univ.

16:30-18:30 — TuC01.11
Robust Predictive PI Controller Based on First-Order Dead Time Model, pp. 5808-5813.
Arousi, Fakhredin — Budapest Univ. of Tech. and Ec.
Schmitz, Ulrich — Shell Rhineland Refinery
Bars, Ruth — Budapest Univ. of Tech. and Ec.
Haber, Robert — Univ. of Applied Science Cologne

16:30-18:30 — TuC01.12
Constrained Control for Systems with Relative Degree One, pp. 5814-5819.
Huba, Mikulas — Slovak Univ. of Tech.
Tapak, Peter — Faculty of Electrical Engineering andInformationTechnologyof Sl
Zakova, Katarina — Slovak Univ. of Tech.

16:30-18:30 — TuC01.13

PI Controller Design for Actuator Preservation, pp. 5820-5824.
Klan, Petr — Acad. of Sciences, Czech Republic
Gorez, R. — Univ. Catholique de Louvain

16:30-18:30 TuC01.14
A Design Method of Modified PID Controllers for Multiple-Input/multiple-Output Plants, pp. 5825-5830.
Hagiwara, Takaaki — Graduate School of Engineering, Gunma Univ.
Yamada, Kou — Gunma Univ.

16:30-18:30 TuC01.15
Optimal LQI Synthesis for Speed Control of Synchronous Actuator under Load Inertia Variations, pp. 5831-5836.
Fadel, Maurice — LAPLACE - INPT
Carriere, Sebastien — INPT
Caux, Stéphane — INPT

16:30-18:30 TuC01.16
Controller Design for Unstable FOPTD Plants Based on Sensitivty, pp. 5837-5841.
Ali, Ahmad — Indian Inst. of Tech. Guwahati India
Majhi, Somanath — Indian Inst. of Tech. Guwahati

16:30-18:30 TuC01.17
Guaranteed Dominant Pole Placement with PID Controllers, pp. 5842-5845.
Wang, Qing-Guo — National Univ. of Singapore
Zhang, Zhiping — National Univ. of Singapore
Astrom, Karl J. — Lund Inst. of Tech.
Zhang, Yu — GE Global Res. Center - Shanghai
Zhang, Yong — GE Global Res. Center

16:30-18:30 TuC01.18
On the Integral Sliding-Mode Control for Sample-Data Systems with State Time-Delay, pp. 5846-5849.
Mu, Lijun — Ocean Univ. of China
Gao, Cunchen — Ocean Univ. of China
Li, Juan — Ocean Univ. of China

16:30-18:30 TuC01.19
Delay-Dependent Decentralized Stabilization of Multi-Channel Singular Linear Continuous-Time Systems with Multiple Point Delays, pp. 5850-5855.
Gui, Weihua — Central South Univ.
Jiang, Zhao-Hui — Central South Univ.
Yang, Chunhua — Central South Univ.
Xie, Yongfang — Central South Univ.

16:30-18:30 TuC01.20
Delay-Dependent H-Inf Control for 2-D State-Delayed Systems, pp. 5856-5861.
Peng, Dan — Yanshan Univ.
Guan, Xinping — Yanshan Univ.
Long, Chengnian — Yanshan Univ.

16:30-18:30 TuC01.21
Robust Stability of Polynomic Interval Polynomials, pp. 5862-5867.
Husek, Petr — Czech Tech. Univ. in Prague

16:30-18:30 TuC01.22
On Positive Real Lemma for Non-Minimal Realization Systems, pp. 5868-5873.
Kunimatsu, Sadaaki — Kumamoto Univ.
Kim, Sang-Hoon — SAMSUNG ELECTRONICS CO.,LTD
Fujii, Takao — Fukui Univ. of Tech.
Ishitobi, Mitsuaki — Kumamoto Univ.

16:30-18:30 TuC01.23
Delay-Dependent Robust H_{infty} Control for Uncertain Singular Systems with Time-Varying Delay, pp. 5874-5879.
Wang, Huijiao — Hangzhou Dianzi Univ.
Xue, Anke — Hangzhou Dianzi Univ.
Lu, Renquan — Zhejiang Univ.
Zhao, Xiaodong — Hangzhou Dianzi Univ.
Zhou, Xiao Hui — Hangzhou Dianzi Univ.

16:30-18:30 TuC01.24
Observer-Based H_infinity Control for Stochastic Systems with Delays and Nonlinear Perturbations: LMI Approach, pp. 5880-5884.
Xue, Anke — Hangzhou Dianzi Univ.
Chen, Yun — Hangzhou Dianzi Univ.
Zhang, Ke-Qin — Quanser Consulting Inc.
Zhao, Xiaodong — Hangzhou Dianzi Univ.
Wang, Jianzhong — Hangzhou Dianzi Univ.
Ge, Ming — Honeywell International

16:30-18:30 TuC01.25
Stabilizing Controllers, Lyapunov Functions, and the Inverse Problem of Optimal Control, pp. 5885-5890.
Rapisarda, Paolo — Univ. of Southampton
Kojima, Chiaki — Univ. of Tokyo

16:30-18:30 TuC01.26
Autonomous Linear Lossless Systems, pp. 5891-5896.
Rao, Shodhan — Univ. of Southampton
Rapisarda, Paolo — Univ. of Southampton

16:30-18:30 TuC01.27
Global Stabilization of Discrete-Time Chain of Integrators by Saturated Feedback, pp. 5897-5902.
Zhou, Bin — Harbin Inst. of Tech.
Duan, Guang-Ren — Harbin Inst. of Tech.

16:30-18:30 TuC01.28
Estimation of Attraction Domains in Wheeled Robot Control Using Absolute Stability Approach, pp. 5903-5908.
Rapoport, Lev — Inst. for Control Sciences RAS; Javad GNSS
Morozov, Yuriy — Inst. of Control Sciences

16:30-18:30 TuC01.29
Mixed H_2/H_infinity Control of Discrete-Time Markovian Jump Systems Via Static Output-Feedback Controllers, pp. 5909-5914.
Shu, Zhan — The Univ. of Hong Kong
Lam, James — Univ. of Hong Kong
Xiong, Junlin — Univ. of Hong Kong

16:30-18:30 TuC01.30
Composite Disturbance-Observer-Based Control and Terminal Sliding Mode Control for Uncertain Structural Systems, pp. 5915-5920.
Wei, Xinjiang — Southeast Univ. Yantai Normal Univ.
Guo, Lei — UMIST

16:30-18:30 TuC01.31
High-Low Gain Redesign for a 4 DOF Spherical Inverted Pendulum, pp. 5921-5926.
Liu, Guangyu — NICTA, The Univ. of Melbourne
Marconi, Lorenzo — Univ. di Bologna

16:30-18:30 TuC01.32
On PERIODICAL OSCILLATIONS of LURIE SYSTEMS with DISCONTINUOUS NONLINEARITY, pp. 5927-5932.
Efimov, Denis — Liege Univ.

16:30-18:30 TuC01.33
Stability of Hybrid Impulsive Systems with Time Delay and Stochastic Effects, pp. 5933-5938.
Yang, Zhichun — Chinese Acad. of Sciences
Hong, Yiguang — Chinese Acad. of Sciences

16:30-18:30 TuC01.34
Image-Based Camera-Robot Target-Tracking Satisfying Multicriteria Constraints, pp. 5939-5944.
Lombardi, Warody C. — Federal Univ. of Santa Catarina
Martins, Nardęnio Almeida — UFSC - Univ. Federal de Santa Catarina
Bertol, Douglas Wildgrube — Federal Univ. of Santa Catarina
Pieri, Edson Roberto De — Federal Univ. of Santa Catarina
Castelan, Eugenio B. — Univ. Federal de Santa Catarina

16:30-18:30 TuC01.35
A Novel Recursive Terminal Sliding Mode with Finite-Time Convergence, pp. 5945-5949.
Yu, Shuanghe — Dalian Maritime Univ.
Du, Jialu — Dalian Maritime Univ.
Yu, Xinghuo — RMIT Univ.
Xu, He — Harbin Engineering Univ.

16:30-18:30 TuC01.36
Efficient Low-Cost Controllers for Constrained Manipulators with Uncertainties and Disturbances, pp. 5950-5955.
Torres, Santiago — Univ. de La Laguna
Mendez, J. A. — Univ. de La Laguna
Acosta, L. — Univ. of La Laguna
Gonzalez, Evelio — Univ. de La Laguna
Toledo, Jonay — Univ. of La Laguna

16:30-18:30 TuC01.37
Constrained Controllability of Second Order Semilinear Systems, pp. 5956-5961.
Klamka, Jerzy — Silesian Univ. of Tech. at Gliwice

16:30-18:30 TuC01.38
Neo Robust Control Theory -Beyond the Small-Gain and Passivity Paradigms, pp. 5962-5968.
Liu, Kang-Zhi — Chiba Univ.

16:30-18:30 TuC01.39
Stability of Zero Dynamics of Sampled-Data Nonlinear Systems, pp. 5969-5973.
Ishitobi, Mitsuaki — Kumamoto Univ.
Nishi, Masatoshi — Kumamoto Univ.
Kunimatsu, Sadaaki — Kumamoto Univ.

16:30-18:30 TuC01.40
Design of Model Reference Adaptive Tracking Controllers for Mismatch Perturbed Nonlinear Systems with Input Nonlinearity, pp. 5974-5979.
Cheng, Chih-Chiang — National Sun Yat-Sen Univ.
Chang, Chao-Chin — National Sun Yat-Sen Univ.
Su, Tai-Ming — National Sun Yat-Sen Univ.

16:30-18:30 TuC01.41
Robust Controller Design to Uncertain Nonlinear Tailless Aircraft, pp. 5980-5985.
Li, Wenqiang — National Univ. of Defense Tech.
Ma, Jianjun — National Univ. of Defense Tech.
Zheng, Zhiqiang — National Univ. of Defense Tech.
Peng, Xuefeng — National Univ. of Defense Tech.

16:30-18:30 TuC01.42
Development and Application of a Sliding Mode Based Diagonal Recurrent Cerebellar Model Articulation Controller, pp. 5986-5991.
Liu, Shan — Huazhong Univ. of Science and Tech.
Wang, Yongji — Hauzhong Univ. of Science And Tech.
Xu, Qi — Huazhong Univ. of Science and Tech.
Fang, Huijuan — Huazhong Univ. of Science and Tech.

16:30-18:30 TuC01.43
Fuzzy Guaranteed Cost Control for Nonlinear Systems with Input and State Time Delay, pp. 5992-5997.
Yang, Xiaoguang — Northeastern Univ. Maritime Univ.
Zhang, Qingling — Northeastern Univ.
Jing, Xin — Northeastern Univ.
An, Yichun — Northeastern Univ.

16:30-18:30 TuC01.44
On Singular Perturbations of Unstable Underactuated Mechanical Systems with Underactuation Degree >= 1, pp. 5998-6003.
Acosta, José Ángel — Univ. de Sevilla
Lopez-Martinez, Manuel — Univ. de Sevilla

16:30-18:30 TuC01.45
Delay-Dependent Robust H Infinity Control for Uncertain Stochastic Systems, pp. 6004-6009.
Li, Minghao — Donghua Univ.
Zhou, Wuneng — Donghua Univ.
Wang, Huijiao — Hangzhou Dianzi Univ.
Chen, Yun — Hangzhou Dianzi Univ.
Lu, Renquan — Zhejiang Univ.
Lu, Hongqian — Coll. of Information Science andTechnology,DonghuaUniversity,

16:30-18:30 TuC01.46
NONLINEAR mathcal{H}_{infty} SYNCHRONIZATION FOR LUR'E SYSTEMS USING TIME-DELAY FEEDBACK CONTROL, pp. 6010-6014.
Zhong, Maiying — Shandong Univ.
Yuan, Shuai — Shandong Univ.
Liu, Yunxia — Shandong Univ.

16:30-18:30 TuC01.47
Simple Realization of Integral Fuzzy Control for Isolated AHPFC Converters, pp. 6015-6020.
Lian, Kuang-Yow — National Taipei Univ. of Tech.
Hong, Chi-Wang — Chung-Yuan Christian Univ.

16:30-18:30 TuC01.48
Absolute Stability of Multivariable Lur'e-Type Descriptor Systems, pp. 6021-6026.
Wada, Teruyo — Osaka Univ.
Ikeda, Masao — Osaka Univ.
Uezato, Eiho — Univ. of the Ryukyus

16:30-18:30 TuC01.49
Discontinuous Output Regulation of the Pendubot, pp. 6027-6032.
Rivera, Jorge — Univ. de Guadalajara
Loukianov, Alexander G. — CINVESTAV IPN GDI
Castillo-Toledo, Bernardino — CINVESTAV-GDL, Mexico

16:30-18:30 TuC01.50
Time-Optimal Trajectory Generator under Jerk Constraints, pp. 6033-6038.
Chen, Gan — Nanzan Univ.
Hayashi, Hideki, Hideki — Nanzan Univ.
Takami, Isao — Nanzan Univ.

16:30-18:30 TuC01.51
Moving Horizon Control and Estimation of Livestock Ventilation Systems and Indoor Climate, pp. 6039-6044.
Wu, Zhuang — Aalborg Univ.
Stoustrup, Jakob — Aalborg Univ.
Jorgensen, John Bagterp — Tech. Univ. of Denmark

16:30-18:30 TuC01.52
Global Exponential Stability of Delayed Parabolic Neural Networks, pp. 6045-6049.
Sheng, Li — Jiangnan Univ.
Yang, Huizhong — Jiangnan Univ.

16:30-18:30 TuC01.53
Boundary Control of Flexible Marine Risers, pp. 6050-6055.
Do, Duc — The Univ. of Western Australia
Pan, Jie — The Univ. of Western Australia

16:30-18:30 TuC01.54
On a Stabilization Problem of Nonlinear Programming Neural Networks, pp. 6056-6059.
Huang, Yuan Can — Beijing Inst. of Tech.
Yu, Chuang — Shenyang Ligong Univ.
Zhu, Lingyun — Beijing Inst. of Tech.

16:30-18:30 TuC01.55
Large-Scale Nonlinear Multivariable Systems (Decomposition, Modeling and Control Problems), pp. 6060-6065.
Akhmetzyanov, Atlas — Trapeznikov Inst. of Control Sciences,RussianAcademyofScien

16:30-18:30 TuC01.56
A Tool for Converting FEM Models into Representations Suitable for Control Synthesis, pp. 6066-6071.
Bokhari, Syed Fawad Raza Ali — Hamburg Univ. of Tech.
Chughtai, Saulat Shuja — Tech. Univ. of Hamburg-Harburg
Werner, Herbert — Hamburg Univ. of Tech.

16:30-18:30 TuC01.57
Group Behaviour Control Based on Aggregation and Dilation, pp. 6072-6077.
Xin, Bin — Beijing Inst. of Tech.
Chen, Jie — Beijing Inst. of Tech.
Dou, Li-Hua — Beijing Inst. of Tech.
Peng, Zhi-hong — Beijing Inst. of Tech.

16:30-18:30 TuC01.58
Improved-PSO-Based Optimal Scheduling for Rectifier Power System, pp. 6078-6083.
Yang, Chunhua — Central South Univ.
Zhu, Hongqiu — Central South Univ.
Gui, Weihua — Central South Univ.

16:30-18:30 TuC01.59
Exponential Stabilization of Linear Systems with Time-Varying Sampling, pp. 6084-6087.
Gao, Huijun — Harbin Inst. of Tech.
Wu, Junli — Harbin Inst. of Tech.
Lam, James — Univ. of Hong Kong
Chu, Danlei — Honeywell Process Solutions

16:30-18:30 TuC01.60
Efficient Computation and Model Selection in Semi-Supervised Learning, pp. 6088-6093.
Wang, Gang — Hong Kong Univ. of Science and Tech.
Qin, Shiyin — Beihang

Huang, Pipei Beihang

16:30-18:30 TuC01.61
Optimal Estimation by Using Fuzzy Systems, pp. 6094-6099.
Amosov, Oleg S. Amur State Univ. of Humanities and Pedagogy
Amosova, Lyudmila N. Amur State Univ. of Humanities and Pedagogy

16:30-18:30 TuC01.62
Dynamic Optimisation of Chemical Engineering Processes Using the Bees Algorithm, pp. 6100-6105.
Pham, D T Cardiff Univ.
Pham, Q.T. Univ. of New South Wales
Ghanbarzdaeh, Afshin Cardiff Univ.
Castellani, Marco Cardiff Univ.

16:30-18:30 TuC01.63
Application of Network Operator Method for Synthesis of Optimal Structure and Parameters of Automatic Control System, pp. 6106-6113.
Diveyev, Askhat Dorodnicyn Computing Centre of the RussianAcademyofSciences
Sofronova, Elena Peoples' Frienfship Univ. of Russia

16:30-18:30 TuC01.64
Robust Fault Diagnosis of Energetic System with Parameter Uncertainties, pp. 6114-6119.
Djeziri, Mohand Arab Ec. Centrale de Lille
Ould bouamama, Belkacem LAIL
Merzouki, Rochdi Ec. Pol. de Lille

16:30-18:30 TuC01.65
A New Objective Function for Controller Tuning, pp. 6120-6124.
Ali, Ahmad Indian Inst. of Tech. Guwahati India
Majhi, Somanath Indian Inst. of Tech. Guwahati

16:30-18:30 TuC01.66
Parallel BMI Optimization Using Unimodal Normal Distribution Crossover GA with Reduced-Order Individual Expression, pp. 6125-6130.
Kawanishi, Michihiro Toyota Tech. Inst.

16:30-18:30 TuC01.67
Frequency Domain Approach to Computing Loop Phase Margins of Multivariable Systems, pp. 6131-6135.
Ye, Zhen National Univ. of Singapore
Wang, Qing-Guo National Univ. of Singapore
Hang, Chang Chieh National Univ. of Singapore
Zhang, Yu GE Global Res. Center - Shanghai
Zhang, Yong GE Global Res. Center

16:30-18:30 TuC01.68
An H-Infinite Robust Tracker Controller for an UAV under Realistic Simulated Environmental Effects, pp. 6136-6141.
López, Juan Univ. Pol. de Madrid
Dormido, Raquel UNED
Dormido, Sebastián UNED
Gómez, José Patricio Univ. Pol. de Madrid
Gómez, Ignacio Univ. Pol. de Madrid

16:30-18:30 TuC01.69
Decentralized Adaptive Robust Tracking Controllers of Uncertain Large Scale Systems with Time Delays, pp. 6142-6147.
Wu, Hansheng Prefectural Univ. of Hiroshima
Shigemaru, Shinji Prefectural Univ. of Hiroshima

16:30-18:30 TuC01.70
Active Queue Management Algorithm Based on Fuzzy Sliding Model Controller, pp. 6148-6153.
Jing, Yuanwei Northeastern Univ.
Yu, Na Northeastern Uni.
Kong, Zhi Northeastern Univ.
Dimirovski, Georgi Marko Dogus Univ. of Istanbul

16:30-18:30 TuC01.71
A QFT/EEAS Design of Multivariable Robust Adaptive Controllers, pp. 6154-6159.
Namaki-Shoushtari, Omid K. N. Toosi Univ. of Tech.
Khaki Sedigh, Ali K.N. Toosi Univ. of Tech.
Araabi, Babak N. Univ. of Tehran

16:30-18:30 TuC01.72
Robust One-Step Model Predictive Control for Discrete Time-Delay Systems, pp. 6160-6165.
Shi, Yujing Northeastern Univ.
Chai, Tianyou Northeastern Univ.
Yue, Heng Northeastern Univ.

16:30-18:30 TuC01.73
Model Bridge Control-Multi-Degree of Freedom Design for High Robustness and High Performances, pp. 6166-6171.
Watanabe, Keiji Yamagata Univ.
Wang, Rui Yamagata Univ.

16:30-18:30 TuC01.74
Stability of TCP/AQM Networks Based on a Switched Time-Delay System Modeling, pp. 6172-6177.
Lu, Zongtao Case Western Res. Univ.
Lin, Wei Case Western Res. Univ.
Liberatore, Vincenzo Case Western Res. Univ.
Sun, Yuanzhang Tsinghua Univ.

TuC02 304A
Asymptotic Stabilization of Nonlinear Systems (Regular Session)
Chair: Johansson, Rolf Lund Univ.
Co-Chair: Tsuzuki, Takayuki Shimane Univ.

16:30-16:50 TuC02.1
Global Asymptotic Stabilization for a Nonlinear System on a Manifold Via a Dynamic Compensator, pp. 6178-6183.
Tsuzuki, Takayuki Shimane Univ.
Yamashita, Yuh Hokkaido Univ.

16:50-17:10 TuC02.2
Dynamically Scaled Generalized Inversion for Asymptotic Stabilization of Underactuated Spacecraft Dynamics, pp. 6184-6189.
Bajodah, Abdulrahman H. King Abdulaziz Univ.

17:10-17:30 TuC02.3
Stabilization of Nonlinear Systems Using Weak-Control-Lyapunov Functions, pp. 6190-6195.
Nishida, Gou RIKEN
Tsuzuki, Takayuki Shimane Univ.
Nakamura, Hisakazu Nara Inst. of Science &Tech.
Yamashita, Yuh Hokkaido Univ.

17:30-17:50 TuC02.4
Separation Principle for a Class of Nonlinear Feedback Systems Augmented with Observers, pp. 6196-6201.
Shiriaev, Anton Umea Univ.
Johansson, Rolf Lund Univ.
Robertsson, Anders LTH, Lund Univ.
Freidovich, Leonid Umeĺ Univ.

17:50-18:10 TuC02.5
A Class of Nonlinear RLC Circuits Globally Stabilizable by Proportional Plus Integral Controllers, pp. 6202-6207.
Castańos, Fernando Lab. des Signaux et Systčmes
Jayawardhana, Bayu Univ. of Manchester
Ortega, Romeo LSS-SUPELEC
Garcia-Canseco, Eloisa Univ. of Groningen

18:10-18:30 TuC02.6
Componentwise Stabilization of Interval Systems, pp. 6208-6213.
Pastravanu, Octavian C. Tech. Univ.
Matcovschi, Mihaela-Hanako Tech. Univ. Gh. Asachi of Iasi

TuC03 304B
Applications of Higher Order Sliding Mode Control (Invited Session)
Chair: Boiko, Igor IMB Controls
Co-Chair: Shtessel, Yuri B. Univ. of Alabama at Huntsville
Organizer: Boiko, Igor IMB Controls
Organizer: Shtessel, Yuri B. Univ. of Alabama at Huntsville
Organizer: Pisano, Alessandro Univ. di Cagliari

16:30-16:50 TuC03.1
Non-Parametric Tuning of PID Controllers Via Modified Second-Order Sliding Mode Algorithms (I), pp. 6214-6219.
Boiko, Igor IMB Controls

16:50-17:10 TuC03.2
Second Order Sliding Mode (SOSM) Approach to Orbital Stabilization of Friction Pendulum Via Position Feedback (I), pp. 6220-6225.

Orlov, Yury — CICESE
Raul Santiesteban Cos, Raul Santiesteban Cos — CICESE
Aguilar, Luis T. — CITEDI-IPN
Acho, Leonardo — EUETIB-Univ. Pol. of Catalunya

17:10-17:30 TuC03.3
Integrated Autopilot and Guidance for Dual Control Missiles Using Higher Order Sliding Mode Control and Observers (I), pp. 6226-6231.
Tournes, Christian — Davidson Tech.
Shtessel, Yuri B. — Univ. of Alabama at Huntsville

17:30-17:50 TuC03.4
High Order Sliding Mode Control of a Sensorless Induction Motor (I), pp. 6232-6237.
Traoré, Dramane — Ec. Centrale De Nantes-CNRS
Plestan, Franck — Ec. Centrale De Nantes-CNRS
Glumineau, Alain — Ec. Centrale Nantes
De Leon, Jesus — Univ. Autonoma de Nuevo Leon

17:50-18:10 TuC03.5
Compressor Surge Suppression by Second-Order Sliding Mode Control Technique (I), pp. 6238-6244.
Pisano, Alessandro — Univ. di Cagliari
Bartolini, Giorgio — Univ. of Cagliari
Muntoni, Aldo — Univ. of Cagliari
Usai, Elio — Univ. degli Studi di Cagliari

18:10-18:30 TuC03.6
Higher Order SM Control of Nonlinear Systems with Unmodeled Actuators (I), pp. 6245-6250.
Loukianov, Alexander G. — CINVESTAV IPN GDI
Fridman, Leonid M. — Univ. of Mexico
Canedo, Jose M. — CINVESTAV
Soto-Cota, Adolfo — Ph.d. Student
Sanchez, Edgar N. — CINVESTAV

TuC04 308
Applications of Nonlinear Control V (Regular Session)
Chair: Marconi, Lorenzo — Univ. di Bologna
Co-Chair: Tyukin, Ivan — Univ. of Leicester

16:30-16:50 TuC04.1
Attenuation of Slugging in Unstable Oil Wells by Nonlinear Control, pp. 6251-6256.
Kaasa, Glenn-Ole — Hydro Res. Centre
Alstad, Vidar — Norsk Hydro ASA
Zhou, Jing — Norwegian Univ. of Science and Tech.
Aamo, Ole Morten — NTNU

16:50-17:10 TuC04.2
A Simple Feedback-Loop for a Frequency Lock on a Narrow Atomic Transition, pp. 6257-6262.
Bonnabel, Silvere — Univ. de Ličge
Dubois, Guilhem — Ec. Normale Supérieure - UPMC-Paris 6 - CNRS
Rouchon, Pierre — ENSMP

17:10-17:30 TuC04.3
Predator-Prey Dynamics Subject to a Threshold Policy with Hysteresis, pp. 6263-6268.
Mendoza Meza, Magno Enrique — Federal Univ. of Rio de Janeiro
Bhaya, Amit — Federal Univ. of Rio De Janeiro
Kaszkurewicz, Eugenius — Univ. Federal de Rio de Janeiro-Brazil

17:30-17:50 TuC04.4
Non-Uniform Small-Gain Theorems for Systems with Critical and Slow Relaxations, pp. 6269-6276.
Tyukin, Ivan — Univ. of Leicester
Nijmeijer, Hendrik — Eindhoven Univ. of Tech.
Van Leeuwen, Cees — Riken Brain Science Inst.

17:50-18:10 TuC04.5
Linear Robust Control for a Nonlinear Active Suspension Model Considering Variable Payload, pp. 6277-6282.
Herrnberger, Michael — Tech. Univ. München
Maeder, Dominik — Tech. Univ. of Munich, Germany
Lohmann, Boris — Tech. Univ. Munich

18:10-18:30 TuC04.6
Integral Sliding Mode Control for Improved Robustness and Accuracy of Induction Motors, pp. 6283-6288.
Mohamed, Haider Abbas F. — Univ. of Malaya
Yang, Soo Siang — Univ. of Malaya
Moghavvemi, Mahmoud — Univ. of Malaya

TuC05 307
Analytic Design of Control Systems (Regular Session)
Chair: Varga, A. — DLR Oberpfaffenhofen
Co-Chair: Lin, Zongli — Univ. of Virginia

16:30-16:50 TuC05.1
A Parametric Lyapunov Equation Approach to Low Gain Feedback Design for Discrete-Time Systems, pp. 6289-6294.
Zhou, Bin — Harbin Inst. of Tech.
Lin, Zongli — Univ. of Virginia
Duan, Guang-Ren — Harbin Inst. of Tech.

16:50-17:10 TuC05.2
On Computing Nullspace Bases - a Fault Detection Perspective, pp. 6295-6300.
Varga, A. — DLR Oberpfaffenhofen

17:10-17:30 TuC05.3
Boundary Predictive Control of Second-Order Linear Modulus-Constant Distributed Parameter Systems Based on Wavelets Transformation, pp. 6301-6306.
Ding, Douzhang — East China Univ. of Science and Tech.
Gu, Xingsheng — East China Univ. of Science and Tech.

17:30-17:50 TuC05.4
A Multi-Parametric Optimization Strategy for Multilevel Hierarchical Control Problems., pp. 6307-6312.
Faisca, Nuno — Imperial Coll. London
Kouramas, Konstantinos — Imperial Coll. London
Pistikopoulos, Efstratios N. — Imperial Coll.

17:50-18:10 TuC05.5
Propagation of Mean Anisotropy of Signals in Filter Connections, pp. 6313-6318.
Kurdyukov, A.P. — Russian Acad. of Sciences
Vladimirov, Igor — The Univ. of Queensland

18:10-18:30 TuC05.6
Non-Parametric H_infty Control Synthesis with Suboptimal Controller Sets., pp. 6319-6324.
Den Hamer, A.J. — Eindhoven Univ. of Tech.
Steinbuch, Maarten — Eindhoven Univ. of Tech.
Weiland, Siep — Eindhoven Univ. of Tech.
Angelis, Georgo — Philips Applied Tech.

TuC06 310A
Delays in Interconnected Systems (Invited Session)
Chair: Niculescu, Silviu-Iulian — Lab. of Signals and Systems (L2S), UMR CNRS8506,CNRS-SUPELEC
Co-Chair: Dugard, Luc — CNRS-INPG-UJF
Organizer: Dugard, Luc — CNRS-INPG-UJF
Organizer: Niculescu, Silviu-Iulian — Lab. of Signals and Systems (L2S), UMR CNRS 8506,CNRS-SUPELEC

16:30-16:50 TuC06.1
A Convolution Approach for Delay Systems Identification (I), pp. 6325-6329.
Belkoura, Lotfi — Univ. de Lille 1
Richard, Jean-Pierre — Ec. Centrale de Lille
Fliess, Michel — Ec. Pol.

16:50-17:10 TuC06.2
Supply Network Dynamics and Delays; Performance, Synchronization, Stability (I), pp. 6330-6335.
Sipahi, Rifat — Northeastern Univ.
Delice, Ismail Ilker — Northeastern Univ.

17:10-17:30 TuC06.3
Control of a Remote System Over Network Including Delays and Packet Dropout (I), pp. 6336-6341.
Seuret, Alexandre — Royal Inst. of Tech.
Richard, Jean-Pierre — Ec. Centrale de Lille

17:30-17:50 TuC06.4
On Strongly Stabilizing Controller Synthesis for Time Delay Systems (I), pp. 6342-6346.

Ozbay, Hitay Bilkent Univ.

17:50-18:10 TuC06.5

Robust Motion Synchronization Control for Interconnected Systems with Human Interaction (I), pp. 6347-6352.

Cheong, Joono Korea Univ.
Niculescu, Silviu-Iulian Lab. of Signals and Systems (L2S)

18:10-18:30 TuC06.6

Modeling Approaches and Robust Stability Conditions for Networked Controlled Systems with Uncertain Delays, pp. 6353-6358.

Dritsas, Leonidas Univ. of Patras
Tzes, Anthony Univ. of Patras

TuC07 310B

Robustness Analysis (Regular Session)

Chair: Petersen, Ian Richard Univ. of New South Wales - ADFA
Co-Chair: Hagiwara, Tomomichi Kyoto Univ.

16:30-16:50 TuC07.1

Frequency-Dependent Scaling Induced by Noncausal Linear Periodically Time-Varying Scaling for Discrete-Time Systems, pp. 6359-6364.

Hagiwara, Tomomichi Kyoto Univ.
Ohara, Yasuhiro Kyoto Univ.

16:50-17:10 TuC07.2

The Real DFM Radius and Minimum Norm Plant Perturbation for General Control Information Flow Constraints, pp. 6365-6370.

Lam, Simon Univ. of Toronto
Davison, Edward J. Univ. of Toronto

17:10-17:30 TuC07.3

The Transmission Zero at S Radius and the Minimum Phase Radius of LTI Systems, pp. 6371-6376.

Lam, Simon Univ. of Toronto
Davison, Edward J. Univ. of Toronto

17:30-17:50 TuC07.4

Invariant Approximations of the Maximal Invariant Set or ``Encircling the Square'', pp. 6377-6382.

Rakovic, Sasa V. ETH Zurich
Fiacchini, Mirko Univ. de Sevilla

17:50-18:10 TuC07.5

Stability Analysis of Discrete LPV Systems Subject to Rate-Bounded Parameters, pp. 6383-6388.

Wei, Chia-Po National Sun Yat-Sen Univ.
Lee, Li National Sun Yat-Sen Univ.

18:10-18:30 TuC07.6

A Kalman Decomposition for Possibly Controllable Uncertain Linear Systems, pp. 6389-6395.

Petersen, Ian Richard Univ. of New South Wales - ADFA

TuC08 310C

Robust Control Applications (Regular Session)

Chair: Hong, Boe-Shong (George) National Chung Cheng Univ.
Co-Chair: Schuster, Eugenio Lehigh Univ.

16:30-16:50 TuC08.1

Linear Quadratic Energy-Motion Regulators of Electric Motorcycles, pp. 6396-6401.

Hong, Boe-Shong (George) National Chung Cheng Univ.
Huang, Chun-Chia National Chung Cheng Univ.
Chiu, Ching-Huang National Formosa Univ.

16:50-17:10 TuC08.2

Robust Control of Resistive Wall Modes in Tokamak Plasmas Using Mu-Synthesis, pp. 6402-6409.

Dalessio, Joseph Lehigh Univ.
Schuster, Eugenio Lehigh Univ.
Humphreys, D.A. General Atomics
Walker, Michael General Atomics
In, Yongkyoon FAR-Tech. Inc
Kim, Jin-Soo FAR-Tech. Inc.

17:10-17:30 TuC08.3

Loop Filter Design for Phase-Locked Loops with Guaranteed Lock-In Range, pp. 6410-6415.

Chou, Yung-Shan Tamkang Univ.
Chen, Yu-Cheng National Taiwan Univ.
Chang, Fan Ren National Taiwan Univ.

17:30-17:50 TuC08.4

A Software Tool for Robust PID Design, pp. 6416-6421.

Garpinger, Olof Lund Univ.
Hagglund, Tore Professor

17:50-18:10 TuC08.5

Robust Real-Time Control of a Two-Rotor Aerodynamic System, pp. 6422-6427.

Petkov, P.Hr. Tech. Univ. of Sofia
Christov, Nicolai D. Tech. Univ. of Sofia
Konstantinov, Mihail M. Univ. of Architecture & Civil Engineering

18:10-18:30 TuC08.6

Robust Torque Tracking Control for E-IVT Hybrid Powertrain, pp. 6428-6433.

Reyss, Olivier SUPELEC
Duc, Gilles SUPELEC
Pognant-Gros, Philippe RENAULT SA
Sandou, Guillaume SUPELEC

TuC09 311C

Nonlinear System Identification IV (Regular Session)

Chair: Coluccio, Loredana Univ. della Calabria
Co-Chair: Sun, Lianming The Univ. of Kitakyushu

16:30-16:50 TuC09.1

A Decoupling Derivative-Based Approach for Hammerstein System Identification, pp. 6434-6439.

Fedele, Giuseppe Univ. della Calabria
Coluccio, Loredana Univ. della Calabria

16:50-17:10 TuC09.2

Identification of Hammerstein and Wiener Models Using Spectral Magnitude Matching, pp. 6440-6445.

Abd-Elrady, Emad Graz Univ. of Tech.
Gan, Li Graz Univ. of Tech.

17:10-17:30 TuC09.3

Modeling and Identification of Electrohydraulic System and Its Application, pp. 6446-6451.

Xing, Zongyi Nanjing Univ. of Science and Tech.
Gao, Qiang nanjing Univ. of science and Tech.
Wu, Yingying nanjing Univ. of science and Tech. ins

17:30-17:50 TuC09.4

Rational Approximation and Identification of Distributed Parameter Systems, pp. 6452-6457.

Gubarev, Vyacheslav National Acad. of Science of Ukraine, NationalSpaceAgencyof U
Zhukov, Oleksii NationalAcademyofScienceofUkraine,NationalSpaceAgencyofUkraine

17:50-18:10 TuC09.5

Identification of Hammerstein Systems with Set-Valued Observations, pp. 6458-6465.

Zhao, Yanlong Chinese Acad. of Sciences

18:10-18:30 TuC09.6

Polytopic Quasi-LPV Model Based on Neural State-Space Models and Application to Air Charge Control of a SI Engine, pp. 6466-6471.

Abbas, Hossam Hamburg Univ. of Tech.
Werner, Herbert Hamburg Univ. of Tech.

TuC10 311B

Particle Filtering and Monte-Carlo Methods (Regular Session)

Chair: Fu, Li-Chen National Taiwan Univ.
Co-Chair: Shah, Sirish Univ. of Alberta

16:30-16:50 TuC10.1

Constrained State Estimation Using Particle Filters, pp. 6472-6477.

Prakash, Jagadeesan Madras Inst. of Tech.
Shah, Sirish Univ. of Alberta
Patwardhan, Sachin IIT Bombay

16:50-17:10 TuC10.2

Identification of Nonlinear Processes with Known Model Structure under Missing Observations, pp. 6478-6483.

Gopaluni, Ratna Bhushan Univ. of British Columbia

17:10-17:30 TuC10.3
Adaptive Particle Filter with Fixed Empirical Density Quality, pp. 6484-6489.
Straka, Ondrej — Univ. of West Bohemia
Simandl, Miroslav — Univ. of West Bohemia

17:30-17:50 TuC10.4
Estimating Volatility and Model Parameters of Stochastic Volatility Models with Jumps Using Particle Filter, pp. 6490-6495.
Aihara, Shin Ichi — Tokyo Univ. of Science, Suwa
Bagchi, Arunabha — Univ. of Twente
Saha, Saikat — Univ. of Twente

17:50-18:10 TuC10.5
Human Tracking by Importance Sampling Particle Filtering on Omnidirectional Camera Platform, pp. 6496-6501.
Song, Chao-Jung — National Taiwan Univ.
Huang, Cheng-Ming — NATIONAL TAIWAN Univ.
Fu, Li-Chen — National Taiwan Univ.

18:10-18:30 TuC10.6
A Fix-Up for the EKF Parameter Estimator, pp. 6502-6507.
Wiberg, Don — UCSC
Oh, Sewon — AJOU Univ.
Youn, Jung Su — samsung-thales company
Johnson, Luke — Univ. of California, Santa Cruz
Hong, Suk Kyo — Ajou Univ.

TuC11 311A
Adaptive Control by Neural Networks (Regular Session)
Chair: Stefanovic, Margareta — Univ. of Wyoming
Co-Chair: Benallegue, Abdelaziz — Univ. of Versailles St Quentin

16:30-16:50 TuC11.1
Direct Adaptive NN Control of MIMO Nonlinear Discrete-Time Systems Using Discrete Nussbaum Gain, pp. 6508-6512.
Zhai, Lianfei — Northeatern Univ.
Yang, Chenguang — National Univ. of Singapore
Ge, Shuzhi Sam — National Univ. of Singapore
Chai, Tianyou — Northeastern Univ.
Lee, Tong Heng — National Univ. of Singapore

16:50-17:10 TuC11.2
Adaptive Control Via Backstepping Technique and Neural Networks of a Quadrotor Helicopter, pp. 6513-6518.
Madani, Tarek — Univ. of Versailles St Quentin en Yvelines
Benallegue, Abdelaziz — Univ. of Versailles St Quentin

17:10-17:30 TuC11.3
A Fuzzy Neural Network Direct Adaptive Iterative Learning Controller for Robot Manipulators, pp. 6519-6524.
Wang, Ying-Chung — Acad. Sinica
Chien, Chiang-Ju — Huafan Univ.
Lee, Der- Tsai — Acad. Sinica

17:30-17:50 TuC11.4
Neuro Robust Adaptive Descending Control of Space Vehicles, pp. 6525-6529.
Zhang, Ran — North Carolina A&T State Univ.
Weng, Liguo — North Carolina A&T State Univ. & National Inst. of
Cai, Wenchuan — North Carolina A&T State Univ.
Zhang, Mingjin — North Carolina A&T State Univ.
Song, Yong D. — North Carolina A&T State Univ.

17:50-18:10 TuC11.5
Reinforcement Hybrid Evolutionary Learning for TSK-Type Neuro-Fuzzy Controller Design, pp. 6530-6535.
Hsu, Yung-Chi — National Chiao-Tung Univ.
Lin, Sheng-Fuu — National Chiao-Tung Univ.

18:10-18:30 TuC11.6
Performance Improvement in Unfalsified Control Using Neural Networks, pp. 6536-6541.
Cao, Jinhua — Univ. of wyoming
Stefanovic, Margareta — Univ. of Wyoming

TuC12 313
Dependable Control of Discrete Event Systems III (Invited Session)
Chair: Frey, Georg — Univ. of Kaiserslautern
Co-Chair: Niel, Eric — INSA de Lyon
Organizer: Faure, Jean-Marc — ENS Cachan
Organizer: Lesage, Jean-Jacques — ENS de Cachan
Organizer: Frey, Georg — Univ. of Kaiserslautern
Organizer: Papadopoulos, Yiannis Ioannis — Univ. of Hull

16:30-16:50 TuC12.1
A Fault Tolerant Architecture for Supervisory Control of Discrete Event Systems (I), pp. 6542-6547.
Paoli, Andrea — Univ. of Bologna
Sartini, Matteo — Univ.
Lafortune, Stephane — Univ. of Michigan

16:50-17:10 TuC12.2
On-Line Fault Inference for Large-Scale Event-Driven Systems Based on Bayesian Network and Timed Markov Model (I), pp. 6548-6553.
Inagaki, Shinkichi — Nagoya Univ.
Ogawa, Hideyuki — Nagoya Univ.
Suzuki, Tatsuya — Nagoya Univ.

17:10-17:30 TuC12.3
Fault Detection of Discrete Event Systems Using Petri Nets and Integer Linear Programming (I), pp. 6554-6559.
Fanti, Maria Pia — Pol. of Bari
Dotoli, Mariagrazia — Pol. di Bari
Mangini, Agostino Marcello — Pol. di Bari

17:30-17:50 TuC12.4
Towards a Fault Tolerant Manufacturing Control System (I), pp. 6560-6565.
Andreasson, Sven-Arne — Chalmers Univ. of Tech.

17:50-18:10 TuC12.5
A Contribution to the Validation to of Operating Mode Switching: Application to Satellite (I), pp. 6566-6571.
Gonzalez Berlanga, Saul Israel — INSA de Lyon
Niel, Eric — INSA de Lyon
Zouari, Belhassen — FST Tunis
Blanquart, Jean-Paul — EADS Astrium

18:10-18:30 TuC12.6
A Component Based Architecture for the Reconfiguration of Hybrid Systems Using Control Description (I), pp. 6572-6577.
Guadri, Ahmed — Ec. Centrale de Lille
Dangoumau, Nathalie — Lab. d'Automatique, Génie InformatiqueetSignal(LAGIS), Ec.
Craye, Etienne — Ec. Centrale de Lille

TuC13 314
Recent Trends in Multiagents Formation Control (Invited Session)
Chair: Anderson, Brian D.O. — Australian National Univ.
Co-Chair: Yu, Changbin — National ICT Australia
Organizer: Anderson, Brian D.O. — Australian National Univ.
Organizer: Yu, Changbin — National ICT Australia

16:30-16:50 TuC13.1
Reduction of Self-Localization Errors in Multi-Agent Autonomous Formations (I), pp. 6578-6583.
Shames, Iman — Australian National Univ.
Fidan, Baris — National ICT Australia
Anderson, Brian D.O. — Australian National Univ.

16:50-17:10 TuC13.2
Agent and Link Redundancy for Autonomous Formations (I), pp. 6584-6589.
Yu, Changbin — National ICT Australia
Anderson, Brian D.O. — Australian National Univ.

17:10-17:30 TuC13.3
Generalized Controller for Directed Triangle Formations (I), pp. 6590-6595.
Cao, Ming — Princeton Univ.
Yu, Changbin — National ICT Australia
Morse, A. Stephen — Yale Univ.
Anderson, Brian D.O. — Australian National Univ.
Dasgupta, Soura — Univ. of Iowa

17:30-17:50 TuC13.4
Formation Control of Heterogeneous Multi-Robot Systems (I), pp. 6596-6601.

Wang, Qining — Peking Univ.
Wu, Ming — the second artillery engineering Coll.
Huang, Yan — Peking Univ.
Wang, Long — Peking Univ.

17:50-18:10 TuC13.5
Distributed Formation Control for Target-Enclosing Operations Based on a Cyclic Pursuit Strategy (I), pp. 6602-6607.
Hara, Shinji — The Univ. of Tokyo
Kim, Tae-Hyoung — Japan Science and Tech. Agency
Hori, Yutaka — The Univ. of Tokyo

18:10-18:30 TuC13.6
Fault Tolerant, Scalable Multi-Agent Control under Medium Access Constraints (I), pp. 6608-6613.
Vemulapalli, Manish — Univ. of Iowa
Dasgupta, Soura — Univ. of Iowa
Kuhl, Jon — Univ. of Iowa

TuC14 318
Control Over Networks III (Regular Session)
Chair: Basar, Tamer — Univ. of Illinois at Urbana-Champaign
Co-Chair: Qiu, Li — Hong Kong Univ. of Sci. & Tech.

16:30-16:50 TuC14.1
A Descriptor Systems Approach to Robust Exponential Stability of Networked Control Systems, pp. 6614-6619.
Zhang, Qingling — Northeastern Univ.
Zheng, Meng — Northeastern Univ.
Song, Min — Northeastern Univ.
Li, Chunji — Northeastern Univ.
Duan, Xiao-dong — Dalian Nationalities Univ.
An, Yichun — Northeastern Univ.

16:50-17:10 TuC14.2
Tracking Performance Limitations in a Linear Feedback System with Remote Sensors, pp. 6620-6625.
Su, Weizhou — South China Univ. of Tech.
Petersen, Ian R. — UNSW at Australian Def. Force Acad.
Qiu, Li — Hong Kong Univ. of Sci. & Tech.

17:10-17:30 TuC14.3
State Feedback Controller Design of Networked Control Systems with Time Delay and Packet Dropout, pp. 6626-6631.
Li, HongBo — Tsinghua Univ.
Sun, Zengqi — Tsinghua Univ.
Chow, Mo-Yuen — North Carolina State Univ.
Chen, Badong — Tsinghua Univ.

17:30-17:50 TuC14.4
Optimal Estimation Over Channels with Limits on Usage, pp. 6632-6637.
Basar, Tamer — Univ. of Illinois at Urbana-Champaign
Bommannavar, Praveen — Univ. of Illinois at Urbana-Champaign

17:50-18:10 TuC14.5
Stability and Passivity of Complex Spatio-Temporal Switching Networks with Coupling Delays, pp. 6638-6641.
Yao, Jing — Tongji Univ.
Wang, Hua O. — Boston Univ.
Guan, Zhi-Hong — Huazhong Univ. of Science & Tech.
Xu, Weisheng — Tongji Univ.

18:10-18:30 TuC14.6
Design of Multiple Actuator-Link Control Systems with Packet Dropouts, pp. 6642-6647.
Quevedo, Daniel E. — The Univ. of Newcastle
Silva, Eduardo I — The Univ. of Newcastle
Nesic, Dragan — Univ. of Melbourne

TuC15 317
Image-Based Biological and Medical Systems Modeling (Invited Session)
Chair: Feng, David Dagan — Hong Kong Pol. Univ.
Co-Chair: Huang, Sung-Cheng — UCLA David Geffen School of Medicine
Organizer: Feng, David Dagan — Hong Kong Pol. Univ.

16:30-16:50 TuC15.1
Adaptive Bolus Chasing Computed Tomography Angiography (I), pp. 6648-6653.
Bai, Er-Wei — Univ. of Iowa
Cai, Zhijun — Univ. of Iowa
Wang, Ge — Univ. of Iowa

16:50-17:10 TuC15.2
Detection of Measurement Outliers in Tracer Kinetics (I), pp. 6654-6657.
Huang, Sung-Cheng — UCLA David Geffen School of Medicine

17:10-17:30 TuC15.3
Model-Based Prediction of the Individual N-Repetition Maximum with Application to Physical Rehabilitation (I), pp. 6658-6663.
Schrempf, Andreas — Univ. of Applied Sciences, Upper Austria
Habelsberger, Winfried — Gebeitskrankenkasse Upper Austria

17:30-17:50 TuC15.4
A Whole Body Model of FDG Metabolism Based on VHP Datasets (I), pp. 6664-6668.
Bai, Jing — Tsinghua Univ.
Qiao, Huiting — Tsinghua Univ.

17:50-18:10 TuC15.5
Reliable Model and Cluster Aided Formation of Parametric Images in Functional Imaging (I), pp. 6669-6674.
Wen, Lingfeng — Univ. of Sydney
Eberl, Stefan — Royal Prince Alfred Hospital
Feng, David Dagan — Hong Kong Pol. Univ.

18:10-18:30 TuC15.6
Macrostructural Biofilm Characterization Via Textural Image Analysis by SGLDM and GLRLM (I), pp. 6675-6680.
Pons, Marie-Noelle — ENSIC
Milferstedt, Kim — Univ. of Illinois at Urbana-Champaign
Morgenroth, Eberhard — Univ. of Illinois at Urbana-Champaign

TuC16 316
Automation for Improving International Stability (Invited Session)
Chair: Kopacek, Peter — Vienna Univ. of Tech.
Co-Chair: Han, Man-Wook — Vienna Univ. of Tech.
Organizer: Kopacek, Peter — Vienna Univ. of Tech.

16:30-16:50 TuC16.1
Choices for Global Social Stability (I), pp. 6681-6685.
Kile, Frederick — Microtrend
Dimirovski, Georgi Marko — Dogus Univ. of Istanbul

16:50-17:10 TuC16.2
Models for International Stability (I), pp. 6686-6690.
Erbe, Heinz — Tech. Univ. Berlin
Kopacek, Peter — Vienna Univ. of Tech.

17:10-17:30 TuC16.3
Systems Security Problems and Cultural Meanings in Control and Automation Systems: Empirical Evidence for Value Conflicts in Systems Engineering (I), pp. 6691-6696.
Freeman, Amanda — Waterford Inst. of Tech.
Stapleton, Larry — School of Science, Waterford Inst. of Tech.

17:30-17:50 TuC16.4
Progressive Adaptive Mechanisms for the International Cooperation, pp. 6697-6702.
Tsyganov, Vladimir — Inst. of Control Sciences Russian Acad. of Sciences

17:50-18:10 TuC16.5
Power Industry Computer Control System Design and Implementation Problems: A Case Study of Poland (I), pp. 6703-6708.
Lewoc, Jozef Bohdan — Design, Res. and Translation
Han, Man-Wook — Vienna Univ. of Tech.

18:10-18:30 TuC16.6
Technological Development and the Human System (I), pp. 6709-6714.
Genser, Robert — IFAC-Beirat Austria

TuC17	320A
Measurement (Highlight Session)	

Chair: Oh, KiJang — POSCO
Co-Chair: Choi, Seho — POSCOLAB, POSCO

16:30-16:50 — TuC17.1
On-Line Red-Scale Measurement System for Wire Rod Coil (I), pp. 6715-6716.
Choi, Seho — POSCOLAB, POSCO
Bae, Homoon — POSCO

16:50-17:10 — TuC17.2
On-Line Overlap Measurement System for the Joining Part of Endless Rolling (I), pp. 6717-6718.
Kang, Myoungkoo — posco
Kim, Yongsoo — posco

17:10-17:30 — TuC17.3
Development of Numerical Model & Temperature Monitoring System for Inductive Heater Oven (I), pp. 6719-6720.
Jung, Wonchul — POSTECH
You, Jongwoo — POSCO
Won, Sangchul — Pohang Univ. of Science & Tech.

17:30-17:50 — TuC17.4
Development of Surface Inspection System for Wire Rod (I), pp. 6721-6722.
Park, Chang Hyun — POSTECH
Choi, Seho — POSCOLAB, POSCO
Bae, Homoon — POSCO
Hwang, Hwawon — POSCO
Kang, Dongyeop — POSTECH
Won, Sangchul — Pohang Univ. of Science & Tech.

17:50-18:10 — TuC17.5
The 3D Position Recognition of Multiple Coils Using Ellipse Fitting with Probabilistic Edge Detection with Stereo Cameras (I), pp. 6723-6728.
Lee, Dongwook — POSTECH
Kim, Sehoon — POSTECH
Kim, Dowan — POSTECH
Won, Sangchul — Pohang Univ. of Science & Tech.

18:10-18:30 — TuC17.6
On-Line Punchless Detection of Laser Welding Part of Cold-Rolling Steel Strip (I), pp. 6729-6730.
Lim, ChoongSoo — POSCO
Oh, KiJang — POSCO
Huh, HyeongJun — POSCO
Park, HyunChul — POSCO

TuC18	320B
Robotics for LCD & Semiconductor Industry (Highlight Session)	

Chair: Kim, Dong-Il — Samsung Electronics
Co-Chair: Kanitani, Kiyoshi — Nachi-Fujikoshi Corp.
Organizer: Song, Ji Oh — Samsung Electronics

16:30-16:50 — TuC18.1
Advanced Control Techniques for Semiconductor and Flat Panel Display Substrate Handling Robots, pp. 6731-6738.
Hosek, Martin — Brooks Automation, Inc.
Moura, Jairo Terra — Brooks Automation, Inc.

16:50-17:10 — TuC18.2
Flexible Manufacturing by Application of RFID and Sensors in Robot Cell Manufacturing Systems, pp. 6739-6744.
Matsuoka, Makoto — Omron Corp.
Watanabe, Tohru — Ritsumeikan Univ.

17:10-17:30 — TuC18.3
Reliability of Large Sized FPD Panel Handling Robot (I), pp. 6745-6746.
Kanitani, Kiyoshi — Nachi-Fujikoshi Corp.

17:30-17:50 — TuC18.4
Fatigue Life Prediction of the LCD Transfer Robot Frame (I), pp. 6747-6748.
Park, Joong Kyung — SAMSUNG Electronics Co., LTD.
Yim, Hong Jae — Kookmin Univ.
Seo, Jong Hwi — SAMSUNG Electronics Co., LTD.
Seo, Soong Young — SAMSUNG Electronics Co., LTD.
Hwang, Jae Chul — Samsung Electronics Co.,Ltd.
Choi, Yong Won — Samsung Electronics Co.,Ltd.

17:50-18:10 — TuC18.5
Error Compensation of a Large Scale LCD Glass Transfer Robot (I), pp. 6749-6750.
Hwang, Jae Chul — Samsung Electronics Co.,Ltd.
Seo, Jong Hwi — SAMSUNG Electronics Co., LTD.
Choi, Yong Won — Samsung Electronics Co.,Ltd.
Yim, Hong Jae — Kookmin Univ.

TuC19	320C
Robot Manipulators III (Regular Session)	

Chair: D'Ippolito, Filippo — Univ. di Palermo
Co-Chair: Melchiorri, Claudio — Univ. of Bologna

16:30-16:50 — TuC19.1
Force Tracking Impedance Control with Variable Target Stiffness, pp. 6751-6756.
Lee, Kwang-Kyu — TUM

16:50-17:10 — TuC19.2
Adaptive Control of Multi-Fingered Robot Hand Using Quaternion, pp. 6757-6762.
Ueki, Satoshi — Gifu Univ.
Kawasaki, Haruhisa — Gifu Univ.
Mouri, Tetsuya — Gifu Univ.

17:10-17:30 — TuC19.3
Robot Force and Impact Control with Feedforward Switching, pp. 6763-6768.
Zotovic, Ranko — Univ. Pol. de Valencia
Valera, Angel — Univ. Pol. de Valencia

17:30-17:50 — TuC19.4
Generalized Proportional Integral Control for a Robot with Flexible Finger Gripper, pp. 6769-6775.
Becedas, Jonathan — Univ. de Castilla-La Mancha
Payo, Ismael — Univ. of Castilla-La Mancha
Feliu, Vicente — Univ. of Castilla-La Mancha
Sira-Ramirez, Hebertt J. — CINVESTAV-IPN

17:50-18:10 — TuC19.5
Planning Setpoints for Contact Force Transitions in Regrasp Tasks of 3D Objects, pp. 6776-6781.
Grosch, Patrick — Tech. Univ. of Catalonia
Suarez, Raul — Univ. Pol. de Catalunya
Carloni, Raffaella — Univ. of Bologna
Melchiorri, Claudio — Univ. of Bologna

18:10-18:30 — TuC19.6
Adaptive Interaction Robot Control with Estimation of Contact Force, pp. 6782-6785.
D'Ippolito, Filippo — Univ. di Palermo
Alonge, Francesco — Univ. of Palermo
Bruno, Antonino — Univ. of Palermo

TuC20	321C
Mobile Robot Control III (Regular Session)	

Chair: van den Boom, Ton J. J. — Delft Univ. of Tech.
Co-Chair: Khorrami, Farshad — Pol. Univ.

16:30-16:50 — TuC20.1
Minimum-Time Control of a Two-Wheeled Differentially Driven Vehicle in the Presence of Slip, pp. 6786-6791.
Piccagli, Stefano — Univ. degli Studi di Brescia
van den Boom, Ton J. J. — Delft Univ. of Tech.
Visioli, Antonio — Univ. of Brescia

16:50-17:10 — TuC20.2
Obstacle Avoidance for Wheeled Robots in Unknown Environments Using Model Predictive Control, pp. 6792-6797.
Yoon, Yongsoon — Seoul National Univ.
Choe, Tokson — agency for defense development
Park, Yongwoon — agency for defense development
Kim, H. Jin — Seoul National Univ.

17:10-17:30 — TuC20.3
Obstacle Avoidance for Unmanned Sea Surface Vehicles: A Hierarchical Approach, pp. 6798-6803.
Krishnamurthy, Prashanth — Pol. Univ.
Khorrami, Farshad — Pol. Univ.
Ng, Tzer Leei — Pol. Univ.

17:30-17:50 — TuC20.4
Reactive Navigation of a Mobile Robot in Unknown Environments, pp. 6804-6809.
Luh, Guan-Chun — Tatung Univ.
Liu, Wei-Wen — Tatung Univ.

Lin, Huang-Kai — Tatung Univ.

17:50-18:10 TuC20.5

A Hybrid Systems Approach to Closed-Loop Navigation of Electromagnetically Actuated Satellite Formations Using Potential Functions, pp. 6810-6814.

Ahsun, Umair — Air Univ.
Miller, David W. — Massachusetts Inst. of Tech.
Ahmed, Shakil — CESAT, NESCOM

18:10-18:30 TuC20.6

Decentralized Formation Control of Multi Vehicles Systems with Non-Holonomic Constraints Using Artificial Potential Field, pp. 6815-6820.

Sisli, Ufuk Yetis — Istanbul Tech. Univ.
Temeltas, Hakan — Istanbul Tech. Univ.

TuC21 321B

Low-Cost Safe Embedded Control System (Invited Session)

Chair: Bayart, Mireille — Univ. de Lille1, LAGIS
Co-Chair: Wang, Wei — Dalian Univ. of Tech.
Organizer: Bayart, Mireille — Univ. de Lille1, LAGIS

16:30-16:50 TuC21.1

Embedded Implementation of Mobile Robots Control (I), pp. 6821-6826.

Valera, Angel — Univ. Pol. de Valencia
Valles, Marina — Assistant Professor
Albertos, Pedro — Univ. Pol. de Valencia
Simarro, Raul — Univ. Pol. de Valencia.
Benítez Sánchez, Ignacio — Pol. Univ. of Valencia

16:50-17:10 TuC21.2

Distribution Diagnosis of Networked Embedded System (I), pp. 6827-6832.

Bayart, Mireille — Univ. de Lille1, LAGIS

17:10-17:30 TuC21.3

Framework for Reliability Evaluation of Networked Control Systems (I), pp. 6833-6838.

Ghostine, Rony — CRAN
Thiriet, Jean-Marc — CNRS-INPG-UJF
Aubry, Jean-François — INPL
Robert, Michel — Univ. Henri Poincaré Nancy 1

17:30-17:50 TuC21.4

Reliability Increasing through Networked Cascade Control Structure – Consideration of Quasi-Redundant Subsystems (I), pp. 6839-6844.

Galdun, Jan — Tech. Univ. of Košice
Ligus, Jan — Tech. Univ. of Košice
Thiriet, Jean-Marc — CNRS-INPG-UJF
Sarnovsky, Jan — Tech. Univ. of Košice

17:50-18:10 TuC21.5

A Low Cost Embedded Control System of Step Motor and Its Application (I), pp. 6845-6849.

Wang, Yong — Dalian Univ. of Tech.
Liu, Quanli — Dalian Univ. of Tech.
Wang, Wei — Dalian Univ. of Tech.
Zhan, Zili — Dalian Seasky Automation Co., Ltd

TuC22 321A

Fuzzy Logic Control Systems (Regular Session)

Chair: Anthierens, Cedric — Inst. des Sciences du Mouvement UMR6233
Co-Chair: Behera, Laxmidhar — Indian Inst. of Tech. Kanpur

16:30-16:50 TuC22.1

Fuzzy Model-Based Model Following Control for a Class of Nonlinear Systems, pp. 6850-6854.

Ohtake, Hiroshi — Univ. of Electro-communications
Tanaka, Kazuo — Univ. of Electro-Communications
Wang, Hua O. — Boston Univ.

16:50-17:10 TuC22.2

Network Inversion Based Controller Design for Discrete T-S Model, pp. 6855-6860.

Kar, Indrani — Indian Inst. of Tech. Kanpur
P., Premkumar — Indian Inst. of Tech. Kanpur
Behera, Laxmidhar — Indian Inst. of Tech. Kanpur

17:10-17:30 TuC22.3

A Sum of Squares Approach to Guaranteed Cost Control of Polynomial Discrete Fuzzy Systems, pp. 6861-6866.

Tanaka, Kazuo — Univ. of Electro-Communications
Ohtake, Hiroshi — Univ. of Electro-communications
Wang, Hua O. — Boston Univ.

17:30-17:50 TuC22.4

The T-S Fuzzy Design and Implementation for Nonlinear Motion Systems with Control Redundancy, pp. 6867-6872.

Shing, Chong-Cheng — National Chiao-Tung Univ.
Lin, Yee-Chang — National Chiao-Tung Univ.
Hsu, Pau-Lo — National Chiao Tung Univ.

17:50-18:10 TuC22.5

Design of a Visual Comfort Sensor for Daylighting Devices, pp. 6873-6878.

Leclercq, Maximilien — Sherpa Engineering
Anthierens, Cedric — Inst. des Sciences du Mouvement UMR6233
Bideaux, Eric — INSA of Lyon
Flambard, Luc — Sherpa Engineering

18:10-18:30 TuC22.6

Enhancing the Flight Simulator Feeling by Minimising Backlash-Effects, pp. 6879-6884.

Amara, Zied — ENSICA
Berard, Caroline — SUPAERO
Bordeneuve-Guibé, Joel — ENSICA

TuC23 323

Industrial Applications of Distributed Real-Time Object-Computing (Invited Session)

Chair: Pereira, Carlos Eduardo — Federal Univ. of Rio Grande do Sol
Co-Chair: Sanz, Ricardo — Univ. Pol. de Madrid
Organizer: Pereira, Carlos Eduardo — Federal Univ. of Rio Grande do Sol
Organizer: Wehrmeister, Marco Aurelio — UFRGS
Organizer: Sanz, Ricardo — Univ. Pol. de Madrid

16:30-16:50 TuC23.1

Evaluating Aspect and Object-Oriented Concepts to Model Distributed Embedded Real-Time Systems Using RT-UML (I), pp. 6885-6890.

Wehrmeister, Marco Aurelio — UFRGS
Freitas, Edison Pignaton — UFRGS
Orfanus, Dalimir — Univ. of Paderborn
Pereira, Carlos Eduardo — Federal Univ. of Rio Grande do Sol
Rammig, Franz — Univ. of Paderborn HNI

16:50-17:10 TuC23.2

Automated Configuration of Component-Based Distributed Real-Time and Embedded Systems from Feature Models (I), pp. 6891-6896.

White, Jules — Vanderbilt Univ.
Schmidt, Douglas C. — Vanderbilt Univ.

17:10-17:30 TuC23.3

Embedded Component Technology for Complex Control Systems (I), pp. 6897-6902.

Sanz, Ricardo — Univ. Pol. de Madrid
Rodriguez, Manuel — Univ. Pol. de Madrid
Martínez, Carlos — Univ. Pol. de Madrid
Hernando, Adolfo — Univ. Pol. de Madrid

17:30-17:50 TuC23.4

Distributed Object-Based Architecture for Controlling Autonomous Vehicles (I), pp. 6903-6908.

Silva, Ronaldo Aparecido — UFSC
Kelber, Christian — UNISINOS
Rico, Julio Normey — Escuela Superior de Ingenieros de Sevill
Becker, Leandro — Federal Univ. of Santa Catarina

17:50-18:10 TuC23.5

The UML – MARTE Standardized Profile (I), pp. 6909-6913.

Gerard, Sebastien — CEA LIST
Selic, Bran — IBM

TuC24 324

Reliability & Safety Analysis: Fault Diagnosis by Discrete Event Systems (Regular Session)

Chair: Zhao, Qing — Univ. of Alberta

Co-Chair: Demmou, Hamid — LAAS -CNRS - Univ. of Toulouse

16:30-16:50 TuC24.1

Fault Diagnosis Using a Timed Discrete Event Approach Based on Interval Observers, pp. 6914-6919.

Meseguer, Jordi — Univ. Pol. de Catalunya (UPC)
Puig, Vicenc — Univ. Pol. de Catalunya
Escobet, Teresa — Univ. Pol. de Catalunya

16:50-17:10 TuC24.2

Reliability Monitoring of Fault Tolerant Control Systems, pp. 6920-6925.

Li, Hongbin — Univ. of Alberta
Zhao, Qing — Univ. of Alberta
Yang, Zhenyu — Aalborg Univ. Esbjerg

17:10-17:30 TuC24.3

Pertinent Scenarios in Temporal Petri Nets for Critical System Analysis, pp. 6926-6931.

Sadou, Nabil — LAAS - CNRS, Univ. of Toulouse
Demmou, Hamid — LAAS -CNRS - Univ. of Toulouse

17:30-17:50 TuC24.4

A Barrier Certificate Approach to the Verification of the Safe Operation of a Chemical Reactor, pp. 6932-6937.

Shah, Gaurang — Tech. Univ. Dortmund
Volker, Marten — Chair of Process Control
Sonntag, Christian — Univ. Dortmund
Engell, Sebastian — Univ. of Dortmund

17:50-18:10 TuC24.5

A Safety Barriers-Based Approach for the Risk Analysis of Socio-Technical Systems, pp. 6938-6943.

Leger, Aurélie — Nancy Univ. Res. Center for Automatic Control,CNRS, UM
Farret, Régis — INERIS
Duval, Carole — Company
Levrat, Eric — Univ.
Weber, Philippe — Nancy Univ. CNRS, (CRAN UMR 7039)
Iung, Benoît — Nancy Univ.

18:10-18:30 TuC24.6

Diagnostics of Industrial Processes in Decentralised Structures with Application of Fuzzy Logic, pp. 6944-6949.

Koscielny, Jan — Warsaw Univ. of Tech.
Bartys, Michal, Zbigniew — Warsaw Univ. of Tech.
Syfert, MichaB; — Warsaw Univ. of Tech.

TuC25 328

Model Predictive and Optimization-Based Control (Regular Session)

Chair: Rossiter, J. Anthony — Univ. of Sheffield
Co-Chair: Skogestad, Sigurd — Norwegian Univ. of Science and Tech.

16:30-16:50 TuC25.1

Stable IHMPC for Unstable Systems, pp. 6950-6955.

Gonzalez, Alejandro, Hernan — Univ. of São Paulo
Sotomayor, Oscar — Pol. School of the Univ. of Sao Paulo
Odloak, Darci — Univ. of São Paulo - Brazil

16:50-17:10 TuC25.2

Explicit MPC with Output Feedback Using Self-Optimizing Control, pp. 6956-6961.

Manum, Henrik — Norwegian Univ. of Science and Tech.
Narasimhan, Sridharakumar — Norwegian Univ. of Science and Tech. (NTNU)
Skogestad, Sigurd — Norwegian Univ. of Science and Tech.

17:10-17:30 TuC25.3

Development and Application of an Integrated MPC Technology, pp. 6962-6967.

Zhu, Yucai — Eindhoven Univ. of Tech.
Xu, Zuhua — Zhajiang Univ.
Zhao, Jun — Zhejiang Univ.
Han, Kai — Zhejiang Univ.
Qian, Jixin — Zhejiang Univ.
Li, Weixin — Sinopec Yangtze Petrochemical Company

17:30-17:50 TuC25.4

Conditions for Which MPC Fails to Converge to the Correct Target, pp. 6968-6973.

Shead, Leo Roger Edward — Univ. of Sheffield
Muske, Kenneth R. — Villanova Univ.
Rossiter, J. Anthony — Univ. of Sheffield

17:50-18:10 TuC25.5

Fast Model Predictive Control Using Online Optimization, pp. 6974-6979.

Wang, Yang — Stanford Univ.
Boyd, Stephen P. — Stanford Univ.

18:10-18:30 TuC25.6

Multiobjective Optimization for Automatic Tuning of Robust Model Based Predictive Controllers, pp. 6980-6985.

Vega, Pastora — Univ. of Salamanca
Francisco, Mario — Univ. of Salamanca
Tadeo, Fernando — Univ. of Valladolid Q4718001C

TuC26 327

Modeling, Operation and Control of Power Systems III (Regular Session)

Chair: Lee, Kwang Y. — Baylor Univ.
Co-Chair: Sawodny, Oliver — Univ. of Stuttgart

16:30-16:50 TuC26.1

Introducing Model Predictive Control for Improving Power Plant Portfolio Performance, pp. 6986-6991.

Edlund, Kristian — Dong Energy
Bendtsen, Jan Dimon — Aalborg Univ.
Břrresen, Simon — DONG Energy
Mřlbak, Tommy — DONG Energy

16:50-17:10 TuC26.2

An Optimal Adaptive Control Approach for Power Systems, pp. 6992-6997.

Geng, Bo — Tsinghua Univ.
Luo, Guiming — Tsinghua Univ.
Kwon, Wook Hyun — Seoul National Univ.

17:10-17:30 TuC26.3

Criteria for Evaluation of Power Balance Control Performance in UCTE Transmission Grid, pp. 6998-7003.

Havel, Petr — Czech Tech. Univ.
Horacek, Petr — Czech Tech. Univ. in Prague
Janecek, Eduard — Univ. of West Bohemia
Fantik, Josef — CEPS a.s.

17:30-17:50 TuC26.4

Dynamic Investigation of Network Restoration by the Pumped-Storage Plant Markersbach in Germany, pp. 7004-7009.

Krüger, Manfred — Univ. of Rostock
Weber, Harald — Univ. of Rostock

17:50-18:10 TuC26.5

Passivity Based Control of Power Plants, pp. 7010-7015.

Wen, Chengtao — Carnegie Mellon Univ.
Ydstie, B. Erik — Carnegie Mellon

18:10-18:30 TuC26.6

Modelling, Simulation, Identification, and Model-Based Control of Integrated Fuel-Cell-Based Power Plants, pp. 7016-7021.

Weickgenannt, Martin — Univ. of Stuttgart
Kharitonov, Alexander — Univ. of Stuttgart
Gepert, Vanessa — Univ. of Stuttgart
Sawodny, Oliver — Univ. of Stuttgart

TuC27 326

Modeling and Identification with Fuzzy and Neural Techniques (Regular Session)

Chair: Sreenatha, Anavatti G. — Australian Defence Force Acad.
Co-Chair: Herreros, Alberto — Univ. of Valladolid

16:30-16:50 TuC27.1

Structure Adaptation of Multi-Layer Perceptron Network for On-Line System Identification, pp. 7022-7027.

Hering, Pavel — Univ. of West Bohemia
Simandl, Miroslav — Univ. of West Bohemia

16:50-17:10 TuC27.2

Improved Training of an Optimal Sparse Least Squares Support Vector Machine, pp. 7028-7033.

Xia, Xiao Lei — Queen's Univ. Belfast
Li, Kang — Queen's Univ. Belfast
Irwin, George W. — Queen's Univ. of Belfast

17:10-17:30 TuC27.3

Interpretability-Accuracy Improvement in a Neuro-Fuzzy ART Based Model of a DC Motor, pp. 7034-7039.

Galende, Marta — Fundación CARTIF
Sainz, Gregorio — Univ. de Valladolid
De La Fuente, Maria Jesus — Univ. De Valladolid. Q4718001C
Herreros, Alberto — Univ. of Valladolid

17:30-17:50 TuC27.4

Fuzzy Mechanism Model with Neural Compensation for Estimation of Shaft Furnace's Product Quality, pp. 7040-7045.

Wu, Fenghua — Northeastern Univ.
Chai, Tianyou — Northeastern Univ.
Yu, Wen — CINVESTAV-IPN

17:50-18:10 TuC27.5

Stable Learning Algorithm Approaches for ANFIS As an Identifier, pp. 7046-7051.

Aliyari Shoorehdeli, Mahdi — Science & Res. Branch Islamic Azad Univ.
Teshnehlab, Mohammad — k. n. toosi Univ. of Tech.
Khaki Sedigh, Ali — K.N. Toosi Univ. of Tech.

18:10-18:30 TuC27.6

Modelling, Control and Optimization of a Continuous Distillation Tower through Fuzzy Techniques, pp. 7052-7057.

Santafé-Moros, Asunción — Univ. Pol. de Valencia
Díez, José Luis — Univ. Pol. de Valencia
Barceló-Rico, Fátima — Univ. Pol. de Valencia
Gozalvez-Zafrilla, Jose M. — Univ. Pol. de Valencia

TuC28 330A
New Trends in Powertrain Control (Regular Session)

Chair: Soliman, Ahmed — OSU
Co-Chair: Alamir, Mazen — Gipsa-Lab. (CNRS-Univ. of Grenoble)

16:30-16:50 TuC28.1

Optimization of Heavy Truck's Driveline Performance Via Model Predictive Control Rated by a Comfort Evaluation Algortihm, pp. 7058-7063.

Webersinke, Lena — Univ. Karlsruhe
Feth, Daniela — Univ. Karlsruhe
Hertweck, Mario — Daimler AG
von Vietinghoff, Anne — Univ. Karlsruhe (TH)
Kiencke, Uwe — Univ. of Karlsruhe

16:50-17:10 TuC28.2

Statistical Engine Knock Control, pp. 7064-7065.

Stotsky, Alexander A. — Volvo Car Corp.

17:10-17:30 TuC28.3

Leakage Detection in a Fuel Evaporative System, pp. 7066-7071.

Frisk, Erik — Linkoping Univ.
Krysander, Mattias — Linköping Univ.

17:30-17:50 TuC28.4

Model-Based Fault Diagnosis of a NOx Aftertreatment System, pp. 7072-7078.

Pisu, Pierluigi — Clemson Univ.
Canova, Marcello — The Ohio State Univ.
Soliman, Ahmed — OSU

17:50-18:10 TuC28.5

Unified MPC Strategy for Idle-Speed Control, Vehicle Start-Up and Gearing Applied to an Automated Manual Transmission, pp. 7079-7085.

Amari, Rachid — IFP
Alamir, Mazen — Gipsa-Lab. (CNRS-Univ. of Grenoble)
Tona, Paolino — IFP

18:10-18:30 TuC28.6

Semi-Physical Neural Network Model in Detecting Engine Transient Faults Using the Local Approach, pp. 7086-7090.

Wang, Xun — Queen's Univ. Belfast
McDowell, Neil — Queen's Univ. Belfast
Kruger, Uwe — The Petroleum Inst.
McCullough, Geoffrey — Internal Combustion Engines Res. Group
Irwin, George W. — Queen's Univ. of Belfast

TuC29 330B
Sensors, Virtual Sensors and Observers (Regular Session)

Chair: Basset, Michel — Univ. de Haute-Alsace
Co-Chair: El Hajjaji, Ahmed — Univ. de Picardie-Jules Verne

16:30-16:50 TuC29.1

Vehicle Roll and Road Bank Angles Estimation, pp. 7091-7097.

Sebsadji, Yazid — INRETS-LCPC
Glaser, Sébastien — INRETS-LCPC
Mammar, Saďd — CNRS
Netto, Mariana — LIVIC - LCPC/INRETS

16:50-17:10 TuC29.2

Non-Fragile Observer-Based Control of Vehicle Dynamics Using T-S Fuzzy Approach, pp. 7098-7103.

El Messoussi, Wissam — Univ. of Picardie Jules Verne
Bosche, Jerome — Univ. of Amiens
Pages, Olivier — Univ. of Picardie Jules Verne
El Hajjaji, Ahmed — Univ. de Picardie-Jules Verne

17:10-17:30 TuC29.3

A Novel Approach to Real Time Tire-Road Grip and Slip Monitoring, pp. 7104-7109.

Andrieux, Arnaud — Renault SAS
Lengellé, Régis — Univ. of Tech. of Troyes
Beauseroy, Pierre — Univ. de Tech. de Troyes
Chabanon, Christian — Renault SAS

17:30-17:50 TuC29.4

An Estimation Process for Vehicle Wheel-Ground Contact Normal Forces, pp. 7110-7115.

Doumiati, Moustapha — Univ. de Tech. de compičgne
Victorino, Alessandro — Univ. de Tech. de Compičgne
Charara, Ali — Univ. de Tech. de Compičgne
Baffet, Guillaume — Univ. de Tech. de Compičgne
Lechner, Daniel — INRETS-MA Lab. Departement of accident mechanismanalysis

17:50-18:10 TuC29.5

Vison-Based Determination of Wheel Camber Angle and Tire Deflection, pp. 7116-7121.

Lamy, Christophe — Univ. de Haute Alsace
Basset, Michel — Univ. de Haute-Alsace

18:10-18:30 TuC29.6

A Single Chip Packaged MEMS G Sensor for Industrial Applications, pp. 7122-7123.

Yoo, Kwangho — SML Electronics, Inc.
Ahn, Taedong — SML Electronics Inc.
Lee, Seungcheol — Mando Corp.
Lim, Jungtaek — Mando Corp.
Kim, Seongsoo — Mando Corp.
Kim, Daehoon — LG Innotek
Cho, Dong-il Dan — Seoul National Univ.

TuC30 330C
Navigation (Regular Session)

Chair: Verriest, Erik I. — Georgia Inst. of Tech.
Co-Chair: Shim, Duk Sun — Chung-Ang Univ.

16:30-16:50 TuC30.1

Interception of a Moving Object in a FIFO Graph, pp. 7124-7129.

Hizem, Mohamed Mejdi — Ec. Lille
Castelain, Emmanuel — Ec. Lille
Toguyeni, Armand — Ec. Lille

16:50-17:10 TuC30.2

Road Navigation System Monitoring Using a Pseudorange Snapshot Test, pp. 7130-7135.

Fouque, Clément — Univ. de Tech. de Compičgne
Bonnifait, Philippe Pascal Patrick — Univ. of Tech. of Compiegne

17:10-17:30 TuC30.3

A Variant to Naismith's Problem with Application to Path Planning, pp. 7136-7141.

Verriest, Erik I. — Georgia Inst. of Tech.

17:30-17:50 TuC30.4

Accommodation Rule of Double Faults for Seven Inertial Sensors, pp. 7142-7147.

Yang, Cheol-Kwan — Chung-Ang Univ.
Shim, Duk Sun — Chung-Ang Univ.

17:50-18:10 TuC30.5

An Intersection Model Based on the Gsom Model, pp. 7148-7153.

Haj-Salem, Habib — INRETS
Lebacque, Jean-Patrick — INRETS

Mammar, Salim SETRA

18:10-18:30 TuC30.6

Urban Traffic Control Problem: A Game Theory Approach, pp. 7154-7159.

Alvarez, Israel CINVESTAV-IPN
Poznyak, Alexander S. CINVESTAV-IPN
Malo, Alejandro CINVESTAV-IPN

TuCCC 401

Milestone Report by IFAC Coordinating Committee on Power and Process Systems (CC6) (Milestone Session)

Chair: Dochain, Denis Univ. Catholique de Louvain

16:30-18:30 TuCCC.1

Monitoring and Control of Process and Power Systems : Adapting to Environmental Challenges, Increasing Competitivity and Changing Customer and Consumer Demands, pp. 7160-7171.

Dochain, Denis Univ. Catholique de Louvain
Marquardt, Wolfgang RWTH Aachen Univ.
Won, Sangchul Pohang Univ. of Science & Tech.
Malik, O.P. The Univ. of Calgary
Kinnaert, Michel Univ. Libre de Bruxelles
Lunze, Jan Ruhr-Univ. Bochum

WePL1 Auditorium (301)

Perspectives on System Identification by Lennart Ljung (Plenary Session)

Chair: Hara, Shinji The Univ. of Tokyo

08:00-09:00 WePL1.1

Perspectives on System Identification, pp. 7172-7184.

Ljung, Lennart Linköping Univ.

WePL2 Auditorium (301)

Automation and Control Systems Technology in Korean Shipbuilding Industry: The State of the Art and the Future Perspectives by Keh-Sik Min (Plenary Session)

Chair: Fleming, P.J. Univ. of Sheffield

09:00-10:00 WePL2.1

Automation and Control Systems Technology in Korean Shipbuilding Industry: The State of the Art and the Future Perspectives, pp. 7185-7190.

Min, Keh-Sik Hyundai Heavy Industries Co., Ltd.

WeA01 Atlantic Hall

Systems and Signals II (Poster Session)

Chair: Campi, Marco Univ. of Brescia
Co-Chair: Park, Youngjin KAIST

10:30-12:30 WeA01.1

An Improved Algorithm for the Design of Testable Subsystems, pp. 7191-7196.

Ploix, Stephane Inst. National Pol. de Grenoble
Yassine, Abed Alrahim Inst. National Pol. de Grenoble
Flaus, Jean-Marie E.N.S.I.E.G.

10:30-12:30 WeA01.2

Testing the Covariance Matrix of the Innovation Sequence in Application to Aircraft Sensor Fault Detection, pp. 7197-7202.

Hajiyev, Chingiz Istanbul Tech. Univ.

10:30-12:30 WeA01.3

Design Method of Fault Detector for Injection Unit, pp. 7203-7208.

Ochi, Kiyoshi The Japan Steel Works,LTD.
Saeki, Masami Hiroshima Univ.

10:30-12:30 WeA01.4

Fault Detection of Distributed Networked Control Systems with Access Constraints, pp. 7209-7214.

Zong, Qun Tianjin Univ.
Liu, Wenjing Tianjin Univ.
Dou, Liqian Tianjin Univ.
Sun, Liankun Tianjin Univ.

10:30-12:30 WeA01.5

Disturbance Decoupled Fault Reconstruction Using Sliding Mode Observers, pp. 7215-7220.

Ng, Kok Yew Monash Univ.
Tan, Chee Pin Monash Univ.
Akmeliawati, Rini Monash Univ. Sunway Campus Malaysia,
Edwards, Christopher Univ. of Leicester

10:30-12:30 WeA01.6

SDG-Based Fault Isolation for Large-Scale Complex Systems Solved by Rough Set Theory, pp. 7221-7226.

Yang, Fan Tsinghua Univ.
Xiao, Deyun Tsinghua Univ.

10:30-12:30 WeA01.7

Active Fault Detection and Dual Control in Multiple Model Framework, pp. 7227-7232.

Puncochar, Ivo Univ. of West Bohemia
Simandl, Miroslav Univ. of West Bohemia

10:30-12:30 WeA01.8

Identification and Abnormal Condition Detection of a Cement Rotary Kiln, pp. 7233-7238.

Makaremi, Iman Univ. of Windsor
Fatehi, Alireza K.N. Toosi Univ. of Tech.
Araabi, Babak N. Univ. of Tehran
Azizi, Morteza Saveh Cement Co.
Cheloian, Ahmad Saveh Cement Company

10:30-12:30 WeA01.9

Fault Diagnosis of AC Servo Motor with Current Signals Based on Wavelet Decomposition and Template Matching Methods, pp. 7239-7244.

Kim, Yountae Pusan National Univ.
Bae, Hyeon Pusan National Univ.
Kim, Sungshin Pusan National Univ.
Vachtsevanos, George J. Georgia Inst. of Tech.

10:30-12:30 WeA01.10

Reduced Bank of Kalman Filters, pp. 7245-7250.

Pachner, Daniel Honeywell
Kroupa, Stepan Czech Tech. Univ.

10:30-12:30 WeA01.11

A Nonlinear Hybrid Fault Detection, Isolation and Estimation Using Bank of Neural Parameter Estimators, pp. 7251-7258.

Sobhani-Tehrani, Ehsan Concordia Univ.
Talebi, H.A. Amirkabir Univ. of Tech.
Khorasani, Khashayar Concordia Univ.

10:30-12:30 WeA01.12

Formulating and Solving Robust Fault Diagnosis Problems Based on a H_; Setting, pp. 7259-7264.

Chen, Jie Brunel Univ.

10:30-12:30 WeA01.13

Hybrid Systems Diagnosis by Coupling Continuous and Discrete Event Techniques, pp. 7265-7270.

Bayoudh, Mehdi LAAS-CNRS, Toulouse Univ.
Trave-Massuyes, Louise CNRS
Olive, Xavier Thales Alenia Space

10:30-12:30 WeA01.14

Fault Diagnosis in a Wireless Network, pp. 7271-7275.

D'Innocenzo, Alessandro Univ. degli Studi dell'Aquila
Di Benedetto, M. Domenica Univ. of L'Aquila
Di Gennaro, Stefano Univ. di L'Aquila

10:30-12:30 WeA01.15

Actuator Fault-Tolerant Control Based on Invariant Set Separation, pp. 7276-7281.

Ocampo-Martinez, Carlos The Univ. of Newcastle
De Dona, Jose Adrian The Univ. of Newcastle
Seron, Maria The Univ. of Newcastle

10:30-12:30 WeA01.16

A MPC for Start-Up Phase Tension and Looper Control in Hot Strip Finishing Mills Using Continuation Approach (I), pp. 7282-7287.

Masuda, Shiro Tokyo Metropolitan Univ.
Asano, Kazuya JFE R&D Corp.
Imai, Kizuku Tokyo Metropolitan Univ.

10:30-12:30 WeA01.17

A Robust Auto-Tuning On-Line Trend Extraction Method, pp. 7288-7293.

Charbonnier, Sylvie INPG/UJF
Damour, Cedric INPG/UJF

10:30-12:30 WeA01.18

Fault Detection and Isolation for a Kind of NCSs with Markov Delays, pp. 7294-7299.

Cheng, Yue Tsinghua Univ.
Ye, Hao Tsinghua Univ.

Wang, Yongqiang — Tsinghua Univ.
Wang, Guizeng — Tsinghua Univ.
Ge, Chuanhu — Tsinghua Univ.

10:30-12:30 WeA01.19
Fault Diagnosis Strategies for a Simulated Nonlinear Aircraft Model, pp. 7300-7307.
Benini, Matteo — Univ. of Ferrara
Bonfe, Marcello — Univ. di Ferrara
Castaldi, Paolo — Univ. of Bologna - Aerospace Engineering Faculty
Geri, Walter — Univ. of Bologna
Simani, Silvio — Univ. of Ferrara

10:30-12:30 WeA01.20
Principal Components Structured Models for Fault Isolation, pp. 7308-7313.
Verde, Cristina — Inst. de Ingenieria, UNAM
Mina, Jesús — Engineering Inst. UNAM

10:30-12:30 WeA01.21
Fault Diagnosis Based on the Enclosure of Parameters Estimated with an Adaptive Observer, pp. 7314-7319.
Combastel, Christophe — ENSEA
Zhang, Qinghua — INRIA
Lalami, Abdelhalim — ENSEA

10:30-12:30 WeA01.22
Paper Path Detection in Ink Jet Printers by Using Speed Perturbation Observer, pp. 7320-7325.
Lu, Ping-Chou — KINPO Electronics, Inc.
Yeh, Syh-Shiuh — National Taipei Univ. of Tech.

10:30-12:30 WeA01.23
Fault Detection and Isolation of Retarded Time-Delay Systems Using a Geometric Approach, pp. 7326-7331.
Meskin, Nader — Concordia Univ.
Khorasani, Khashayar — Concordia Univ.

10:30-12:30 WeA01.24
New Residual Generation Design for Fault Detection, pp. 7332-7337.
Larroque, Benoît — LGP-ENIT
Noureddine, Farid — LGP-ENIT
Rotella, Frederic — ENIT

10:30-12:30 WeA01.25
Fault Detection Based on Uncertain Models with Bounded Parameters and Bounded Parameter Variations, pp. 7338-7343.
Adrot, Olivier — INPG - UJF - CNRS
Flaus, Jean-Marie — E.N.S.I.E.G.

10:30-12:30 WeA01.26
Fault Detection Based on Orthotopic Set Membership Identification for Robot Manipulators, pp. 7344-7349.
Reppa, Vasso — Univ. OF PATRAS
Tzes, Anthony — Univ. of Patras

10:30-12:30 WeA01.27
Fault Diagnosis with the Use of the Knowledge about Symptoms Delay Intervals, pp. 7350-7355.
Koscielny, Jan — Warsaw Univ. of Tech.
Syfert, MichaB; — Warsaw Univ. of Tech.
Dziembowski, BolesB;aw — Warsaw Univ. of Tech.

10:30-12:30 WeA01.28
Statistical Properties and Design Criterions for AI-Based Fault Isolation, pp. 7356-7362.
Nyberg, Mattias — Linkoping Univ.
Krysander, Mattias — Linköping Univ.

10:30-12:30 WeA01.29
GIMC-Based Fault Detection and Its Application to Magnetic Suspension System, pp. 7363-7368.
Nakaso, Yujiro — Kanazawa Univ.
Namerikawa, Toru — Kanazawa Univ.

10:30-12:30 WeA01.30
A Diagnostic Model for Identifying Parametric Faults, pp. 7369-7374.
Doraiswami, Rajamani — Univ. of New Brunswick
Diduch, C.P. — Univ. of New Brunswick
Tang, Jiong — Univ. of New Brunswick

10:30-12:30 WeA01.31
Fault Detection System Design for Networked Control System with Stochastically Varying Transmission Delays, pp. 7375-7380.
Al-Salami, Ibrahim — Univ. of Duisburg-Essen
Ding, Steven X. — Univ. of Duisburg-Essen
Zhang, Ping — Univ. of Duisburg-Essen

10:30-12:30 WeA01.32
Bayesian Based Fault Diagnosis: Application to an Electrical Motor, pp. 7381-7386.
Mechraoui, Amine — Lab. grenoblois de l'image, de la parole, du signal et de
Medjaher, Kamal — FEMTO-ST Inst. UMR CNRS 6174 - UFC / ENSMM / UTBM
Zerhouni, Noureddine — FEMTO-ST Inst. UMR CNRS 6174 - UFC / ENSMM / UTBM

10:30-12:30 WeA01.33
A Fault-Tolerant Control Strategy for Takagi-Sugeno Fuzzy Systems, pp. 7387-7392.
Witczak, Marcin — Univ. of Zielona Gora
Dziekan, Lukasz — Univ. of Zielona Gora
Puig, Vicenc — Univ. Pol. de Catalunya
Korbicz, Jozef — Univ. of Zielona Gora

10:30-12:30 WeA01.34
An Algebraic Approach for Behavioral Model Decomposition, pp. 7393-7398.
Berdjag, Denis — Univ. of Science and Tech. of Lille
Cocquempot, Vincent — LAGIS - LILLE 1 Univ.
Christophe, Cyrille — Univ. des Sciences et Tech. de Lille

10:30-12:30 WeA01.35
A System for Automated Final Quality Assessment in the Manufacturing of Vacuum Cleaner Motors, pp. 7399-7404.
Benko, Uros — Jozef Stefan Inst.
Petrovcic, Janko — Jozef Stefan Inst.
Musizza, Bojan — Jozef Stefan Inst.
Juricic, Dani — Jozef Stefan Inst.

10:30-12:30 WeA01.36
Online Statistical Monitoring and Fault Classification of the Tennessee Eastman Challenge Process Based on Dynamic Independent Component Analysis and Support Vector Machine, pp. 7405-7412.
Salahshoor, Karim — petroleum Univ. of Tech.
Kiasi, Fariborz — petroleum Univ. of Tech.

10:30-12:30 WeA01.37
On-Line Process Monitoring Based on Wavelet-ICA Methodology, pp. 7413-7420.
Salahshoor, Karim — petroleum Univ. of Tech.
Kiasi, Fariborz — petroleum Univ. of Tech.

10:30-12:30 WeA01.38
Neural Network Based System Identification for Autonomous Flight of an Eagle Helicopter, pp. 7421-7426.
Samal, Mahendra — UNSW@ADFA
Sreenatha, Anavatti G. — Australian Defence Force Acad.
Garratt, Matthew — UNSW@ADFA

10:30-12:30 WeA01.39
LPV Design of Charge Control for an SI Engine Based on LFT Neural State-Space Models, pp. 7427-7432.
Abbas, Hossam — Hamburg Univ. of Tech.
Werner, Herbert — Hamburg Univ. of Tech.

10:30-12:30 WeA01.40
Biosocial Culture Inspired Hierarchical Algorithm for MISO Block Oriented Nonlinear System Identification - Application to Ozone Modeling, pp. 7433-7438.
Naitali, Abdessamad — emi, Univ. Mohammed V de Rabat-Agdal
Giri, Fouad — GREYC - Univ. de Caen
Elayan, Elamari — Univ. of Caen
Mohamed, Haloua — Ec. Mohammadia d'Ingénieurs, Univ. Mohammed V Agdal

10:30-12:30 WeA01.41
Nonlinear System Identification in a Noisy Environment Using Wavelet Based SDP Models, pp. 7439-7444.
Truong, Nguyen-Vu — RMIT Univ.
Wang, Liuping — RMIT Univ.

10:30-12:30 WeA01.42
A New Cluster Validity Criterion for Fuzzy C-Regression Models Clustering and Its Application to Fuzzy Model Identification, pp. 7445-7450.

Kung, Chung-Chun — Tatung Univ.
Su, Jui-Yiao — Tatung Univ.

10:30-12:30 WeA01.43
Least Squares Method Applied to Rail Vehicle Contact Condition Monitoring, pp. 7451-7456.
Charles, Guy — Loughborough Univ.
Dixon, Roger — Loughborough Univ.
Goodall, R.M. — Loughborough Univ.

10:30-12:30 WeA01.44
Non-Linear Identification and Analysis of a HEUI System, pp. 7457-7462.
Liu, Jui-Jung — Kainan Univ.
Lee, Ya-Wei — Ordnance Readiness and Development Center
Cheng, Chiz-Chung — Lee-Ming Inst. of Tech.

10:30-12:30 WeA01.45
Feedback Analysis of Radial Basis Functions Neural Networks Via Small Gain Theorem, pp. 7463-7467.
Ali, S. Saad Azhar — Air Univ.
Shafiq, Muhammad — GIKI
Ba-Khashwain, Jamil M. — King Fahd Univ. of Petroleum & Minerals
Al-Sunni, Fouad M. — King Fahd Univ. of Pet. & Min.

10:30-12:30 WeA01.46
Lipschitz Numbers: A Medium for Delay Estimation, pp. 7468-7473.
Makaremi, Iman — Univ. of Windsor
Fatehi, Alireza — K.N. Toosi Univ. of Tech.
Araabi, Babak N. — Univ. of Tehran

10:30-12:30 WeA01.47
A Novel RSMI Based on Regression and Natural Power Method, pp. 7474-7479.
Wu, Ping — Zhejiang Univ.
Yang, ChunJie — Zhejiang Univ.
Song, Zhi-Huan — Zhejiang Univ.

10:30-12:30 WeA01.48
Nonlinear System Identification and Control Using an Input-Output Recurrent Neurofuzzy Network, pp. 7480-7485.
Gonzalez-Olvera, Marcos A. — National Autonomous Univ. of Mexico (UNAM)
Tang, Yu — National Univ. of Mexico

10:30-12:30 WeA01.49
Operatorial Parametrizing of Controlled Dynamic Systems - Application to the Fed-Batch Bioreactor Control Problem, pp. 7486-7490.
Montseny, Emmanuel — Univ. of Toulouse
Doncescu, Andrei — Lab. of Architecture and Analysis of Systems CNRS

10:30-12:30 WeA01.50
An Innovative Method for Identification of Dynamic Systems Based on LoLiMoT, pp. 7491-7497.
Ahmad Sharbafi, Maziar — Univ. of Tehran
Mohammadi Nejad, Aida — Khaje Nasir Toosi Univ. of Tech.

10:30-12:30 WeA01.51
Fuzzy Model Based Indirect Adaptive Control Design for Nonlinear Systems with a Dead-Zone, pp. 7498-7503.
Chen, Her-Sheng — TATUNG Univ.
Yu, Wen-Shyong — Tatung Univ.

10:30-12:30 WeA01.52
New Hybrid Model and Switched PI Observer for Dry Friction Systems, pp. 7504-7509.
Nouailletas, Rémy — LCIS, ESISAR
Le, Hoang Bao — LCIS-ESISAR-INPG
Mendes, Eduardo — LCIS-ESISAR-INPG
Koenig, D. — Inpg - Esisar

10:30-12:30 WeA01.53
Recursive Identification Algorithms Based on Minimizing Estimation Error, pp. 7510-7515.
Luo, Guiming — Tsinghua Univ.
Kimura, Hidenori — The Inst. of Physical and Chemical Res. (RIKEN)
Kwon, Wook Hyun — Seoul National Univ.

10:30-12:30 WeA01.54
Optimal Spectral Expansion for Discrete Control, pp. 7516-7521.
Vykhovanets, Valery — Intitute of Control Science

10:30-12:30 WeA01.55
Dynamical Effects of Vision-Based Position Measurement, pp. 7522-7527.
Laroche, Edouard — LSIIT
Delavigne, Julien — Strasbourg Univ. 1

10:30-12:30 WeA01.56
An Improved MILP Method for Data Rectifications with Gross Error Candidates, pp. 7528-7533.
Li, Jianlie — Zhejiang Univ.
Rong, Gang — Zhejiang Univ.
Wang, Xu — Zhejiang Univ.
Feng, YiPing — ZheJiang Univ.

10:30-12:30 WeA01.57
Identification and Distance Detection for Ultrasonic Sensor by Correlation Method, pp. 7534-7538.
Jang, Jin S. — Pukyong National Univ.
Joo, Moon G. — Pukyong National Univ.
Lee, Won Chang — Pukyong National Univ.
Jung, Dong Won — Rist
Lim, Zhong Soo — Rist

10:30-12:30 WeA01.58
Systematic Evaluation of Relaxation Circumstances Based on Bio-Neurological Signals (I), pp. 7539-7543.
Chen, Lanlan — Saga Univ.
Sugi, Takenao — Saga Univ.
Shirakawa, Shuichiro — National Center of Neurology and Psychiatry, Tokyo, Japan
Zou, Junzhong — East China Univ. of Science and Tech.
Nakamura, Masatoshi — Graduate School of Science and Engineering, Saga Univ.

10:30-12:30 WeA01.59
Higher Order Digital Delta-Sigma Modulator with Small Fluctuation: Sliding Mode Operation Approach, pp. 7544-7549.
Yoneya, Akihiko — Nagoya Inst. of Tech.

10:30-12:30 WeA01.60
Adaptive Active Noise Control Schemes for Headset Applications, pp. 7550-7555.
Dandasi, Veeravasantarao — Indian Inst. of Tech. Kanpur
S, Ajay — National Inst. of Tech. Karnataka, Surathkal
P., Premkumar — Indian Inst. of Tech. Kanpur
Behera, Laxmidhar — Indian Inst. of Tech. Kanpur

10:30-12:30 WeA01.61
A Continuous-Time Fixed-Lag Smoother Converging in Finite Time, pp. 7556-7559.
Kwon, Bo Kyu — Seoul National Univ.
Kwon, Wook Hyun — Seoul National Univ.

10:30-12:30 WeA01.62
An Optimal Sequential Decentralized Filter of Discrete-Time Systems with Cross-Correlated Noises, pp. 7560-7565.
Wen, Chenglin — Hangzhou Dianzi Univ.
Wen, Chuanbo — Shanghai Dianji Univ.
Y.Li, Yuan — Li Yuan

10:30-12:30 WeA01.63
Nonlinear ANC Using a Third-Order Volterra Filter with an LDLT-FAP Algorithm, pp. 7566-7569.
Seo, J.B. — Hanyang Univ.
Kim, K.J. — Hanyang Univ.
Nam, Sang Won — Hanyang Univ.

10:30-12:30 WeA01.64
Velocity and Acceleration Estimation for Optical Incremental Encoders, pp. 7570-7575.
Merry, Roel — Eindhoven Univ. of Tech.
Molengraft, René van de — Eindhoven Univ. of Tech.
Steinbuch, Maarten — Eindhoven Univ. of Tech.

10:30-12:30 WeA01.65
Sampling of Noisy Signals: Spectral vs Anti-Aliasing Filters, pp. 7576-7581.
Blachuta, Marian — Silesian Tech. Univ.
Grygiel, Rafal — Silesian Tech. Univ.

10:30-12:30 WeA01.66
Approximations for State Estimation in a Plane Using Two Two-Axis Accelerometers, pp. 7582-7587.
Boje, Edward — Univ. of KwaZulu Natal

10:30-12:30 WeA01.67

A Self-Evolving Interval Type-2 Fuzzy Neural Network for Nonlinear Systems Identification, pp. 7588-7593.

Juang, Chia-Feng — National Chung Hsing Univ.
Lu, Chun-Feng — Chung-Chou Inst. of Tech.
Tsao, Yu-Wei — National Chung-Hsing Univ.

10:30-12:30 WeA01.68

Recursive Motion Recovery Based on Dynamic Vision, pp. 7594-7599.

Chen, Xinkai — Shibaura Inst. of Tech.

WeA02 304A

Nonlinear Observers I (Regular Session)

Chair: Guay, Martin — Queen's Univ.
Co-Chair: Hammouri, Hassan — Univ. Claude Bernard

10:30-10:50 WeA02.1

Approximate Observer Error Linearization for Nonlinear Systems with Input, pp. 7600-7605.

Bäuml, Markus — Univ. Erlangen-Nürnberg
Deutscher, Joachim — Univ. Erlangen-Nürnberg

10:50-11:10 WeA02.2

High-Gain Observers in the Presence of Measurement Noise: A Switched-Gain Approach, pp. 7606-7611.

Ahrens, Jeffrey — Corning Inc.
Khalil, Hassan K. — Michigan State Univ.

11:10-11:30 WeA02.3

Qubit Hamiltonian Identification: A Symmetry-Preserving Observer-Based Approach, pp. 7612-7617.

Bonnabel, Silvere — Univ. de Ličge
Mirrahimi, Mazyar — INRIA Rocquencourt
Rouchon, Pierre — ENSMP

11:30-11:50 WeA02.4

An Approach to Unknown Input Observation for Non-Input-Affine Nonlinear MIMO Systems, pp. 7618-7623.

Stegmann, Nadine — Univ. of Kaiserslautern
Liu, Steven — Univ. of Kaiserslautern

11:50-12:10 WeA02.5

On the Numerical Investigation of a Luenberger Type Observer for Infinite-Dimensional Vibrating Systems, pp. 7624-7629.

Li, Xiao-Dong — Univ. Claude Bernard Lyon 1
Xu, Chengzhong — Univ. Claude Bernard - Lyon1
Peng, Yue-Jun — Univ. Blaise Pascal Clermont-Ferrand II
Tucsnak, M. — Univ. of Nancy

12:10-12:30 WeA02.6

Observer Design for a Class of Uniformly Observable MIMO Nonlinear Systems with Coupled Structure, pp. 7630-7635.

Liu, Feng-Long — Univ. de Caen, ENSICAEN
Farza, Mondher — Univ. DE CAEN, ENSICAEN
M'Saad, Mohammed — GREYC CNRS UMR 6072
Hammouri, Hassan — Univ. Claude Bernard

WeA03 304B

Control of Switched Systems (Regular Session)

Chair: Celikovsky, Sergej — Inst. of Information Theory and Automation, Acad. of Science of the Czech Republic; Faculty of EE, Czech Tech. Univ.
Co-Chair: van den Boom, Ton J. J. — Delft Univ. of Tech.

10:30-10:50 WeA03.1

Reliable Adaptive Control for Switched Fuzzy Systems, pp. 7636-7641.

Zhang, Le — Northeastern Univ. of shenyang
Andreeski, Cvetko — Faculty of Tourism and Hospitality
Dimirovski, Georgi Marko — Dogus Univ. of Istanbul
Jing, Yuanwei — Northeastern Univ.

10:50-11:10 WeA03.2

Average Dwell-Time Method to Stabilization and L2-Gain Analysis for Uncertain Switched Nonlinear Systems, pp. 7642-7647.

Wang, Min — Key Lab. of Integrated Automation ofProcessIndustry,Minist
Dimirovski, Georgi Marko — Dogus Univ. of Istanbul
Zhao, Jun — The Australian National Univ.

11:10-11:30 WeA03.3

Robust Stabilizability of Switched Linear Time-Delay Systems with Polytopic Uncertainties, pp. 7648-7653.

Yao, Zhenxian — Tianjin Univ.
Wang, Yijing — Tianjin Univ.
Zuo, Zhiqiang — Tianjin Univ.
Zhao, Huimin — Tianjin Univ.
Zhang, Guoshan — Tianjin Univ.

11:30-11:50 WeA03.4

A Hamiltonian Approach for the Optimal Control of the Switching Signal for a DC-DC Converter, pp. 7654-7659.

Corona, Daniele — TU Delft
Buisson, Jean — Supélec
De Schutter, Bart — Delft Univ. of Tech.

11:50-12:10 WeA03.5

Model Predictive Control for Switching Max-Plus-Linear Systems with Random and Deterministic Switching, pp. 7660-7665.

van den Boom, Ton J. J. — Delft Univ. of Tech.
De Schutter, Bart — Delft Univ. of Tech.

12:10-12:30 WeA03.6

Model Reduction for Switched Linear Discrete-Time Systems with Polytopic Uncertainties and Arbitrary Switching, pp. 7666-7671.

Zhang, Lixian — Ec. Pol. de Montreal
Shi, Peng — Faculty of Advanced Tech.
Basin, Michael V. — Autonomous Univ. of Nuevo Leon

WeA04 308

Nonlinear Pendulum Control (Regular Session)

Chair: Xin, Xin — Okayama Prefectural Univ.
Co-Chair: Gordillo, Francisco — Univ. de Sevilla

10:30-10:50 WeA04.1

Swing-Up Control Based on Virtually Composite Links for an N-Link Underactuated Robot with Passive First Joint, pp. 7672-7677.

Xin, Xin — Okayama Prefectural Univ.
Kaneda, Masahiro — Okayama Prefectural Univ.
Yamasaki, Taiga — Okayama Prefectural Univ.
She, Jin-Hua — Tokyo Univ. of Tech.

10:50-11:10 WeA04.2

Passivity-Based Control of an Overhead Travelling Crane, pp. 7678-7683.

Aschemann, Harald — Univ. of Rostock

11:10-11:30 WeA04.3

Backstepping Control of a High-Speed Linear Axis Driven by Pneumatic Muscles, pp. 7684-7689.

Schindele, Dominik — Univ. of Rostock
Aschemann, Harald — Univ. of Rostock

11:30-11:50 WeA04.4

Control of Mechanical Systems with Constraints: Two Pendulums Case Study, pp. 7690-7694.

Ananyevskiy, Mikhail — Saint-Petersburg State Univ.
Fradkov, Alexander L. — Acad. of Sciences of Russia
Nijmeijer, Hendrik — Eindhoven Univ. of Tech.

11:50-12:10 WeA04.5

A Controller for Swinging-Up and Stabilizing the Inverted Pendulum, pp. 7695-7699.

Aracil, Javier — Univ. de Sevilla
Acosta, José Ángel — Univ. de Sevilla
Gordillo, Francisco — Univ. de Sevilla

12:10-12:30 WeA04.6

Interconnection and Damping Assignment Passivity--Based Control of the Pendubot, pp. 7700-7704.

Sandoval, Jesus — Inst. Tecnologico de La Paz
Ortega, Romeo — LSS-SUPELEC
Kelly, Rafael — CICESE

WeA05 307

Controller Constraints and Structure I (Regular Session)

Chair: Balemi, Silvano — SUPSI (Scuola Univ. Professionale della SvizzeraItaliana)
Co-Chair: Herrmann, Guido — Univ. of Bristol

10:30-10:50 WeA05.1

Wind Evaluation Breadboard Control Architecture, Dynamic Model and Performance, pp. 7705-7710.

Viera Curbelo, Teodora Aleida — Inst. de Astrofisica de Canarias
Zuluaga, Pablo — Inst. de Astrofisica de Canarias

Reyes, Marcos	Inst. de Astrofisica de Canarias
Núñez, Miguel	Inst. de Astrofísica de Canarias
Castro Lopez-Tarruella, Fco. Javier	Gran Telescopio de Canarias

10:50-11:10 WeA05.2

Complexity Reduction in Explicit MPC through Model Reduction, pp. 7711-7716.

Hovland, Svein	Norwegian Univ. of Sci & Tech.
Gravdahl, Jan Tommy	Norwegian Univ. of Science & Tech.

11:10-11:30 WeA05.3

Coordinating Fuzzy Control of the Sintering Process, pp. 7717-7722.

Xiang, Jie	Central South Univ.
Wu, Min	Central South Univ.
Duan, Ping	Central South Univ.
Cao, Weihua	Central South Univ.
He, Yong	Central South Univ.

11:30-11:50 WeA05.4

Partial-Order Reduction of Observers for Linear Systems, pp. 7723-7728.

Balemi, Silvano	SUPSI (Scuola Univ. Professionale della Svizzera Italian

11:50-12:10 WeA05.5

Improving Sector-Based Results for Systems with Deadzone Nonlinearities, pp. 7729-7734.

Turner, Matthew C.	Univ. of Leicester
Herrmann, Guido	Univ. of Bristol
Postlethwaite, Ian	the Univ. of Leicester

12:10-12:30 WeA05.6

Damping Angular Oscillations of a Pendulum under State Constraints, pp. 7735-7742.

Okanouchi, Satoru	Oshima National Coll. of Maritime Tech.
Yoshida, Kazunobu	Shimane Univ.
Matsumoto, Itaru	Yonago National Coll. of Tech.
Kawabe, Hisashi	Hiroshima Inst. of Tech.

WeA06 310A

Infinite Dimensional Systems: Distributed Parameter Systems (Regular Session)

Chair: Werner, Herbert	Hamburg Univ. of Tech.
Co-Chair: Chen, YangQuan	Utah State Univ.

10:30-10:50 WeA06.1

On the Accessibility of Distributed Parameter Systems, pp. 7743-7748.

Rieger, Karl	Johannes Kepler Univ. of Linz
Schlacher, Kurt	Johannes Kepler Univ. of Linz
Schöberl, Markus	Johannes Kepler Univ. of Linz

10:50-11:10 WeA06.2

Sampled-Data Output Feedback Control of Distributed Parameter Systems Via Semi-Discretization in Space, pp. 7749-7754.

Tan, Ying	The Univ. of Melbourne
Nesic, Dragan	Univ. of Melbourne

11:10-11:30 WeA06.3

Controller Implementation for a Class of Spatially-Varying Distributed Parameter Systems, pp. 7755-7760.

Candogan, Utku Ozan	MIT
Ozbay, Hitay	Bilkent Univ.
Ozaktas, Haldun M.	Bilkent Univ.

11:30-11:50 WeA06.4

Distributed Control for a Class of Spatially Interconnected Discrete-Time Systems, pp. 7761-7766.

Chughtai, Saulat Shuja	Tech. Univ. of Hamburg-Harburg
Werner, Herbert	Hamburg Univ. of Tech.

11:50-12:10 WeA06.5

New Dilated LMIs to Synthesize Controllers for a Class of Spatially Interconnected Systems, pp. 7767-7771.

Chughtai, Saulat Shuja	Tech. Univ. of Hamburg-Harburg
Werner, Herbert	Hamburg Univ. of Tech.

12:10-12:30 WeA06.6

Resource-Constrained Sensor Routing for Parameter Estimation of Distributed Systems, pp. 7772-7777.

Patan, Maciej	Univ. of Zielona Gora
Tricaud, Christophe	Utah State Univ.
Chen, YangQuan	Utah State Univ.

WeA07 310B

Optimal Control Theory I (Regular Session)

Chair: Colaneri, Patrizio	Pol. di Milano
Co-Chair: Logist, Filip	Katholieke Univ. Leuven

10:30-10:50 WeA07.1

Mitigation of Curse of Dimensionality in Dynamic Programming, pp. 7778-7783.

Li, Duan	Chinese Univ. of Hong Kong
Wang, Qing	Chinese Univ. of Hong Kong
Wang, Jun	Qingdao Univ.
Yao, Yirong	Shanghai Univ.

10:50-11:10 WeA07.2

Conjugation of Hamiltonian Systems in Optimal Control Problems, pp. 7784-7789.

Krasovskii, Andrey	Inst. of Mathematics and Mechanics of Ural Branch ofRAS
Tarasyev, Alexander	Inst. of Mathematics and Mechanics of Ural Branch ofRAS

11:10-11:30 WeA07.3

A Switched MPC Approach to Hierarchical Control, pp. 7790-7795.

Scattolini, Riccardo	Pol. di Milano
Colaneri, Patrizio	Pol. di Milano
De Vito, Daniele	Pol. di Milano

11:30-11:50 WeA07.4

Possibilities of the Cross-Entropy Method Usage in the Control Theory, pp. 7796-7801.

Tahirovic, Adnan	Univ. of Sarajevo, Pol. di Milano
Lacevic, Bakir	Univ. of Sarajevo

11:50-12:10 WeA07.5

Efficiently Solving Multiple Objective Optimal Control Problems, pp. 7802-7807.

Logist, Filip	Katholieke Univ. Leuven
Van Erdeghem, Peter M.M.	KU Leuven
Smets, Ilse	Biotec - Bioprocess Tech. And Control
Van Impe, Jan F.M.	Katholieke Univ. Leuven

12:10-12:30 WeA07.6

Optimal Control of Switched Systems: A Polynomial Approach, pp. 7808-7813.

Mojica Nava, Eduardo	Ec. des Mines de Nantes
Meziat, Rene	Univ. of Los Andes
Quijano, Nicanor	The Ohio State Univ.
Gauthier, Alain	Univ. de los Andes
Rakoto-Ravalontsalama, Naly	Ec. des Mines de Nantes

WeA08 310C

Optimization Based Controller Synthesis I (Regular Session)

Chair: Sugie, Toshiharu	Kyoto Univ.
Co-Chair: Dumur, Didier	Ec. Superieure d'Electricite

10:30-10:50 WeA08.1

Systematic Design of Optimal Performance Weight and Controller in Mixed-Ľ; Synthesis., pp. 7814-7819.

Pettazzi, Lorenzo	Univ. of Bremen
Lanzon, Alexander	Univ. of Manchester

10:50-11:10 WeA08.2

Nonsmooth Frequency Shaping Control Design with an Application, pp. 7820-7825.

Simőes, Alberto	ONERA-CERT
Apkarian, Pierre	UPS
Noll, Dominikus	UPS

11:10-11:30 WeA08.3

Robust Pole Placement Via Reflection Axes Polytopes, pp. 7826-7831.

Nurges, Ulo	Tallinn Univ. of Tech.
Rustern, Ennu	Head of The Inst.

11:30-11:50 WeA08.4

Off-Line Robustification of Model Predictive Control for Uncertain Multivariable Systems, pp. 7832-7837.

Stoica, Cristina Nicoleta	Supelec
Rodriguez-Ayerbe, Pedro	Supelec
Dumur, Didier	Ec. Superieure d'Electricite

11:50-12:10 WeA08.5

A Gradient Method for the Static Output Feedback Mixed H2/H-Infinity Control, pp. 7838-7842.
Kami, Yasushi — Akashi National Coll. of Tech.
Nobuyama, Eitaku — Kyushu Inst. of Tech.

12:10-12:30 WeA08.6
Synthesis of Fixed-Structure H-Infinity Controllers Via Constrained Particle Swarm Optimization, pp. 7843-7848.
Maruta, Ichiro — Kyoto Univ.
Kim, Tae-Hyoung — Japan Science and Tech. Agency
Sugie, Toshiharu — Kyoto Univ.

WeA09 311C
Hammerstein-Wiener System Identification (Invited Session)
Chair: Giri, Fouad — GREYC - Univ. de Caen
Co-Chair: Rodellar, Jose — Tech. Univ. of Catalonia
Organizer: Giri, Fouad — GREYC - Univ. de Caen
Organizer: Ikhouane, Faycal — Univ. Pol. de Catalunya

10:30-11:10 WeA09.1
Nonlinear System Identification under Various Prior Knowledge (I), pp. 7849-7858.
Z;liwiD;ski, PrzemysB;aw — WrocB;aw Univ. of Tech.
Hasiewicz, Zygmunt — Wroclaw Univ. of Tech.
Mzyk, Grzegorz — Wroclaw Univ. of Tech.

11:10-11:30 WeA09.2
Hammerstien Systems Identification in Presence of Hysteresis-Backlash Nonlinearity (I), pp. 7859-7864.
Giri, Fouad — GREYC - Univ. de Caen
Rochdi, Youssef — Ec. D'INGENIEURS MOHAMMEDIA RABAT
Elayan, Elamari — Univ. of Caen
Chaoui, Fatima-Zahra — ENSET
Brouri, Adil — EMI

11:30-11:50 WeA09.3
Nonparametric Identification of the Nonlinear Element in Wiener Systems (I), pp. 7865-7870.
Rochdi, Youssef — Ec. D'INGENIEURS MOHAMMEDIA RABAT
Chaoui, Fatima-Zahra — ENSET
Giri, Fouad — GREYC - Univ. de Caen
Brouri, Adil — EMI
Boulal, Anis — Univ. MOHAMED V EMI RABAT

11:50-12:10 WeA09.4
Adaptive Tracking and Recursive Identification for a Class of Hammerstein Systems (I), pp. 7871-7876.
Zhao, Wenxiao — Acad. of Mathematics and Systems Science, ChineseAcedemyof S
Chen, Han Fu — AMSS, Chinese Acad. of Sciences

12:10-12:30 WeA09.5
Identification of a Magnetorheological Damper: Theory and Experiments (I), pp. 7877-7882.
Rodriguez Tsouroudkdissian, Arturo — Univ. Pol. de Catalunya (UPC)
Ikhouane, Faycal — Univ. Pol. de Catalunya
Rodellar, Jose — Tech. Univ. of Catalonia
Luo, Ningsu — Univ. of Girona

WeA10 311B
Fault Detection I (Regular Session)
Chair: Jämsä-Jounela, Sirkka-Liisa — Helsinki Univ. of Tech.
Co-Chair: Aaslund, Jan — Linköping Univ.

10:30-10:50 WeA10.1
On Threshold Optimization in Fault Tolerant Systems, pp. 7883-7888.
Gustafsson, Fredrik — Linköping Univ.
Nielsen, Lars — Linköping Univ.
Frisk, Erik — Linkoping Univ.
Krysander, Mattias — Linköping Univ.
Aaslund, Jan — Linköping Univ.

10:50-11:10 WeA10.2
Reconstruction-Based Contribution for Process Monitoring, pp. 7889-7894.
Alcala, Carlos — Univ. of Southern California
Qin, S. Joe — Univ. of Southern California

11:10-11:30 WeA10.3
Sensor Placement for Fault Isolation in Linear Differential-Algebraic Systems, pp. 7895-7900.
Krysander, Mattias — Linköping Univ.
Frisk, Erik — Linkoping Univ.
Aaslund, Jan — Linköping Univ.

11:30-11:50 WeA10.4
On Fault Detection under Soft Computing Model Uncertainty, pp. 7901-7906.
Korbicz, Jozef — Univ. of Zielona Gora
Witczak, Marcin — Univ. of Zielona Gora

11:50-12:10 WeA10.5
Observer-Based Residual Generation for Linear Differential-Algebraic Equation Systems, pp. 7907-7912.
Svärd, Carl — Linköping Univ.
Nyberg, Mattias — Linkoping Univ.

12:10-12:30 WeA10.6
Leak Detection in Open Water Channels, pp. 7913-7918.
Weyer, Erik — Univ. of Melbourne
Bastin, Georges — Univ. Catholique de Louvain

WeA11 311A
Nonlinear Adaptive Control I (Regular Session)
Chair: Ikonen, Enso — Univ. of Oulu
Co-Chair: Wang, Haiqing — Univ. of Duisburg-Essen

10:30-10:50 WeA11.1
Adaptive Process Control Using Controlled Finite Markov Chains Based on Multiple Models, pp. 7919-7924.
Ikonen, Enso — Univ. of Oulu
Kortela, Urpo — Univ. of Oulu

10:50-11:10 WeA11.2
Adaptive Fuzzy Control Based on Fuzzy Neural Network for Uncertain Nonlinear Systems, pp. 7925-7930.
Huang, Ying J. — Yuan Ze Univ.
Kuo, Tzu-Chun — Ching Yun Univ.

11:10-11:30 WeA11.3
Correction for Non-Identical Units in Multi-Unit Optimization, pp. 7931-7936.
Woodward, Lyne — École Pol. de Montréal
Perrier, Michel — Ec. Pol.
Srinivasan, B. — Ec. Pol. Montreal

11:30-11:50 WeA11.4
Adaptive Control of a Class of Nonlinear Discrete-Time Systems with Online Kernel Learning, pp. 7937-7942.
Gao, Yanchen — Qingdao Mesnac Co., LTD.
Liu, Yi — Zhejiang Univ.
Wang, Haiqing — Zhejiang Univ.
Li, Ping — Zhejiang Univ.

11:50-12:10 WeA11.5
Dynamic Feedback Tracking Control of Nonholonomic Mobile Robots with Unknown Camera Parameters, pp. 7943-7948.
Wang, Chaoli — The Univ. of Shanghai For Science and Tech. 200031
Liao, Qinwu — Univ. of Shanghai for Science and Tech.
Mei, Yingchun — Univ. of Shanghai for Science and Tech. , 200093, Chi

12:10-12:30 WeA11.6
A Finite Step Scheme for General Near-Optimal Control –the Deterministic Case, pp. 7949-7954.
Jiang, Danchi — Univ. of Tasmania

WeA12 313
Hybrid Systems Modeling (Regular Session)
Chair: Mosterman, Pieter — The MathWorks, Inc.
Co-Chair: Camlibel, Kanat — Univ. of Groningen

10:30-10:50 WeA12.1
Stream and State-Based Semantics of Hierarchy in Block Diagrams, pp. 7955-7960.
Denckla, Ben — -
Mosterman, Pieter — The MathWorks, Inc.

10:50-11:10 WeA12.2
Combinatorial Vector Fields for Piecewise Affine Control Systems, pp. 7961-7966.

Wisniewski, Rafal — Aalborg Univ.
Larsen, Jesper Abildgaard — Aalborg Univ.

11:10-11:30 WeA12.3
Zero-Crossing Location and Detection Algorithms for Hybrid System Simulation, pp. 7967-7972.
Zhang, Fu — The Mathworks
Yeddanapudi, Murali — The Mathworks, Inc
Mosterman, Pieter — The MathWorks, Inc.

11:30-11:50 WeA12.4
Well-Posed Bimodal Piecewise Linear Systems Do Not Exhibit Zeno Behavior, pp. 7973-7978.
Camlibel, Kanat — Univ. of Groningen

11:50-12:10 WeA12.5
Concrete Syntax and Semantics of the Compositional Interchange Format for Hybrid Systems, pp. 7979-7986.
Van Beek, D.A. (Bert) — Eindhoven Univ. of Tech.
Reniers, Michel — TU/e
Rooda, J.E. — Eindhoven Univ. of Tech.
Schiffelers, Ramon R.H. — Eindhoven Univ. of Tech.

12:10-12:30 WeA12.6
Harmonic Analysis of Pulse-Width Modulated Systems, pp. 7987-7993.
Almer, Stefan — Royal Inst. of Tech.
Jonsson, Ulf T. — Royal Inst. of Tech.

WeA13 314
Stochastic Control (Regular Session)
Chair: Do Val, Joao B.R. — UNICAMP - FEEC
Co-Chair: Zhang, Hui — Zhejiang Univ.

10:30-10:50 WeA13.1
On Statistical Control of Stochastic Servo-Systems: Performance-Measure Statistics and State-Feedback Paradigm, pp. 7994-8000.
Pham, Khanh D. — AIR FORCE Res. Lab.

10:50-11:10 WeA13.2
A Formula for the Optimal Cost in the General Discrete-Time LEQG Problem, pp. 8001-8008.
Ainikkal, Shaiju Johny — UNSW@ADFA
Petersen, Ian Richard — Univ. of New South Wales - ADFA

11:10-11:30 WeA13.3
Stochastic Optimal Control Based on Value-Function Approximation Using Sinc Interpolation, pp. 8009-8014.
Weissel, Florian — Univ. Karlsruhe (TH)
Huber, Marco F. — Univ. Karlsruhe (TH)
Brunn, Dietrich — Univ. Karlsruhe
Hanebeck, Uwe — Univ. Karlsruhe

11:30-11:50 WeA13.4
Improved Convergence Rate for a Recursive Procedure in a Production and Storage Problem, pp. 8015-8020.
Salles, José Leandro Félix — Federal Univ. of Espírito Santo
Do Val, Joao B.R. — UNICAMP - FEEC

11:50-12:10 WeA13.5
Epsilon-Entropy and H_infinity Entropy in Continuous Time Systems, pp. 8021-8026.
Zhang, Hui — Zhejiang Univ.
Sun, Youxian — Zhejiang Univ.

12:10-12:30 WeA13.6
A Carleman Approximation Scheme for a Stochastic Optimal Control Problem in the Continuous-Time Framework, pp. 8027-8032.
Mavelli, Gabriella — Consiglio Nazionale Delle Ricerche
Palumbo, Pasquale — IASI-CNR

WeA14 318
Networked Systems: Rate Constraints, Quantization and Unreliable Communication (Invited Session)
Chair: Zampieri, Sandro — Univ. di Padova
Co-Chair: Quevedo, Daniel E. — The Univ. of Newcastle
Organizer: Zampieri, Sandro — Univ. di Padova

10:30-10:50 WeA14.1
Decentralized Stabilization of Networked Systems under Data-Rate Constraints (I), pp. 8033-8038.
Matveev, Alexey S. — St.Petersburg Univ.
Savkin, Andrey V. — Univ. of New South Wales

10:50-11:10 WeA14.2
Observer-Based Quantized Output Feedback Control of Nonlinear Systems (I), pp. 8039-8043.
Liberzon, Daniel — Univ. of Illinois at Urbana-Champaign

11:10-11:30 WeA14.3
On Networked Control Architectures for MIMO Plants (I), pp. 8044-8049.
Silva, Eduardo I — The Univ. of Newcastle
Goodwin, Graham C. — Univ. of Newcastle
Quevedo, Daniel E. — The Univ. of Newcastle

11:30-11:50 WeA14.4
On the Feedback Information in Stabilization Over Unreliable Channels (I), pp. 8050-8055.
Ishii, Hideaki — Tokyo Inst. of Tech.

11:50-12:10 WeA14.5
Optimal Linear Quadratic Regulator for Markovian Jump Linear Systems, in the Presence of One Time-Step Delayed Mode Observations (I), pp. 8056-8061.
Matei, Ion — Univ. of Maryland
Martins, Nuno C. — Univ. of Maryland
Baras, John S. — Univ. of Maryland

12:10-12:30 WeA14.6
A Probabilistic Analysis of the Average Consensus Algorithm with Quantized Communication (I), pp. 8062-8067.
Carli, Ruggero — Univ. of Padova
Fagnani, Fabio — Pol. Di Torino
Frasca, Paolo — Pol. di Torino
Zampieri, Sandro — Univ. di Padova

WeA15 317
Modeling Methods and Clinical Applications in Medical and Biological Systems I (Invited Session)
Chair: Andreassen, Steen — Aalborg Univ.
Co-Chair: Chase, J. Geoffrey — Univ. of Canterbury
Organizer: Andreassen, Steen — Aalborg Univ.
Organizer: Chase, J. Geoffrey — Univ. of Canterbury

10:30-10:50 WeA15.1
Cardiovascular Modelling and Identification in Septic Shock - Experimental Validation (I), pp. 8068-8073.
Desaive, Thomas — Univ. of Liege
Lambermont, Bernard — Univ. of Liege
Ghuysen, Alexandre — Univ. of Liege
Kolh, Philippe — Univ. of Liege
Dauby, Pierre C. — Univ. of Liege
Starfinger, Christina — Univ. of Canterbury
Hann, Christopher E — Univ. of Canterbury
Chase, J. Geoffrey — Univ. of Canterbury
Shaw, Geoffrey M — Christchurch Hospital, Canterbury District Health Board

10:50-11:10 WeA15.2
Prediction Validation of Two Glycaemic Control Models in Critical Care (I), pp. 8074-8079.
Pielmeier, Ulrike — Aalborg Univ.
Chase, J. Geoffrey — Univ. of Canterbury
Andreassen, Steen — Aalborg Univ.
Haure, Pernille — Aalborg Hospital
Steenfeldt Nielsen, Birgitte — Aalborg Hospital
Shaw, Geoffrey M — Christchurch Hospital, Canterbury District Health Board

11:10-11:30 WeA15.3
Decision Support of Inspired Oxygen Fraction Using a Model of Oxygen Transport (I), pp. 8080-8084.
Karbing, Dan Stieper — Aalborg Univ.
Kjćrgaard, Sřren — Aalborg Hospital, Aarhus Univ.
Smith, Bram W — Aalborg Univ.
Allerřd, Charlotte — Aalborg Hospital, Aarhus Univ.
Espersen, Kurt — Rigshospitalet, Univ. of Copenhagen
Andreassen, Steen — Aalborg Univ.
Rees, Stephen Edward — Aalborg Univ.

11:30-11:50 WeA15.4
Glucose-Insulin Pharmacodynamic Surface Modeling Comparison (I), pp. 8085-8090.
Chase, J. Geoffrey — Univ. of Canterbury

Andreassen, Steen — Aalborg Univ.
Pielmeier, Ulrike — Aalborg Univ.
Hann, Christopher E — Univ. of Canterbury

11:50-12:10 — WeA15.5
Nonparametric Prediction of Free-Light Chain Generation in Multiple Myeloma Patients (I), pp. 8091-8096.
Hattersley, John Glenn — Univ. of Warwick
Evans, Neil D. — Univ. of Warwick
Chappell, Michael — Univ. of Warwick
Mead, Graham — The Binding Site
Hutchison, Colin — Queen Elizabeth Hospital

12:10-12:30 — WeA15.6
Transferability Modelling in the TREAT Decision Support System (I), pp. 8097-8102.
Zalounina, Alina — Aalborg Univ.
Andreassen, Steen — Aalborg Univ.
Leibovici, Leonard — Rabin Medical Center, Beilinson Hospital
Paul, Mical — Rabin Medical Center, Beilinson Hospital

WeA16 — 316
Perspectives for an Human Centred Systems Engineering: Trends and Issues (Regular Session)
Chair: Mayer, Frédérique — ENSGSI
Co-Chair: Mkrttchian, Vardan — All Armenian Internet Univ. - HHH Univ.

10:30-10:50 — WeA16.1
Convergent Cognitype for Speeding-Up the Strategic Conversation, pp. 8103-8108.
Raikov, Alexander — Inst. of Control Sciences RAS

10:50-11:10 — WeA16.2
Elerning and Social Perspective in All Armenian Internet University, pp. 8109-8112.
Mkrttchian, Vardan — All Armenian Internet Univ. - HHH Univ.
Brandt, Dietrich — Univ. of Tech.
Yeranosyan, Hasmik — All Armenian Internet Univ.

11:10-11:30 — WeA16.3
The Use of an Axiological Lens to Review Globalised Automation and Control Systems Projects (I), pp. 8113-8118.
Stapleton, Larry — School of Science, Waterford Inst. of Tech.
Freeman, Amanda — Waterford Inst. of Tech.

11:30-11:50 — WeA16.4
An Approach to Knowledge Management in Research Organization, pp. 8119-8123.
Gubanov, Dmitry — Inst. of Control Sciences RAS

11:50-12:10 — WeA16.5
Usability-Engineering in the Context of Product Development: Results of an Experts Focus Group, pp. 8124-8128.
Roese, Kerstin — Univ. of Kaiserslautern

WeA17 — 320A
Virtual-Remote Labs in Control Education: Real Experiences (Highlight Session)
Chair: Vlacic, Ljubo — Griffith Univ.
Co-Chair: Dormido, Sebastián — UNED
Organizer: Dormido, Sebastián — UNED

10:30-10:50 — WeA17.1
Simulated versus Hardware Laboratories for Control Education: A Critical Appraisal (I), pp. 8129-8134.
Welsh, James — Univ. of Newcastle
Daredia, Talib — Matrikon
Sobora, Frank — Univ. of Newcastle
Vlacic, Ljubo — Griffith Univ.
Goodwin, Graham C. — Univ. of Newcastle

10:50-11:10 — WeA17.2
Remote Lab: Online Support and Awareness Analysis (I), pp. 8135-8140.
Salzmann, Christophe — Ec. Pol. Fédérale de Lausanne
Gillet, Denis — Ec. Pol. Fédérale de Lausanne (EPFL)
Scott, Peter — Open Univ.
Quick, Kevin — Open Univ.

11:10-11:30 — WeA17.3
Grid Supported Learning Environment in Control Education (I), pp. 8141-8146.
Szczytowski, Piotr — Ruhr-Univ. Bochum
Schmid, Christian — Ruhr-Univ. Bochum

11:30-11:50 — WeA17.4
A Remote Laboratory on PID Autotuning (I), pp. 8147-8152.
Leva, Alberto — Pol. di Milano
Donida, Filippo — Pol. di Milano

11:50-12:10 — WeA17.5
RACT: A Remote Lab for Robotics Experiments (I), pp. 8153-8158.
Casini, Marco — Univ. di Siena
Chinello, Francesco — Univ. di Siena
Prattichizzo, Domenico — Univ. of Siena
Vicino, Antonio — Univ. di Siena

12:10-12:30 — WeA17.6
Developing and Implementing Virtual and Remote Labs for Control Education: The UNED Pilot Experience (I), pp. 8159-8164.
Dormido, Sebastián — UNED
Vargas Oyarzun, Hector — Univ. Nacional de Educacion a Distancia (UNED) Madrid
Sánchez Moreno, José — UNED
Dormido, Raquel — UNED
Duro, Natividad — Univ. Nacional De Educacion A Distancia (uned)
Dormido Canto, Sebastián — UNED
Morilla, F. — ETSI Informatica, UNED

WeA18 — 320B
Automation in the Semiconductor, Display, and Electronics Industry (Highlight Session)
Chair: Choi, Jungyun — Samsung Electronics
Co-Chair: Chae, Junjae — Korea Aerospace Univ.
Organizer: Song, Ji Oh — Samsung Electronics Co.,LTD.

10:30-10:50 — WeA18.1
Cluster Tool for Control of Semiconductor and FPD Equipment (I), pp. 8165-8170.
Choi, Yong Man — kornic
Aiga, Jo — kornic

10:50-11:10 — WeA18.2
A Novel Value Innovation for a PE-CVD Fab Equipment by Using Cluster Tool Control Technology, pp. 8171-8172.
Choi, Byeong-Kap — Samsung Electronics

11:10-11:30 — WeA18.3
A SERCOS NETWORK BASED MODULAR MOTION SOLUTION for SEMICONDUCTOR & FPD EQUIPMENTS (I), pp. 8173-8174.
Ahn, Sung-Chan — Rockwell Automation Korea
Lee, Sang-Sub — Rockwell Automation Korea
Jung, Yong-Kuk — Rockwell Automation Korea
Lee, Sang-Hoon — Rockwell Automation Korea
Kang, Duk-Hyun — Rockwell Automation Korea

11:30-11:50 — WeA18.4
PDP Visual Inspection System in PDP Aging Process, pp. 8175-8176.
Ko, Min Seok — Samsung SDI
Kim, Jae Hyung — Samsung SDI
Choi, In Hwa — Samsung SDI
Heo, Kyung Hoe — Samsung SDI Production Engineering Lab.

WeA19 — 320C
Automated Optical Inspection Systems for Electronics Manufacturing Industry (Invited Session)
Chair: Jeong, Dae Hwa — LG Electronics Inc.
Co-Chair: Kang, Heuiseok — Korea Inst. of Industrial Tech.
Organizer: Jeong, Dae Hwa — LG Electronics Inc.

10:30-10:50 — WeA19.1
Defect Classification Using Bayesian Approach for Tape Substrate Inspection System (I), pp. 8177-8182.
Roh, Young Jun — LG Electronics
Jeong, Dae Hwa — LG Electronics Inc.
Kim, CheolWoo — LG Electronics
Jung, ChangOok — LG Electronics

10:50-11:10 — WeA19.2

The Embedded Vision System for Portable Applications (I), pp. 8183-8184.
Kang, Heuiseok — Korea Inst. of Industrial Tech.

11:10-11:30 WeA19.3
A New Image Restoration Technique for SEM (I), pp. 8185-8189.
Nakahira, Kenji — Hitahi, Ltd.
Miyamoto, Atsushi — Hitahi, Ltd.
Honda, Toshifumi — Production Engineering Res. Lab. Hitachi Ltd.

11:30-11:50 WeA19.4
Region Mura Detection Using Efficient High Pass Filtering Based on Fast Average Operation (I), pp. 8190-8195.
Kim, Seong-Hoon — LG Electronics
Kang, Tae Gyu — LG Electronics
Jeong, Dae Hwa — LG Electronics Inc.

11:50-12:10 WeA19.5
Optical Pattern Inspection for Flex PCB — Challenges & Solution (I), pp. 8196-8202.
Kondala, Rambabu — TATA Elxsi Ltd
Munivarkarasan, Dineshkumar — Tata Elxsi Ltd, Bangalore
Kallipudi, Vijay Kumar — Tata Elxsi Limited
Siddineni, Pandari Nath — TATA Elxsi Limited
Roh, Young Jun — LG Electronics

WeA20 321C
Informationally Structured Environments for Robotics (Invited Session)
Chair: Hashimoto, Hideki — Univ. of Tokyo
Co-Chair: Er, Meng Joo — NTU
Organizer: Hashimoto, Hideki — Univ. of Tokyo

10:30-10:50 WeA20.1
Automated Calibration of Distributed Laser Range Finders Based on Object Tracking in Overlapping Sensing Regions, pp. 8203-8208.
Sasaki, Takeshi — The Univ. of Tokyo
Hashimoto, Hideki — Univ. of Tokyo

10:50-11:10 WeA20.2
Calibration of Widely Distributed Vision Cameras by Mobile Robots with Cooperative Positioning (I), pp. 8209-8214.
Yokoya, Tsuyoshi — Kyushu Univ.
Hasegawa, Tsutomu — Kyushu Univ.
Kurazume, Ryo — Kyushu Univ.

11:10-11:30 WeA20.3
Generating Robot Arm Motion by Using Generalized Environmental Information (I), pp. 8215-8220.
Wang, Siliang — Tokyo Metropolitan Univ.
Sato, Eri — Tokyo Metropolitan Univ.
Yamaguchi, Toru — Tokyo Metropolitan Univ.

11:30-11:50 WeA20.4
Design of Ubiquitous Space for the Robotic Library System and Its Application (I), pp. 8221-8225.
Kim, Bong Keun — Intelligent Systems Res. Inst. NationalInstituteof Adva

11:50-12:10 WeA20.5
Perception of Dynamic Environments in Autonomous Robots (I), pp. 8226-8231.
Er, Meng Joo — NTU
Bay, Zi Jing — Nangyang Tech. Univ. DSO National Lab.
Zhou, Yi — Singapore Pol.

12:10-12:30 WeA20.6
Evaluation of Mental Stress by Analyzing Accelerated Plethysmogram Applied Chaos Theory and Examination of Welfare Space Installed User's Vital Sign (I), pp. 8232-8235.
Fujimoto, Yasunari — Tokyo Metropolitan Inst. of Tech.
Yamaguchi, Toru — Tokyo Metropolitan Univ.

WeA21 321B
Dynamics and Control of Micro and Nano-Scale Systems I (Invited Session)
Chair: Moheimani, S.O. Reza — Univ. of Newcastle
Co-Chair: Sebastian, Abu — IBM Res.
Organizer: Moheimani, S.O. Reza — Univ. of Newcastle
Organizer: Sebastian, Abu — IBM Res.

10:30-11:10 WeA21.1
Architectures for Tracking Control in Atomic Force Microscopes (I), pp. 8236-8250.
Butterworth, Jeffrey Austin — Univ. of Colorado
Pao, Lucy Y. — Univ. of Colorado at Boulder
Abramovitch, Daniel Y. — Agilent Lab.

11:10-11:30 WeA21.2
Two Sensor Based H-Infinity Control of a Piezoelectric Tube Scanner (I), pp. 8251-8256.
Mahmood, Iskandar Al-Thani — The Univ. of Newcastle
Liu, Kexiu — The Univ. of newcastle
Moheimani, S.O. Reza — Univ. of Newcastle

11:30-11:50 WeA21.3
Two-Degree-Of-Freedom Tracking Control of Piezoelectric Tube Scanners in Two-Dimensional Scanning Applications (I), pp. 8257-8262.
Maess, Johannes — Univ. of Stuttgart
Becker, Jens — Univ. of Stuttgart
Gaul, Lothar — Univ. of Stuttgart
Allgower, Frank — Univ. of Stuttgart

11:50-12:10 WeA21.4
Real-Time State Estimation and Fault Detection for Controlling Atomic Force Microscope Based Nano Manipualtion (I), pp. 8263-8268.
Liu, Lianqing — Shenyang Inst. of Automation
Xi, Ning — Michigan State Univ.
Luo, Yilun — Michigan State Univ.
Zhang, Jiangbo — Michigan State Univ.
Li, Guangyong — Michigan State Univ.
Wang, Yuechao — Chinese Acad. of Sciences

12:10-12:30 WeA21.5
Hysteresis Inverse Iterative Learning Control of Piezoactuators in AFM (I), pp. 8269-8274.
Leang, Kam K. — Virginia Commonwealth Univ.
Ashley, Seth — Virginia Commonwealth Univ.
Aridogan, Mustafa U. — Virginia Commonwealth Univ.

WeA22 321A
Mechatronic Trends in Trains (Invited Session)
Chair: Goodall, R.M. — Loughborough Univ.
Co-Chair: Mei, Tx — The Univ. of Leeds
Organizer: Goodall, R.M. — Loughborough Univ.

10:30-10:50 WeA22.1
A Mechatronic Approach for Anti-Slip Control in Railway Traction (I), pp. 8275-8280.
Mei, Tx — The Univ. of Leeds
Yu, Jh — The Univ. of Leeds
Wilson, Da — The Univ. of Leeds

10:50-11:10 WeA22.2
Control Alternatives for Yaw Actuated Force Steered Bogies (I), pp. 8281-8286.
Simson, Scott — Central Queensland Univ.
Cole, Colin — Central Queensland Univ.

11:10-11:30 WeA22.3
Vibration Damping of a Flexible Car Body Structure Using Piezo-Stack Actuators (I), pp. 8287-8292.
Kozek, Martin — Vienna Univ. of Tech.
Benatzky, Christian — Vienna Univ. of Tech.
Schirrer, Alexander — Vienna Univ. of Tech.
Stribersky, Anton — Siemens Transportation Systems GmbH & Co KG

11:30-11:50 WeA22.4
Pantograph Dynamics and Control of Tilting Train (I), pp. 8293-8298.
Luo, Ren — Southwest Jiaotong Univ.

11:50-12:10 WeA22.5
Condition Monitoring and Fault Detection of Railway Vehicle Suspension Using Multiple-Model Approach (I), pp. 8299-8304.
Tsunashima, Hitoshi — Nihon Univ.

12:10-12:30 WeA22.6
Optimised Sensor Configuration for a Maglev Suspension, pp. 8305-8310.
Michail, Konstantinos — Loughborough Univ.
Zolotas, Argyrios — Loughborough Univ.
Goodall, R.M. — Loughborough Univ.

WeA23 323
Industrial Applications of Real-Time Distributed Embedded Systems (Regular Session)
Chair: Frey, Georg — Univ. of Kaiserslautern
Co-Chair: Berruet, Pascal — Univ. de Bretagne Sud

10:30-11:10 WeA23.1
It's Time for a Change: The Sun Java Real-Time System for Automation Systems (I), pp. 8311-8314.
Bollella, Gregory — Sun Microsystems

11:10-11:30 WeA23.2
Sentient Objects for Designing and Controlling Service Robots (I), pp. 8315-8320.
Kaiser, Jörg — Otto-von-Guericke-Univ. Magdeburg
Schulze, Michael — Otto-von-Guericke-Univ.
Zug, Sebastian — Otto-von-Guericke-Univ. Magdeburg
Cardeira, Carlos — IDMEC
Carreira, Fernando — Pol. Inst. of Lisbon

11:30-11:50 WeA23.3
Solving the Deployment Problem of IEC 61499 Applications, pp. 8321-8326.
Hussain, Tanvir — Univ. of Kaiserslautern
Frey, Georg — Univ. of Kaiserslautern

11:50-12:10 WeA23.4
Control Code Generation Using Model Engineering for an Electric Train, pp. 8327-8332.
Frizon de Lamotte, Florent — Univ. Européenne de Bretagne - UBS
Berruet, Pascal — Univ. de Bretagne Sud
Rossi, André — Univ. de Bretagne Sud
Philippe, Jean-Luc — Univ. de Bretagne Sud

12:10-12:30 WeA23.5
Enhancement of the Precision Time Protocol in Automation Networks with a Line Topology, pp. 8333-8338.
Na, Chongning — Siemens AG
Obradovic, Dragan — Siemens
Scheiterer, Ruxandra Lupas — Siemens AG
Steindl, Günter — Siemens AG
Götz, Franz-Josef — Siemens AG

WeA24 324
Production Planning & Control (Regular Session)
Chair: Pogromsky, A. Yu. — Eindhoven Univ. of Tech.
Co-Chair: Song, Dong-Ping — Univ. of Plymouth

10:30-10:50 WeA24.1
Production Control and Steady-State Performance Analysis for a Two-Stage Manufacturing System with Finite Buffer Sizes, pp. 8339-8344.
Song, Dong-Ping — Univ. of Plymouth

10:50-11:10 WeA24.2
An Advanced ATP Decision Support System in Stockout Situations, pp. 8345-8350.
Lauras, Matthieu — Ec. des Mines d'Albi-Carmaux
Humez, Verane — Ec. des Mines d'Albi-Carmaux
Okongwu, Uche — Toulouse Business School
Dupont, Lionel — Ec. des Mines d'Albi-Carmaux

11:10-11:30 WeA24.3
An Anti-Windup Based Approach to the Control of Manufacturing Systems, pp. 8351-8356.
van den Bremer, W.A.P. — Eindhoven Univ. of Tech.
van den Berg, R.A. — Eindhoven Univ. of Tech.
Pogromsky, A. Yu. — Eindhoven Univ. of Tech.
Rooda, J.E. — Eindhoven Univ. of Tech.

11:30-11:50 WeA24.4
A Control and Monitoring Oriented Model of a Film Manufacturing Process, pp. 8357-8361.
Hur, Sung-ho — Univ. of Strathclyde
Balderud, Jonas — Univ. of Strathclyde
Katebi, Reza — Univ. of Strathclyde

11:50-12:10 WeA24.5
An Expert Mill Cutter and Cutting Parameters Selection System Incorporating a Control Strategy, pp. 8362-8367.
Rubio, Luis — Basque Country Univ.
de la Sen, Manuel — Univ. del Pais Vasco

12:10-12:30 WeA24.6
Integrated Analysis of Quality and Production Logistics Performance in Asynchronous Manufacturing Lines, pp. 8368-8374.
Colledani, Marcello — Pol. di Milano

WeA25 328
Model Predictive and Optimization-Based Control: Applications (Regular Session)
Chair: Huang, Biao — Univ. of Alberta
Co-Chair: Othman, Sami — Univ. Claude Bernard Lyon 1

10:30-10:50 WeA25.1
Model Predictive Control of Free Surfactant Concentration in Emulsion Polymerization, pp. 8375-8380.
Da Silva, Bruno — Univ. Lyon 1
Dufour, Pascal — Univ. Lyon 1
Othman, Nida — Univ. Claude Bernard Lyon 1
Othman, Sami — Univ. Claude Bernard Lyon 1

10:50-11:10 WeA25.2
Hybrid Fuzzy Predictive Control of a Batch Reactor Using a Branch and Bound and a Genetic Algorithm Approach, pp. 8381-8386.
Causa Morales, Javier Jesús — Univ. de Chile
Karer, Gorazd — Univ. of Ljubljana
Nuńez, Alfredo — Univ. de Chile
Saez, Doris — Univ. de Chile
Skrjanc, Igor — Univ. of Ljubljana
Zupancic, Borut — Faculty of Electrical Engineering, Univ. of Ljubljana

11:10-11:30 WeA25.3
Performance Assessment and Model Validation of Two Industrial MPC Controllers, pp. 8387-8394.
Jiang, Hailei — Univ. of alberta
Shah, Sirish — Univ. of Alberta
Huang, Biao — Univ. of Alberta
Wilson, Bruce — Suncor Energy Inc.
Patwardhan, Rohit — Matrikon Inc.
Szeto, Foon — Suncor Energy Inc.

11:30-11:50 WeA25.4
Robustness Issues Related to the Application of Distributed Model Predictive Control Strategies, pp. 8395-8400.
Al-Gherwi, Walid — Univ. of Waterloo
Budman, Hector M. — Univ. of Waterloo
Elkamel, Ali — Univ. of Waterloo

11:50-12:10 WeA25.5
Simple Pulse-Step Model Predictive Controller, pp. 8401-8406.
Schlegel, Milos — Univ. of West Bohemia in Pilsen
Sobota, Jaroslav — Univ. of West Bohemia in Pilsen

12:10-12:30 WeA25.6
Reliable Optimal Control of a Fed-Batch Bio-Reactor Using Ant Colony Optimization and Bootstrap Aggregated Neural Networks, pp. 8407-8412.
Al-Mahrouqi, Mahmood — Newcastle Univ.
Zhang, Jie — Newcastle Univ.

WeA26 327
Control of Power Systems I (Regular Session)
Chair: Wertz, Vincent — Univ. catholique de Louvain
Co-Chair: Weissbach, Tobias — Univ. Stuttgart

10:30-10:50 WeA26.1
ROBUST SPEED CONTROL OF PMSM USING Mixed NONLINEAR H_; /SMC Techniques, pp. 8413-8418.
Ghafari, Alireza — Univ. of Tehran
Yazdanpanah, M. J. — Univ. of Tehran
Faiz, Javad — Univ. of Tehran

10:50-11:10 WeA26.2
Robust Decentralized Switching Power System Stabilisers for Interconnected Power Grids: Stability Using Dwell Time, pp. 8419-8424.
Athanasius, Germane Xavier — Univ. OF NEW SOUTH WALES, AUSTRALIA
Pota, Hemanshu — Univ. of New South Wales
Ugrinovskii, Valery — Univ. of New South Wales

11:10-11:30 WeA26.3
Optimal Control of Fuel Processing System Using Generalized Linear Quadratic Gaussian and Loop Transfer Recovery Method,

pp. 8425-8430.
Tsai, Huan-Liang — Da-Yeh Univ.
Lin, Jium-Ming — Chung Hua Univ.

11:30-11:50 — WeA26.4
Robust Coordinated Passivation Control for Generator Excitation and TCSC System, pp. 8431-8436.
Sun, Li-Ying — Northeastern Univ.
Dimirovski, Georgi Marko — Dogus Univ. of Istanbul
Zhao, Jun — The Australian National Univ.

11:50-12:10 — WeA26.5
Performance Limitations Arising in the Control of Power Plants, pp. 8437-8442.
Wertz, Vincent — Univ. catholique de Louvain
Silva, Eduardo Ignacio — The Univ. of Newcastle
Goodwin, Graham C. — Univ. of Newcastle
Codrons, Benoît — Lab.

12:10-12:30 — WeA26.6
Designing a Bidding-Agent for Electricity Markets: A Multi Agent Cooperative Learning Approach, pp. 8443-8448.
Nouri Dariani, Ali — Univ. of Tehran
Fazeli Neishabour, Arastoo — Sharif Univ. of Tech.
Rahimi-Kian, Ashkan — Univ. of Tehran
Ahmad Sharbafi, Maziar — Univ. of Tehran

WeA27 — 326
Control Software Technology (Regular Session)
Chair: Marcos, Marga — Univ. del País Vasco
Co-Chair: Thiry, Laurent — ENSISA

10:30-10:50 — WeA27.1
Functional Metamodels for the Development of Control Software, pp. 8449-8454.
Thiry, Laurent — ENSISA
Thirion, Bernard — ENSISA

10:50-11:10 — WeA27.2
A Metamodeling Approach for Safe Control Software, pp. 8455-8460.
Collonville, Thomas — ENSISA
Thiry, Laurent — ENSISA
Perronne, Jean-Marc — ENSISA
Thirion, Bernard — ENSISA

11:10-11:30 — WeA27.3
Middleware Based on XML Technologies for Achieving True Interoperability between PLC Programming Tools, pp. 8461-8466.
Estévez, Elisabet — Univ. del País Vasco
Marcos, Marga — Univ. del País Vasco
Orive, Dario — Univ. del País Vasco
López, A. Fabián — Faculty of Engineering, Univ. of the Basque Country
Irisarri, Edurne — Pol. Univ. Coll. Univ. of the Basque Count
Perez, Federico — Univ. of the Basque Country

11:30-11:50 — WeA27.4
Towards the Conformance Analysis of IEC 61131-3 PLC Programming Tools, pp. 8467-8472.
Estévez, Elisabet — Univ. del País Vasco
Marcos, Marga — Univ. del País Vasco
Sarachaga González, MŞ Isabel — Faculty of Engineering, Univ. of the Basque Country
Burgos, Arantzazu — E.U.I.T.I. de Bilbao, Univ. of the Basque Country

11:50-12:10 — WeA27.5
A Review of Matlab's SISOTOOL; Features and Contributions to Control Education, pp. 8473-8474.
Tan, Chee Pin — Monash Univ.
Teoh, Kok Soo — Monash Univ.
Jones, Lim Jen Nee — Monash Univ. Sunway Campus Malaysia

12:10-12:30 — WeA27.6
Middleware for Control Kernel Implementation in Embedded Control Systems, pp. 8475-8480.
Fernández, Adel — CUJAE, Havana, Cuba
Valles, Marina — Assistant Professor
Crespo, A. — Univ. Pol. de Valencia
Albertos, Pedro — Univ. Pol. de Valencia
Simo, Jose — Univ. Pol. de Valencia

WeA28 — 330A
Engine Modelling (Regular Session)
Chair: Rizzo, Gianfranco — Univ. of Salerno
Co-Chair: Corde, Gilles — IFP

10:30-10:50 — WeA28.1
Modelling, Parameter Identification and Dynamics Analysis of a Common Rail Injection System for Gasoline Engines, pp. 8481-8486.
Corno, Matteo — Pol. di Milano
Savaresi, Sergio — Pol. di Milano
Scattolini, Riccardo — Pol. di Milano
Comignaghi, Emilio — FIAT Powertrain Tech. SPA
Palma, Antonio — Elasis SPA
Sofia, Marco — FIAT Powertrain Tech. SPA
Sepe, Eduardo — Elasis - Fiat Powertrain Tech.

10:50-11:10 — WeA28.2
Modelling and Control of the Air System of a Turbocharged Gasoline Engine, pp. 8487-8494.
Moulin, Philippe — IFP
Chauvin, Jonathan — IFP
Youssef, Bilal — INPG

11:10-11:30 — WeA28.3
Air Mass Flow Analysis for SI Engine: EGR and Scavenging, pp. 8495-8500.
Palma, Antonio — Elasis SPA
Palladino, Angelo — Univ. degli Studi del Sannio
Fiengo, Giovanni — Univ. degli Studi del Sannio
De Cristofaro, Ferdinando — Elasis
Garofalo, Fabio — Elasis S.C.p.A.
Glielmo, Luigi — Univ. of Sannio

11:30-11:50 — WeA28.4
Real-Time Combustion Parameters Estimation for HCCI-Diesel Engine Based on Knock Sensor Measurement, pp. 8501-8507.
Chauvin, Jonathan — IFP
Grondin, Olivier — Inst. Français du Pétrole
Nguyen, Emmanuel — IFP
Guillemin, Fabrice — IFP

11:50-12:10 — WeA28.5
Recurrent Neural Networks for Air-Fuel Ratio Estimation and Control in Spark-Ignited Engines, pp. 8508-8513.
Sorrentino, Marco — Univ. of Salerno
Arsie, Ivan — Univ. of Salerno
Pianese, Cesare — Univ. OF SALERNO
Rizzo, Gianfranco — Univ. of Salerno
Di Iorio, Silvana — Univ. of Salerno

12:10-12:30 — WeA28.6
Grey-Box Control Oriented Engine Emissions Models, pp. 8514-8519.
Hirsch, Markus — Johannes Kepler Univ. Linz Center of Mechatronics
Alberer, Daniel — Johannes Kepler Univ. Linz
Del Re, Luigi — Johannes Kepler Univ.

WeA29 — 330B
Accident Reduction and Fault Tolerant Systems (Regular Session)
Chair: Gissinger, Gerard — Univ. of Mulhouse
Co-Chair: Gaspar, Peter — Computer & Automation Inst. of HAS

10:30-10:50 — WeA29.1
Development of a Collision Avoidance Algorithm Using Elastic Band Theory, pp. 8520-8525.
Ararat, Oncu — Istanbul Tech. Univ.
Aksun Guvenc, Bilin — Istanbul Tech. Univ.

10:50-11:10 — WeA29.2
Analytical Study of Human Errors Causing Traffic Accidents from the View Point of Consciousness Transition, pp. 8526-8531.
Yamada, Kiichi — Hyundai Motor Japan R&D Center
Suzuki, Keisuke — Daido Inst. of Tech.
Minakami, Yumie — Hyundai Motor Japan R&D Center

11:10-11:30 — WeA29.3
Control Concept for Forward Collision Warning and Mitigation, pp. 8532-8533.
Hong, Daegun — MANDO Corp.

Kang, Hyoung-Jin — Mando Corp.
Yoon, Paljoo — Mando Corp.

11:30-11:50 WeA29.4
Sliding Mode Observer Based Predictive Fault Diagnosis of a Steer-By-Wire System, pp. 8534-8539.
Hasan, Mohammad Sharif-ul — Cummins, Inc.
Anwar, Sohel — Purdue School of Engr. & Tech.

11:50-12:10 WeA29.5
A Fault-Tolerant Vehicle Control Design, pp. 8540-8545.
Gaspar, Peter — Computer & Automation Inst. of HAS
Szabo, Zoltan — Hungarian Acad. of Sciences
Bokor, Jozsef — Hungarian Acad. of Sciences

12:10-12:30 WeA29.6
Design, Tuning and Evaluation of Integrated ACC/CA Systems, pp. 8546-8551.
Moon, Seung-Wuk — Seoul National Univ.
Yi, Kyongsu — Seoul National Univ.
Moon, Ilki — Hyundai Motor Company

WeA30 330C
Intelligent Vehicles Navigation and Control I (Regular Session)
Chair: Hong, Keum-Shik — Pusan National Univ.
Co-Chair: Mahony, Robert — Australian National Univ.

10:30-10:50 WeA30.1
Moving Ground Target Tracking in Dense Obstacle Areas Using UAVs, pp. 8552-8557.
Kim, Jongrae — Univ. of Glasgow
Kim, Yoonsoo — Univ. of Stellenbosch

10:50-11:10 WeA30.2
Output Based Observation and Control for Visual Servoing of VTOL UAV's, pp. 8558-8563.
Le Bras, Florent — Delegation generale de l'armement
Hamel, Tarek — Univ. de Nice Sophia Antipolis
Mahony, Robert — Australian National Univ.

11:10-11:30 WeA30.3
MPC with Nonlinear H-Infinity Control for Path Tracking of a Quad-Rotor Helicopter, pp. 8564-8569.
Raffo, Guilherme Vianna — Univ. de Sevilla
Ortega, M. G. — Univ. de Sevilla
Rubio, Francisco R. — Univ. de Sevilla

11:30-11:50 WeA30.4
Using the Unscented Kalman Filter and a Non-Linear Two-Track Model for Vehicle State Estimation, pp. 8570-8575.
Reif, Konrad — Berufsakademie Friedrichshafen, Univ. of CooperateEducation
Renner, Kerstin — Patentanwaltskanzlei von Kreisler Selting Werner
Saeger, Martin — RWTH Aachen

11:50-12:10 WeA30.5
Aircraft Landing Control Based on CMAC and GA Techniques, pp. 8576-8581.
Juang, Jih-Gau — National Taiwan Ocean Univ.
Lin, Wen-Pin — National Taiwan Ocean Univ.

12:10-12:30 WeA30.6
Time-Varying Feedback Control of an Unmanned Autonomous Industrial Forklift, pp. 8582-8587.
Tamba, Tua Agustinus — Pusan National Univ.
Hong, Keum-Shik — Pusan National Univ.
Tjokronegoro, Harijono A. — Bandung Inst. of Tech.

WeB02 304A
Nonlinear Observers II (Regular Session)
Chair: Pascoal, Antonio M. — ISR-Inst. Superior Tecnico
Co-Chair: Oliveira, Paulo Jorge — Inst. Superior Técnico

14:00-14:20 WeB02.1
Unknown Input Observer Synthesis Method with Modified mathcal{H}_{infty} Criteria for Nonlinear Systems Using Sobolev Norms, pp. 8588-8593.
Zemouche, Ali — Louis Pasteur Univ.
Boutayeb, Mohamed — Nancy Univ.

14:20-14:40 WeB02.2
Non-Linear Observer on Lie Groups for Left-Invariant Dynamics with Right-Left Equivariant Output, pp. 8594-8598.
Bonnabel, Silvere — Univ. de Ličge
Martin, Philippe — Ec. des Mines de Paris
Rouchon, Pierre — ENSMP

14:40-15:00 WeB02.3
A Nonlinear Observer for Rigid Body Attitude Estimation Using Vector Observations, pp. 8599-8604.
Vasconcelos, José Fernandes — Inst. Superior Técnico
Silvestre, Carlos — Inst. Superior Tecnico
Oliveira, Paulo Jorge — Inst. Superior Técnico

15:00-15:20 WeB02.4
Identification and Convergence Analysis of a Class of Continuous-Time Multiple-Model Adaptive Estimators, pp. 8605-8610.
Aguiar, A. Pedro — Inst. Superior Tecnico
Hassani, Vahid — Inst. Superior Tecnico (IST)
Pascoal, Antonio M. — ISR-Inst. Superior Tecnico
Athans, Michael — Inst. Superior Tecnico

15:20-15:40 WeB02.5
Asymptotically Optimal Nonlinear Filtering: Theory and Examples with Application to Target State Estimation, pp. 8611-8617.
Çimen, Tayfun — ROKETSAN Missiles Industries Inc.
Merttopçuo_;lu, A. Osman — ROKETSAN Missiles Industries Inc.

15:40-16:00 WeB02.6
Observer Forms for Perspective Systems, pp. 8618-8623.
Dahl, Ola — School of Tech. and Society, Malmö Univ.
Wang, Yebin — Univ. of Alberta
Lynch, Alan Francis — Univ. of Alberta
Heyden, Anders — School of Tech. and Society, Malmö Univ.

WeB03 304B
Output Feedback Sliding Mode Control (Regular Session)
Chair: Spurgeon, Sarah K. — Univ. of Leicester
Co-Chair: Kim, Kyung-Soo — Korea Advanced Inst. of Science and Tech.

14:00-14:20 WeB03.1
Stabilizability of Uncertain Switched Systems Via Static/Dynamic Output Feedback Sliding Mode Control, pp. 8624-8629.
Lian, Jie — Northeastern Univ.
Dimirovski, Georgi Marko — Dogus Univ. of Istanbul
Zhao, Jun — The Australian National Univ.

14:20-14:40 WeB03.2
Sliding Mode Static Output Feedback Control for Uncertain Systems: A Polytopic Approach, pp. 8630-8635.
Andrade Da Silva, Jose Manuel — Univ. of Leicester
Spurgeon, Sarah K. — Univ. of Leicester
Edwards, Christopher — Univ. of Leicester

14:40-15:00 WeB03.3
Output Feedback Control: A Robust Solution Based on Second Order Sliding Mode, pp. 8636-8641.
Plestan, Franck — Ec. Centrale De Nantes-CNRS
Moulay, Emmanuel — Ec. Centrale de Nantes
Glumineau, Alain — Ec. Centrale Nantes
Cheviron, Thibault — DGA - CNRS

15:00-15:20 WeB03.4
Static Output Feedback Sliding Mode Control for Time-Varying Delay Systems with Time-Delayed Nonlinear Disturbances, pp. 8642-8647.
Yan, Xing-Gang — Univ. of Leicester
Spurgeon, Sarah K. — Univ. of Leicester
Edwards, Christopher — Univ. of Leicester

15:20-15:40 WeB03.5
Discrete–time Output Feedback Sliding Mode Control of a Large Pressurized Heavy Water Reactor, pp. 8648-8653.
Reddy, Datatreya — IIT Bombay
Park, Youngjin — KAIST
Bandyopadhyay, Bijnan — IIT Bombay
Tiwari, Akhilanand Pati — Bhabha Atomic Res. Centre

15:40-16:00 WeB03.6
Robust Static Output Feedback Sliding Mode Control Design Via an

Artificial Stabilizing Delay, pp. 8654-8659.
Seuret, Alexandre — Royal Inst. of Tech.
Edwards, Christopher — Univ. of Leicester
Spurgeon, Sarah K. — Univ. of Leicester
Fridman, E. M. — Tel-Aviv Univ.

WeB04 — 308
Polynomial Design Methods (Invited Session)
Chair: Kucera, Vladimir — Czech Tech. Univ. in Prague
Co-Chair: Lampe, Bernhard P. — Univ. of Rostock
Organizer: Hromcik, Martin — Czech Tech. Univ.

14:00-14:20 — WeB04.1
Sampled-Data Polynomial Modal Control of Linear Periodic Plants with Time-Delay (I), pp. 8660-8665.
Lampe, Bernhard P. — Univ. of Rostock
Rosenwasser, Efim N. — Marine Tech. Univ. of Saint Petersburg

14:20-14:40 — WeB04.2
Real-Time 2DoF Control of a Quadruple Tank System with Integral Action (I), pp. 8666-8671.
Herceg, Martin — Slovak Univ. of Tech. in Bratislava
Mikles, Jan — Slovak Tech. Univ.
Fikar, Miroslav — STU in Bratislava
Kvasnica, Michal — Slovak Univ. of Tech. in Bratislava
Cirka, Lubos — Slovak Univ. of Tech. Faculty of Chemical

14:40-15:00 — WeB04.3
Solving the Optimal PWM Problem for Odd Symmetry Waveforms (I), pp. 8672-8677.
Kujan, Petr — Acad. of Sciences of the Czech Republic
Hromcik, Martin — Czech Tech. Univ.
Sebek, Michael — Czech Tech. Univ. in Prague

15:00-15:20 — WeB04.4
Algebraic Approach to LQ-Optimal Control of Spatially Distributed Systems: 2-D Case (I), pp. 8678-8683.
Augusta, Petr — Acad. of Sciences of the Czech Republic
Hurak, Zdenek — Centre For Applied Cybernetics, Czech Tech. Univ.

15:20-15:40 — WeB04.5
Stability Analysis and Design for Polynomial Nonlinear Systems Using SOS with Application to Aircraft Flight Control, pp. 8684-8689.
Zhao, Dan — Nanyang Tech. Univ.
Wang, Jian Liang — Nanyang Tech. Univ.

15:40-16:00 — WeB04.6
A Technique of a Stability Domain Determination for Nonlinear Discrete Polynomial Systems, pp. 8690-8694.
Benhadj Braiek, Naceur — Ec. Pol. de Tunisie
Jerbi, Houssem — Ec. Pol. de Tunisie
Bacha, Anis — Ec. Pol. de Tunisie

WeB05 — 307
Controller Constraints and Structure II (Regular Session)
Chair: Sandberg, Henrik — Royal Inst. of Tech. (KTH)
Co-Chair: Rodellar, Jose — Tech. Univ. of Catalonia

14:00-14:20 — WeB05.1
Effect of Time-Delay on the Derivative Feedback Control of a 2-Degree-Of-Freedom Torsional Bar with Parameter Perturbations, pp. 8695-8700.
Han, Qing-Long — Central Queensland Univ.
Yu, Xinghuo — RMIT Univ.
Feng, Yong — Harbin Inst. of Tech.
Chen, Guanrong Ron — City Univ. of Hong Kong

14:20-14:40 — WeB05.2
A Design Procedure for Overlapped Guaranteed Cost Controllers, pp. 8701-8706.
Palacios, Francisco — Tech. Univ. of Catalonia (UPC)
Rodellar, Jose — Tech. Univ. of Catalonia
Rossell, Josep M. — Univ. Pol. de Catalunya

14:40-15:00 — WeB05.3
Quantizer Design for Interconnected Feedback Control Systems, pp. 8707-8712.
Zhai, Guisheng — Osaka Prefecture Univ.
Chen, Ning — Central South Univ.
Gui, Weihua — Central South Univ.

15:00-15:20 — WeB05.4
Relations between Control Signal Properties and Robustness Measures, pp. 8713-8718.
Larsson, Per-Ola — Lund Univ.
Hagglund, Tore — Professor

15:20-15:40 — WeB05.5
Control-Oriented Sensor/Actuator Location Measures for Active Noise Control, pp. 8719-8724.
Sánchez-Peńa, Ricardo S. — Univ. Pol. de Catalunya
Cugueró, Miquel Ŕ. — Univ. Pol. de Catalunya (UPC)

15:40-16:00 — WeB05.6
Model Reduction of Interconnected Linear Systems Using Structured Gramians, pp. 8725-8730.
Sandberg, Henrik — Royal Inst. of Tech. (KTH)
Murray, Richard M. — California Inst. of Tech.

WeB06 — 310A
Infinite Dimensional Systems: Stabilization and Control (Regular Session)
Chair: Guo, Bao-Zhu — The Chinese Acad. of Sciences
Co-Chair: Kugi, Andreas — Vienna Univ. of Tech.

14:00-14:20 — WeB06.1
Backstepping Boundary Controllers and Observers for the Rayleigh Beam, pp. 8731-8736.
Lertphinyovong, Jittichai — Chulalongkorn Univ.
Khovidhungij, Watcharapong — Chulalongkorn Univ.

14:20-14:40 — WeB06.2
Approximate Stabilization of a Quantum Particle in a 1D Infinite Potential Well, pp. 8737-8742.
Beauchard, Karine — Univ. Paris-Sud, France
Mirrahimi, Mazyar — INRIA Rocquencourt

14:40-15:00 — WeB06.3
Feedforward Control Design for the Inviscid Burger Equation Using Formal Power Series and Summation Methods, pp. 8743-8748.
Wagner, Marc Oliver — Vienna Univ. of Tech.
Meurer, Thomas — Vienna Univ. of Tech.
Kugi, Andreas — Vienna Univ. of Tech.

15:00-15:20 — WeB06.4
Robust Regulation of Infinite-Dimensional Systems with Infinite-Dimensional Exosystems, pp. 8749-8754.
Hamalainen, Timo — Tampere Univ. of Tech.
Pohjolainen, Seppo — Tampere Univ. of Tech.

15:20-15:40 — WeB06.5
Boundary Output Feedback Stabilization of a One-Dimensional Wave Equation System with Time Delay, pp. 8755-8760.
Guo, Bao-Zhu — Acad. of Math. and Syst. Sciences
Xu, Chengzhong — Univ. Claude Bernard - Lyon1

15:40-16:00 — WeB06.6
Strong Stabilization of a Non-Uniform SCOLE Model, pp. 8761-8766.
Zhao, Xiaowei — Imperial Coll. London
Weiss, George — Tel Aviv Univ.

WeB07 — 310B
Optimal Control Theory II (Regular Session)
Chair: Lee, Kwang Soon — Sogang Univ.
Co-Chair: Behera, Laxmidhar — Indian Inst. of Tech. Kanpur

14:00-14:20 — WeB07.1
Control of Multivariable Systems Using Modified Local Optimal Controller, pp. 8767-8772.
Ashry, Mahmoud — Univ. of manchester
Abou-Zayed, Usama — Univ. of manchester
Breikin, Tim — Univ. of manchester

14:20-14:40 — WeB07.2
Formulas for Discrete Time LQR, LQG, LEQG and Minimax LQG Optimal Control Problems, pp. 8773-8778.
Ainikkal, Shaiju Johny — UNSW@ADFA
Petersen, Ian Richard — Univ. of New South Wales - ADFA

14:40-15:00 — WeB07.3
Linear Quadratic Regulation for Continuous-Time Systems with Time-Varying Delay, pp. 8779-8784.
Zhang, Huanshui — Shandong Univ.
Wang, Wei — Shenzhen Graduate School of

Harbin Inst. of Tech.
Xie, Lihua — Nanyang Tech. Univ.

15:00-15:20 WeB07.4
A Suboptimal Controller Design Methodology for Input-Output Feedback-Linearizable Systems, pp. 8785-8790.
Mohajerin Esfahani, Peyman — Sharif Univ. and Tech.
Karimi-Ghartemani, Masoud — Univ. of Toronto

15:20-15:40 WeB07.5
A New Iterative Procedure to Obtain H-Infinity, L-Infinity Optimal Regulators, pp. 8791-8796.
Keviczky, Laszlo — Hungarian Acad. of Sciences; Comp. and Auto. Res. Inst.
Banyasz, Csilla — Hungarian Acad. of Sciences

15:40-16:00 WeB07.6
Continuous-Time Single Network Adaptive Critic for Regulator Design of Nonlinear Control Affine Systems, pp. 8797-8802.
Kumar, Swagat — Indian Inst. of Tech. Kanpur
Padhi, Radhakant — Indian Inst. of Science
Behera, Laxmidhar — Indian Inst. of Tech. Kanpur

WeB08 310C
Optimization Based Controller Synthesis II (Regular Session)
Chair: Rakovic, Sasa V. — ETH Zurich
Co-Chair: Sebe, Noboru — Kyushu Inst. of Tech.

14:00-14:20 WeB08.1
Max-Min Optimal Control of Constrained Discrete-Time Systems, pp. 8803-8808.
Baric, Miroslav — Swiss Federal Inst. of Tech.
Rakovic, Sasa V. — ETH Zurich
Besselmann, Thomas — ETH Zurich
Morari, Manfred — Swiss Federal Inst. of Tech.

14:20-14:40 WeB08.2
Robust Multi-Model Predictive Control Using LMIs, pp. 8809-8814.
Falugi, Paola — Supelec
Olaru, Sorin — Supelec
Dumur, Didier — Ec. Superieure d'Electricite

14:40-15:00 WeB08.3
Disturbance Rejection Control in Coordinated Systems, pp. 8815-8820.
Kang, Keunmo — Univ. of California San Diego
Zhang, David — Univ. of California, San Diego
Bitmead, Robert — Univ. of California San Diego

15:00-15:20 WeB08.4
New LMI Characterizations for Discrete-Time Descriptor Systems and Application to Multiobjetive Control System Synthesis, pp. 8821-8827.
Sebe, Noboru — Kyushu Inst. of Tech.

15:20-15:40 WeB08.5
Design of Robust Quadratic-Optimal Controllers for Linear Multivariable Output Feedback PID Uncertain Control Systems, pp. 8828-8833.
Chen, Shinn-Horng — National Kaohsiung Univ. of applied sciences
Ho, Wen-Hsien — National Kaohsiung First Univ. of Science andTechnology
Chou, Jyh-Horng — National Kaohsiung First Univ. of Science andTechnology
Liu, Tung-Kuan — National Kaohsiung First Univ. of ScienceandTechnology

15:40-16:00 WeB08.6
Robust H_; Controller Design for Aircraft Lateral Dynamics Using Multi-Objective Optimization and Genetic Algorithms, pp. 8834-8839.
Giacomán-Zarzar, Manuel — ITESM, Campus Monterrey
Ramírez-Mendoza, Ricardo A. — ITESM Campus Monterrey
Fleming, P.J. — Univ. of Sheffield
Griffin, Ian — Rolls-Royce
Molina-Cristobal, Arturo — The Univ. of Sheffield

WeB09 311C
Subspace-Based System Identification (Regular Session)
Chair: Chiuso, Alessandro — Univ. of Padova
Co-Chair: McKelvey, Tomas — Chalmers Univ. of Tech.

14:00-14:20 WeB09.1
Subspace Identification of a Class of Large-Scale Systems, pp. 8840-8845.
Massioni, Paolo — Delft Univ. of Tech.
Verhaegen, Michel — Delft Univ. of Tech.

14:20-14:40 WeB09.2
A Subspace Method for Frequency Selective Identification of Stochastic Systems, pp. 8846-8851.
McKelvey, Tomas — Chalmers Univ. of Tech.
Atala, Hector — Ericsson
Blanco Parada, David — Ericsson

14:40-15:00 WeB09.3
Estimation of the Uncertainty in a Helicopter Dynamic Model Identified by the Subspace-Based Method Using Bootstrap Techniques, pp. 8852-8859.
Li, Ping — Univ. of Leicester
Postlethwaite, Ian — the Univ. of Leicester
Turner, Matthew C. — Univ. of Leicester

15:00-15:20 WeB09.4
Thermodynamic Identification of Buildings Using Wireless Sensor Networks, pp. 8860-8865.
Toffoli, Elena — Univ. di Padova
Baldan, Giancarlo — Univ. of padua
Albertin, Guido — Univ. di Padova
Schenato, Luca — Univ. of Padova
Chiuso, Alessandro — Univ. of Padova
Beghi, Alessandro — Univ. di Padova

15:20-15:40 WeB09.5
Closed Loop LPV Identification of the Time-Varying Dynamics of a Variable Speed Wind Turbine, pp. 8866-8871.
Wingerden, van, Jan-Willem — Delft Univ. of Tech.
Houtzager, Ivo — Delft Univ. of Tech.
Felici, Federico — EPFL
Verhaegen, Michel — Delft Univ. of Tech.

15:40-16:00 WeB09.6
Recursive Subspace Model Identification Based on Vector Autoregressive Modelling, pp. 8872-8877.
Wu, Ping — Zhejiang Univ.
Yang, ChunJie — Zhejiang Univ.
Song, Zhi-Huan — Zhejiang Univ.

WeB10 311B
Fault Detection II (Regular Session)
Chair: Basseville, Michčle — CNRS-IRISA
Co-Chair: Kim, Yoonsoo — Univ. of Stellenbosch

14:00-14:20 WeB10.1
Fault-Tolerant Cooperative Target Tracking in Distributed UAV Networks, pp. 8878-8883.
Kim, Yoonsoo — Univ. of Stellenbosch
Gu, Dawei — Univ. of Leicester
Postlethwaite, Ian — the Univ. of Leicester

14:20-14:40 WeB10.2
Fault Detection of Networked Control Systems with Packet Dropout, pp. 8884-8889.
Wang, Yongqiang — Tsinghua Univ.
Ding, Steven X. — Univ. of Duisburg-Essen
Zhang, Ping — Univ. of Duisburg-Essen
Li, Wei — Univ. of Duisburg-Essen
Ye, Hao — Tsinghua Univ.
Wang, Guizeng — Tsinghua Univ.

14:40-15:00 WeB10.3
Information Based Fault Diagnosis, pp. 8890-8895.
Niemann, Henrik — Tech. Univ. of Denmark
Poulsen, Niels K. — The Tech. Univ. of Denmark

15:00-15:20 WeB10.4
Process Fault Monitoring Using Data Fusion Based on Extended Kalman Filter Incorporated with Time-Delayed Measurements, pp. 8896-8901.
Mosallaei, Mohsen — Petroleum Univ. of Tech. (PUT)
Salahshoor, Karim — petroleum Univ. of Tech.

15:20-15:40 WeB10.5
Disturbance Attenuation and Fault Detection Via Zero-Pole Assignment: A Dynamic Observer Approach, pp. 8902-8907.
Dai, Xuewu — Univ. of Manchester
Gao, Zhiwei — The Univ. of Manchester
Breikin, Tim — Univ. of manchester
Wang, Hong — the Univ. of Manchester

15:40-16:00 WeB10.6
Fault Detection and Isolation for Nonlinear Systems with Full State Information, pp. 8908-8912.
Wang, Wei — Beihang Univ.
Yang, Bo — Beihang Univ.
Zhou, Kemin — Lousiana State Univ.
Ren, Zhang — Beihang Univ.

WeB11 311A
Robust Adaptive Control (Regular Session)
Chair: Lin, Wei — Case Western Res. Univ.
Co-Chair: Blazic, Saso — Univ. of Ljubljana

14:00-14:20 WeB11.1
A New Leakage Term in the Adaptive Law, pp. 8913-8918.
Blazic, Saso — Univ. of Ljubljana
Skrjanc, Igor — Univ. of Ljubljana
Matko, Drago — Univ. of Ljubljana

14:20-14:40 WeB11.2
An Adaptive H-Infinity Control for Robotic Manipulator with Compensation of Input Torque Uncertainty, pp. 8919-8924.
Sato, Kazuya — Saga Univ.

14:40-15:00 WeB11.3
Unfalsified Virtual Reference Adaptive Switching Control of Plants with Persistent Disturbances, pp. 8925-8930.
Battistelli, Giorgio — Univ. of Florence
Mosca, Edoardo — Univ. of Florence
Safonov, Michael G. — Univ. of Southern California
Tesi, Pietro — Univ. degli Studi di Firenze

15:00-15:20 WeB11.4
Semi-Global Robust Stabilization of a Family of Uncertain Nonlinear Systems by Non-Smooth Output Feedback: The Planar Case, pp. 8931-8936.
Yang, Bo — Texas Tech. Univ.
Lin, Wei — Case Western Res. Univ.
Sun, Yuanzhang — Tsinghua Univ.

15:20-15:40 WeB11.5
Delay Independent Stabilization and ASC, pp. 8937-8942.
Amemiya, Takashi — Setsunan Univ.

15:40-16:00 WeB11.6
Self-Repairing and Adaptive Tracking for MIMO Systems with Sensor Failures, pp. 8943-8948.
Takahashi, Masanori — Tokai Univ.

WeB12 313
Reachability Computations for Hybrid Systems (Invited Session)
Chair: Gueguen, Herve — Supelec
Co-Chair: Bujorianu, Manuela — Univ. of Twente
Organizer: Gueguen, Herve — Supelec

14:00-14:40 WeB12.1
Safety Verification and Reachability Analysis for Hybrid Systems (I), pp. 8949-8959.
Gueguen, Herve — SUPELEC
Lefebvre, Marie-Anne — Supelec
Nasri, Othman — Supelec
Zaytoon, Janan — Univ. of Reims

14:40-15:00 WeB12.2
Reachability Computation for Hybrid Systems with Ariadne (I), pp. 8960-8965.
Benvenuti, Luca — Univ. di Roma
Bresolin, Davide — Univ. of Verona
Casagrande, Alberto — Univ. of Udine
Collins, Pieter — CWI
Ferrari, Alberto — Parades Geie
Mazzi, Emanuele — PARADES
Sangiovanni-vincentelli, Alberto — Univ. of California at Berkeley
Villa, Tiziano — PARADES G.E.I.E.

15:00-15:20 WeB12.3
Efficient Reachability Analysis for Linear Systems Using Support Functions (I), pp. 8966-8971.
Girard, Antoine — Univ. Joseph Fourier
Le Guernic, Colas — VERIMAG

15:20-15:40 WeB12.4
Reachability Analysis of Uncertain Nonlinear Systems Using Guaranteed Set Integration (I), pp. 8972-8977.
Ramdani, Nacim — INRIA
Meslem, Nacim — Univ. Paris XII
Candau, Yves — Univ. Paris XII

15:40-16:00 WeB12.5
Approximate Abstractions of Stochastic Hybrid Systems, pp. 8978-8983.
Bujorianu, Manuela — Univ. of Twente
Bujorianu, Marius Constantin — Univ. of Twente
Blom, Henk A.P. — National Aerospace Lab. NLR

WeB13 314
Applications of Stochastic Systems Theory (Regular Session)
Chair: James, Matthew R. — Australian National Univ.
Co-Chair: Cenedese, Angelo — Univ. of Padova

14:00-14:20 WeB13.1
On the Estimation of Atmospheric Turbulence Layers, pp. 8984-8989.
Beghi, Alessandro — Univ. di Padova
Cenedese, Angelo — Univ. of Padova
Masiero, Andrea — Univ. di Padova

14:20-14:40 WeB13.2
The Autocovariance Least Squares Technique for GPS Interference/Jamming Detection, pp. 8990-8995.
Abdel-Hafez, Mamoun — American Univ. of Sharjah

14:40-15:00 WeB13.3
Multi-Loop Feedback Control for Atom Laser Coherence, pp. 8996-9001.
Yanagisawa, Masahiro — Australian National Univ.
James, Matthew R. — Australian National Univ.

15:00-15:20 WeB13.4
An Adaptive Sensor Fusion Method with Applications in Integrated Navigation, pp. 9002-9007.
Jwo, Dah-Jing — National Taiwan Ocean Univ.
Weng, Tsu-Pin — National Taiwan Ocean Univ.

15:20-15:40 WeB13.5
Regulation of a Manned Sea-Surface Vehicle Via Stochastic Optimal Control, pp. 9008-9013.
Carravetta, Francesco — IASI-CNR
Felici, Giovanni — IASI
Palumbo, Pasquale — IASI-CNR

15:40-16:00 WeB13.6
Decentralized State Estimation of Distributed Phenomena Based on Covariance Bounds, pp. 9014-9020.
Sawo, Felix — Univ. of Karlsruhe
Beutler, Frederik — Univ. Karlsruhe (TH)
Hanebeck, Uwe — Univ. Karlsruhe

WeB14 318
Networked Systems: Consensus of Multi-Agent Systems and Related Results (Invited Session)
Chair: Angeli, David — Imperial Coll.
Co-Chair: Bliman, Pierre-Alexandre J — INRIA-Rocquencourt
Organizer: Bliman, Pierre-Alexandre J — INRIA-Rocquencourt
Organizer: Angeli, David — Univ. of Firenze

14:00-14:20 WeB14.1
Tight Estimates for Non-Stationary Consensus with Fixed Underlying Spanning Tree (I), pp. 9021-9026.
Angeli, David — Imperial Coll.
Bliman, Pierre-Alexandre J — INRIA-Rocquencourt

14:20-14:40 WeB14.2
Robust Control in Uncertain Multi-Inventory Systems and Consensus Problems (I), pp. 9027-9032.
Bauso, Dario — Univ. di Palermo
Giarre', Laura — Univ. di Palermo
Pesenti, Raffaele — Univ. Ca' Foscari di Venezia

14:40-15:00 WeB14.3
Contractive Distributed MPC for Consensus in Networks of Single and Double-Integrators (I), pp. 9033-9038.
Ferrari-Trecate, Giancarlo — Univ. degli Studi di Pavia
Galbusera, Luca — Pol. di Milano
Marciandi, Marco Pietro Enrico — CESI Ricerca S.p.A.

Scattolini, Riccardo — Pol. di Milano

15:00-15:20 WeB14.4
A Eulerian Approach to the Analysis of Rendez-Vous Algorithms (I), pp. 9039-9044.
Canuto, Claudio — Pol. di Torino
Fagnani, Fabio — Pol. Di Torino
Tilli, Paolo — Pol. di Torino

15:20-15:40 WeB14.5
Global Synchronization on the Circle (I), pp. 9045-9050.
Sarlette, Alain — Univ. of Ličge
Tuna, S. Emre — Univ. of California, Santa Barbara
Blondel, Vincent — Univ. catholique de Louvain
Sepulchre, Rodolphe J. — Univ. de Liege

15:40-16:00 WeB14.6
Asymmetric Randomized Gossip Algorithms for Consensus (I), pp. 9051-9056.
Fagnani, Fabio — Pol. Di Torino
Zampieri, Sandro — Univ. di Padova

WeB15 317
Modeling Methods and Clinical Applications in Medical and Biological Systems II (Invited Session)
Chair: Chase, J. Geoffrey — Univ. of Canterbury
Co-Chair: Andreassen, Steen — Aalborg Univ.
Organizer: Chase, J. Geoffrey — Univ. of Canterbury
Organizer: Andreassen, Steen — Aalborg Univ.

14:00-14:20 WeB15.1
A Mathematical Model of Cyclin B1 Dynamics at the Single Cell Level in Osteosarcoma Cells (I), pp. 9057-9062.
Perez-Velazquez, Judith — Univ. of Warwick
Evans, Neil D. — Univ. of Warwick
Chappell, Michael — Univ. of Warwick
Errington, Rachel — Cardiff Univ.
Smith, Paul — Cardiff Univ.
Khan, Imtiaz — Cardiff Univ.

14:20-14:40 WeB15.2
Goal-Directed Therapy for General ICU Patients Using Aggregated Multi-Objective Optimisation (I), pp. 9063-9068.
Wang, Ang — The Univ. of Sheffield
Panoutsos, George — Univ.
Mahfouf, Mahdi — The Univ. of Sheffield
Mills, Gary — Royal Hallamshire Hospital

14:40-15:00 WeB15.3
Nonlinear Model Predictive Control with Moving Horizon State and Disturbance Estimation - Application to the Normalization of Blood Glucose in the Critically Ill (I), pp. 9069-9074.
Haverbeke, Niels — Katholieke Univ. Leuven
Van Herpe, Tom — Katholieke Univ. Leuven
Diehl, Moritz — Univ. of Heidelberg
Van den Berghe, Greet — Katholieke Univ. Leuven
De Moor, Bart — K.U.Leuven

15:00-15:20 WeB15.4
The Structural Identifiability of SIR Type Epidemic Models with Incomplete Immunity and Birth Targeted Vaccination (I), pp. 9075-9080.
Chapman, James — Univ. of Warwick
Evans, Neil D. — Univ. of Warwick

15:20-15:40 WeB15.5
Modeling Neural Spiking Activity in the Sub-Thalamic Nucleus of Parkinson's Patients and Healthy Primates, pp. 9081-9086.
Sarma, Sridevi — Massachusetts Inst. of Tech.
Cheng, Ming — Massachusetts General Hospital
Hu, Rollin — Massachusetts General Hospital
Williams, Ziv — massachusetts general hospital
Brown, Emery — MIT
Eskandar, Emad — massachusetts general hospital

15:40-16:00 WeB15.6
Impedance Control of Two D.o.f CPM Device for Upper Limb Disorders, pp. 9087-9092.
Miyaguchi, Shota — Kumamoto Univ.
Nojiri, Kousei — Kumamoto Univ.
Matsunaga, Nobutomo — Kumamoto Univ.
Kawaji, Shigeyasu — Kumamoto Univ.

WeB17 320A
New Trials for Control Education (Highlight Session)
Chair: Kang, Chul-Goo — Konkuk Univ.
Co-Chair: Melchiorri, Claudio — Univ. of Bologna
Organizer: Kang, Chul-Goo — Konkuk Univ.

14:00-14:20 WeB17.1
E-Learning Experiences in Control Education (I), pp. 9093-9098.
Kang, Chul-Goo — Konkuk Univ.

14:20-14:40 WeB17.2
Use of Cranes in System Dynamics and Controls Education, pp. 9099-9104.
Singhose, William E. — Georgia Inst. of Tech.
Vaughan, Joshua — Georgia Tech.
Danielson, Jon — Georgia Tech.
Lawrence, Jason — Georgia Inst. of Tech.

14:40-15:00 WeB17.3
Control Engineering Education with Experiments on Real-Time Control System Implementation (I), pp. 9105-9110.
Kim, Byung Kook — Korea Advanced Inst. of Science and Tech.

15:00-15:20 WeB17.4
Roboticad: An Educational Tool for Robotics, pp. 9111-9116.
Falconi, Riccardo — Univ. of Bologna
Melchiorri, Claudio — Univ. of Bologna

15:20-15:40 WeB17.5
Remote Experiments for Control Education, pp. 9117-9121.
Han, Soo Hee — Seoul National Univ.
Kwon, Bo Kyu — Seoul National Univ.

15:40-16:00 WeB17.6
Rapid Control Prototyping for Robot Soccer, pp. 9122-9127.
Han, Soo Hee — Seoul National Univ.
Ahn, Choon ki — Seoul National Univ.

WeB18 320B
Automation (Highlight Session)
Chair: Qin, S. Joe — Univ. of Southern California
Co-Chair: Wang, Dingwei — Northeastern Univ.

14:00-14:20 WeB18.1
Development of Automatic Strapping Machine Using the PET Band (I), pp. 9128-9129.
You, KiSung — Res. Inst. of Scienceadn Tech.
Jeong, Hee Don — RIST

14:20-14:40 WeB18.2
Probabilistic Control of Mobile Robot (I), pp. 9130-9131.
Ryu, HwangRyol — Res. Inst. of Science and Tech.
You, KiSung — Res. Inst. of Scienceadn Tech.
Choi, Chintae — RIST

14:40-15:00 WeB18.3
Data Based Multivariate Pseudo Correlation Analysis in Steel Industry for Optimized Variable Selection (I), pp. 9132-9137.
Schrems, Andrea — Johannes Kepler Univ.
Pichler, Kurt — Linz Center of Mechatronics GmbH
Krimpelstätter, Konrad — Siemens VAI Metals Tech. GmbH & Co,
Del Re, Luigi — Johannes Kepler Univ.

15:00-15:20 WeB18.4
A New Model and Control of Coating Process at Galvanizing Line (I), pp. 9138-9143.
Shin, Kitae — POSCO
Chung, Wan Kyun — Pohang Univ. of Science & Tech.

15:20-15:40 WeB18.5
Fisher Discriminant Analysis for Semiconductor Tool Matching (I), pp. 9144-9148.
Cherry, Gregory — AMD
Qin, S. Joe — Univ. of Southern California

15:40-16:00 WeB18.6
Integrated Scheduling System on Steel-Making and Continuous Casting with Application (I), pp. 9149-9150.
Lu, Kebin — Baosteel Group
Huang, Kewei — Tech. Centre of Baosteel Group
Wang, Dingwei — Northeastern Univ.

WeB19 320C
Robotics Interaction (Regular Session)

Chair: Fahmy, A. A. — Cardiff Univ.
Co-Chair: Schmidt, Guenther — Tech. Univ. Muenchen

14:00-14:20 WeB19.1
Interactive Genetic Algorithm for Designing the Appearance of Software Robot Using Homologous Chromosome Representation, pp. 9151-9155.
Choi, Seung-Hwan — Korea Advanced Inst. of Science and Tech.
Han, Seung-Beom — Korea Advanced Inst. of Science and Tech.
Kim, Jong-Hwan — Korea Advanced Inst. of Science and Tech.

14:20-14:40 WeB19.2
Development of User-Adaptive Value System of Learning Function Using Interactive EC, pp. 9156-9161.
Suga, Yuki — Waseda Univ.
Sugano, Shigeki — Waseda Univ.
Ikuma, Yoshinori — Waseda Univ.
Ogata, Tetsuya — Kyoto Univ.

14:40-15:00 WeB19.3
Easing Wheelchair Control by Gaze-Based Estimation of Intended Motion, pp. 9162-9167.
Bartolein, Christian — Univ. of Mannheim
Wagner, Achim — Univ. of Mannheim
Jipp, Meike — Univ. of Mannheim
Badreddin, Essam — Univ. of Heidelberg

15:00-15:20 WeB19.4
Fuzzy Hysteresis Coordinator for Neuro-Fuzzy Position Controlled Manipulators, pp. 9168-9173.
Pham, D T — Cardiff Univ.
Fahmy, A. A. — Cardiff Univ.
Eldukhri, E. E. — Cardiff Univ.

15:20-15:40 WeB19.5
Master-Slave Telecontrol of a Class of Underactuated Mechanical Systems with Communication Time-Delay, pp. 9174-9179.
Pe ńaloza-Mejía, Ollin — CINVESTAV-IPN
Alvarez-Gallegos, Jaime — CINVESTAV-IPN
Marquez-Martinez, Luis Alejandro — CICESE Res. Center

15:40-16:00 WeB19.6
Kinesthetic Telepresent Control with Application to Defusing of Mines, pp. 9180-9185.
Schmidt, Guenther — Tech. Univ. Muenchen
Kron, Alexander — TU Muenchen

WeB20 321C
Robotics Estimation I (Regular Session)
Chair: Hu, Xiaoming — Royal Inst. of Tech.
Co-Chair: Zhang, Hai-Qiang — Beijing Inst. of Tech.

14:00-14:20 WeB20.1
Three Dimension Curve Welding Seam Modeling for Seam Tracking, pp. 9186-9191.
Chen, Haiyong — Chinese Acad. of sciences
Xu, De — Inst. of Automation, Chinese Acad. of Sciences
Wang, Hong — the Univ. of Manchester

14:20-14:40 WeB20.2
Door Detection without Apriori Color Knowledge, pp. 9192-9196.
Zhang, Hai-Qiang — Beijing Inst. of Tech.
Dou, Li-Hua — Beijing Inst. of Tech.
Chen, Jie — Beijing Inst. of Tech.

14:40-15:00 WeB20.3
Dynamic Object Identification by a Moving Robot Using Laser Data, pp. 9197-9202.
Amarasinghe, Dilan — Memorial Univ. of Newfoundland
Mann, George K. I. — Memorial Univ. of Newfoundland
Gosine, Raymond G. — Memorial Univ. of Newfoundland

15:00-15:20 WeB20.4
Stable Target Tracking Using Observer Based Velocity Estimation, pp. 9203-9208.
Gustavi, Tove — Royal Inst. of Tech.
Hu, Xiaoming — Royal Inst. of Tech.

15:20-15:40 WeB20.5
Robustness Analysis of Mobile Robot Velocity Estimation Using a Regular Polygonal Array of Optical Mice, pp. 9209-9214.
Kim, Sungbok — Hankuk Univ. of Foreign Studies
Lee, Sanghyup — Hankuk Univ. of Foreign Studies

15:40-16:00 WeB20.6
A Vision-Based Technique for Vehicle Slip and Velocity Estimation, pp. 9215-9220.
Song, Xiaojing — King's Coll. London
Seneviratne, Lakmal D — King's Coll. London
Althoefer, Kaspar — King's Coll. London
Song, Zibin — King's Coll. London
Mohseni-Vahed, Shahram — King’s Coll. London

WeB21 321B
Dynamics and Control of Micro and Nano-Scale Systems II (Invited Session)
Chair: Moheimani, S.O. Reza — Univ. of Newcastle
Co-Chair: Sebastian, Abu — IBM Zurich Res. Lab.
Organizer: Moheimani, S.O. Reza — Univ. of Newcastle
Organizer: Sebastian, Abu — IBM Res.

14:00-14:40 WeB21.1
Review of Feedforward Approaches for Nano Precision Positioning in High Speed SPM Operation (I), pp. 9221-9229.
Devasia, Santosh — Univ. of Washington

14:40-15:00 WeB21.2
Optimal Model Matching Design for High Bandwidth, High Resolution Positioning in AFM (I), pp. 9230-9235.
Lee, Chibum — Univ. of Illinois at Urbana-Champaign
Salapaka, Srinivasa — Univ. of Illinois

15:00-15:20 WeB21.3
Track-Follow Control for High-Density Probe-Based Storage Devices (I), pp. 9236-9241.
Pantazi, Angeliki — IBM
Sebastian, Abu — IBM Res.
Pozidis, Haralampos — IBM
Eleftheriou, Evangelos — IBM

15:20-15:40 WeB21.4
A Self Servo Writing Scheme for a MEMS Storage Device with Sub-Nanometer Precision (I), pp. 9242-9247.
Sebastian, Abu — IBM Zurich Res. Lab.
Pantazi, Angeliki — IBM
Moheimani, S.O. Reza — Univ. of Newcastle
Pozidis, Haralampos — IBM
Eleftheriou, Evangelos — IBM

15:40-16:00 WeB21.5
Plug-In Robust Compensator for a 3 DOF Piezoelectric Nanorobotic Positioner (I), pp. 9248-9253.
Fall, Abdoulaye — Univ. of Orléans
Boukhnifer, Moussa — ENSI de Bourges-Univ. d’Orléans
Ferreira, Antoine — Univ. d'Orléans- ENSI de Bourges

WeB22 321A
Estimation and Control of State and Disturbance in Mechatronic Systems (Regular Session)
Chair: Pao, Lucy Y. — Univ. of Colorado at Boulder
Co-Chair: Horowitz, Roberto — Univ. of California at Berkeley

14:00-14:20 WeB22.1
A Reset State Estimator for Linear Systems to Suppress Sensor Quantization Effects, pp. 9254-9259.
Zheng, Jinchuan — The Univ. of Newcastle, Australia
Fu, Minyue — Univ. of Newcastle

14:20-14:40 WeB22.2
Extended Luenberger Observer for a MIMO Nonlinear Nonholonomic System, pp. 9260-9265.
Ergueta, Edgar — Univ. of california, Berkeley
Seifried, Robert — Univ. of Stuttgart
Horowitz, Roberto — Univ. of California at Berkeley
Tomizuka, Masayoshi — Univ. of California, Berkeley

14:40-15:00 WeB22.3
A Performance Comparison of an EKF and a High Gain Observer for an Electropneumatic Positioning System: Simulation and Practical Results, pp. 9266-9271.
Qiu, Zhiping — INSA
Pham, Minh Tu — INSA de Lyon
Smaoui, Mohamed — INSA de Lyon

Thomasset, Daniel — INSA de Lyon

15:00-15:20 — WeB22.4

Design of Disturbance Observer Via the Robust Stabilization and H_; Loop Shaping Methods, pp. 9272-9277.

Moon, Jun — Hanyang Univ.
Lee, Choong Woo — Hanyang Univ.
Chung, Chung Choo — Hanyang Univ.
Kim, Young Sik — LG Electronics Inst. of Tech.

15:20-15:40 — WeB22.5

Multirate Digital Servo Drive Based on Acceleration Observer and Disturbance Compensator, pp. 9278-9283.

Chen, Chin-Sheng — National Taipei Univ. of Tech.
Teng, Ying-Tsung — National Taipei Univ. of Tech.

15:40-16:00 — WeB22.6

Disturbance Rejection in Parameter-Varying Web-Winding Systems, pp. 9284-9289.

Zhong, Hua — Univ. of colorado at Boulder
Pao, Lucy Y. — Univ. of Colorado at Boulder

WeB23 — 323

Industrial Applications of Real-Time Embedded and Distributed Systems (Invited Session)

Chair: Pereira, Carlos Eduardo — Federal Univ. of Rio Grande do Sol
Co-Chair: Madsen, Jan — Tech. Univ. of Denmark
Organizer: Pereira, Carlos Eduardo — Federal Univ. of Rio Grande do Sol
Organizer: Goetz, Marcelo — Federal Univ. of Rio Grande do Sul
Organizer: Rammig, Franz — Univ. of Paderborn HNI

14:00-14:20 — WeB23.1

On Hybrid Hw/Sw Components for Embedded System Design (I), pp. 9290-9295.

Marcondes, Hugo — Federal Univ. of Santa Catarina
Fröhlich, Antônio Augusto — Federal Univ. of Santa Catarina

14:20-14:40 — WeB23.2

Model-Driven Product-Line Architectures for Mobile Devices (I), pp. 9296-9301.

White, Jules — Vanderbilt Univ.
Schmidt, Douglas C. — Vanderbilt Univ.

14:40-15:00 — WeB23.3

System-Level Verification of Multi-Core Embedded Systems Using Timed-Automata (I), pp. 9302-9307.

Madsen, Jan — Tech. Univ. of Denmark
Hansen, Michael R. — Tech. Univ. of Denmark
Brekling, Aske W. — Tech. Univ. of Denmark

15:00-15:20 — WeB23.4

A Dynamically Reconfigurable Automotive Control System Architecture (I), pp. 9308-9313.

Rettberg, Achim — Univ. Paderborn
Anthony, Richard — The Univ. of Greenwich
Chen, DeJiu — Royal Inst. of Tech.
Jahnich, Isabell — Univ. Paderborn
de Boer, Gerrit — Robert Bosch GmbH
Ekelin, Cecilia — Volvo Tech. AB

15:20-15:40 — WeB23.5

Real-Time Mesh Networks for Industrial Applications (I), pp. 9314-9319.

Herms, Andre — Univ. of Magdeburg
Nett, Edgar — Univ. of Magdeburg
Schemmer, Stefan — rt-solutions.de GmbH

15:40-16:00 — WeB23.6

Application Experiences with a Real-Time Java Processor (I), pp. 9320-9325.

Schoeberl, Martin — Vienna Univ. of Tech. Austria

WeB24 — 324

New Trend in Decentralized Control (Invited Session)

Chair: Bakule, Lubomir — Acad. of Sciences of Czech Republic
Co-Chair: Brdys, Mietek M.A. — Univ. of Birmingham
Organizer: Bakule, Lubomir — Inst. of Information Theory and Automation of the ASCR

14:00-14:40 — WeB24.1

Stabilization of Nonlinear Switched Continuous-Time Complex Systems (I), pp. 9326-9331.

Bakule, Lubomir — Acad. of Sciences of Czech Republic
de la Sen, Manuel — Univ. del Pais Vasco

14:40-15:00 — WeB24.2

Decentralized Robust Control of Large-Scale Time-Delay Systems (I), pp. 9332-9337.

Iftar, Altug — Anadolu Univ.

15:00-15:20 — WeB24.3

Consensus Based Overlapping Decentralized Estimation with Missing Observations and Communication Faults (I), pp. 9338-9343.

Stankovic, Srdjan — Univ. of Belgrade
Stankovic, Milos — Univ. of Illinois, Urbana-Champaign
Stipanovic, Dusan M. — Univ. of Illinois at Urbana-Champaign

15:20-15:40 — WeB24.4

Flocking of Decentralized Multi-Agent Systems with Application to Nonholonomic Multi-Robots (I), pp. 9344-9349.

Li, Qin — Pol. Univ.
Jiang, Zhong-Ping — Pol. Univ.

WeB25 — 328

Process Control Applications (Regular Session)

Chair: Stoustrup, Jakob — Aalborg Univ.
Co-Chair: Braslavsky, Julio H. — The Univ. of Newcastle

14:00-14:20 — WeB25.1

Tuning of PID-Controller Based on the External Disturbance Spectrum, pp. 9350-9355.

Torgashov, Andrey — Inst. for Automation and Control Processes FEB RAS

14:20-14:40 — WeB25.2

Laguerre-Volterra Observer-Controller Design and Its Applications, pp. 9356-9361.

Zhang, Haitao — Huazhong (Central China) Univ. of ScienceandTechnology
Chen, Michael Z.Q. — Univ. of Leicester
Chen, Zhiyong — The Univ. of Newcastle

14:40-15:00 — WeB25.3

Constraint Control of Recycle Systems with Input Multiplicities, pp. 9362-9367.

Seki, Hiroya — Tokyo Inst. of Tech.
Hoshino, Satoshi — Tokyo Inst. of Tech.
Naka, Yuji — Tokyo Inst. of Tech.

15:00-15:20 — WeB25.4

A Simulation Study on Model Predictive Control and Extremum Seeking Control for Heap Bioleaching Processes, pp. 9368-9373.

Godoy, Boris I — The Univ. of Newcastle
Braslavsky, Julio H. — The Univ. of Newcastle
Aguero, Juan C — The Univ. of Newcastle

15:20-15:40 — WeB25.5

An Active Defrost Scheme with a Balanced Energy Consumption and Food Quality Loss in Supermarket Refrigeration Systems, pp. 9374-9379.

Cai, Junping — Aalborg Univ.
Stoustrup, Jakob — Aalborg Univ.
Rasmussen, Bjarne D. — GRUNDFOS Management A/S

15:40-16:00 — WeB25.6

Multi-Model Approaches for Integrated Design of Wastewater Treatment Plants with Model Predictive Control, pp. 9380-9385.

Francisco, Mario — Univ. of Salamanca
Vega, Pastora — Univ. of Salamanca

WeB26 — 327

Control of Power Systems II (Regular Session)

Chair: Lamnabhi-Lagarrigue, Françoise — CNRS-EECI
Co-Chair: Majanne, Yrjö — Tampere Univ. of Tech.

14:00-14:20 — WeB26.1

Stabilizing Multimachine Systems with Decentralized and Nonlinear Feedbacks, pp. 9386-9391.

Zhou, Jun — Kyoto Univ.
Ohsawa, Yasuharu — Kyoto Univ.

14:20-14:40 — WeB26.2

Short and Long-Term Dynamic Voltage Instability, pp. 9392-9397.
Hossain, Md. Jahangir — UNSW@ADFA
Pota, Hemanshu — Univ. of New South Wales
Ugrinovskii, Valery — Univ. of New South Wales

14:40-15:00 WeB26.3
On Transient Stability of Multi-Machine Power Systems: A "Globally" Convergent Controller for Structure-Preserving Models, pp. 9398-9403.
Dib, Wissam — LSS-SUPELEC
Barabanov, Andrey E. — Saint Petersburg State Univ.
Ortega, Romeo — LSS-SUPELEC
Lamnabhi-Lagarrigue, Françoise — CNRS-EECI

15:00-15:20 WeB26.4
Oscillation Behaviour of the Enlarged UCTE Power System Including the Turkish Power System, pp. 9404-9409.
Lehner, Joachim — Univ. Stuttgart, Inst. of Process Engineering
Weissbach, Tobias — Univ. Stuttgart
Scheffknecht, Günter — Univ. Stuttgart

15:20-15:40 WeB26.5
Automatic Generation Controller Design in Deregulated and Networked Environment Using Predictive Control Strategy, pp. 9410-9414.
Zhang, Jianhua — North China Electric Power Univ.
Hao, Jinhua — North China Electric Power Univ.
Hou, Guolian — North China Electric Power Univ.

15:40-16:00 WeB26.6
Nonlinear Control of PWM AC/DC Boost Rectifiers - Theoretical Analysis of Closed-Loop Performances, pp. 9415-9420.
Giri, Fouad — GREYC - Univ. de Caen
Abouloifa, Abdelmajid — EMI
Lachkar, Ibtissam — EMI
Chaoui, Fatima-Zahra — ENSET

WeB27 326
Networked Control (Regular Session)
Chair: Stetsjura, Gennady — Inst. of Control Sciences RAS
Co-Chair: Roosta, Alireza — Shiraz Univ. of Tech.

14:00-14:20 WeB27.1
Architecture and Mechanism Design for Real-Time and Fault-Tolerant Etherware for Networked Control, pp. 9421-9426.
Kim, Kyoung-Dae — Univ. of Illinois at Urbana-Champaign
Kumar, P. R. — Univ. of Illinois at Urbana-Champaign

14:20-14:40 WeB27.2
Towards a Multi-Sector Cooperation in Air-Traffic Control Supported by a Meta-Common Workspace, pp. 9427-9432.
Guiost, Benoit — Univ. de Valenciennes
Debernard, Serge — Univ. of Valenciennes
Poulain, Thierry — Univ. de Valenciennes
Millot, Patrick — Univ. of Valenciennes

14:40-15:00 WeB27.3
H1 Fieldbus Network Delay; a Digital Pole Placement Control Design, pp. 9433-9436.
Abdel-Ghaffar, Hesham — Invensys Engineering & Service Egypt
Hammad, Sherif — Ain Shams Univ.
Zaki, Ahmed — Ain Shams Univ. Faculty of Engineering

15:00-15:20 WeB27.4
High Security Monitoring and Control of Process Via Internet, pp. 9437-9441.
Roosta, Alireza — Shiraz Univ. of Tech.
Fakhrpour, Fakhrpour — Petroleum Univ. of Tech.

15:20-15:40 WeB27.5
Use of the Group Operations, Fractal Channels and Switching of Consecutive Channels in the Multiprocessing Control Systems, pp. 9442-9446.
Stetsjura, Gennady — Inst. of Control Sciences RAS
Karavay, Mikhail — Trapeznikov Inst. of Control Sciences RAS

15:40-16:00 WeB27.6
SPI: An Active Queue Management Algorithm for HSTCP, pp. 9447-9452.
Liu, Zhixin — Yanshan Univ.
Yang, Huilong — Inst. of Electrical Engineering,Yanshan Univ.
Guan, Xinping — Yanshan Univ.

WeB28 330A
Engine Control (Regular Session)
Chair: Isermann, Rolf — Univ. of Tech. Darmstadt
Co-Chair: Chamaillard, Y. — LME

14:00-14:20 WeB28.1
Neural Sliding-Mode Control of Engine Torque, pp. 9453-9458.
Huang, Ting — Univ. of Illinois at Chicago
Liu, Derong — Univ. of Illinois at Chicago
Javaherian, Hossein — GM R&D
Jin, Ning — Univ. of Illinois at Chicago

14:20-14:40 WeB28.2
Compensation of Sub-Harmonic Vibrations During Engine Idle by Variable Fuel Injection Control, pp. 9459-9466.
Walter, Andreas — Univ. of Karlsruhe
Murt, Mustafa — --
Kiencke, Uwe — Univ. of Karlsruhe
Jones, Stephen — LuK GmbH & Co. oHG
Winkler, Thomas — LuK GmbH & Co. oHG

14:40-15:00 WeB28.3
Control of Future Low Temperature Combustion Technologies with Nonlinear Model Based Predictive Control Based on Neural Networks, pp. 9467-9472.
Hoffmann, Kai — RWTH Aachen Univ.
Seebach, Dieter — RWTH Aachen
Pischinger, Stefan — RWTH Aachen
Abel, Dirk — RWTH-Aachen Univ.

15:00-15:20 WeB28.4
Robust Engine Torque Control by Discrete Event Disturbance Observer, pp. 9473-9478.
Nagata, Takashi — Univ. of California, Berkeley
Tomizuka, Masayoshi — Univ. of California, Berkeley

15:20-15:40 WeB28.5
Adaptive Control of Engine Torque with Input Delays, pp. 9479-9484.
Gruenbacher, Engelbert — Linz Center of Mechatronics
Del Re, Luigi — Johannes Kepler Univ.
Kokal, Helmut — AVL
Schmidt, Martin — AVL
Paulweber, Michael — AVL

15:40-16:00 WeB28.6
Robust Model Predictive Control of a Diesel Engine Airpath, pp. 9485-9490.
Langthaler, Peter — Johannes Kepler Univ.
Del Re, Luigi — Johannes Kepler Univ.

WeB29 330B
Intelligent Vehicle, Safety and Body Systems (Regular Session)
Chair: Huh, Kunsoo — Hanyang Univ.
Co-Chair: Chwa, Dongkyoung — Ajou Univ.

14:00-14:20 WeB29.1
Evaluation of Lane Keeping Assistance Controllers in HIL Simulations, pp. 9491-9496.
Hwang, Junyeon — Hanyang Univ.
Huh, Kunsoo — Hanyang Univ.
Kang, Hyoung-Jin — Mando Corp.
Yoon, Paljoo — Mando Corp.
Na, Hyuckmin — Mando
Jung, Hogi — Mando Co.

14:20-14:40 WeB29.2
A Study on Lane Keeping Assistance System Based on Steering Torque Control, pp. 9497-9498.
Min, Suk Ki — Hyundai-Kia Motors
Shin, Dong Ho — Hyundai-Kia Motors
Lee, Jae Kwan — Hyundai-Kia Motors
Lee, In Sik — Hyundai-Kia Motors

14:40-15:00 WeB29.3
Roll Angle Estimation for Smart Munitions under GPS Jamming Environment, pp. 9499-9504.
Lee, Han Sung — Seoul National Univ.

Park, HeeYoung — Hyundai Heavy Industries Co., Ltd
Kim, KwangJin — Seoul National Univ.
Lee, Jang Gyu — Seoul National Univ.
Park, Chan Gook — Seoul National Univ.

15:00-15:20 WeB29.4
A CAN-Based Distributed Control System for Autonomous All-Terrain Vehicle (ATV), pp. 9505-9510.
Song, Bongsob — Ajou Univ.
Chwa, Dongkyoung — Ajou Univ.
Baek, Woonhyuk — Ajou Univ.
Jang, Seyong — AJOU Univ.
Song, Hoin — Ajou Univ.
Kim, Soontae — Ajou Univ.

15:20-15:40 WeB29.5
The Software Platform Development of a New Microcontroller for Automotive Body Systems, pp. 9511-9515.
Chang, Jae Ho — CARNES company Ltd.

15:40-16:00 WeB29.6
Best Practice to Design Test Cases to Improve Reusability for Automotive Body Electronics System, pp. 9516-9521.
Lee, Seungyong — Carnes

WeB30 330C
Intelligent Vehicles Navigation and Control II (Regular Session)
Chair: Ozguner, Umit — Ohio State Univ.
Co-Chair: To, Thanh Binh — Volkswagen AG

14:00-14:20 WeB30.1
Rao-Blackwellised Inertial Simultaneous Localisation and Mapping, pp. 9522-9527.
Kim, Jonghyuk — Australian National Univ.

14:20-14:40 WeB30.2
A Low Cost Vision Based Localization System Using Fiducial Markers, pp. 9528-9533.
Mutka, Alan — Faculty of Electrical Engineering and Computing
Miklic, Damjan — Faculty of Electrical Engineering and Computing, Univ.
Draganjac, Ivica — Faculty of Electrical Engineering and Computing, Zagreb
Bogdan, Stjepan — Univ. of Zagreb

14:40-15:00 WeB30.3
CityACC - on the Way towards an Intelligent Autonomous Driving, pp. 9534-9539.
To, Thanh Binh — Volkswagen AG
Meinecke, Marc-Michael — Volkswagen AG
Schroven, Frank — Volkswagen AG
Nedevschi, Sergiu — Tech. Univ. of Cluj-Napoca
Knaup, Jörn Christian — Volkswagen AG

15:00-15:20 WeB30.4
Hybrid State System Development for Autonomous Vehicle Control in Urban Scenarios, pp. 9540-9545.
Kurt, Arda — The Ohio State Univ.
Ozguner, Umit — Ohio State Univ.

15:20-15:40 WeB30.5
Point-To-Point Control and Trajectory Tracking in Wheeled Mobile Robots: Some Further Results and Applications, pp. 9546-9551.
Ailon, Amit — Ben Gurion Univ. of The Negev
Zohar, Ilan — Ben Gurion Univ. of the Negev

15:40-16:00 WeB30.6
Constrained Model Predictive Control for Nonholonomic Vehicle Regulation Problem, pp. 9552-9557.
Zhu, Yongjie — The Ohio State Unversity
Ozguner, Umit — Ohio State Univ.

WeC01 Atlantic Hall
Bio & Social Systems (Poster Session)
Chair: Pons, Marie-Noelle — ENSIC
Co-Chair: Dimirovski, Georgi Marko — Dogus Univ. of Istanbul

16:30-18:30 WeC01.1
Modeling of the Climate for a Greenhouse in the North-East of México, pp. 9558-9563.
Leal Iga, Javier — Univ. Autonoma de Nuevo Leon, Monterrey, México.

16:30-18:30 WeC01.2
An Agent Based Model for Agro-Ecosystem, pp. 9564-9568.
Zhang, Youhua — Anhui Agricultural Univ.
Sa, Li — Univ.
Xiong, Fanlun — Univ.
Cheng, BoBo — Univ.
Xu, JiCheng — Univ.

16:30-18:30 WeC01.3
A Systems Engineering Approach to Viticulture On-Farm Irrigation, pp. 9569-9574.
Ooi, Su Ki — The Univ. of Melbourne
Mareels, Iven — The Univ. of Melbourne
Cooley, Nicola — The Univ. of Melbourne
Dunn, Greg — The Univ. of Melbourne
Thoms, Gavin — Univ. of Melbourne

16:30-18:30 WeC01.4
Influence of the Time Step in Ann Modelling of Thermal Stratification of Solar Storage, pp. 9575-9578.
Farkas, Istvan — Szent Istvan Univ.

16:30-18:30 WeC01.5
Enhancement of NDVI Information from Satellite Imagery by Combining with Low-Altitude Sensing, pp. 9579-9584.
Han-ya, Issei — Hokkaido Univ.
Ishii, Kazunobu — Hokkaido Univ.
Noguchi, Noboru — Hokkaido Univ.

16:30-18:30 WeC01.6
The Study on the Effect of Biogas Addition on the Diesel Tractor Engine for the Development of a Biogas Controller, pp. 9585-9590.
Jaber, Nizar — Hokkaido Univ.
Tsukamoto, Takayuki — Hokkaido Univ.
Noguchi, Noboru — Hokkaido Univ.

16:30-18:30 WeC01.7
Development of the Heat and Mass Transfer Modell for Mixed-Flow Grain Dryer, pp. 9591-9595.
Mellmann, Jochen — Leibniz-Inst. für Agrartechnik Potsdam-Bornim e.V. (ATB)
Gottschalk, Klaus — Leibniz-Inst. für Agrartechnik Potsdam-Bornim e.V. (ATB)
Istvan, Farkas — Szent István Univ.

16:30-18:30 WeC01.8
Directional Classification of Cortical Signals Using a Liquid State Machine, pp. 9596-9600.
Huang, Jiangshuai — Huazhong Univ. of Science and Tech.
Fang, Huijuan — Huazhong Univ. of Science and Tech.
Wang, Yongji — Hauzhong Univ. of Science And Tech.

16:30-18:30 WeC01.9
Automatic Drug Delivery in Anesthesia-The Design of an Anesthesia Assistant System, pp. 9601-9606.
Simanski, Olaf — Univ. of Rostock
Kaehler, Ralf — Inst. of Energy and Enviroment Consultation
Schubert, Agnes — Univ. of Rostock
Janda, Matthias — Univ. of Rostock
Bajorat, Jörn — Univ. of Rostock
Hofmockel, Rainer — Univ. of Rostock
Lampe, Bernhard P. — Univ. of Rostock

16:30-18:30 WeC01.10
An Advanced Decision Support System for Medical Diagnosis, pp. 9607-9612.
Dumitrache, Ioan — Univ. Pol. of Bucharest
Mihu, Ioana — Univ. Pol. of Bucharest
Voinescu, Monica — Univ. Pol. of Bucharest

16:30-18:30 WeC01.11
Fractional Calculus in NMR, pp. 9613-9618.
Magin, Richard — Univ. of Illinois at Chicago
Baleanu, Dumitru — Cankaya Univ. Faculty of Arts and Sciences
Feng, Xu — Univ. of Illinois at Chicago

16:30-18:30 WeC01.12
A Novel Clustering Method for Quick Partial Volume Estimation in MR Brain Images, pp. 9619-9624.
Szilagyi, Laszlo — Budapest Univ. of Tech. and Ec.
Szilagyi, Sandor Miklos — Sapientia - Hungarian Science

Univ. of Transylvania
Benyo, Balazs — Budapest Univ. of Tech. and Ec.
Benyo, Zoltan — Budapest Univ. of Tech. and Ec.

16:30-18:30 WeC01.13
Improved Intensity Inhomogeneity Correction Techniques in MR Brain Image Segmentation, pp. 9625-9630.
Szilagyi, Laszlo — Budapest Univ. of Tech. and Ec.
David, Laszlo — Sapientia - Hungarian Science Univ. of Transylvania
Szilagyi, Sandor Miklos — Sapientia - Hungarian Science Univ. of Transylvania
Benyo, Balazs — Budapest Univ. of Tech. and Ec.
Benyo, Zoltan — Budapest Univ. of Tech. and Ec.

16:30-18:30 WeC01.14
Neural Observer to Trehalose Estimation, pp. 9631-9636.
Cabrera, Agustin — Un. Prof. Inter. De Biotecnologia Del
Aranda-Barradas, Juan Silvestre — IPN
Chairez Oria, Isaac — CINVESTAV-IPN
Ramirez-Sotelo, Guadalupe — UPIBI-IPN

16:30-18:30 WeC01.15
Surgery Planning Simulation for Closed Reduction and Internal Fixation, pp. 9637-9642.
Jung, Hoeryong — Korea Advanced Inst. of Science and Tech.
Lee, Doo Yong — KAIST

16:30-18:30 WeC01.16
Integration Solution for the Communication with Healthcare Devices in Intensive Care Units, pp. 9643-9648.
Rodriguez Gonzalez, Jose Luis — CARTIF Foundation
Martin Toral, Susana — CARTIF Foundation
Perez Turiel, Javier — CARTIF Foundation

16:30-18:30 WeC01.17
System Identification for Control of a Main Irrigation Canal Pool, pp. 9649-9654.
Rivas Perez, Raul — Havana Pol. Univ.
Feliu, Vicente — Univ. of Castilla-La Mancha
Castillo, Fernando J. — Univ. of Castilla La Mancha
Linares Saez, Antonio — Construcción y Tecnologia Ambiental S.A. BEFESA

16:30-18:30 WeC01.18
State Estimation in Biotechnological Processes Using a Software-Sensor Combining Full-Horizon Observer and Neural Networks, pp. 9655-9660.
Hoerrmann, Joachim — Christian-Albrechts-Univ. of Kiel
Barth, Dorothee — Christian-Albrechts-Univ. of Kiel
Kraeling, Michael — Christian-Albrechts-Univ. of Kiel
Roeck, Helmut — Christian-Albrechts Univ. of Kiel

16:30-18:30 WeC01.19
Fast Shake Mixing Control with Low Air Entrainment, pp. 9661-9666.
Maeda, Masahiro — Gifu Univ.
Yano, Ken'ichi — Gifu Univ.

16:30-18:30 WeC01.20
Interval Observers for Uncertain Nonlinear Systems. Application to Bioreactors, pp. 9667-9672.
Meslem, Nacim — Univ. Paris XII
Ramdani, Nacim — INRIA
Candau, Yves — Univ. Paris XII

16:30-18:30 WeC01.21
Multi-Scale Framework for Modeling and Control of Fermentation Processes, pp. 9673-9678.
Nandong, Jobrun — Curtin Univ. of Tech. Sarawak Campus
Samyudia, Yudi — Curtin Univ. of Tech.
Tade, Moses O. — Curtin Univ. of Tech.

16:30-18:30 WeC01.22
Modeling of Fermentation Processes Using Online Kernel Learning Algorithm, pp. 9679-9684.
Liu, Yi — Zhejiang Univ.
Yang, Diancai — Qingdao Mesnac Co., LTD.
Wang, Haiqing — Zhejiang Univ.
Li, Ping — Zhejiang Univ.

16:30-18:30 WeC01.23
A Closed-Loop Exponential Feeding Law for Multi-Substrate Fermentation Processes, pp. 9685-9689.
Pico-Marco, Enric — Tech. Univ. of Valencia
Navarro, Jose Luis — Univ. Pol. de Valencia

16:30-18:30 WeC01.24
Unknown Input Observers for Biological Processes, pp. 9690-9694.
Rapaport, Alain — INRA
Dochain, Denis — Univ. Catholique de Louvain
Harmand, Jérome — INRA
Acuna, Gonzalo — Univ. de Santiago de Chile

16:30-18:30 WeC01.25
Identification and Modeling of Co-Rhythmic Genes from Micro-Array Time Series Data, pp. 9695-9700.
Wang, Wenxue — Texas Tech. Univ.
Ghosh, Bijoy — Texas Tech. Univ.

16:30-18:30 WeC01.26
Global Sensitivity Analysis of Biochemical Reaction Networks Via Semidefinite Programming, pp. 9701-9706.
Waldherr, Steffen — Univ. of Stuttgart
Findeisen, Rolf — Univ. of Stuttgart
Allgower, Frank — Univ. of Stuttgart

16:30-18:30 WeC01.27
Continuous Selection of the Fastest Growing Species in the Chemostat, pp. 9707-9712.
Masci, Pierre — INRIA
Bernard, Olivier — Inria
Grognard, Frederic — INRIA Sophia-Antipolis

16:30-18:30 WeC01.28
Adaptive Extremum-Seeking Control Applied to Productivity Optimization in Yeast Fed-Batch Cultures, pp. 9713-9718.
Dewasme, Laurent — Faculté Pol. de Mons
Vande Wouwer, Alain — Faculté Pol. de Mons

16:30-18:30 WeC01.29
Determination of Macroscopic Reaction Schemes: Towards a Unifying View, pp. 9719-9724.
Bogaerts, Philippe — Univ. Libre de Bruxelles
Rooman, Marianne — Univ. Libre de Bruxelles
Vastemans, Vincent — Univ. Libre de Bruxelles
Vande Wouwer, Alain — Faculté Pol. de Mons

16:30-18:30 WeC01.30
Extended Luenberger Observer-Based Fault Detection for an Activated Sludge Process, pp. 9725-9730.
Nejjari, Fatiha — Univ. Pol. de Catalunya
Puig, Vicenc — Univ. Pol. de Catalunya

16:30-18:30 WeC01.31
Network Effect on Loyalty for Service Systems, pp. 9731-9736.
Liu, Q.G. — Tsinghua Univ.
Zhou, J. — Tsinghua Univ.

16:30-18:30 WeC01.32
A Hands-On Laboratory for Introductory Automatic Control Courses, pp. 9737-9742.
Su, Juing-Huei — Lunghwa Univ. of science and Tech.
Lee, Chyi-Shyong — Lunghwa Univ. of Science and Tech.
Hsieh, Cheng-Chang — Lunghwa Univ. of Science and Tech.
Lin, Kuo-En — Lunghwa Univ. of Science and Tech.
Chang, Jia-Hao — Lunghwa Univ. of Science and Tech.
Lin, Gu-Hong — Lunghwa Univ. of Science and Tech.

16:30-18:30 WeC01.33
A Hands-On Laboratory for Autonomous Mobile Robot Design Courses, pp. 9743-9748.
Su, Juing-Huei — Lunghwa Univ. of science and Tech.
Lee, Chyi-Shyong — Lunghwa Univ. of Science and Tech.
Lin, Kuo-En — Lunghwa Univ. of Science and Tech.
Chang, Jia-Hao — Lunghwa Univ. of Science and Tech.

Chiu, Ming-Hsien — Lunghwa Univ. of science and Tech.
Lin, Gu-Hong — Lunghwa Univ. of Science and Tech.

16:30-18:30 WeC01.34
Physical Workbench for Technical Training in Discrete Time Control, pp. 9749-9754.
Llaría, Alvaro — ESTIA
Camblong, Haritza — ESTIA
Curea, Octavian — ESTIA
Jiménez, Jaime — Univ. del País Vasco, Escuela Técnica Superior de Ingenier

16:30-18:30 WeC01.35
WinMechLab: A Windows-Based Software Tool for Real-Time Control of Mechatronic Systems, pp. 9755-9760.
Campa, Ricardo — Inst. Tecnologico de la Laguna
Kelly, Rafael — CICESE

16:30-18:30 WeC01.36
CAN-Bus Based Rapid Control Prototyping System for Education Laboratories, pp. 9761-9766.
Bucher, Roberto — Scuola Univ. Professionale
Balemi, Silvano — SUPSI (Scuola Univ. Professionale della Svizzera Italian

16:30-18:30 WeC01.37
Two-Input Two-Output Laboratory-Scale Temperature System Based on Peltier Modules, pp. 9767-9772.
Barros, Péricles R. — Univ. Federal de Campina Grande
Acioli Junior, George — Univ. Federal de Campina Grande
Morais, João Batista — Univ. Federal de Campina Grande

16:30-18:30 WeC01.38
A Process Control Platform for Education in the Virtual Factory Laboratory System, pp. 9773-9778.
Wang, Jishuai — Zhejiang Univ.
Rong, Gang — Zhejiang Univ.
Gu, Haijie — Zhejiang Univ.
Wang, Qiang — Zhejiang Univ.
Feng, YiPing — ZheJiang Univ.

16:30-18:30 WeC01.39
Four Rotor Helicopter Control Laboratory Plant, pp. 9779-9784.
Toledo, Jonay — Univ. of La Laguna
Acosta, L. — Univ. of La Laguna
Sigut, M. — Univ. of La Laguna
Felipe, Jonatán — Univ. of La Laguna
Morales, Nestor — Univ. of La Laguna
Torres, Santiago — Univ. de La Laguna

16:30-18:30 WeC01.40
A Laboratory Platform for Project Based Training Concerning the Development of Complex Networked Control Systems, pp. 9785-9790.
Kaufmann, Michael — Univ. of Karlsruhe
Schweiger, Frank — Tec-Solution
Bretthauer, Georg — Forschungszentrum Karlsruhe

16:30-18:30 WeC01.41
Development of an Electronic Simulator Named "MPDT" for Control Education, pp. 9791-9796.
Bui, Quyen T. T. — Pusan National Univ.
Pham, Thuong Cat — Inst. of Information Tech.
Hong, Keum-Shik — Pusan National Univ.

16:30-18:30 WeC01.42
An Integrated Internet-Based Package for Teaching Motion Control: Content and Testing Results, pp. 9797-9801.
Buiu, Catalin — Pol. Univ. of Bucharest

16:30-18:30 WeC01.43
Development of Educational Web-Based Simulator and Its Evaluation, pp. 9802-9806.
Mkrttchian, Vardan — All Armenian Internet Univ. - HHH Univ.
Kljajic, Miroljub — Univ. of Maribor
Škraba, Andrej — Univ. of Maribor
Yeranosyan, Hasmik — All Armenian Internet Univ.
Kljaji_; Borštnar, Mirjana — Univ. of Maribor

16:30-18:30 WeC01.44
Virtual Laboratory for Distance Learning, Remote Process Control, pp. 9807-9811.
Popescu, Dumitru — Pol. Univ. of Bucharest
Lupu, Ciprian — Pol. Univ. of Bucharest
Dimon, Catalin — Univ. Pol. of Bucharest
Matei, Ion — Pol. Univ. of Bucharest

16:30-18:30 WeC01.45
Experimental Identification - an Interactive Online Course, pp. 9812-9816.
Cirka, Lubos — Slovak Univ. of Tech. in Bratislava
Fikar, Miroslav — STU in Bratislava
Kvasnica, Michal — Slovak Univ. of Tech. in Bratislava
Herceg, Martin — Slovak Univ. of Tech. in Bratislava

16:30-18:30 WeC01.46
A Novel E-Laboratory for Remote Monitoring and Control, pp. 9817-9822.
Li, Lixiong — Shanghai Univ.
Deng, Jing — Shanghai Univ.
Li, Kang — Queen's Univ. Belfast
Fei, Minrui — Shanghai Univ.

16:30-18:30 WeC01.47
Metabolic Control Analysis of Complex Biological Systems, pp. 9823-9827.
Yun, Choamun — Korea Advanced Inst. of Science and Tech.
Kim, Young — Korea Advanced Inst. of Science and Tech.
Lee, Sang Yup — Korea Advanced Inst. of Science and Tech.
Park, Sunwon — Korea Advanced Inst. of Science and Tech.

16:30-18:30 WeC01.48
Fibonacci and Futility, pp. 9828-9833.
Chernyshov, Kirill — V.A. Trapeznikov Inst. of Control Sciences

WeC02 304A
Nonlinear Observers and Observability (Regular Session)
Chair: Xia, Xiaohua — Univ. of Pretoria
Co-Chair: Yaz, Edwin — Marquette Univ.

16:30-16:50 WeC02.1
Current Output Observer for Discrete-Time Nonlinear Stochastic Systems, pp. 9834-9839.
Zhai, Tongyan — Marquette Univ.
Yaz, Edwin — Marquette Univ.
Jeong, Chung Seop — Marquette Univ.

16:50-17:10 WeC02.2
Stochastically Resilient Design of Mixed H2-Dissipative Observers for Discrete-Time Nonlinear Systems, pp. 9840-9845.
Jeong, Chung Seop — Marquette Univ.
Yaz, Edwin — Marquette Univ.
Yaz, Yvonne — Milwaukee School of Engineering

17:10-17:30 WeC02.3
Uniformly Observable and Globally Lipschitzian Nonlinear Systems Admit Semi-Global Finite-Time Observers, pp. 9846-9851.
Shen, Yanjun — China Three Gorges Univ.
Xia, Xiaohua — Univ. of Pretoria

17:30-17:50 WeC02.4
Possible Non-Integrability of Observable Space for Discrete-Time Nonlinear Control Systems, pp. 9852-9856.
Kotta, Ülle — Inst. of Cybernetics at TUT
Schlacher, Kurt — Johannes Kepler Univ. of Linz

17:50-18:10 WeC02.5
An Invariant Observer for Earth-Velocity-Aided Attitude Heading Reference Systems, pp. 9857-9864.
Martin, Philippe — Ec. des Mines de Paris
Salaün, Erwan — Ec. des Mines de Paris

18:10-18:30 WeC02.6
Observers Synthesis Method for a Class of Nonlinear Discrete-Time Systems with Extension to Observer-Based Control, pp. 9865-9870.
Zemouche, Ali — Louis Pasteur Univ.
Boutayeb, Mohamed — Nancy Univ.

WeC03 304B

Sliding Mode Control (Regular Session)

Chair: Khalil, Hassan K. — Michigan State Univ.
Co-Chair: Loukianov, Alexander G. — CINVESTAV IPN GDl

16:30-16:50 WeC03.1
Adaptive Sliding Mode Attitude and Vibration Control of Flexible Spacecraft under Unknown Disturbance and Uncertainty, pp. 9871-9876.
Hu, Qinglei — Harbin Inst. of Tech.

16:50-17:10 WeC03.2
A New Design for Chattering Reduction in Sliding Mode Control, pp. 9877-9881.
Chen, Chi-Che — National Taiwan Univ.
Chen, Min-Shin — National Taiwan Univ.

17:10-17:30 WeC03.3
Robust Control of Uncertain Switched Delay Systems: A Sliding Mode Control Design, pp. 9882-9887.
Lian, Jie — Northeastern Univ.
Dimirovski, Georgi Marko — Dogus Univ. of Istanbul
Zhao, Jun — The Australian National Univ.

17:30-17:50 WeC03.4
A New Terminal Sliding Mode Control for Robotic Manipulators, pp. 9888-9893.
Zhao, Dongya — Shanghai Jiao Tong Univ.
Li, Shaoyuan — Shanghai Jiao Tong Univ.
Gao, Feng — Shanghai Jiao Tong Univ.

17:50-18:10 WeC03.5
A Model Predictive Control Approach to Predict Sliding Surface, pp. 9894-9898.
Montaseri, Ghazal — Univ. of Tehran
Yazdanpanah, M. J. — Univ. of Tehran

18:10-18:30 WeC03.6
Integral Nested Sliding Mode Control for Robotic Manipulators, pp. 9899-9904.
González Jiménez, Luis Enrique — Centro de Investigaciones y Estudios Avanzados del IPN, Unidad G
Loukianov, Alexander G. — CINVESTAV IPN GDl
Bayro-Corrochano, Eduardo Jose — Centro de Investigacion y de Estudios Avanzados del I.P.N. Cl

WeC04 308
Linear Matrix Inequalities and Their Applications (Regular Session)

Chair: Kogan, Mark M. — Architecture And Civil Engineering Univ.
Co-Chair: James, Matthew R. — Australian National Univ.

16:30-16:50 WeC04.1
LMI Based Output-Feedback Controllers: Gamma-Optimal versus Linear Quadratic, pp. 9905-9909.
Balandin, Dmitry V. — Res. Inst. for Appl. Math & Cyber.
Kogan, Mark M. — Architecture And Civil Engineering Univ.

16:50-17:10 WeC04.2
Controller Synthesis of an Uncertain Three Tank System Using Polytypic System Approach, pp. 9910-9915.
Iqbal, Muhammad — CASE
Raza, Qarab — CASE
Bhatti, Aamer Iqbal — Muhammad Ali Jinnah Univ. Islamabad
Ayub, Ayaz — IDS

17:10-17:30 WeC04.3
Observer Based Controller Design for Linear Systems with Input Constraints, pp. 9916-9921.
Lens, Hendrik — TU Darmstadt
Adamy, Jürgen — Tech. Univ. Darmstadt

17:30-17:50 WeC04.4
Quantum LQG Control with Quantum Mechanical Controllers, pp. 9922-9927.
Nurdin, Hendra Ishwara — Australian National Univ.
James, Matthew R. — Australian National Univ.
Petersen, Ian Richard — Univ. of New South Wales - ADFA

17:50-18:10 WeC04.5
Stabilization of the Inverted Pendulum with Backlash Using H_{infty}-LMI Technique, pp. 9928-9933.
Pujol, Gisela — Escola Univ. d'Enginyeria Tecnica Industrial
Acho, Leonardo — EUETIB-Univ. Pol. of Catalunya

18:10-18:30 WeC04.6
Saturated LMI Control of Hysteretic Base-Isolated Structures, pp. 9934-9939.
Pozo, Francesc — Univ. Pol. de Catalunya
Pujol, Gisela — Escola Univ. d'Enginyeria Tecnica Industrial
Acho, Leonardo — EUETIB-Univ. Pol. of Catalunya

WeC05 307
Decentralized Control (Regular Session)

Chair: Middleton, Rick — National Univ. of Ireland
Co-Chair: Dallagi, Anes — Univ. of Alberta

16:30-16:50 WeC05.1
Modification of Model Predictive Control to Reduce Cross-Coupling, pp. 9940-9945.
Middleton, Rick — National Univ. of Ireland
Adams, Gregory John — Univ. of Newcastle

16:50-17:10 WeC05.2
A Generalized Design of Decoupling Multivariable Control for Disturbance Rejection, pp. 9946-9951.
Huang, Hsiao-Ping — National Taiwan Univ.
Lin, Feng-Yi — National Taiwan Univ.
Jeng, Jyh-Cheng — National Taiwan Univ.

17:10-17:30 WeC05.3
Decentralized PID Controller Design for a MIMO Evaporator Based on Colonial Competitive Algorithm, pp. 9952-9957.
Rajabioun, Ramin — Tehran Univ.
Hashemzadeh, Farzad — Tehran Univ.
Atashpaz-Gargary, Esmaeil — tehran Univ.
Mesgari, Bahman — Tehran Univ.
Rajaee, Farzad — Faculty of Engineering, Campus#2, Univ. of Tehran

17:30-17:50 WeC05.4
Coordination of Decentralized Large-Scale Process Optimal Control Problems, pp. 9958-9963.
Dallagi, Anes — Univ. of Alberta
Marcos, Natalia Iris — Univ. of Alberta
Forbes, J. Fraser — Univ. of Alberta

17:50-18:10 WeC05.5
Robust Decentralized Data Fusion Based on Internal Ellipsoid Approximation, pp. 9964-9969.
Zhou, Yan — Shanghai Jiao Tong Univ.
Li, Jianxun — Shanghai Jiao Tong Univ.

18:10-18:30 WeC05.6
Decentralized Boundary Control of Irrigation Canal Networks Via a Strict Lyapunov Method, pp. 9970-9975.
Li, Li — The Univ. of Melbourne

WeC06 310A
Descriptor Systems (Regular Session)

Chair: Marx, Benoit — Centre de Recherche en Automatique de Nancy
Co-Chair: Yung, Chee-Fai — National Taiwan Ocean Univ.

16:30-16:50 WeC06.1
Stability and L2-Norm Bound Conditions for Takagi-Sugeno Descriptor Systems, pp. 9976-9981.
Marx, Benoit — Centre de Recherche en Automatique de Nancy
Ragot, Jose — CRAN-INPL

16:50-17:10 WeC06.2
Bounded Real Lemma for Linear Discrete-Time Descriptor Systems, pp. 9982-9986.
Yung, Chee-Fai — National Taiwan Ocean Univ.
Wang, Chih-Chieh — MiTAC International Corp.
Wu, Po-Feng — National Taiwan Ocean Univ.
Wang, He-Sheng — National Taiwan Ocean Univ.

17:10-17:30 WeC06.3
On the Regularity for Singular Linear System with Markov Jump Parameters, pp. 9987-9992.
Manfrim, Amanda Liz Pacifico — Univ. of Sao Paulo
Terra, Marco Henrique — Univ. of Sao Paulo

Costa, Eduardo F. Univ. de São Paulo
Ishihara, João Yoshiyuki Univ. of Brasília

17:30-17:50 WeC06.4
Gain-Scheduled Controller Synthesis Based on New LMIs for Dissipativity of Descriptor LPV Systems, pp. 9993-9998.
Masubuchi, Izumi Hiroshima Univ.
Suzuki, Atsushi Hiroshima Univ.

17:50-18:10 WeC06.5
Stabilisation of Singular LPV Systems, pp. 9999-10002.
Chadli, Mohammed Univ. de Picardie-Jules Verne
Daafouz, Jamal CRAN -INPL
Darouach, Mohamed Univ. Henri Poincare-Nancy

18:10-18:30 WeC06.6
H-Infinity Control for Linear Discrete-Time Descriptor Systems: State Feedback and Full Information Cases, pp. 10003-10008.
Yung, Chee-Fai National Taiwan Ocean Univ.

WeC07 310B
Industrial Applications of Optimal Control (Regular Session)
Chair: Cantoni, Michael Univ. of Melbourne
Co-Chair: Badreddin, Essam Univ. of Heidelberg

16:30-16:50 WeC07.1
Intelligent Control for Flotation Process, pp. 10009-10014.
Geng, Zengxian Northeastern Univ. Shenyang,China
Chai, Tianyou Northeastern Univ.
Yue, Heng Northeastern Univ.
Wang, Hong the Univ. of Manchester
Su, Chun-Yi Concordia Univ.

16:50-17:10 WeC07.2
H_2/H_infty Multiobjectives for Fault Detection in Uncertain Polytopic Systems, pp. 10015-10020.
Acuńa-Bravo, Wilber Univ. de Los Andes
Rios-Bolivar, Addison Univ. De Los Andes

17:10-17:30 WeC07.3
Suboptimal Hybrid Model Predictive Control: Application to Sewer Networks, pp. 10021-10026.
Ocampo-Martinez, Carlos The Univ. of Newcastle
Ingimundarson, Ari Tech. Univ. of Catalonia
Bemporad, A Univ. of Siena
Puig, Vicenc Univ. Pol. de Catalunya

17:30-17:50 WeC07.4
Extremum-Seeking-Based Receding-Horizon Optimal Control of Plasma Current Profile in the DIII-D Tokamak, pp. 10027-10032.
Ou, Yongsheng Lehigh Univ.
Xu, Chao Lehigh Univ.
Schuster, Eugenio Lehigh Univ.
Luce, Tim General Atomics
Ferron, J. R. General Atomics
Walker, Michael General Atomics
Humphreys, D.A. General Atomics

17:50-18:10 WeC07.5
Distributed Controller Design for Open Water Channels, pp. 10033-10038.
Li, Yuping Univ. of Melbourne
Cantoni, Michael Univ. of Melbourne

18:10-18:30 WeC07.6
Application of a Game-Theoretic Multi-Loop Control System Design with Robust Performance, pp. 10039-10044.
Wellenreuther, Andrea Univ. of Heidelberg
Gambier, Adrian Univ. of Heidelberg
Badreddin, Essam Univ. of Heidelberg

WeC08 310C
Convex Optimization and Relaxations (Regular Session)
Co-Chair: Tibken, Bernd Univ. of Wuppertal

16:30-16:50 WeC08.1
Structure Exploitation in Semi-Definite Programs for Systems Analysis, pp. 10045-10050.
Johansson, Janne Harju Linköping Univ.
Hansson, Anders Linkoping Univ.

16:50-17:10 WeC08.2
Improved Approach for Optimization Problems of Determining the C-Numerical Range, pp. 10051-10056.
Fan, Youping Univ. of Wuppertal
Tibken, Bernd Univ. of Wuppertal

17:10-17:30 WeC08.3
Guaranteed Bounds for Robust LMI Problems with Polynomial Parameter Dependence, pp. 10057-10062.
Warthenpfuhl, Sascha Alexander Univ. of Wuppertal
Tibken, Bernd Univ. of Wuppertal

17:30-17:50 WeC08.4
An Off-Line MPC Strategy for Nonlinear Systems Based on SOS Programming, pp. 10063-10068.
Franze', Giuseppe Univ. della Calabria
Casavola, Alessandro Univ. Della Calabria
Famularo, Domenico Univ. degli Studi Mediterranea di Reggio Calabria
Garone, Emanuele Univ. della Calabria

17:50-18:10 WeC08.5
Distribution-Dependent Robust Linear Optimization with Asymmetric Uncertainty and Application to Optimal Control, pp. 10069-10074.
Paschalidis, Ioannis Boston Univ.
Kang, Seong-Cheol Boston Univ.
Li, Keyong Boston Univ.

18:10-18:30 WeC08.6
Incremental Regression Function Construction with Small Landmarks, pp. 10075-10080.
Wang, Gang Hong Kong Univ. of Science and Tech.
Qin, Shiyin Beihang
Huang, Pipei Beihang

WeC09 311C
Recursive Identification (Regular Session)
Chair: Niedzwiecki, Maciej,Jan Gdansk Univ. of Tech.
Co-Chair: Rotkowitz, Michael The Univ. of Melbourne

16:30-16:50 WeC09.1
Recursive Parameter Estimation by Means of the SG-Algorithm, pp. 10081-10086.
Evestedt, Magnus Uppsala Univ.
Medvedev, Alexander V. Uppsala Univ.

16:50-17:10 WeC09.2
Optimal and Suboptimal Smoothing Algorithms for Identification of Time-Varying Systems with Randomly Drifting Parameters, pp. 10087-10092.
Niedzwiecki, Maciej,Jan Gdansk Univ. of Tech.

17:10-17:30 WeC09.3
Elementwise Decoupling and Convergence of the Riccati Equation in the SG-Algorithm, pp. 10093-10098.
Medvedev, Alexander V. Uppsala Univ.
Evestedt, Magnus Uppsala Univ.

17:30-17:50 WeC09.4
Recursive Sparse Estimation Using a Gaussian Sum Filter, pp. 10099-10105.
Blackhall, Lachlan The Australian National Univ.
Rotkowitz, Michael The Univ. of Melbourne

17:50-18:10 WeC09.5
Fast Moving Window Algorithm for QR and Cholesky Decompositions, pp. 10106-10111.
Liang, Wuxing Queen's Univ. Belfast
Kruger, Uwe Queens Univ. of Belfast
Wang, Xun Queen's Univ. Belfast
Xie, Lei National Key Lab. of Industrial Control Tech.
Littler, Tim Queen's Univ. Belfast

18:10-18:30 WeC09.6
An Information Theoretic Approach to Hybrid Deconvolution Problems, pp. 10112-10117.
Fagnani, Fabio Pol. Di Torino
Fosson, Sophie Marie Scuola Normale Superiore di Pisa

WeC10 311B
Fault Detection III (Regular Session)
Chair: Patton, Ron J. Univ. of Hull
Co-Chair: Gertler, Janos J. George Mason Univ.

16:30-16:50 WeC10.1

Adaptive Fault Detection for a Class of Nonlinear Systems Based on Output Estimator Design, pp. 10118-10123.

Chen, Wei-tian	Simon Fraser Univ.
Saif, Mehrdad	Simon Fraser Univ.

16:50-17:10 WeC10.2

Robust Consistency-Based Diagnosis of Nonlinear Systems by Set Observation, pp. 10124-10129.

Wolff, Florian	Univ. Karlsruhe (TH)
Krutina, Patrick	Univ. Karlsruhe (TH)
Krebs, Volker G.	Univ. Karlsruhe (TH)

17:10-17:30 WeC10.3

Fault Detection for Singular Ts Fuzzy Systems with Time-Delay, pp. 10130-10135.

Chen, Li	Shandong Ec. Univ.
Zhong, Maiying	Shandong Univ.

17:30-17:50 WeC10.4

Two Improved Approaches to Fault Detection with Unknown Inputs, pp. 10136-10141.

Xu, Jun	National Univ. of Singapore
Lum, Kai-Yew	National Univ. of Singapore
Loh, Ai-Poh	National Univ. of Singapore
Xie, Lihua	Nanyang Tech. Univ.

17:50-18:10 WeC10.5

Fault Diagnosis for Switching System Using Observer Kalman Filter IDentification, pp. 10142-10147.

Akhenak, Abdelkader	Ec. des Mines de Douai
Bako, Laurent	Ec. des Mines de Douai
Duviella, Eric	Ec. des Mines de Douai
Pekpe, Komi Midzodzi	Cran
Lecoeuche, Stéphane	Mines de Douai

18:10-18:30 WeC10.6

A Direct Approach to Fault Detection in Non-Uniformly Sampled Systems, pp. 10148-10153.

Izadi, Iman	Univ. of Alberta
Shah, Sirish	Univ. of Alberta
Chen, Tongwen	Univ. of Alberta

WeC11 311A

Adaptive, Nonlinear and Robust Control (Regular Session)

Chair: Bobtsov, Alexey	Saint-Petersburg State Univ. of Information Tech. Mechanics and Optics
Co-Chair: Gu, Dawei	Univ. of Leicester

16:30-16:50 WeC11.1

Multichannel Adaptive Stochastic Filtering for Active Noise Control in Personal Computers, pp. 10154-10159.

Kinney, Charles	Univ. of California at San Diego
Lee, Intae	Univ. of California, San Diego
de Callafon, Raymond	Univ. of California, San Diego
Jam, Mehrban	Hewlett-Packard

16:50-17:10 WeC11.2

Adaptive Observer Design for Chaotic Duffing System, pp. 10160-10165.

Bobtsov, Alexey	Saint-PetersburgStateUniversityofInformationTechnologiesMechani
Pyrkin, Anton	Saint-Petersburg State Univ. of Information Tech. Mec
Slita, Olga	Baltic State Tech. Univ.
Nikolaev, Nikolay	Saint-Petersburg State Univ. of Information Tech. Me

17:10-17:30 WeC11.3

Stability Analysis and Control Design for an Underactuated Walking Robot Via Computation of a Transverse Linearization, pp. 10166-10171.

Freidovich, Leonid	UmeĺUniv.
Shiriaev, Anton	Umea Univ.
Manchester, Ian	UmeĺUniv.

17:30-17:50 WeC11.4

Robust Adaptive Fault-Tolerant Control of the F-14 Aircraft under Sensor Failures, pp. 10172-10177.

Fekri, Sajjad	Univ. of Leicester
Gu, Dawei	Univ. of Leicester
Postlethwaite, Ian	the Univ. of Leicester
Athans, Michael	Inst. Superior Tecnico

17:50-18:10 WeC11.5

Aircraft Airbrakes Compensation Design Using Iterative Inversion, pp. 10178-10183.

Ronceray, Lilian	Airbus France
Mouyon, Philippe	ONERA
Tebbani, Sihem	Supelec
Puyou, Guilhem	Airbus France
Alazard, Daniel	Univ. de Toulouse - ISAE

18:10-18:30 WeC11.6

Design of Adaptive Sliding Mode Controller (ASM) for a Distillation Column, pp. 10184-10189.

Biswas, Pinak Pani	IIT Kharagpur
Ray, Shubhabrata	IIT Kharagpur
Samanta, Amar Nath	Indian Inst. of Tech.

WeC12 313

Analysis and Control of Hybrid Systems (Regular Session)

Chair: Lunze, Jan	Ruhr-Univ. Bochum
Co-Chair: Imura, Jun-ichi	Tokyo Inst. of Tech.

16:30-16:50 WeC12.1

Reachability and Robust Control of PWA Systems with Parameter Variations and Bounded Disturbance, pp. 10190-10195.

Thomas, Jean	Beni-Sueif Univ.
Dumur, Didier	Ec. Superieure d'Electricite
Olaru, Sorin	Supelec
Buisson, Jean	Supélec

16:50-17:10 WeC12.2

Robust Explicit Time Optimal Controllers for Linear Systems Via Decomposition Principle, pp. 10196-10200.

Sui, Dan	NUS
Feng, Le	The Norwegian Univ. of Science and Tech.
Hovd, Morten	Norwegian Univ. of Tech. and Science

17:10-17:30 WeC12.3

Finite Abstractions of Discrete-Time Linear Systems and Its Application to Optimal Control, pp. 10201-10206.

Tazaki, Yuichi	Tokyo Inst. of Tech.
Imura, Jun-ichi	Tokyo Inst. of Tech.

17:30-17:50 WeC12.4

A New Hybrid System Identification Algorithm with Automatic Tuning, pp. 10207-10212.

Lauer, Fabien	Nancy-Univ.
Bloch, Gerard	Nancy Univ.

17:50-18:10 WeC12.5

Hybrid Adaptive Observer for a Brushless DC Motor, pp. 10213-10218.

Niemczyk, Piotr	Aalborg Univ.
Porchez, Thomas	Aalborg Univ.
Bendtsen, Jan Dimon	Aalborg Univ.
Kallesŕe, Carsten Skovmose	Grundfos Management A/S

18:10-18:30 WeC12.6

Observability of Affine Discrete-Time Asynchronous Switched Systems, pp. 10219-10224.

Kajdan, Rudy	Univ. d'Orléans
Aubry, Didier	Univ. d'Orléans
Kratz, Frederic	ENSIB

WeC13 314

Stochastic System Identification (Regular Session)

Chair: Fuchs, Jean Jacques	Univ. de Rennes
Co-Chair: Vasiliev, Vyacheslav	Univ. of Tomsk

16:30-16:50 WeC13.1

On the Use of Sparse Representations in the Identification of Line Spectra., pp. 10225-10229.

Fuchs, Jean Jacques	Univ. de Rennes

16:50-17:10 WeC13.2

On Sequential Parameter Estimation of a Linear Regression Process, pp. 10230-10235.

Kuechler, Uwe	Humboldt Univ. Berlin
Vasiliev, Vyacheslav	Univ. of Tomsk

17:10-17:30 WeC13.3

The Gradient Algorithm for Parameter and Output Estimation for Dual-Rate CARARMA Systems, pp. 10236-10239.

Yang, Huizhong — Jiangnan Univ.
Tian, Jun — Jiangnan Univ.

17:30-17:50 WeC13.4
Identification for a Kind of Disturbed Multi-Dimensional Wiener System, pp. 10240-10245.
Fan, Dan — Tsinghua Univ.
Luo, Guiming — Tsinghua Univ.
Zhao, Yue — Tsinghua Univ.
Kwon, Wook Hyun — Seoul National Univ.

17:50-18:10 WeC13.5
Optimal State Filtering and Parameter Identification for Linear Stochastic Time-Delay Systems, pp. 10246-10251.
Basin, Michael V. — Autonomous Univ. of Nuevo Leon
Shi, Peng — Faculty of Advanced Tech.
Calderon Alvarez, Dario — Autonomous Univ. of Nuevo Leon

18:10-18:30 WeC13.6
Localization Based on Observations Linear in Log Range, pp. 10252-10257.
Gustafsson, Fredrik — Linköping Univ.
Gunnarsson, Fredrik — Linköping Univ.

WeC14 318
Advances in Networked Systems: Asynchronous Control, Estimation and Synchronization Problems (Invited Session)
Chair: Ben Gaid, Mongi — IFP
Co-Chair: Johansson, Karl Henrik — Royal Inst. of Tech.
Organizer: Ben Gaid, Mohamed El Mongi — INRIA
Organizer: Johansson, Karl Henrik — Royal Inst. of Tech.
Organizer: Canudas de Wit, Carlos — CNRS-GIPSA-Lab.

16:30-16:50 WeC14.1
A Design Methodology for Weakly-Hard Real-Time Control (I), pp. 10258-10264.
Ben Gaid, Mongi — IFP
Simon, Daniel — Inria Rhone-alpes
Sename, Olivier — INPG

16:50-17:10 WeC14.2
Stabilization of Lebesgue Sampled Systems with Bounded Controls: The Chain of Integrators Case (I), pp. 10265-10270.
Marchand, Nicolas — GIPSA-Lab. CNRS

17:10-17:30 WeC14.3
On Iterative System Design and Separation in Control Over Noisy Channels (I), pp. 10271-10276.
Bao, Lei — Royal Inst. of Tech. (KTH)
Skoglund, Mikael — Royal Inst. of Tech.
Johansson, Karl Henrik — Royal Inst. of Tech.

17:30-17:50 WeC14.4
Passivity of Interconnected Asynchronous Discrete-Time Systems (I), pp. 10277-10282.
Canudas de Wit, Carlos — CNRS-GIPSA-Lab.
Ramos Cueli, José — INRIA Rhône-Alpes

17:50-18:10 WeC14.5
Analysis of Networked Estimation under Contention-Based Medium Access (I), pp. 10283-10288.
Rabi, Maben — Royal Inst. of Tech. (KTH)
Stabellini, Luca — Royal Inst. of Tech. (KTH)
Almstrom, Peter — Royal Inst. of Tech.
Johansson, Mikael — Royal Inst. of Tech.

18:10-18:30 WeC14.6
A PI Consensus Controller for Networked Clocks Synchronization (I), pp. 10289-10294.
Carli, Ruggero — Univ. of Padova
Chiuso, Alessandro — Univ. of Padova
Schenato, Luca — Univ. of Padova
Zampieri, Sandro — Univ. di Padova

WeC15 317
Modeling Methods and Clinical Applications in Medical and Biological Systems III (Regular Session)
Chair: Bai, Er-Wei — Univ. of Iowa
Co-Chair: Zurakowski, Ryan — Univ. of Delaware

16:30-16:50 WeC15.1
A New Delay-SIR Model for Pulse Vaccination, pp. 10295-10300.
Briat, Corentin — INPG/ENSIEG
Verriest, Erik I. — Georgia Inst. of Tech.

16:50-17:10 WeC15.2
Challenging the Optimality of the Pulse Excitation in Magnetic Resonance Imaging, pp. 10301-10306.
Tahayori, Bahman — The Univ. of Melbourne
Johnston, Leigh — Univ. of Melbourne
Mareels, Iven — The Univ. of Melbourne
Farrell, Peter M. — Univ. of Melbourne

17:10-17:30 WeC15.3
Model Simplification of Signal Transduction Pathway Networks Via a Hybrid Inference Strategy, pp. 10307-10312.
Jia, Jianfang — North Univ. of China
Yue, Hong — Univ. of Strathclyde

17:30-17:50 WeC15.4
Control Problems in Antiangiogenic Therapy - Comparison of Six Models, pp. 10313-10318.
Swierniak, Andrzej — Silesian Tech. Univ.

17:50-18:10 WeC15.5
Bifurcations in a Mathematical Model of Non-Basal Testosterone Production, pp. 10319-10324.
Churilov, Alexander — St.Petersburg State Marine Tech. Univ.
Medvedev, Alexander V. — Uppsala Univ.
Shepeljavyi, Alexander — St. Petersburg State Univ.

18:10-18:30 WeC15.6
Resistance Risk Management in HIV Therapy Switching with Explicit Quiescent T-Cell Modeling, pp. 10325-10330.
Zurakowski, Ryan — Univ. of Delaware
Luo, Rutao — Univ. of Delaware

WeC17 320A
Control Education: Curricula (Regular Session)
Chair: Keel, Lee H. — Tennessee State Univ.
Co-Chair: Rossiter, J. Anthony — Univ. of Sheffield

16:30-16:50 WeC17.1
Typical Control Curricula and Using Software for Teaching/assessment: A UK Perspective, pp. 10331-10336.
Rossiter, J. Anthony — Univ. of Sheffield
Giaouris, Damian — Univ. of Newcastle
Mitchell, Richard — Univ. of Reading
McKenna, Paul — Glasgow Caledonian Univ.

16:50-17:10 WeC17.2
A Challenge for a New Organization in Systems and Control Curricula, pp. 10337-10342.
Dourado, Antonio — Univ. of Coimbra

17:10-17:30 WeC17.3
Whether the Spreaded Good Opinion about Fuzzy Controllers Is Justified, pp. 10343-10348.
Gessing, Ryszard — Pol. Slaska

17:30-17:50 WeC17.4
Method and Practice of the Education Quality Evaluation on Master of Engineering in Control Engineering of China, pp. 10349-10354.
Pan, Quan — Northwestern Pol. Univ.
Wang, Xiong — Tsinghua Univ. China
Cheng, Yongmei — Northwestern Pol. Univ.
Liu, Yong — NorthwesternPolytechnical Univ.

17:50-18:10 WeC17.5
Undergraduate Control Education: Theory and Practices, pp. 10355-10358.
Thakar, Vishvjit — A.D. Patel Inst. of Tech.
Joshi, Rutvij — A.D.Patel Inst. of Tech.

18:10-18:30 WeC17.6
New Approaches to Control Education, pp. 10359-10364.
Mitra, S. Mitra — Texas A&M Univ.
Keel, Lee H. — Tennessee State Univ.
Bhattacharyya, Shankar P. — Texas A & M Univ.

WeC18 320B
Future Industrial Development (Highlight Session)
Chair: Malik, O.P. — The Univ. of Calgary
Co-Chair: Caccia, Massimo — CNR-ISSIA

16:30-16:50 WeC18.1

Development of Scaled PRT System Based on In-Track Linear Induction Motor (I), pp. 10365-10366.

Quan, Zhonghua	POSCON Corp.
Kim, HyunSoo	POSCON Corp. R&D Center
Ryou, MyungSeon	POSCON Corp. R&D Center
Kim, MalSoo	POSCON Corp. R&D Center
Choi, ChangHo	POSCON Corp. R&D Center
Choi, Seunggap	POSCON Corp.

16:50-17:10 WeC18.2

Design of High Reliable Safety Data Link(HR-SDL) for Safety Grade PLC for Nuclear Power Plants (I), pp. 10367-10368.

Choi, KyungChul	POSCON Corp. R&D Center
Song, SeungWhan	POSCON Corp. R&D Center
Noh, YoungHun	POSCON Corp. R&D Center
Yun, DongHwa	POSCON Corp.
Jung, ChangHwa	POSCON Corp. R&D Center

17:10-17:30 WeC18.3

A Generation IV Nuclear Power Plant Nautral Circulation System Design for Emergency Cooling (I), pp. 10369-10370.

Lee, HyongWon	POSCON Corp. R&D Center
Kim, Jae Sig	POSCON Corp. R&D Center

17:30-17:50 WeC18.4

Identification of Synchronous Generator Using Nonlinear Feedback Model, pp. 10371-10376.

Sadabadi, Mahdiye Sadat	Amirkabir Univ. of Tech.
Karrari, Mehdi	Amirkabir Univ. of Tech.
Malik, O.P.	The Univ. of Calgary

17:50-18:10 WeC18.5

An Innovative Marking Machine Integrated with a GNU/Linux-Based Embedded Real-Time Platform (I), pp. 10377-10382.

Caccia, Massimo	CNR-ISSIA
Ravera, Gianfranco	Green Project Srl
Bertone, Alessio	Green Project Srl
Bruzzone, Gabriele	CNR-ISSIA

18:10-18:30 WeC18.6

BRIS for KSTAR Superconducting Coil (I), pp. 10383-10384.

Song, Inho	Korea Univ.
Ahn, HyunSik	Korea Univ.
Jang, GyeYeong	Korea Univ.
Park, KiWon	POSCON
Yun, MinSeong	POSCON
Shin, HyunSeok	POSCON
Lee, YeongWun	POSCON
Choi, ChangHo	POSCON Corp. R&D Center
Cho, Moohyun	POSTECH

WeC19 320C

Networked Robotic Systems (Regular Session)

Chair: Kim, Dong-Han	Kyung Hee Univ.
Co-Chair: Naso, David	Pol. di Bari

16:30-16:50 WeC19.1

Probabilistic and Self-Organized Strategies to Coordinate Multiple Robotic Pursuers in the Pursuit of an Adversarial Evaders, pp. 10385-10390.

Zheng, Jianying	Chinese Acad. of Sciences
Yu, Haibin	Chinese Acad. of Sciences
Liang, Wei	Yu Haibin
Peng, Zeng	Shenyang Inst. of Automation

16:50-17:10 WeC19.2

CSMA/CD-R for a Wireless Multi-Robot Commuication, pp. 10391-10396.

Kim, Dong-Han	Kyung Hee Univ.
Kim, Jong-Hwan	Korea Advanced Inst. of Science and Tech.

17:10-17:30 WeC19.3

Multi-Robot Tracking of Mobile Target Based on Communication, pp. 10397-10402.

Liu, Lei	Huazhong Univ. of Science and Tech.
Wang, Yongji	Hauzhong Univ. of Science And Tech.

17:30-17:50 WeC19.4

Implementation of the High Availability Concept in Networked Robotic Systems, pp. 10403-10408.

Anton, Florin Daniel	Univ. Pol. of Bucharest
Borangiu, Theodor	automatics
Anton, Silvia	Univ. Pol. of Bucharest

17:50-18:10 WeC19.5

Deployment of Mobile Sensor Networks with Discontinuous Dynamics, pp. 10409-10414.

Lee, Jaeyong	Samsung Heavy Industries
Jayasuriya, Suhada	Texas A&M Univ.

18:10-18:30 WeC19.6

Matrix-Based Scheduling and Control of a Mobile Sensor Network, pp. 10415-10420.

Schiraldi, Vito	Pol. di Bari
Giordano, Vincenzo	Pol. di Bari
Naso, David	Pol. di Bari
Turchiano, Biagio	Pol. di bari
Lewis, Frank L.	Univ. of Texas at Arlington

WeC20 321C

Robotics Estimation II (Regular Session)

Chair: Poulsen, Niels K.	The Tech. Univ. of Denmark
Co-Chair: Plestan, Franck	Ec. Centrale De Nantes-CNRS

16:30-16:50 WeC20.1

Sensor Fusion Using Fuzzy Integrals and Diverse Bayesian Networks, pp. 10421-10426.

Walls, Jamie	North Carolina A&T State Univ.
Esterline, Albert	North Carolina A&T State Univ.
Homaifar, Abdollah	North Carolina A&T State Univ.

16:50-17:10 WeC20.2

Kalmtool Used for Mobile Robot Navigation, pp. 10427-10432.

Mogensen, Lars V.	Tech. Univ. of Denmark
Andersen, Nils A.	Tech. Univ. of Denmark
Ravn, Ole	Tech. Univ. of Denmark
Poulsen, Niels K.	The Tech. Univ. of Denmark

17:10-17:30 WeC20.3

WLAN Based Pose Estimation for Mobile Robots, pp. 10433-10438.

Roehrig, Christof	Univ. of Applied Sciences Dortmund
Kuenemund, Frank	Univ. of Applied Sciences Dortmund

17:30-17:50 WeC20.4

Absolute Orientation Angle Estimation of a Quadruped Robot Using Nonlinear Observers, pp. 10439-10444.

Rengifo-Rodas, Carlos-Felipe	Ec. Centrale De Nantes - CNRS - Univ. del Cauca
Plestan, Franck	Ec. Centrale De Nantes-CNRS
Aoustin, Yannick	CNRS, Univ. of nantes

17:50-18:10 WeC20.5

Estimation of 3-D Transformation from 2-D Observing Image Using Dual Quaternion, pp. 10445-10450.

Chiang, Yi-Te	Lee-Ming Inst. of Tech.
Huang, Po-Yen	National Taiwan Univ.
Chen, Hung-Wei	National Taiwan Univ.
Chang, Fan Ren	National Taiwan Univ.

18:10-18:30 WeC20.6

Force Distribution Estimation of Wheeled Mobile Robot: Application to Friction Coefficients Estimation, pp. 10451-10455.

Choi, Hyun Do	KAIST
Kang, Hyunsuk	Korea Advanced Inst. of Science and Tech.
Hyun, Kyung Hak	KAIST
Kim, Soohyun	KAIST
Kwak, Yoon Keun	KAIST

WeC21 321B

Dynamics and Control of Micro and Nano-Scale Systems III (Invited Session)

Chair: Moheimani, S.O. Reza	Univ. of Newcastle
Co-Chair: Sebastian, Abu	IBM Res.
Organizer: Moheimani, S.O. Reza	Univ. of Newcastle
Organizer: Sebastian, Abu	IBM Res.

16:30-17:10 WeC21.1

Control and Systems Approaches to Atomic Force Microscopy (I), pp. 10456-10467.

Agarwal, Pranav	Univ. of Minnesota, twin cities
Salapaka, Murti V.	Univ. of Minnesota, twin cities

17:10-17:30 WeC21.2

Modeling and Control of Electrical Breakdown Process of Carbon Nanotubes (I), pp. 10468-10473.

Luo, Yilun — Michigan State Univ.
Xi, Ning — Michigan State Univ.
Liu, Lianqing — Shenyang Inst. of Automation
Zhang, Jiangbo — Michigan State Univ.

17:30-17:50 WeC21.3

Dynamics of Integrated Silicon Micro-Heaters (I), pp. 10474-10479.

Sebastian, Abu — IBM Zurich Res. Lab.
Wiesmann, Dorothea — IBM Zurich Res. Lab.

17:50-18:10 WeC21.4

Real-Time Monitoring of Thin Film Microstructure in Chemical Vapor Deposition Using a Modified Moving Horizon Estimation (I), pp. 10480-10485.

Xiong, Rentian — Georgia Inst. of Tech.
Grover Gallivan, Martha — Georgia Inst. of Tech.

18:10-18:30 WeC21.5

External Force Assisted Nanorobotic Assembly of 3-D Helical Nanobelts (I), pp. 10486-10491.

Hwang, Gilgueng — Inst. of Industrial Science, The Univ. of Tokyo
Bagutti, Lorenzo — ETH Zurich
Hashimoto, Hideki — Univ. of Tokyo

WeC22 321A

Identification and Diagnosis of Mechatronic Systems (Regular Session)

Chair: Braatz, Richard D. — Univ. of Illinois at Urbana-Champaign
Co-Chair: Wang, Danwei — Nanyang Tech. Univ.

16:30-16:50 WeC22.1

Modelling and Identification for Control Design of Compliant Fluidic Actuators with Rotary Elastic Chambers: Hydraulic Case Study, pp. 10492-10497.

Mihajlov, Miroslav — Univ. of Bremen
Ivlev, Oleg — Friedrich-Wilhelm-Bessel-Inst. Forschungsgesellschaftm.b.H
Graeser, Axel — Univ. of Bremen

16:50-17:10 WeC22.2

A New Identification Method for Mechatronic Systems in Closed-Loop from Only Control Data, pp. 10498-10503.

Gautier, Maxime — IRCCyN
Janot, Alexandre — IRCCyN
Vandanjon, Pierre-Olivier — Lab. Central des Ponts et Chaussées

17:10-17:30 WeC22.3

Hydrodynamic Parameter Estimation of an Open Frame Unmanned Underwater Vehicle, pp. 10504-10509.

Avila, Juan Pablo Julca — Univ. of Sao Paulo
Maruyama, Newton — Univ. of Sao Paulo
Adamowski, Julio Cezar — Univ. of Sao Paulo

17:30-17:50 WeC22.4

Telediagnosis of Transmission Channel and Actuators Faults on a Mobile Robot, pp. 10510-10515.

Fawaz, Khaled — LAGIS, UMR-CNRS 8146, Pol. Lille
Merzouki, Rochdi — Ec. Pol. de Lille
Ould bouamama, Belkacem — LAIL

17:50-18:10 WeC22.5

Monitoring Ability Analysis and Qualitative Fault Diagnosis Using Hybrid Bond Graph, pp. 10516-10521.

Low, Chang Boon — Nanyang Tech. Univ.
Wang, Danwei — Nanyang Tech. Univ.
Arogeti, Shai — Nanyang Tech. Univ.
Zhang, Jing Bing — Singapore Inst. of Manufacturing Tech.

18:10-18:30 WeC22.6

Causality Assignment and Model Approximation for Quantitative Hybrid Bond Graph-Based Fault Diagnosis, pp. 10522-10527.

Low, Chang Boon — Nanyang Tech. Univ.
Wang, Danwei — Nanyang Tech. Univ.
Arogeti, Shai — Nanyang Tech. Univ.
Zhang, Jing Bing — Singapore Inst. of Manufacturing Tech.

WeC23 323

Discrete Event Systems in Manufacturing (Regular Session)

Chair: Silva, José Reinaldo — Univ. of São Paulo
Co-Chair: Nishi, Tatsushi — Osaka Univ.

16:30-16:50 WeC23.1

Lagrangian Relaxation Technique for Solving Scheduling Problems by Decomposition of Timed Petri Nets, pp. 10528-10533.

Nishi, Tatsushi — Osaka Univ.
Shimatani, Kenichi — Osaka Univ.
Inuiguchi, Masahiro — Osaka Univ.

16:50-17:10 WeC23.2

A Procedure to Compute a Probabilistic Bound for the Maximum Tardiness Using Stochastic Simulation, pp. 10534-10539.

Mebarki, Nasser — IUT de Nantes
Shahzad, Muhammad Atif — Univ. of Nantes

17:10-17:30 WeC23.3

Simulation As a Support of Design and Validation of a Product Driven Control System, pp. 10540-10545.

El Haouzi, Hind — Nancy Univ.
Petin, Jean-Francois — Nancy Univ.
Thomas, André — Nancy Univ.

17:30-17:50 WeC23.4

Modeling of Programs and Its Verification for Programmable Logic Controllers, pp. 10546-10551.

Sarmento, Cleber Alves — Univ. of São Paulo (USP) - Escola Pol.
Silva, José Reinaldo — Univ. of São Paulo
Miyagi, Paulo Eigi — Univ. of Sao Paulo, Escola Pol.
Santos Filho, Diolino José — Escola Pol. - Univ. of São Paulo (USP)

17:50-18:10 WeC23.5

An Implementation Environment for Automated Manufacturing Systems, pp. 10552-10557.

Diogo, Ricardo Alexandre — Pontifical Catholic Univ. of Parana
Vicari, Carlos Alberto — Pontifical Catholic Univ. of Parana
Rocha Loures, Eduardo — Pontifical Catholic Univ. of Paraná
Busetti, Marco Antonio — Pontifical Catholic Univ. of Parana
Santos, Eduardo Alves Portela — Pontifical Catholic Univ. of Parana

18:10-18:30 WeC23.6

A Hybrid Control Architecture Applied to Flexible Manufacturing Systems, pp. 10558-10563.

Cantillo, Jairo — Pontifical Catholic Univ. of Parana
Busetti, Marco Antonio — Pontifical Catholic Univ. of Parana
Santos, Eduardo Alves Portela — Pontifical Catholic Univ. of Parana
Rocha Loures, Eduardo — Pontifical Catholic Univ. of Paraná

WeC24 324

Supply and Logistics Networks (Regular Session)

Chair: Shimizu, Yoshiaki — Toyohashi Univ. of Tech.
Co-Chair: Grunder, Olivier — Systems and Transports Lab. SeT/UTBM

16:30-16:50 WeC24.1

A Hybrid Meta-Heuristic Method for Multimodal Logistic Network Design Over Planning Horizon, pp. 10564-10569.

Shimizu, Yoshiaki — Toyohashi Univ. of Tech.
Yamazaki, Yoshihiro — Toyohashi Univ. of Tech.
Wada, Takeshi — Osaka Prefectural Coll. of Tech.

16:50-17:10 WeC24.2

Supply Chain Planning under Uncertainty: A Chance Constrained Programming Approach, pp. 10570-10575.

Mitra, Kishalay — Tata Consultancy Services Limited
Gudi, Ravindra — IIT Bombay
Patwardhan, Sachin — IIT Bombay
Sardar, Gautam — Tata Consultancy Services

17:10-17:30 WeC24.3

A Differential Evolution &Genetic Algorithm for Vehicle Routing Problem with Simultaneous Delivery and Pick-Up and Time Windows, pp. 10576-10581.

Cao, Erbao — Hunan Univ. P.R.China

17:30-17:50 WeC24.4

A Proposal on Agent-Based Production Planning in Integrated

Supply Network, pp. 10582-10587.
Opadiji, Jayeola Femi — Kobe Univ.
Kaihara, Toshiya — Kobe Univ.

17:50-18:10 — WeC24.5
Entropy Based Optimization of Decentralized Supply Chain Networks, pp. 10588-10593.
Thangavelu, Sundar Raj — NUS
Samavedham, Lakshminarayanan — National Univ. of Singapore

18:10-18:30 — WeC24.6
The Holding and the Transportation Costs Optimization in a Simple Supply Chain : The Multiple Transporters Case, pp. 10594-10599.
Grunder, Olivier — Systems and Transports Lab. SeT/UTBM

WeC25 — 328
Industrial Application of Process Control (Invited Session)
Chair: Han, Chonghun — Seoul National Univ.
Co-Chair: Yu, Cheng-Ching — National Taiwan Univ.
Organizer: Han, Chonghun — Seoul National Univ.
Organizer: Yu, Cheng-Ching — National Taiwan Univ.

16:30-16:50 — WeC25.1
A Step-By-Step Approach Toward Advanced Process Control System in Petrochemical Industry (I), pp. 10600-10601.
Lee, Jinsuk — Samsung Total

16:50-17:10 — WeC25.2
Development of Adaptive Soft Sensor Based on Statistical Identification of Key Variables (I), pp. 10602-10607.
Ma, Mingda — Harbin Inst. of Tech.
Ko, Jing-Wei — CPC Petroleum Corp.
Wang, San-Jang — Ta Hwa Inst. of Tech.
Wu, Ming-Feng — National Tsing-Hua Univ.
Jang, Shi-Shang — National Tsing-Hua Univ.
Shieh, Shien-Shu — Chang Jung Univ.
Wong, David, S.H. — National Tsing-Hua Univ.

17:10-17:30 — WeC25.3
Practice and Challenges in Chemical Process Control Applications in Japan (I), pp. 10608-10613.
Ogawa, Morimasa — Yamatake Corp.
Kano, Manabu — Kyoto Univ.

17:30-17:50 — WeC25.4
Process Automation Development in China (I), pp. 10614-10616.
Wang, Shuqing — Zhejiang Univ.
Chu, Jian — Zhejiang Univ.
Su, Hongye — Zhejiang Univ.
Rong, Gang — Zhejiang Univ.
Gu, Yong — Zhejiang Univ.
Jin, Xiaoming — Zhejiang Univ.
Zhang, Jianming — Zhejiang Univ.
Xie, Lei — Zhejiang Univ.

17:50-18:10 — WeC25.5
Control and Optimization of a Large Scale Refinery Hydrogen Network (I), pp. 10617-10619.
Lee, Youngkoun — SK Energy
Park, Hurnkyoun — SK Energy
Jeong, Changho — SK energy

18:10-18:30 — WeC25.6
Nonlinear Model Predictive Control of a Run-Of-Mine Ore Milling Circuit, pp. 10620-10625.
Coetzee, Lodewicus Charl — Univ. of Pretoria
Kerrigan, Eric C. — Imperial Coll. London
Craig, Ian — Univ. of Pretoria

WeC26 — 327
Control of Power Systems III (Regular Session)
Chair: Maciejowski, Jan — Univ. of Cambridge
Co-Chair: Odgaard, Peter Fogh — KK electronic a/s

16:30-16:50 — WeC26.1
Hybrid Model Predictive Control Applied to Switching Control of Burner Load for a Compact Marine Boiler Design, pp. 10626-10633.
Solberg, Brian — Aalborg Industries A/S
Andersen, Palle — Aalborg Univ.
Maciejowski, Jan — Univ. of Cambridge
Stoustrup, Jakob — Aalborg Univ.

16:50-17:10 — WeC26.2
Constrained Control of a Once-Through Boiler with Recirculation, pp. 10634-10639.
Trangbaek, Klaus — Aalborg Univ.

17:10-17:30 — WeC26.3
Identification of the Primary Circuit Dynamics in a Pressurized Water Nuclear Power Plant, pp. 10640-10645.
Fazekas, Csaba — Computer and Automation Res. Inst.
Szederkenyi, Gabor — Computer and Automation Res. Inst. Hungarian
Hangos, Katalin M. — Computer & Automation Rsrch. Inst. of the Hungarian

17:30-17:50 — WeC26.4
On-Line Estimation of Wind Turbine Power Coefficients Using Unknown Input Observers, pp. 10646-10651.
Odgaard, Peter Fogh — KK electronic a/s
Nielsen, Rasmus — KK-electronic a/s
Damgaard, Chris — KK-electronic a/s

17:50-18:10 — WeC26.5
Real-Time Moisture Content Monitoring of Solid Biomass in Grate Combustion, pp. 10652-10656.
Ruusunen, Mika — Univ. of Oulu

18:10-18:30 — WeC26.6
Possibilities of Fault Tolerant Control in Thermal Power Plants, pp. 10657-10661.
Majanne, Yrjö — Tampere Univ. of Tech.

WeC27 — 326
Real-Time Systems (Regular Session)
Chair: de la Puente, Juan Antonio — Univ. Pol. de Madrid
Co-Chair: Marcos, Marga — Univ. del País Vasco

16:30-16:50 — WeC27.1
The Fault-Tolerant Extension of System Area Networks of Multiprocessor System, pp. 10662-10667.
Podlazov, Viktor — Trapeznikov Inst. of Control Sciences RAS
Nikolaev, Artem — The Lab. of Newest Information Tech. - LANIT

16:50-17:10 — WeC27.2
Control Performance Evaluation of Selected Methods of Feedback Scheduling of Real-Time Control Tasks, pp. 10668-10673.
Lozoya Gamez, Rafael Camilo — Tech. Univ. of Catalonia
Marti, Pau — Tech. Univ. of Catalonia
Velasco, Manel — Tech. Univ. of Catalonia
Fuertes, Josep M. — Tech. Univ. of Catalonia

17:10-17:30 — WeC27.3
Real-Time Monitoring and Diagnosis Platform for a Machining Process, pp. 10674-10679.
Portillo Perez, Eva — Univ. of the Basque Country
Marcos, Marga — Univ. del País Vasco
Cabanes, Itziar — Univ. of the Basque Country
Orive, Dario — Univ. del País Vasco
Sánchez, José Antonio — Univ. of the Basque Country

17:30-17:50 — WeC27.4
The ASSERT Virtual Machine: A Predictable Platform for Real-Time Systems, pp. 10680-10685.
de la Puente, Juan Antonio — Univ. Pol. de Madrid
Zamorano, Juan — Univ. Pol. de Madrid
Pulido, José A. — Univ. Pol. de Madrid
Urueńa, Santiago — Univ. Pol. de Madrid

17:50-18:10 — WeC27.5
Real-Time Obstacle Avoidance by Visually Recognizing Laser Patterns, pp. 10686-10691.
Chang, Wen-Chung — National Taipei Univ. of Tech.
Cho, Chih-Wei — National Taipei Univ. of Tech.

18:10-18:30 — WeC27.6
Hierarchical and Distributed Embedded Control Kernel, pp. 10692-10697.
Simarro, Raul — Univ. Pol. de Valencia.
Coronel, Javier O. — Univ. Pol. de Valencia
Simo, Jose — Univ. Pol. de Valencia
Blanes, Juan F. — Univ. Pol. de Valencia

WeC28 330A
Powertrain Control (Regular Session)
Chair: Del Re, Luigi — Johannes Kepler Univ.
Co-Chair: Sunwoo, Myoungho — Hanyang Univ.

16:30-16:50 WeC28.1
Electromechanical Valve Actuator with Hybrid MMF for Camless Engine, pp. 10698-10703.
Liu, Jieng-Jang — National Taiwan Univ.
Yang, Yee-Pien — National Taiwan Univ.
Xu, Jia-Hong — National Taiwan Univ.

16:50-17:10 WeC28.2
Optimal Selection of Control Inputs for Diesel Engines, pp. 10704-10709.
Alberer, Daniel — Johannes Kepler Univ. Linz
Hirsch, Markus — Johannes Kepler Univ. Linz Center of Mechatronics
Del Re, Luigi — Johannes Kepler Univ.

17:10-17:30 WeC28.3
Modelling of a Fuel Supply System for Model-Based Calibration, pp. 10710-10711.
Tomforde, Michael — IAV GmbH
Jeinsch, Torsten — IAV GmbH
Blath, Jan P. — IAV GmbH
Dünow, Hans P. — IAV GmbH

17:30-17:50 WeC28.4
Development of SILS and RCP for OSEK-OS Based ECU, pp. 10712-10718.
Sunwoo, Myoungho — Hanyang Univ.

17:50-18:10 WeC28.5
Fuel Economy Improvement Strategy for Light Duty Hybrid Truck Based on Fuel Consumption Computational Model Using Neural Network, pp. 10719-10725.
Suzuki, Masahiro — Hino Motors, Ltd.
Raksincharoensak, Pongsathorn — Tokyo Univ. of Agriculture and Tech.
Nagai, Masao — Tokyo Univ. of Agriculture and Tech.

18:10-18:30 WeC28.6
Estimating the Maneuver Quality of an Automatic Motion Inverter for End-Of-Line Tuning in Agricultural Tractors, pp. 10726-10731.
Tanelli, Mara — Pol. di Milano
Savaresi, Sergio — Pol. di Milano
Manzoni, Vincenzo — Pol. di Milano
Monizza, Federico — Univ. degli Studi di Bergamo
Taroni, Francesco — none
Mangili, Alberto — Same Deutz-FAhr Group SpA

WeC29 330B
Chassis Control and Supervision (Regular Session)
Chair: Akar, Mehmet — Bogazici Univ.
Co-Chair: Scalzi, Stefano — Univ. of Rome Tor Vergata

16:30-16:50 WeC29.1
Integrated Active Front Steering and Semiactive Rear Differential Control in Rear Wheel Drive Vehicles, pp. 10732-10737.
Scalzi, Stefano — Univ. of Rome Tor Vergata
Marino, Riccardo — Univ. di Roma Tor Vergata

16:50-17:10 WeC29.2
Active Coordination of the Individually Actuated Wheel Braking and Steering to Enhance Vehicle Lateral Stability and Handling, pp. 10738-10743.
Dincmen, Erkin — Istanbul Tech. Univ.
Acarman, Tankut — Galatasaray Univ.

17:10-17:30 WeC29.3
An Integrated Chassis Controller for Automotive Vehicle Emulation, pp. 10744-10749.
Akar, Mehmet — Bogazici Univ.
Kalkkuhl, Jens Christian — DaimlerChrysler AG

17:30-17:50 WeC29.4
GL_2 Estimation of Front Wheel Disturbance, pp. 10750-10755.
Akbari, Ahmad — Tech. Univ. of Munich
Lohmann, Boris — Tech. Univ. München
Salimbahrami, Behnam — Tech. Univ. Munich

17:50-18:10 WeC29.5
Control of Electric Power Steering Systems - from State of Art to Future Challenges, pp. 10756-10757.
Grüner, Stefan — ZF-Lenksysteme GmbH
Gaedke, Alexander — ZF-Lenksysteme GmbH
Karch, Gerald — ZF-Lenksysteme GmbH

18:10-18:30 WeC29.6
Explicit Nonlinear MPC of an Automotive Electromechanical Brake, pp. 10758-10763.
Lee, Chih Feng — The Univ. of Melbourne
Manzie, Chris — The Univ. of Melbourne
Line, Chris — The Univ. of Melbourne

WeC30 330C
Multi-Vehicle Systems I (Regular Session)
Chair: Zheng, Yu Fan — East China Normal Univ.
Co-Chair: Hsu, Liu — COPPE - Federal Univ. of Rio de Janeiro

16:30-16:50 WeC30.1
Consensus in Networks with Diverse Input and Communication Delays, pp. 10764-10769.
Tian, Yu-Ping — Southeast Univ.
Liu, Cheng-Lin — Southeast Univ.

16:50-17:10 WeC30.2
Consensus of Dynamical Agents in Time-Varying Networks, pp. 10770-10775.
Zheng, Yu Fan — East China Normal Univ.

17:10-17:30 WeC30.3
Collective Behavior of Multi-Agent Systems under Digital Communication Network, pp. 10776-10781.
Yu, Hongwang — Shanghai Univ.
Zheng, Yu Fan — East China Normal Univ.

17:30-17:50 WeC30.4
Coordination of Multi-Agent Systems with Communication Delays, pp. 10782-10787.
Liu, Cheng-Lin — Southeast Univ.
Tian, Yu-Ping — Southeast Univ.

17:50-18:10 WeC30.5
Adaptive Formation Control Using Artificial Potentials for Euler-Lagrange Agents, pp. 10788-10793.
Pereira, Ademir Rodrigues — COPPE/ Federal Univ. of Rio de Janeiro
Hsu, Liu — COPPE - Federal Univ. of Rio de Janeiro

18:10-18:30 WeC30.6
Stability Investigation of a Robotic Swarm with Limited Field of View, pp. 10794-10799.
Etemadi, Shahram — Sharif Univ. of Tech.
Alasty, Aria — Sharif Univ. of Tech.
Vossoughi, Gholamreza — Sharif Univ. of Tech.

WeCCC 401
Milestone Report by IFAC Coordinating Committee on Mechatronics, Robotics and Components (CC4) (Milestone Session)
Chair: Boverie, Serge — Continental Automotive France

16:30-18:30 WeCCC.1
Mechatronics, Robotics and Components for Automation and Control - IFAC Milestone Report, pp. 10800-10809.
Boverie, Serge — Continental Automotive France
Cho, Dong-il Dan — Seoul National Univ.
Hashimoto, Hideki — Univ. of Tokyo
Tomizuka, Masayoshi — Univ. of California, Berkeley
Wang, Wei — Dalian Univ. of Tech.
Zuehlke, Detlef — TU Kaiserslautern

ThPL1 Auditorium (301)
A Control-Theoretic Approach to Model-Based Medicine by Hidenori Kimura (Plenary Session)
Chair: Jämsä-Jounela, Sirkka-Liisa — Helsinki Univ. of Tech.

08:00-09:00 ThPL1.1
A Control-Theoretic Approach to Model-Based Medicine, pp. 10810-10821.
Kimura, Hidenori — The Inst. of Physical and Chemical Res. (RIKEN)

ThPL2 Auditorium (301)
BigDog, the Rough-Terrain Robot by Marc Raibert (Plenary Session)
Chair: Cho, Hyung Suck — KAIST

09:00-10:00 ThPL2.1
BigDog, the Rough-Terrain Quadruped Robot, pp. 10822-10825.
Raibert, Marc — Boston Dynamics

ThA01 Atlantic Hall
Industrial Control Systems (Poster Session)
Chair: Dochain, Denis — Univ. Catholique de Louvain
Co-Chair: Marquardt, Wolfgang — RWTH Aachen Univ.

10:30-12:30 ThA01.1
On-Line Fault Detection and Classification for a Compressor Process in the Oxygen Plant, pp. 10826-10831.
Liu, Jialin — Fortune Inst. of Tech.
Chen, Ding-Sou — China Steel Corp.

10:30-12:30 ThA01.2
Linear Analysis and Control of a Boiler-Turbine Unit, pp. 10832-10837.
Tan, Wen — North China Electric Power Univ.
Fang, Fang — North China Electric Power Univ.

10:30-12:30 ThA01.3
Industrial Temperature PID Controller for Pb-Free Soldering Iron, pp. 10838-10843.
Hamane, Hiroto — kogakuin Univ.
Miyazaki, Kazuyoshi — TOHO Electrical Inc.

10:30-12:30 ThA01.4
Hybrid Model Based Optimal Control for a Metallurgy Process, pp. 10844-10850.
Qiu, Zhifeng — Katholieke Univ. Leuven
Deconinck, Geert — Katholieke Univ. Leuven
Gui, Weihua — Central South Univ.
Yang, Chunhua — Central South Univ.

10:30-12:30 ThA01.5
Development of Integrated Alstom Gasification Simulator for Implementation Using DCS CS3000, pp. 10851-10856.
Haryanto, Ade — Pusan National Univ.
Siregar, Parsaulian — Bandung Inst. of Tech.
Kurniadi, Deddy — Bandung Inst. of Tech.
Hong, Keum-Shik — Pusan National Univ.

10:30-12:30 ThA01.6
Cascaded Parameter Estimation for a Water Treatment Plant Using Particle Filters, pp. 10857-10862.
Lendek, Zsofia — Delft Univ. of Tech.
van Schagen, K.M. — Delft Univ. of Tech.
Babuska, Robert — Delft Univ. of Tech.
Veersma, A. — Waternet
De Schutter, Bart — Delft Univ. of Tech.

10:30-12:30 ThA01.7
Predictive Ratio Control of Multizone Thermal Processing System in Lithography, pp. 10863-10868.
Tay, Arthur — National Univ. of Singapore
Tan, Kok Kiong — National Univ. of Singapore
Zhao, Shao — National Univ. of Singapore
Lee, Tong Heng — National Univ. of Singapore

10:30-12:30 ThA01.8
Centralized & Decentralized Temperature Generalized Predictive Control of a Passive-HVAC Process, pp. 10869-10874.
Riadi, Riad — Univ. Angers
Tawegoum, Rousseau — Univ. Angers
Rachid, Ahmed — Univ. de Picardie-Jules Verne
Chassériaux, Gérard — Univ. Angers

10:30-12:30 ThA01.9
IEC 61499 Component Based Approach for Batch Control Systems, pp. 10875-10880.
Dimitrova, Desislava — Univ. of Chemical Tech. and Metallurgy
Panjaitan, Seno — Univ. of Kaiserslautern
Batchkova, Idilia — Univ. of Chemical Tech. and Metallurgy
Frey, Georg — Univ. of Kaiserslautern

10:30-12:30 ThA01.10
Feedback Linearization –Based Control for a Class of Chemical Processes in Non-Standard Nonlinear Singular Perturbation Form, pp. 10881-10885.
Sarabi-Jamab, Atiye — Tehran Univ.
Yazdanpanah, Mohammad Javad — Univ. of Tehran

10:30-12:30 ThA01.11
An Improved Off-Line Approach for Output Feedback Robust Model Predictive Control, pp. 10886-10891.
Zibaee Nejad, Mohammad Hadi — Tarbiat Modares Univ.
Asemani, Mohammad Hassan — Tarbiat Modares Univ.
Majd, Vahid Johari — Tarbiat Modares Univ.

10:30-12:30 ThA01.12
Disturbance Rejection and Set-Point Following of Periodic Signals Using Predictive Control with Constraints, pp. 10892-10897.
Wang, Liuping — RMIT Univ.
Gawthrop, Peter — Univ. of Glasgow

10:30-12:30 ThA01.13
Adaptive Predictive Control Strategy Using Wavenet Based Plant Modeling, pp. 10898-10903.
Nazaruddin, Yul Yunazwin — Inst. Teknologi Bandung (ITB)
Cahyadi, Ferdian — Inst. Teknologi Bandung (ITB)

10:30-12:30 ThA01.14
Model Predictive Control of Linear Induction Motor Drive, pp. 10904-10909.
Hassan, Ahmad — Univ.
Thomas, Jean — Beni-Sueif Univ.

10:30-12:30 ThA01.15
Model-Based Predictive Control for the Exhaust Gas Cycle of an Oxyfuel-Process, pp. 10910-10915.
Nötges, Thomas — RWTH Aachen Univ.
Hölemann, Sebastian — RWTH Aachen Univ.
Abel, Dirk — RWTH-Aachen Univ.

10:30-12:30 ThA01.16
Hybrid Predictive Control of Supermarket Refrigeration Systems: An Optimal Time Switching Strategy, pp. 10916-10922.
Sarabia, Daniel — Univ. of Valladolid
de Prada, Cesar — Univ. of Valladolid

10:30-12:30 ThA01.17
Optimization of Operating Procedure of LNG Storage Facilities Using Rigorous BOR Model, pp. 10923-10926.
Kim, Ho Soo — Seoul National Univ.
Shin, Myung-wook — Seoul National Univ.
Yoon, En Sup — Seoul National Univ.

10:30-12:30 ThA01.18
Reliable Multi-Objective On-Line Re-Optimisation Control of Batch Processes Based on Bootstrap Aggregated Neural Networks, pp. 10927-10932.
Mukherjee, Ankur — Newcastle Univ.
Zhang, Jie — Newcastle Univ.

10:30-12:30 ThA01.19
Relay-Based Autotuning of PID Controller for Improved Load Disturbance Rejection, pp. 10933-10938.
Liu, Tao — Hong Kong Univ. of Science & Tech.
Gao, Furong — Hong Kong Univ. of Sci & Tech.

10:30-12:30 ThA01.20
Design of Uniform Temperature Controller Based on Temperature Difference Model, pp. 10939-10944.
Matsunaga, Nobutomo — Kumamoto Univ.
Kawaji, Shigeyasu — Kumamoto Univ.

10:30-12:30 ThA01.21
Iterative Feedback Tuning of Cross-Directional Processes Controller, pp. 10945-10950.
Yan, Jun — Univ. of British Columbia
Dumont, Guy — Univ. of British Columbia
Loewen, Philip D. — Univ. of British Columbia

10:30-12:30 ThA01.22
A Comparative Analysis of Nonlinear Control Approaches for Non-Minimum Phase Processes, pp. 10951-10956.
Ramírez Estay, Héctor Miguel — Univ. de Concepción
Sbarbaro, Daniel G. — Univ. de Concepcion

10:30-12:30 ThA01.23
A Detection Algorithm for Bifurcations in Dynamical Systems Using

Reduced Order Models, pp. 10957-10962.
Wattamwar, Satyajit — Tech. Univ. of Eindhoven
Weiland, Siep — Eindhoven Univ. of Tech.
Backx, Ton — Eindhoven Univ. of Tech.

10:30-12:30 ThA01.24
Towards Clean-Coal Control Technologies: Modelling Conversion of Carbon Oxide into Hydrogen by a Shift Reactor, pp. 10963-10970.
Bittanti, Sergio — Pol. di Milano
Canevese, Silvia — CESI RICERCA
De Marco, Antonio — Consultant
Prandoni, Valter — CESI RICERCA
Serrau, Daniela — Pol. di Milano

10:30-12:30 ThA01.25
Modeling Waste Heat Recovery System of Industrial Ammonia Process Plant Using LPV Identification, pp. 10971-10976.
Bambang, Riyanto — Bandung Inst. of Tech.
Subagio, Heri — Bandung Inst. of Tech.
Praharso, Praharso — PT Pupuk Kaltim

10:30-12:30 ThA01.26
Qualitative and Quantitative Synthetic Methodology for Blending Optimization in Lead-Zinc Sintering, pp. 10977-10982.
Wang, Chun-Sheng — Central South Univ.
Wu, Min — Central South Univ.
She, Jin-Hua — Tokyo Univ. of Tech.
Cao, Weihua — Central South Univ.
He, Yong — Central South Univ.

10:30-12:30 ThA01.27
A Dynamic Soft-Sensing Method Based on Impulses Response Template and Parameter Estimation with Modified DE Optimization, pp. 10983-10988.
Lu, Wenxiang — Tsinghua Univ.
Yang, Qing — Tsinghua Univ.
Huang, Dexian — Tsinghua Univ.
Jin, Yihui — Tsinghua Univ.

10:30-12:30 ThA01.28
Network Structure and Robustness of Intracellular Oscillators, pp. 10989-10994.
Jacobsen, Elling W. — KTH
Trane, Camilla — KTH

10:30-12:30 ThA01.29
Multivariable LQG Control of a Proton Exchange Membrane Fuel Cell System, pp. 10995-11000.
Wang, Fu-Cheng — National Taiwan Univ.
Hsuan-Tsung, Chen — National Taiwan Univ.
Yen, Jia-Yush — National Taiwan Univ.

10:30-12:30 ThA01.30
Visualization of Dynamic Parameters of a Multivariable System Using Self-Organizing Maps, pp. 11001-11006.
Fuertes Martinez, Juan Jose — Univ. de Leon
Prada, Miguel Angel — Univ. de Leon
Dominguez Gonzalez, Manuel — Univ. de Leon
Reguera Acevedo, Perfecto — Univ. de Leon
Diaz Blanco, Ignacio — Univ. de Oviedo
Diez Gonzalez, Alberto Benjamin — Univ. de Oviedo

10:30-12:30 ThA01.31
Greedy Kernel Components Acting on ANFIS to Predict BOF Steelmaking Endpoint, pp. 11007-11012.
Han, Min — Dalian Univ. of Tech.
Huang, Xiaoqing — Dalian Univ. of Tech.

10:30-12:30 ThA01.32
Power Transformer Fault Diagnosis Based on Data Fusion, pp. 11013-11017.
Lv, Feng — Hebei Normal Univ.
Du, Hai-lian — He Bei Normal Univ.
Sun, Hao — North China Electric Power Univ.
Wang, Zhanfeng — Shijiazhuang Univ. of Ec.
Li, Yuan — Shenyang Inst. Chemical Tech.

10:30-12:30 ThA01.33
A Two Level Hierarchical Control Structure for Optimizing a Rougher Flotation Circui, pp. 11018-11022.
Sbarbaro, Daniel G. — Univ. de Concepcion
Maldonado, Miguel — Laval Univ.
Cipriano, Aldo — Pontificia Univ. Catolica de Chile

10:30-12:30 ThA01.34
Modern Algorithms and Systems for Monitoring and Control of Milling and Flotation Process, pp. 11023-11027.
Morozov, Valery — Moscow state Univ. of mining
Avdokhin, Viktor — Moscow state Univ. of mining
Ulitenko, Konstantin — JSC Souscvetmetavtomatika
Topchaev, Vladimir — JSC Souscvetmetavtomatika
Stoliarov, Valeri — JSC Elscort
Ganbaatar, Zorigtyn — Erdenet Mining Corp.
Delgerbat, Lodoy — Erdenet Mining Corp.

10:30-12:30 ThA01.35
Advanced Control System of the Steam Pressure in a Fire-Tube Boiler, pp. 11028-11033.
Rodriguez Vazquez, Renato — Pontificia Univ. Católica del Peru
Rivas Perez, Raul — Havana Pol. Univ.
Sotomayor Moriano, Javier — Pontificia Univ. Católica del Perú
Perán, J. Ramón — Univ. of Valladolid

10:30-12:30 ThA01.36
Research of Large-Scale Reduced SQP Algorithm for Chemical Process System Optimization, pp. 11034-11040.
Jiang, Aipeng — Hangzhou Dianzi Univ.

10:30-12:30 ThA01.37
Robust Control for Output Voltage across Load of DC-DC Converter Matching with Remote Sensing, pp. 11041-11046.
Takegami, Eiji — DENSEI-LAMBDA K.K.
Higuchi, Kohji — The Univ. of Electro-Communications
Nakano, Kazushi — the Univ. of Electro-Communications
Kajikawa, Tatsuyoshi — The Univ. of Electro-Communications

10:30-12:30 ThA01.38
An Improved Nonlinear Speed Controller for Series DC Motors, pp. 11047-11052.
Zhao, Dongbo — Tsinghua Univ.
Zhang, Ning — Tsinghua Univ.
Zhao, Jun — The Australian National Univ.

10:30-12:30 ThA01.39
A Market-Based MAS Framework for Microgrids, pp. 11053-11058.
Qiu, Zhifeng — Katholieke Univ. Leuven
Deconinck, Geert — Katholieke Univ. Leuven
Gui, Ning — Univ. Antwerpen
Duan, Rui — Katholieke Univ. Leuven
Belmans, Ronnie — Katholieke Univ. Leuven

10:30-12:30 ThA01.40
Sliding Mode Indicator Model's at Thermal Control System for Furnace, pp. 11059-11063.
Mkrttchian, Vardan — All Armenian Internet Univ. - HHH Univ.
Simonyan, Sargis — State Enginering Univ. of Armenia
Khachaturova, Anna — Inst. of Physical Res. of National Acad. of
Yeranosyan, Hasmik — All Armenian Internet Univ.

10:30-12:30 ThA01.41
A Global Solution to Economic Dispatch with Multiple Fuel Units Using a Function Merger, pp. 11064-11069.
Min, Kyung-Il — Yonsei Univ.
Moon, Young-Hyun — Yonsei Univ.
Lee, Su-Won — Inst. of TMS Information Tech.

10:30-12:30 ThA01.42
IMPLEMENTATION OF a PC-BASED SIMULATOR FOR TARASHT POWER PLANT (Turbine Case Study), pp. 11070-11075.
Yazdizadeh, Alireza — Power and Water Univ. of Tech.

10:30-12:30 ThA01.43
Advanced Tuning of POD Controllers for Electric Power Systems Using FACTS Devices, pp. 11076-11077.
Korba, Petr — ABB Corp. Res. Ltd.
Segundo, Rafael — ABB Corp. Res. Ltd.
Chaudhuri, Balarko — Imperial Coll. London

10:30-12:30 ThA01.44
Architecture of Embedded Human-Machine Interface for Intelligent Electronics Devices, pp. 11078-11079.
Kim, Byung-Jin — Hyundai Heavy Industries Co., LTD.

Kim, Hyunsung — Hyundai Heavy Industries Co., LTD.
Kim, Joon Gyo — Inha Univ.
Kim, Jiyoon — Inha Univ.
Park, Jaehyun — Inha Univ.

10:30-12:30 ThA01.45
Trajectory Planning for Flatness-Based Two-Degree-Of-Freedom Control of a Pumped Storage Power Station, pp. 11080-11085.
Treuer, Michael — Univ. Stuttgart
Weissbach, Tobias — Univ. Stuttgart
Scheffknecht, Günter — Univ. Stuttgart
Hagenmeyer, Veit — BASF Aktiengesellschaft

10:30-12:30 ThA01.46
Design of Robust Power System Stabilizer Using Genetic Algorithm-Based Fixed-Structure H_; Loop Shaping Control, pp. 11086-11091.
Ngamroo, Issarachai — King Mongkut's Inst. of Tech. Ladkrabang
Goda, Tadahiro — Kyushu Univ.
Ali nandar, Cuk Supriyadi — KMITL
Kunakorn, Anantawat — KMITL
Kaitwanidvilai, Somyot — King Mongkut's Inst. of Tech. Ladkrabang
Hashiguchi, T — Kyushu Univ.

10:30-12:30 ThA01.47
Preventing Refrigerated Foodstuffs in Supermarkets from Being Discarded on Hot Days by MPC, pp. 11092-11097.
Cai, Junping — Aalborg Univ.
Stoustrup, Jakob — Aalborg Univ.
Jorgensen, John Bagterp — Tech. Univ. of Denmark

10:30-12:30 ThA01.48
Reducing the Energy Consumption of Space Heating in Buildings: Design of an Optimal Controller., pp. 11098-11105.
Raffenel, Yoann — Ec. Centrale de Lyon
Blanco, Eric — AMPERE Lab.
Virgone, Joseph — Univ. Lyon 1, IUTA
Neveux, Philippe — Univ. d'Avignon et des Pays de Vaucluse
Thomas, Gerard — Ec. Centrale de Lyon
Scorletti, Gerard — Ec. Centrale de Lyon

10:30-12:30 ThA01.49
Power System Stabilization Using Swarm Tuned Fuzzy Controller, pp. 11106-11111.
El-Metwally, K.A — Cairo Univ.

10:30-12:30 ThA01.50
Fault-Tolerant MPC Control of PEM Fuel Cells, pp. 11112-11117.
Puig, Vicenc — Univ. Pol. de Catalunya
Feroldi, Diego — Univ. Pol. de Catalunya
Serra,, Maria — Univ. Pol. de Catalunya
Quevedo, Joseba — Tech. Univ. of Catalonia
Riera, Jordi — Univ. Pol. de Catalunya

10:30-12:30 ThA01.51
Novel Causal Digraph Reasoning for Fault Diagnosis with Application on the Paper Machine Short Circulation Process, pp. 11118-11123.
Cheng, Hui — Helsinki Univ. of Tech.
Nikus, Mats — Helsinki Univ. of Tech.
Jämsä-Jounela, Sirkka-Liisa — Helsinki Univ. of Tech.

10:30-12:30 ThA01.52
A Method to Improve Human Prognosis in Supervision of Complex Systems, pp. 11124-11129.
Delepine, Olivier — Univ. of Valenciennes
Caulier, Patrice — Univ. of Valenciennes
Vanderhaegen, Frédéric — Univ. of Valenciennes

10:30-12:30 ThA01.53
Control System Diagnosis Algorithm Optimization - the Combinatorial Entropy Approach, pp. 11130-11135.
Borowczyk, Henryk — Air Force Inst. of Tech.

10:30-12:30 ThA01.54
Real-Time Implementation of Fault-Tolerant Control Using Model Predictive Control, pp. 11136-11141.
Miksch, Tobias — Univ. of Heidelberg
Gambier, Adrian — Univ. of Heidelberg
Badreddin, Essam — Univ. of Heidelberg

10:30-12:30 ThA01.55
Case-Based Detection of Operating Conditions in Complex Nonlinear Systems, pp. 11142-11147.
Juuso, Esko Kalevi — Univ. of Oulu
Timo, Ahola — Outokumpu

10:30-12:30 ThA01.56
Linear Dynamic Modeling of Spacecraft with Various Flexible Appendages, pp. 11148-11153.
Tantawi, Khalid — SUPAERO
Alazard, Daniel — Univ. de Toulouse - ISAE
Cumer, Christelle — ONERA

ThA02 304A
Faults and Estimation (Regular Session)
Chair: Kinnaert, Michel — Univ. Libre de Bruxelles
Co-Chair: Chakraborty, Debraj — Indian Inst. of Tech. Bombay

10:30-10:50 ThA02.1
Fault Diagnosis in Nonlinear Systems Using Interconnected Sliding Mode Observers, pp. 11154-11159.
Sharma, Rahul — The Univ. of Melbourne
Aldeen, Mohammad — The Univ. of Melbourne

10:50-11:10 ThA02.2
Actuator Fault Compensation Control for Nonlinear Systems, pp. 11160-11165.
Zhang, Yingwei — Northeastern Univ.
Qin, S. Joe — Univ. of Southern California

11:10-11:30 ThA02.3
Fault Detection for Non-Gaussian Stochastic Systems Via Augmented Lyapunov Functional Approach, pp. 11166-11171.
Li, Tao — Southeast Univ.
Sun, Changyin — Southeast Univ.
Wei, Xinjiang — Southeast Univ. Yantai Normal Univ.

11:30-11:50 ThA02.4
Preserving System Performance During Feedback Failure, pp. 11172-11177.
Chakraborty, Debraj — Indian Inst. of Tech. Bombay
Hammer, Jacob — Univ. of Florida

11:50-12:10 ThA02.5
Estimation and Control for Systems with Nonlinearly Parameterized Perturbations, pp. 11178-11183.
Grip, HÍvard Fjćr — Norwegian Univ. of Science and Tech.
Johansen, Tor Arne — Norwegian Univ. of Science and Tech.
Imsland, Lars — SINTEF ICT

12:10-12:30 ThA02.6
On the State and Parameter Simultaneous Estimation Problem in Induction Motors, pp. 11184-11189.
Ticlea, Alexandru — Pol. Univ. of Bucharest
Besancon, Gildas — ENSIEG-INPG

ThA03 304B
Predictive Control (Regular Session)
Chair: Alamir, Mazen — Gipsa-Lab. (CNRS-Univ. of Grenoble)
Co-Chair: Mosca, Edoardo — Univ. of Florence

10:30-10:50 ThA03.1
Least Restrictive Move-Blocking Model Predictive Control, pp. 11190-11195.
Gondhalekar, Ravi — Tokyo Inst. of Tech.
Imura, Jun-ichi — Tokyo Inst. of Tech.

10:50-11:10 ThA03.2
Predictive Control of Hybrid Systems: Stability Results for Sub-Optimal Solutions, pp. 11196-11201.
Lazar, Mircea — Eindhoven Univ. of Tech.
Heemels, Maurice — Tech. Univ. Eindhoven

11:10-11:30 ThA03.3
Model Predictive Control Using Hybrid Feedback, pp. 11202-11207.
Gerard, Mathieu — Delft Univ. of Tech.
Verhaegen, Michel — Delft Univ. of Tech.

11:30-11:50 ThA03.4
Predictive Control for Linear Systems with Delayed Input Subject to Constraints, pp. 11208-11213.
Olaru, Sorin — Supelec

Niculescu, Silviu-Iulian — Lab. of Signals and Systems (L2S), UMR CNRS 8506,CNRS-SUPE

11:50-12:10 ThA03.5
Horizon-Switching Predictive Set-Point Tracking under Mixed Control Saturations and Persistent Disturbances, pp. 11214-11219.
Mosca, Edoardo — Univ. of Florence
Tesi, Pietro — Univ. degli Studi di Firenze
Zhang, Jingxin — Monash Univ.

12:10-12:30 ThA03.6
Computation and Bounding of Robust Invariant Sets for Uncertain Systems, pp. 11220-11225.
Benlaoukli, Hichem — Supélec
Olaru, Sorin — Supelec
Boucher, Patrick — Ec. Superieure d'Electricite

ThA04 308
Tracking Control (Regular Session)
Chair: Kim, H. Jin — Seoul National Univ.
Co-Chair: Schmid, Robert — The Univ. of Melbourne

10:30-10:50 ThA04.1
PI Tracking Control with Mixed H2 and H-Infinite Performance of Descriptor Time Delay System for Output PDFs Based on B-Spline Neural Networks, pp. 11226-11231.
Sun, Hai qin — Southeast Univ. Nanjing, P.R. China
Zhang, Kan_Jian — Southeast Univ.
Guo, Lei — UMIST

10:50-11:10 ThA04.2
Setpoint Servo Problem for Symmetric Affine Systems -Asymptotical Stabilizaton by PI Control, pp. 11232-11237.
Shimizu, Kiyotaka — Keio Univ.
Tamura, Kenichi — Keio Univ.

11:10-11:30 ThA04.3
Implementation of Plug-In Type Repetitive Controller for Position-Base Periodic Control Systems, pp. 11238-11243.
Hsu, Ge-Liang — National Cheng Kung Univ.
Yao, Wu-Sung — National Cheng Kung Univ.
Tsai, Mi-Ching — National Cheng Kung Univ.

11:30-11:50 ThA04.4
Real-Time Visual Predictive Controller for Image-Based Trajectory Tracking of a Mobile Robot, pp. 11244-11249.
Allibert, Guillaume — Pol.
Courtial, Estelle — Pol. Univ. d'Orléans
Toure, Y. — Univ. d'orléans- IUT de Bourges

11:50-12:10 ThA04.5
An Effective Algorithm for Analytical Computation of Flat Outputs Over the Weyl Algebra, pp. 11250-11256.
Morio, Vincent — Univ. Bordeaux I
Cazaurang, Franck — Univ. Bordeaux I
Zolghadri, Ali — Univ. Bordeaux I

12:10-12:30 ThA04.6
Nonovershooting Linear Multivariable State Feedback Tracking Controllers, pp. 11257-11262.
Schmid, Robert — The Univ. of Melbourne
Ntogramatzidis, Lorenzo — The Univ. of Melbourne

ThA05 307
Adaptive Control I (Regular Session)
Chair: Tomei, Patrizio — Univ. of Roma Tor Vergata
Co-Chair: Costa, Ramon R. — COPPE - Federal Univ. of Rio de Janeiro

10:30-10:50 ThA05.1
Functional Adaptive Control for Multi-Input Multi-Output Systems, pp. 11263-11268.
Kral, Ladislav — Univ. of West Bohemia in Pilsen
Simandl, Miroslav — Univ. of West Bohemia

10:50-11:10 ThA05.2
Intelligent Adaptive Dynamic Matrix Control, pp. 11269-11274.
Posada Aguilar, José David — Univ. del Norte
Sanjuan, Marco — Univ. del Norte

11:10-11:30 ThA05.3
Improving Transient Behavior of MIMO Adaptive Systems, pp. 11275-11280.
Pinto, Marcos Ferreira Duarte — Federal Univ. of Rio de Janeiro
Costa, Ramon R. — COPPE - Federal Univ. of Rio de Janeiro

11:30-11:50 ThA05.4
Output Feedback Strict Passivity of Discrete-Time Nonlinear Systems and Adaptive Control System Design, pp. 11281-11286.
Mizumoto, Ikuro — Kumamoto Univ.
Ohdaira, Satoshi — Kumamoto Univ.
Iwai, Zenta — Kumamoto Univ.

11:50-12:10 ThA05.5
Self-Tuning Type-2 PID Control System and Its Application, pp. 11287-11292.
Sato, Takao — Univ. of Hyogo
Kameoka, Koichi — Univ. of Hyogo

12:10-12:30 ThA05.6
Adaptive Regulator for Uncertain Linear Minimum Phase Systems with Unknown Undermodeled Exosystems, pp. 11293-11298.
Marino, Riccardo — Univ. di Roma Tor Vergata
Tomei, Patrizio — Univ. of Roma Tor Vergata

ThA06 310A
Disturbance Rejection and Control (Regular Session)
Chair: Guo, Bao-Zhu — The Chinese Acad. of Sciences
Co-Chair: Dion, Jean-Michel — Univ. de Grenoble

10:30-10:50 ThA06.1
Sensor Classification for the Disturbance Rejection by Measurement Feedback Problem, pp. 11299-11303.
Dion, Jean-Michel — Univ. de Grenoble
Commault, Christian. — GIPSA-Lab.
Trinh, Do Hieu — Gipsa Lab.

10:50-11:10 ThA06.2
Disturbance Decoupling with Preview for Two-Dimensional Systems, pp. 11304-11309.
Ntogramatzidis, Lorenzo — The Univ. of Melbourne
Cantoni, Michael — Univ. of Melbourne
Yang, Ran — Sun Yat-Sen Univ.

11:10-11:30 ThA06.3
Disturbance Compensation on Uncertain Systems: Feedforward Control Design for Stable Systems, pp. 11310-11315.
Vilanova, Ramon — Univ. Autňnoma de Barcelona
Arrieta, Orlando — Univ. Autonoma de Barcelona
Ibeas, Asier — Univ. Autónoma de Barcelona
Balaguer, Pedro — Univ. Autonoma de Barcelona
Pedret, Carles — Univ. Autňnoma de Barcelona

11:30-11:50 ThA06.4
Almost Self-Bounded Controlled Invariant Subspaces and Almost Disturbance Decoupling, pp. 11316-11321.
Malabre, Michel — UMR CNRS 6597
Zou, Runmin — Ec. Centrale de Nantes,France

11:50-12:10 ThA06.5
Stability Analysis for an Euler-Bernoulli Beam under Local Internal Control and Boundary Observation, pp. 11322-11327.
Wang, Jun-Min — Beijing Inst. of Tech.
Guo, Bao-Zhu — Acad. of Math. and Syst. Sciences

12:10-12:30 ThA06.6
Stabilization of Multidimensional Wave Equations under Non-Collocated Controls and Observations, pp. 11328-11333.
Shao, Zhi-Chao — Univ. of the Witwatersrand
Guo, Bao-Zhu — Acad. of Math. and Syst. Sciences
Yao, Cui-Zhen — Beijing Inst. of Tech.

ThA07 310B
Control Problems for Dynamical Systems under Conflict and Uncertainty (Invited Session)
Chair: Tarasyev, Alexander — Inst. of Mathematics and Mechanics of Ural Branch ofRAS
Co-Chair: Glad, Torkel — Linkoping Univ.
Organizer: Ushakov, Vladimir — Inst. of Mathematics and Mechanics of Ural Branch ofthe Russian
Organizer: Subbotina, Nina — Inst. of Mathematics and Mechanics of UralBranchoftheRussian Aca

10:30-10:50 ThA07.1
Positional Procedures for Solving Dynamical Optimization Problems of Prescribed Duration (I), pp. 11334-11339.

Subbotina, Nina — Inst. of Mathematics and Mechanics of UralBranchoftheRussian
Tarasyev, Alexander — Inst. of Mathematics and Mechanics of Ural Branch ofRAS
Ushakov, Vladimir — Inst. of Mathematics and Mechanics of Ural Branch ofthe Russ

10:50-11:10 ThA07.2
Rational Approximation of Nonlinear Optimal Control Problems, pp. 11340-11345.
Sjöberg, Johan — Linköpings Univ.
Glad, Torkel — Linkoping Univ.

11:10-11:30 ThA07.3
Nonlinear H_; Robust Control for Six DOF Equations of Motion of Rigid Body with Mass Uncertainty, pp. 11346-11351.
Kung, Chien-Chun — National Defense Univ.

11:30-11:50 ThA07.4
Numerical Solution of the Isaacs Equation for Differential Games with State Constraints (I), pp. 11352-11356.
Falcone, Maurizio — SAPIENZA - Univ. di Roma
Cristiani, Emiliano — ENSTA

11:50-12:10 ThA07.5
On Dynamical Optimization of Conflict Hereditary Systems (I), pp. 11357-11362.
Lukoyanov, Nikolay — Inst. of Mathematics and Mechanics of the Ural Branch of the

12:10-12:30 ThA07.6
On the Characterization of the Discrete Mode Uncertainty in Hybrid State Estimation, pp. 11363-11368.
Pina, Luís — Inst. Superior Técnico, Tech. Univ. of Lisbon
Botto, Miguel Ayala — Tech. Univ. of Lisbon

ThA08 310C
Robust Linear Matrix Inequalities (Regular Session)
Chair: Ebihara, Yoshio — Kyoto Univ.
Co-Chair: Shcherbakov, P.S. — Moscow Inst. of Control Sciences

10:30-10:50 ThA08.1
Semidefinite Programs with Interval Uncertainty: Reduced Vertex Results, pp. 11369-11374.
Calafiore, Giuseppe — Pol. di Torino
Dabbene, Fabrizio — Pol. di Torino

10:50-11:10 ThA08.2
Robust Stability of Nonlinear Systems, pp. 11375-11378.
Schwenk, Sebastian — Univ. of Wuppertal
Tibken, Bernd — Univ. of Wuppertal

11:10-11:30 ThA08.3
Extracting Worst Case Perturbations for Robustness Analysis of Parameter-Dependent LTI Systems, pp. 11379-11384.
Onishi, Yusuke — Kyoto Univ.
Ebihara, Yoshio — Kyoto Univ.
Hagiwara, Tomomichi — Kyoto Univ.

11:30-11:50 ThA08.4
Extensions of Petersen's Lemma on Matrix Uncertainty, pp. 11385-11390.
Shcherbakov, P.S. — Moscow Inst. of Control Sciences
Topunov, Michael — Inst. for Control Science

11:50-12:10 ThA08.5
Robust Stability/Performance Analysis for Polytopic Systems Via Multiple Slack Variable Approach, pp. 11391-11396.
Sato, Masayuki — Japan Aerospace Exploration Agency

12:10-12:30 ThA08.6
A Descriptor System Approach to Robust Control for Polytopic Systems with Time Delay and Its Application to Flight Control, pp. 11397-11402.
Shen, Chao — Northeastern Univ.
Jing, Yuanwei — Northeastern Univ.
Wang, Qingli — Shenyang Inst. of Engineering
Ban, Ying — Northeastern Univ.

ThA09 311C
Grey Box System Identification (Regular Session)
Chair: Bittanti, Sergio — Pol. di Milano
Co-Chair: Bobtsov, Alexey — Saint-PetersburgStateUniversityofInformationTechnologiesMechanics andOptics

10:30-10:50 ThA09.1
Frequency Identification of Biased Harmonic Disturbance, pp. 11403-11408.
Bobtsov, Alexey — Saint-PetersburgStateUniversityofInformationTechnologiesMechani
Nikolaev, Nikolay — Saint-Petersburg State Univ. of InformationTechnologies Me
Slita, Olga — Baltic State Tech. Univ.

10:50-11:10 ThA09.2
Estimation of White-Box Model Parameters Via Artificial Data Generation: A Two-Stage Approach, pp. 11409-11414.
Garatti, Simone — Pol. di Milano
Bittanti, Sergio — Pol. di Milano

11:10-11:30 ThA09.3
Grey Box Modelling – Branches and Experiences, pp. 11415-11420.
Sohlberg, Björn — Dalarna Univ.
Jacobsen, Elling — Automatic Control

11:30-11:50 ThA09.4
Determining Identifiable Parameterizations for Large-Scale Physical Models in Reservoir Engineering, pp. 11421-11426.
Van Doren, Jorn F.M. — Delft Univ. of Tech.
Van den Hof, Paul M.J. — Delft Univ. of Tech.
Jansen, Jan Dirk — Delft Univ. of Tech.
Bosgra, Okko H. — Eindhoven Univ. of Tech.

11:50-12:10 ThA09.5
A Novel Hybrid Neural Network for Modeling Rare-Earth Extraction Process, pp. 11427-11432.
Jia, Wenjun — Northeastern Univ.
Chai, Tianyou — Northeastern Univ.
Yu, Wen — CINVESTAV-IPN

12:10-12:30 ThA09.6
Multirate Data Assimilation in a Cultivation Process, pp. 11433-11438.
Barrero Mendoza, Oscar — Univ. de Ibague
Petersen, Jorgen — Novo Nordisk A/S
Jřrgensen, Sten Bay — Tech. Univ. of Denmark

ThA10 311B
Excitation and Experiment Design (Regular Session)
Chair: Hjalmarsson, HĺIkan — KTH
Co-Chair: Bombois, Xavier — Delft Univ. of Tech.

10:30-10:50 ThA10.1
Persistency of Excitation in Subspace Predictive Control, pp. 11439-11444.
Hallouzi, Redouane — Delft Univ. of Tech.
Verhaegen, Michel — Delft Univ. of Tech.

10:50-11:10 ThA10.2
Finite-Time Experiment Design with Multisines, pp. 11445-11450.
Bombois, Xavier — Delft Univ. of Tech.
Barenthin, Märta — KTH
Van den Hof, Paul M.J. — Delft Univ. of Tech.

11:10-11:30 ThA10.3
The Cost of Complexity in Identification of FIR Systems, pp. 11451-11456.
Rojas, Cristian — The Univ. of Newcastle
Barenthin, Märta — KTH
Welsh, James — Univ. of Newcastle
Hjalmarsson, HĺIkan — KTH

11:30-11:50 ThA10.4
Optimal Input Design for On-Line Identification: A Coupled Observer-MPC Approach, pp. 11457-11462.
Flila, Saida — Univ. Lyon1
Dufour, Pascal — Univ. Lyon 1
Hammouri, Hassan — Univ. Claude Bernard

11:50-12:10 ThA10.5
Optimal Input Design for Model Discrimination Based on Kullback Divergence, pp. 11463-11467.
Uosaki, Katsuji — Fukui Univ. of Tech.
Hatanaka, Toshiharu — Osaka Univ.

12:10-12:30 ThA10.6

State and Input Observability for Structured Bilinear Systems: A Graph-Theoretic Approach, pp. 11468-11473.
Boukhobza, Taha — Univ. Henri Poincaré Nancy 1
Hamelin, Hamelin — Nancy Univ.

ThA11 311A
Linear Parametrically Varying (LPV) Methodologies (Regular Session)
Chair: Park, PooGyeon — Pohang Univ. of Sci. & Tech.
Co-Chair: Zenger, Kai — Helsinki Univ. of Tech.

10:30-10:50 ThA11.1
Frequency Domain Identification of Linear, Deterministically Time-Varying Systems, pp. 11474-11479.
Lataire, John — Vrije Univ. Brussel
Pintelon, Rik — Vrije Univ. Brussel

10:50-11:10 ThA11.2
Linear Parameter Varying Control for Sampled-Data Multi-Rate Systems, pp. 11480-11485.
Antunes, Duarte — Inst. Superior Tecnico, Inst. forSystemsandRobotics
Silvestre, Carlos — Inst. Superior Tecnico
Cunha, Rita — Inst. Superior Técnico, Inst. for Systems and

11:10-11:30 ThA11.3
Representations with Constant System Matrices of Linear Time-Periodic Dynamical Systems, pp. 11486-11490.
Zenger, Kai — Helsinki Univ. of Tech.
Ylinen, Raimo — Helsinki Univ. of Tech.

11:30-11:50 ThA11.4
Brockett Problem for Systems with Feedback Delay, pp. 11491-11496.
Insperger, Tamas — Budapest Univ. of Tech. and Ec.
Stepan, Gabor — Budapest Univ. of Tech. and Ec.

11:50-12:10 ThA11.5
LPV APPROACH FOR Hinfinity FILTER DESIGN FOR a CLASS OF NONLINEAR SYSTEMS, pp. 11497-11502.
Gérard, Benjamin Francis — Nancy Univ.
Souley Ali, Harouna — Univ. Henri Poincaré
Zasadzinski, Michel — Cran
Darouach, Mohamed — Univ. Henri Poincare-Nancy

12:10-12:30 ThA11.6
Stabilization of 2-D Linear Parameter-Varying Systems Using Parameter-Dependent Lyapunov Function: An LMI Approach, pp. 11503-11507.
Yun, Sung Wook — POSTECH
Choi, Yun Jong — POSTECH
Park, PooGyeon — Pohang Univ. of Sci. & Tech.

ThA12 313
Stability of Hybrid and Switched Systems (Regular Session)
Chair: Li, Guang — The Univ. of Bristol
Co-Chair: Efimov, Denis — Liege Univ.

10:30-10:50 ThA12.1
Switched Mutual--Master-Slave Synchronisation: Application to Mechanical Systems, pp. 11508-11513.
Efimov, Denis — Inst. for Problems of Mechanical Eng.
Panteley, Elena V. — CNRS
Loria, Antonio — CNRS
Fradkov, Alexander L. — Acad. of Sciences of Russia

10:50-11:10 ThA12.2
Stability and Control of Systems with Uncertain Time-Varying Sampling Period and Time Delay, pp. 11514-11519.
Izák, Michal — Univ. of Kaiserslautern
Görges, Daniel — Univ. of Kaiserslautern
Liu, Steven — Tech. Univ. Kaiserslautern

11:10-11:30 ThA12.3
Stability of Discrete Impulsive Hybrid Systems Via Comparison Principle, pp. 11520-11525.
Liu, Bin — The Australian National Univ.
Hill, David J. — The Australian National Univ.

11:30-11:50 ThA12.4
Robust Switching of Switched Linear Systems, pp. 11526-11529.
Sun, Zhendong — South China Univ. of Tech.

11:50-12:10 ThA12.5
Performance and Stability Analysis of Discontinuous PWA Systems by Piecing Together PWQ Functions, pp. 11530-11535.
Gondhalekar, Ravi — Tokyo Inst. of Tech.
Imura, Jun-ichi — Tokyo Inst. of Tech.

12:10-12:30 ThA12.6
On a Generalization of the Kalman-Yakubovich-Popov Lemma, pp. 11536-11541.
Curran, Paul — NUI Dublin

ThA13 314
Learning and Estimation (Regular Session)
Chair: Horn, Joachim — Helmut-Schmidt-Univ. / Univ. of the Federal Armed
Co-Chair: Chang, Hyeong Soo — Sogang Univ.

10:30-10:50 ThA13.1
SPLL: Simultaneous Probabilistic Localization and Learning, pp. 11542-11547.
Betoni Parodi, Bruno — Siemens AG
Szabo, Andrei — Siemens AG
Horn, Joachim — Helmut-Schmidt-Univ. / Univ. of the Federal Armed
Bamberger, Joachim — Siemens AG

10:50-11:10 ThA13.2
Randomized Algorithm: A Viability Computation, pp. 11548-11553.
Djeridane, Badis — ETH Zurich
Crück, Eva — Ec. Pol. / CNRS
Lygeros, John — ETH Zurich

11:10-11:30 ThA13.3
Design and Real Time Implementation of a Fuzzy Tuned H_; Estimator in a Low Cost AHRS, pp. 11554-11559.
Keighobadi, Jafar — Amirkabir Univ. of Tech. (Tehran Pol.
Kabganian, Mansour — Amirkabir Univ. of Tech. (Tehran Pol.
Yazdanpanah, M. J. — Univ. of Tehran

11:30-11:50 ThA13.4
Gap-Free Bounds for Stochastic Multi-Armed Bandit, pp. 11560-11563.
Juditsky, Anatoly — Univ. Grenoble I
Nazin, Alexander V. — Inst. of Control Sciences RAS
Tsybakov, Alexander — CREST
Vayatis, Nicolas — ENS de Cachan, Univ. CNRS

11:50-12:10 ThA13.5
Statistic Tracking Control for Non-Gaussian Systems Using T-S Fuzzy Model, pp. 11564-11569.
Yi, Yang — Southeast Univ.
Li, Tao — Southeast Univ.
Guo, Lei — UMIST

12:10-12:30 ThA13.6
Robust Fault Detection Linear Interval Observers Avoiding the Wrapping Effect, pp. 11570-11575.
Meseguer, Jordi — Univ. Pol. de Catalunya (UPC)
Puig, Vicenc — Univ. Pol. de Catalunya
Escobet, Teresa — Univ. Pol. de Catalunya

ThA14 318
Networks and Control (Invited Session)
Co-Chair: Fraisse, Philippe — LIRMM, Univ. de Montpellier 2
Organizer: Andreu, David — LIRMM-CNRS, Univ. of Montpellier 2
Organizer: Fraisse, Philippe — LIRMM, Univ. de Montpellier 2

10:30-10:50 ThA14.1
Proposition and Validation of an Original MAC Layer with Simultaneous Accesses for Low Latency Wireless Control/command Applications (I), pp. 11576-11581.
Van Den Bossche, Adrien — Univ. of Toulouse
Val, Thierry — Univ. of Toulouse
Campo, Eric — Univ. of Toulouse

10:50-11:10 ThA14.2
On the Implementation of One Process Control Application Type through a Network. Considering Three LANs: CAN, WiFi, ZigBee (I), pp. 11582-11587.
Mouney, Gérard — Univ. Toulouse 3
Juanole, Guy — Univ. Toulouse

Calmettes, Christophe — Centre Univ. JF Champollion

11:10-11:30 ThA14.3
Wireless Distributed Architecture for Therapeutic FES: Metrology for Muscle Control (I), pp. 11588-11593.
Toussaint, Mickael — LIRMM, Univ. de Montpellier 2
Andreu, David — LIRMM-CNRS, Univ. of Montpellier 2
Fraisse, Philippe — LIRMM, Univ. de Montpellier 2

11:30-11:50 ThA14.4
Sampled-Data Networked Control Systems with Random Time Delay, pp. 11594-11599.
Chen, Chih-Chung — Tech. Univ. Munich
Hirche, Sandra — Tech. Univ. Muenchen
Buss, Martin — Tech. Univ. Muenchen

11:50-12:10 ThA14.5
Constrained Control of Event-Driven Networked Systems, pp. 11600-11605.
Dritsas, Leonidas — Univ. of Patras
Tzes, Anthony — Univ. of Patras

12:10-12:30 ThA14.6
The Motion Message Estimator in Networked Control Systems, pp. 11606-11611.
Hsieh, Chen-Chou — National Chiao-Tung Univ.
Hsu, Pau-Lo — National Chiao Tung Univ.
Wang, Bor-Chyun — China Univ. of Tchnology

ThA15 317
Control and Regulation in Biological Systems (Regular Session)
Chair: Schrempf, Andreas — Univ. of Applied Sciences, Upper Austria
Co-Chair: Wen, Lingfeng — Univ. of Sydney

10:30-10:50 ThA15.1
Towards Model-Based Continuous-Time Identification of the Human Balance Controller, pp. 11612-11617.
Gawthrop, Peter — Univ. of Glasgow
Wang, Liuping — RMIT Univ.

10:50-11:10 ThA15.2
Heart Rate Regulation During Exercise with Various Loads: Identification and Nonlinear H_{infty} Control, pp. 11618-11623.
Cheng, Teddy M. — Univ. of New South Wales
Savkin, Andrey V. — Univ. of New South Wales
Celler, Branko G. — The Univ. of New South Wales
Su, Steven W. — Univ. of Tech. Sydney
Wang, Lu — The Univ. of New South Wales

11:10-11:30 ThA15.3
Adaptive Feedback Control in Deep Brain Stimulation: A Simulation Study, pp. 11624-11629.
Santaniello, Sabato — Univ. degli Studi del Sannio
Fiengo, Giovanni — Univ. degli Studi del Sannio
Glielmo, Luigi — Univ. of Sannio

11:30-11:50 ThA15.4
Application of a Novel Optimization-Based Approach to Characterize Integrated Signalling, Regulatory, and Metabolic Biochemical Networks, pp. 11630-11635.
Lee, Jong Min — Univ. of Alberta
Gianchandani, Erwin P. — Univ. of Virginia
Eddy, James A. — Univ. of Virginia
Papin, Jason A. — Univ. of Virginia

11:50-12:10 ThA15.5
Advanced Regulatory Controller for Automatic Control of Anesthesia, pp. 11636-11641.
Yelneedi, Sreenivas — NUS
Samavedham, Lakshminarayanan — National Univ. of Singapore
Rangaiah, Gade Pandu — National Univ. of Singapore

12:10-12:30 ThA15.6
Active Cardiac Stabilization Using H Infinity Control Methodology, pp. 11642-11647.
Bachta, Wael — LSIIT
Laroche, Edouard — LSIIT
Renaud, Pierre — LGeCo-INSA STARSOURG
Gangloff, Jacques — LSIIT

ThA17 320A
Control Education: Teaching Tools and Methods (Regular Session)
Chair: Dzielinski, Andrzej — Warsaw Univ. of Tech.
Co-Chair: Morales-Menendez, Ruben — Tecnologico de Monterrey, Campus Monterrey

10:30-10:50 ThA17.1
Testing of Control Programs in Distant Education, pp. 11648-11653.
Susta, Richard — Faculty of Electrical Eng., CTU of Prague
Burget, Pavel — Czech Tech. Univ. in Prague, FEE

10:50-11:10 ThA17.2
Simulation and Experimental Tools for Fractional Order Control Education, pp. 11654-11659.
Dzielinski, Andrzej — Warsaw Univ. of Tech.
Sierociuk, Dominik — Warsaw Univ. of Tech. (ISEP)

11:10-11:30 ThA17.3
Control Education within a Multidisciplinary Summer Course on Applied Mobile Robotics, pp. 11660-11665.
Pacheco, Lluís — Univ. of Girona
Luo, Ningsu — Univ. de Girona
Ferrer-Mallorquí, Inčs — Univ. de Girona
Cufi, Xavier — Univ. of Girona

11:30-11:50 ThA17.4
Teaching Digital Controllers for Finite Settling Time by Using Model-Based Control Education (MBCE) in a Constructivist Framework, pp. 11666-11671.
Gambier, Adrian — Univ. of Heidelberg

11:50-12:10 ThA17.5
Simplifying the Practical Approach of the Process Control Teaching, pp. 11672-11677.
Morales-Menendez, Ruben — Tecnologico de Monterrey, Campus Monterrey
Lopez-Lauterio, Tomas — Tecnologico de Monterrey, campus Monterrey
Ramírez-Mendoza, Ricardo A. — ITESM Campus Monterrey
Guedea, Federico — Univ. of Waterloo, ITESM

12:10-12:30 ThA17.6
Corrected Mathematical Model of Quadruple Tank Process, pp. 11678-11683.
Roinila, Tomi — Tampere Univ. of Tech.
Jaatinen, Antti — Tampere Univ. of Tech.
Vilkko, Matti Kalervo — Tampere Univ. of Tech.

ThA18 320B
Control Methods in Robotics (Regular Session)
Chair: de la Puente, Juan Antonio — Univ. Pol. de Madrid
Co-Chair: Santibanez, Victor — Inst. Tecnologico De La Laguna

10:30-10:50 ThA18.1
PID Controllers for Robots Equipped with Brushed DC-Motors Revisited, pp. 11684-11689.
Hernandez-Guzman, Victor M. — Univ. Autonoma De Queretaro
Santibanez, Victor — Inst. Tecnologico De La Laguna
Carrillo-Serrano, Roberto Valentin — Univ. Autonoma de Queretaro

10:50-11:10 ThA18.2
A New Saturated Nonlinear PID Global Regulator for Robot Manipulators, pp. 11690-11695.
Santibanez, Victor — Inst. Tecnologico De La Laguna
Kelly, Rafael — CICESE
Zavala-Rio, Arturo — Inst. Potosino de Investigacion Cientifica y Tecnologica
Parada, Ricardo Pavel — Inst. tecnologico de La Laguna

11:10-11:30 ThA18.3
Nonlinear Adaptive H-Infinity Output Feedback Tracking Control for Robotic Systems, pp. 11696-11701.
Levi, Itzhak — Ben Gurion Univ. of the Negev, Israel
Berman, Nadav — Ben Gurion Univ. of The Negev
Ailon, Amit — Ben Gurion Univ. of The Negev

11:30-11:50 ThA18.4
Neural Network Adaptive Robust Tracking Control for Uncertain Robotic Systems with Delays, pp. 11702-11707.
Wang, Yaonan — Hunan Univ.
Zuo, Yi — Hunan Univ.

Huang, Lihong Hunan Univ.
Li, Chunsheng Guangdong Commercial Coll.

11:50-12:10 ThA18.5
Neural Network Robot Control with Noisy Learning, pp. 11708-11713.
Ishihara, Abraham K. Stanford Univ.
van Doornik, Johan Stanford Univ.
Ben-Menahem, Shahar stanford

12:10-12:30 ThA18.6
Hybrid Input Shaping and Feedback Control Schemes of a Flexible Robot Manipulator, pp. 11714-11719.
Mohamed, Zaharuddin Faculty of Electrical Engineering
Ahmad, Mohd Ashraf Univ. Malaysia Pahang

ThA19 320C
Recent Advances in Intelligent Autonomous Systems (Invited Session)
Chair: Ahn, Hyo-Sung Gwangju Inst. of Science and Tech. (GIST)
Co-Chair: Moore, Kevin L. Colorado School of Mines
Organizer: Ahn, Hyo-Sung Gwangju Inst. of Science and Tech. (GIST)

10:30-10:50 ThA19.1
A Tutorial Introduction to Autonomous Systems (I), pp. 11720-11731.
Moore, Kevin L. Colorado School of Mines

10:50-11:10 ThA19.2
Reference Tag-Based Indoor Localization Techniques (I), pp. 11732-11737.
Ahn, Hyo-Sung Gwangju Inst. of Science and Tech. (GIST)
Yu, Wonpil ETRI

11:10-11:30 ThA19.3
A Steward Robot to Help Daily Activities in a Smart House Environment (I), pp. 11738-11743.
Park, Kwang-Hyun Kwangwoon Univ.
Lee, Hyong-Euk Lee KAIST
Bien, Zeungnam Korea Advanced Inst. of Science and Tech.

11:30-11:50 ThA19.4
Band-Reconfigurable Multi-UAV-Based Cooperative Remote Sensing for Real-Time Water Management and Distributed Irrigation Control (I), pp. 11744-11749.
Chao, Haiyang Utah State Univ.
Baumann, Marc Utah State Univ.
Jensens, Austin Utah State Univ.
Chen, YangQuan Utah State Univ.
Cao, Yongcan Utah State Univ.
Ren, Wei Utah State Univ.
McKee, Mac Utah State Univ.

11:50-12:10 ThA19.5
Non-Cooperative Outcomes for Stochastic Multi-Player Nash Games: Decision Strategies towards Multi-Attribute Performance Robustness, pp. 11750-11756.
Pham, Khanh D. AIR FORCE Res. Lab.

12:10-12:30 ThA19.6
Robust Landmark Detection and Localization; a Multisensor Approach, pp. 11757-11762.
Amarasinghe, Dilan Memorial Univ. of Newfoundland
Mann, George K. I. Memorial Univ. of Newfoundland
Gosine, Raymond G. Memorial Univ. of Newfoundland

ThA20 321C
Flexible Robots (Regular Session)
Chair: Sasiadek, Jurek Z Carleton Univ.
Co-Chair: Pieri, Edson Roberto De Federal Univ. of Santa Catarina

10:30-10:50 ThA20.1
Reference Tracking versus Path-Following for One-Link Manipulator Flexible Robot, pp. 11763-11768.
Pires, Pedro IST, TULisbon
Martins, Jorge IST, TULisbon
Sa da Costa, Jose IST, TULisbon

10:50-11:10 ThA20.2
Practical Robust Control for Flexible Joint Robot Manipulators, pp. 11769-11774.
Yeon, Je Sung Hanyang Univ.
Park, Jong Hyeon Hanyang Univ.
Lee, Sang-Hun Hyundai Heavy Industries Co., Ltd.

11:10-11:30 ThA20.3
Backstepping Control Design of a Single-Link Flexible Robotic Manipulator, pp. 11775-11780.
Huang, Jhih-Wei National Chi Nan Univ.
Lin, Jung-Shan National Chi Nan Univ.

11:30-11:50 ThA20.4
Control of a Flexible Robot Using Fuzzy Logic and a Noncollocated Sensor, pp. 11781-11786.
Green, Anthony Carleton Univ.
Sasiadek, Jurek Z Carleton Univ.

11:50-12:10 ThA20.5
Vibration Control of a Flexible Link Manipulator Using Smart Structures, pp. 11787-11792.
Salmasi, Hamid Univ. of Saskatchewan
Fotouhi, Reza Univ. of Saskatchewan
Nikiforuk, Peter Univ. of Saskatchewan

12:10-12:30 ThA20.6
Friction Compensation in Flexible Joints Robot with GMS Model: Identification, Control and Experimental Results, pp. 11793-11798.
Casanova, Christiano Correa UFSC - Univ. Federal de Santa Catarina
Pieri, Edson Roberto De Federal Univ. of Santa Catarina
Moreno, Ubirajara F. Federal Univ. of Santa Catarina
Castelan, Eugenio B. Univ. Federal de Santa Catarina

ThA21 321B
Dynamics and Control of Micro and Nano-Scale Systems IV (Invited Session)
Chair: Moheimani, S.O. Reza Univ. of Newcastle
Co-Chair: Sebastian, Abu IBM Res.
Organizer: Moheimani, S.O. Reza Univ. of Newcastle
Organizer: Sebastian, Abu IBM Res.

10:30-10:50 ThA21.1
A Closed-Loop Approach to Reducing Scan Errors in Nanopositioning Platforms (I), pp. 11799-11804.
Aphale, Sumeet Univ. of Newcastle, Australia
Bhikkaji, Bharath Newcastle Univ.
Moheimani, S.O. Reza Univ. of Newcastle

10:50-11:10 ThA21.2
Optimal Input Signals for Bandlimited Scanning Systems (I), pp. 11805-11810.
Fleming, Andrew John Univ. of Newcastle
Wills, Adrian George Univ. of Newcastle

11:10-11:30 ThA21.3
Physical-Model-Based Control of a Piezoelectric Tube Scanner (I), pp. 11811-11816.
Gawthrop, Peter Univ. of Glasgow
Bhikkaji, Bharath Newcastle Univ.
Moheimani, S.O. Reza Univ. of Newcastle

11:30-11:50 ThA21.4
Control of a Five-Degrees-Of-Freedom Nanopositioner, pp. 11817-11822.
Shen, Jing-Chung National Formosa Univ.

11:50-12:10 ThA21.5
Design Methodology for Robust and Fault-Tolerant Control of a Microprehensile Microrobot-On-Chip (I), pp. 11823-11828.
Boukhnifer, Moussa ENSI de Bourges-Univ. d'Orléans
Ferreira, Antoine Univ. d'Orléans- ENSI de Bourges
Kratz, Frederic ENSIB

ThA22 321A
Vibration Control and Flexible Systems (Regular Session)
Chair: Savaresi, Sergio Pol. di Milano
Co-Chair: Visioli, Antonio Univ. of Brescia

10:30-10:50 ThA22.1
Iterative Feedforward Tuning for Residual Vibration Reduction, pp. 11829-11834.
Visioli, Antonio Univ. of Brescia
Piazzi, Aurelio Univ. of Parma

10:50-11:10 ThA22.2

Vibration Reduction in a Washing Machine Via Damping Control, pp. 11835-11840.

Spelta, Cristiano — Univ. degli studi di Bergamo
Savaresi, Sergio — Pol. di Milano
Fraternale, Giuseppe — Indesit company
Gaudiano, Nicola — Indesit Company

11:10-11:30 ThA22.3

An Advanced System for Vibration Control of Flexible Structures, pp. 11841-11846.

Cavallo, Alberto — Seconda Univ. degli Studi di Napoli
De Maria, G. — Seconda Univ. degli Studi di Napoli SUN
Natale, Ciro — Seconda Univ. degli Studi di Napoli
Pirozzi, Salvatore — Seconda Univ. di Napoli

11:30-11:50 ThA22.4

Boundary Control of a Vibrating Composite Laminated Rectangular Plate, pp. 11847-11852.

Rastgoftar, Hossein — Shiraz Univ.
Eghtesad, Mohammad — Shiraz Univ.
Khayatian, Alireza — Shiraz Univ.

11:50-12:10 ThA22.5

Robust Control of a Bending-Torsion Coupled Flexible Arm with Uncertainties, pp. 11853-11858.

Watanabe, Toru — Coll. of science and Tech. Nihon Univ.

12:10-12:30 ThA22.6

Influence of Actuator Size and Location on Robust Stability of Actively Controlled Flexible Beams, pp. 11859-11864.

Benatzky, Christian — Vienna Univ. of Tech.
Kozek, Martin — Vienna Univ. of Tech.

ThA23 323

R2R System Technology for Printed Electronics (Invited Session)

Chair: Lee, Sangyoon — Konkuk Univ.
Co-Chair: Kang, Chul-Goo — Konkuk Univ.
Organizer: Lee, Sangyoon — Konkuk Univ.

10:30-10:50 ThA23.1

A Feed-Forward Tension Control in Drying Section of Roll to Roll E-Printing System (I), pp. 11865-11870.

Lee, Chang Woo — Konkuk Univ.
Lee, Jang Won — Konkuk Univ.
Kim, Ho Joon — Konkuk Univ.
Shin, KeeHyun — Konkuk Univ.

10:50-11:10 ThA23.2

Development of a Lateral Control Simulation Software for Roll-To-Roll Systems (I), pp. 11871-11876.

Lee, Sangyoon — Konkuk Univ.
Ho, Thanhtam — Konkuk Univ.
Shin, Hyeunhun — Konkuk Univ.

11:10-11:30 ThA23.3

MIMO Tension Modelling and Control for Roll-To-Roll Converting Machines (I), pp. 11877-11882.

Kang, Chul-Goo — Konkuk Univ.
Lee, Bong-Ju — Konkuk Univ.

11:30-11:50 ThA23.4

Design Parameter Analysis of a Roll-To-Roll Printing Machine (I), pp. 11883-11888.

Kang, Chul-Goo — Konkuk Univ.
Lee, Bong-Ju — Konkuk Univ.

11:50-12:10 ThA23.5

Tension Estimation by Using Register Error in Roll to Roll E-Printing System (I), pp. 11889-11894.

Lee, Jang Won — Konkuk Univ.
Lee, Chang Woo — Konkuk Univ.
Shin, KeeHyun — Konkuk Univ.

ThA24 324

Semantic-Based Solutions for Enterprise Integration and Networking (Invited Session)

Chair: Boudjlida, Nacer — Nancy-Univ. LORIA, INRIA, CNRS
Co-Chair: Panetto, Hervé — Nancy-Univ.
Organizer: Boudjlida, Nacer — Nancy-Univ. LORIA, INRIA, CNRS
Organizer: Panetto, Hervé — ESIAL - Nancy-Univ.
Organizer: Krogstie, John — NTNU

10:30-11:10 ThA24.1

The Unified Enterprise Modelling Language – Overview and Further Work (I), pp. 11895-11906.

Anaya, Victor — Univ. Pol. de Valencia
Berio, Giuseppe — Univ. of Torino
Harzallah, Mounira — LINA -Univ. of Nantes
Heymans, Patrick — Univ. of Namur (FUNDP)
Matulevicius, Raimundas — Univ. of Namur
Opdahl, Andreas L — Univ. of Bergen
Panetto, Hervé — Nancy-Univ.
Verdecho, Maria Jose — Univ. Pol. de Valencia

11:10-11:30 ThA24.2

Enterprise Modelling and Ontology (I), pp. 11907-11912.

Zouggar, Nabila — Univ. de Bordeaux
Chen, David — Univ. Bordeaux I
Vallespir, Bruno — Univ. of Bordeaux 1

11:30-11:50 ThA24.3

Preparation of Papers for IFAC Conferences & Symposia: Ontology-Based Methodology for Collaborative Process Definition of Enterprise Networks (I), pp. 11913-11918.

Rajsiri, Vatcharaphun — Ec. des Mines d'Albi-Carmaux
Lorre, Jean-Pierre — EBM WebSourcing
Benaben, Frederick — Ec. des Mines d'Albi-Carmaux
Pingaud, Hervé — ENSTIMAC

11:50-12:10 ThA24.4

Components Selection Methods for Enterprise Interoperability in Multi Domain Models (I), pp. 11919-11924.

Feng, Ke — Southeast Univ.
Li, Xiaoping — Southeast Univ.
Wang, Qian — Southeast Univ.
Shan, Jingjing — Southeast Univ.

12:10-12:30 ThA24.5

A Systemic Approach to Interoperability Formalization (I), pp. 11925-11930.

Naudet, Yannick — Henri Tudor Public Res. Center
Latour, Thibaud — Henri Tudor Public Res. Center
Chen, David — Univ. Bordeaux I

ThA25 328

Applied Process Control (Regular Session)

Chair: Yu, Cheng-Ching — National Taiwan Univ.
Co-Chair: Aksikas, Ilyasse — Univ. of Alberta

10:30-10:50 ThA25.1

Implementation of Optimal Decisions in the Presence of Uncertainty, pp. 11931-11936.

Barz, Tilman — TU-Berlin
Arellano-Garcia, Harvey — TU Berlin
Wozny, Günter — TU-Berlin

10:50-11:10 ThA25.2

Robust Multivariable PI Control: Applications to Process Control, pp. 11937-11942.

Seshagiri, Sridhar — San Diego State Univ.

11:10-11:30 ThA25.3

Estimation of Distillation Compositions Using Sensitivity Matrix Analysis and Kernel Ridge Regression, pp. 11943-11948.

Li, Qi — Dalian Univ. of Tech.
Shao, Cheng — Dalian Univ. of Tech.

11:30-11:50 ThA25.4

Context-Based State Estimation in Semiconductor Manufacturing: Reference Path Based State Transformation Approach, pp. 11949-11954.

Su, An-Jhih — National Taiwan Univ.
Yu, Cheng-Ching — National Taiwan Univ.
Jeng, Jyh-Cheng — National Taipei Univ. of Tech.
Huang, Hsiao-Ping — National Taiwan Univ.
Yang, Cheng-Jer — ProMOS Tech. Inc.
Chiou, Hung-Wen — ProMOS Tech. Inc.
Yang, Shu-Ching — ProMOS Tech. Inc.

11:50-12:10 ThA25.5

Control of Time-Varying Distributed Parameter Plug Flow Reactor

by LQR, pp. 11955-11960.
Aksikas, Ilyasse — Univ. of Alberta
Fuxman, Adrian Matias — Univ. of Alberta
Forbes, J. Fraser — Univ. of Alberta

12:10-12:30 ThA25.6
Researches on Load Balancing Control Problem for the Systems with Multiple Parallel Entities Using Differences Control Technique, pp. 11961-11966.
Wang, Xingxuan — Fudan Univ.
Zheng, Da-Zhong — Tsinghua Univ.

ThA26 327
Dynamic Interaction of Power Plants (Regular Session)
Chair: Xu, Tao — Univ. of Durham
Co-Chair: Moon, Un-Chul — ChungAng Univ.

10:30-11:10 ThA26.1
Voltage Control Techniques for Electrical Distribution Networks Including Distributed Generation, pp. 11967-11971.
Xu, Tao — Univ. of Durham
Taylor, Philip — Univ. of Durham

11:10-11:30 ThA26.2
Improvement of the Performance of Scheduled Stepwise Power Programme Changes within the European Power System, pp. 11972-11977.
Weissbach, Tobias — Univ. Stuttgart
Welfonder, Ernst — Univ. Stuttgart

11:30-11:50 ThA26.3
Application of Model Predictive Control to a Cascade of River Power Plants, pp. 11978-11983.
Setz, Cornelia — ETH Zurich
Heinrich, Adrienne — Philips
Rostalski, Philipp — ETH Zurich
Papafotiou, Georgios — ABB Corp. Res.
Morari, Manfred — Swiss Federal Inst. of Tech.

11:50-12:10 ThA26.4
An Adaptive Dynamic Matrix Control of a Boiler-Turbine System, pp. 11984-11989.
Lee, Kwang Y. — Baylor Univ.
Lee, Jae-Du — ChungAng Univ.
Moon, Un-Chul — ChungAng Univ.
Lee, Seung-Chul — ChungAng Univ.

12:10-12:30 ThA26.5
Design and Simulation on Improved Repetitive Controller for Inverted Power Supply, pp. 11990-11994.
Jia, Deli — Harbin Univ. of Science and Tech.
You, Bo — Harbin Univ. of Science and Tech.
Zhang, Fengjing — Harbin Univ. of Science and Tech.

ThA27 326
Flow Control in Internet (Regular Session)
Chair: Roth, Hubert — Univ. Siegen
Co-Chair: Pavel, Lacra — Univ. of Toronto

10:30-10:50 ThA27.1
Metropolis Criterion Based Q-Learning Flow Control for High-Speed Networks, pp. 11995-12000.
Li, Xin — Northeastern Univ.
Jing, Yuanwei — Northeastern Univ.
Dimirovski, Georgi Marko — Dogus Univ. of Istanbul
Zhang, Siying — Northeastern Univ.

10:50-11:10 ThA27.2
State-Space Approach to Pricing Design in OSNR Nash Game, pp. 12001-12006.
Zhu, Quanyan — Univ. of Toronto
Pavel, Lacra — Univ. of Toronto

11:10-11:30 ThA27.3
Observer-Based Robust Controller Design for Active Queue Management, pp. 12007-12012.
Zhou, Yucheng — Department of Res. Inst. of Wood Industry Chinese
Wang, Hongwei — Northeastern Univ.
Jing, Yuanwei — Northeastern Univ.
Liu, Xiaoping — Northeastern Univ.

11:30-11:50 ThA27.4
Sliding Mode Control for Uncertain Time-Delay TCP/AQM Network Systems, pp. 12013-12018.
Wang, Hongwei — Northeastern Univ.
Jing, Yuanwei — Northeastern Univ.
Zhou, Yucheng — Department of Res. Inst. of Wood Industry Chinese
Chen, Zhaona — Northeastern Univ.
Liu, Xiaoping — Northeastern Univ.

11:50-12:10 ThA27.5
A Passive Network Measurement-Based Traffic Control Algorithm in Gateway of P2P Systems, pp. 12019-12023.
Jiang, Yibo — Zhejiang Univ. of Tech.
Chen, Weijie — Zhejiang Univ. of Tech.
Wang, Wanliang — Zhejiang Univ. of Tech.
Zheng, Jianwei — Zhejiang Univ. of Tech.
Zhao, Yanwei — Zhejiang Univ. of Tech.

ThA28 330A
Flexible Structure Diagnosis and Health Monitoring (Regular Session)
Chair: Agrawal, Brij — Naval Postgraduate School
Co-Chair: Alazard, Daniel — ONERA-CERT / SUPAERO

10:30-10:50 ThA28.1
An Adaptive Statistical Approach to Flutter Monitoring, pp. 12024-12029.
Zouari, Rafik — IRISA/INRIA
Mevel, Laurent — IRISA/INRIA
Basseville, Michele — IRISA/CNRS

10:50-11:10 ThA28.2
Fault-Tolerant Control Using Dynamic Inversion and Model Predictive Control Applied to an Aerospace Benchmark, pp. 12030-12035.
Joosten, Diederick — Delft Univ. of Tech.
van den Boom, Ton J. J. — Delft Univ. of Tech.
Lombaerts, Thomas — Delft Univ. of Tech.

11:10-11:30 ThA28.3
Development of a Robust Model-Based Fault Diagnosis Technique for Reusable Launch Vehicles. a Case Study, pp. 12036-12041.
Falcoz, Alexandre — Univ. of Bordeaux1, IMS Lab.
Henry, David — Univ. Bordeaux I
Zolghadri, Ali — Univ. Bordeaux I

11:30-11:50 ThA28.4
On Learning Compressed Diagnosis Classifiers, pp. 12042-12047.
Provan, Gregory — Univ. Coll. Cork

11:50-12:10 ThA28.5
Digital Filters for Gain Stabilization of Flexible Vehicle Dynamics, pp. 12048-12053.
Samar, Raza — National Engineering & Scientific Commission

12:10-12:30 ThA28.6
Rest-To-Rest Slew Maneuver of Three-Axis Rotational Flexible Spacecraft, pp. 12054-12060.
Kim, Jae Jun — Naval Postgraduate School
Agrawal, Brij — Naval Postgraduate School

ThA29 330B
Automotive Systems Control (Regular Session)
Chair: Liu, Li — Department of Mechanical System Engineering,TokyoUniversity of Agriculture and Tech.
Co-Chair: Chang, Jae Kyun — CARNES Co. Ltd.

10:30-10:50 ThA29.1
Automotive Systems Engineering, pp. 12061-12064.
Chang, Jae Kyun — CARNES Co. Ltd.

10:50-11:10 ThA29.2
NCGPC with Dynamic Extension Applied to a Turbocharged Diesel Engine, pp. 12065-12070.
Dabo, Marcelin — Univ. de Rouen
Langlois, Nicolas — IRSEEM / ESIGELEC
Respondek, Witold — Inst. National des Sciences Appliquees
Chafouk, Houcine — IRSEEM / ESIGELEC

11:10-11:30 ThA29.3
A Study of Predicting Model of an Electrical Energy Balance for a Conventional Vehicle, pp. 12071-12072.
Kim, Sungtae — Hyundai Motor Co.

Chung, Seungmyun — Hyundai Motor Co.
Shin, Wanjae — Hyundai Motor Company
Lee, Je Been — HMC

11:30-11:50 ThA29.4
On Torque Control of Handling and Steering Feel for Avoidance Maneuver with Electric Power Steering, pp. 12073-12078.
Liu, Li — Department of Mechanical System Engineering,TokyoUniversity of A
Nagai, Masao — Tokyo Univ. of Agriculture and Tech.
Raksincharoensak, Pongsathorn — Tokyo Univ. of Agriculture and Tech.

11:50-12:10 ThA29.5
FlexRay Communication for the High Speed Distributed Control System, pp. 12079-12080.
Kim, Seunghoon — Hyundai-Kia Motors

12:10-12:30 ThA29.6
A Reliable Gateway for In-Vehicle Networks, pp. 12081-12086.
Seo, Suk-Hyun — Sungkyunkwan Univ.
Kim, Jin-Ho — Sungkyunkwan Univ.
Moon, Tae-Youn — Sungkyunkwan Univ.
Kwon, Key Ho — Sungkyunkwan Univ.
Hwang, Sung-Ho — Sungkyunkwan Univ.
Jeon, Jae Wook — Sungkyunkwan Univ.

ThA30 330C
Multi-Vehicle Systems II (Regular Session)
Chair: Pagilla, Prabhakar R. — Oklahoma State Univ.
Co-Chair: Fidan, Baris — National ICT Australia

10:30-10:50 ThA30.1
Hierarchical UAV Formation Control for Cooperative Surveillance, pp. 12087-12092.
Sutton, Andrew — ANU
Fidan, Baris — National ICT Australia
van der Walle, Dirk — ANU

10:50-11:10 ThA30.2
Multi-UAV Cooperative Fault Detection Employing Vision Based Relative Position Estimation, pp. 12093-12098.
Heredia, Guillermo — Univ. of Seville
Caballero, Fernando — Univ. of Seville
Maza, Ivan — Univ. of Seville
Merino, Luis — Pablo de Olavide Univ.
Viguria, Antidio — Univ. of Seville
Ollero, Anibal Ollero — Escuela Superior de Ingenieros - Univ. de Sevilla

11:10-11:30 ThA30.3
Leader-Following Formation Navigation for Multiple Robots with Collision Avoidance, pp. 12099-12104.
Sakurama, Kazunori — The Univ. of Electro-Communications
Nakano, Kazushi — the Univ. of Electro-Communications

11:30-11:50 ThA30.4
A Distributed Constraint Force Approach for Coordination of Multiple Mobile Robots, pp. 12105-12110.
Zou, Yunfei — Oklahoma State Univ.
Pagilla, Prabhakar R. — Oklahoma State Univ.

11:50-12:10 ThA30.5
LMI-Based Control of Vehicle Platoons for Robust Longitudinal Guidance, pp. 12111-12116.
Maschuw, Jan Philipp — RWTH Aachen Univ.
Kessler, Guenter C. — RWTH Aachen Univ.
Abel, Dirk — RWTH-Aachen Univ.

12:10-12:30 ThA30.6
Optimal Trajectories for Homing Navigation with Bearing Measurements, pp. 12117-12123.
Bishop, Adrian — Deakin Univ.
Pathirana, Pubudu N. — Deakin Univ.

ThB02 304A
Nonlinear Output Regulation (Regular Session)
Chair: Ding, Zhengtao — The Univ. of Manchester
Co-Chair: Oguchi, Toshiki — Tokyo Metropolitan Univ.

14:00-14:20 ThB02.1
Solvability of the Regulator Equation: L^2-Space Approach, pp. 12124-12128.
Rehak, Branislav — Inst. of Information Theory and Automation, Acad. of Scien

14:20-14:40 ThB02.2
Design of Continuous and Discontinuous Output Regulators for a MAGLEV System, pp. 12129-12134.
Rivera, Jorge — Univ. de Guadalajara
Loukianov, Alexander G. — CINVESTAV IPN GDI
Castillo-Toledo, Bernardino — CINVESTAV-GDL, Mexico

14:40-15:00 ThB02.3
Global Robust Output Regulation of Nonlinear Strict Feedforward Systems, pp. 12135-12140.
Chen, Tianshi — The Chinese Univ. of Hong Kong
Huang, Jie — The Chinese Univ. of Hong Kong

15:00-15:20 ThB02.4
Global Output Regulation of Nonlinear Time-Delay Output Feedback Systems with Unknown Exosystems, pp. 12141-12146.
Chen, Cailian — The Univ. of Manchester
Ding, Zhengtao — The Univ. of Manchester

15:20-15:40 ThB02.5
Certainty Equivalence in Nonlinear Output Regulation with Unmeasurable Regulated Error, pp. 12147-12152.
Celani, Fabio — Sapienza Univ. of Rome

15:40-16:00 ThB02.6
Synchronization of Four Identical Nonlinear Systems with Time-Delay, pp. 12153-12158.
Oguchi, Toshiki — Tokyo Metropolitan Univ.
Nijmeijer, Hendrik — Eindhoven Univ. of Tech.
Yamamoto, Takashi — Tokyo Metropolitan Univ.
Kniknie, Thijs — Eindhoven Univ. of Tech.

ThB03 304B
Nonlinear Predictive Control (Regular Session)
Chair: Kouvaritakis, Basil — Oxford Univ.
Co-Chair: Nagy, Zoltan K. — Loughborough Univ.

14:00-14:20 ThB03.1
A Dual Mode MPC Scheme for Nonlinear Processes, pp. 12159-12164.
Gutiérrez González, Luisa Paulina — National Univ. of Colombia
Odloak, Darci — Univ. of São Paulo - Brazil
Sotomayor, Oscar — Pol. School of the Univ. of Sao Paulo
Alvarez, Hernan — National Univ. of Colombia

14:20-14:40 ThB03.2
Fast Nonlinear Model Predictive Control Using Set Membership Approximation, pp. 12165-12170.
Canale, Massimo — Pol. di Torino
Fagiano, Lorenzo — Pol. di Torino
Milanese, Mario — Pol. di Torino

14:40-15:00 ThB03.3
A New Nonlinear Predictive Control Approach Using Hammerstein Models with Compensation Term, pp. 12171-12176.
Casillo, Danielle Simone S. — Federal Univ. of Rio Grande do Norte
Maitelli, André Laurindo — Federal Univ. of Rio Grande do Norte
Barros Fontes, Adhemar — Federal Univ. of Bahia

15:00-15:20 ThB03.4
Nonlinear Model Predictive Control of an Industrial Batch Reactor Subject to Swelling Constraint, pp. 12177-12182.
Simon, Levente — ETH Zurich
Nagy, Zoltan K. — Loughborough Univ.
Hungerbuehler, Konrad — ETH Zurich

15:20-15:40 ThB03.5
Nonlinear One-Step Predictive Control of an Active Magnetic Bearing, pp. 12183-12188.
Bonnet, Stéphane — Univ. de Tech. de Compiegne
De Miras, Jérôme — UMR HeuDiaSyC CNRS 6599
Vidolov, Boris — Univ. de Tech. de Compiegne

15:40-16:00 ThB03.6
Periodic Use of Time-Varying State Feedbacks for the Receding Horizon Control of Bilinear Systems, pp. 12189-12193.
Lee, Young Il — Seoul National Univ. of Tech.

Kouvaritakis, Basil — Oxford Univ.
Cannon, Mark — Univ. of Oxford

ThB04 — 308
Tracking Control Applications (Regular Session)
Chair: Bensoussan, David — École de Tech. supérieure - Univ. of Quebec
Co-Chair: Li, Shihua — Southeast Univ.

14:00-14:20 — ThB04.1
Adaptive Tracking Control for an Overhead Crane System, pp. 12194-12199.
Ma, Bojun — Nankai Univ.
Fang, Yongchun — Nankai Univ.
Zhang, Xuebo — Nankai Univ.

14:20-14:40 — ThB04.2
Arbitrarily Fast Tracking Feedback Systems for a Class of Nonlinear Plants, pp. 12200-12205.
Bensoussan, David — École de Tech. supérieure - Univ. of Quebec
Hammami, Maher — faculté des sciences

14:40-15:00 — ThB04.3
Trajectory Tracking Controller Design for an Unmanned Air Vehicle, pp. 12206-12211.
Natesan, Kannan — Univ. of Leicester
Gu, Dawei — Univ. of Leicester
Postlethwaite, Ian — the Univ. of Leicester

15:00-15:20 — ThB04.4
Finite-Time Tracking Control of a Nonholonomic Mobile Robot, pp. 12212-12217.
Wang, Zhao — Southeast Univ.
Li, Shihua — Southeast Univ.
Fei, Shumin — Southeast Univ.

15:20-15:40 — ThB04.5
On Feedback Linearization for Robust Tracking Control of Flexible Joint Robots, pp. 12218-12223.
Moberg, Stig — ABB AB - Robotics
Hanssen, Sven — ABB Automation Tech.

15:40-16:00 — ThB04.6
Tracking Control of a Induction Motor: An Output Feedback Approach, pp. 12224-12229.
Araujo, Gustavo — Univ. de Los Andes
Ríos-Bolívar, Miguel — Univ. de Los Andes
Lischinsky, Pablo — Univ. de Los Andes

ThB05 — 307
Adaptive Control II (Regular Session)
Chair: Leva, Alberto — Pol. di Milano
Co-Chair: Chen, Xinkai — Shibaura Inst. of Tech.

14:00-14:20 — ThB05.1
An ILC-Based Minimum Entropy PI Controller for Unknown and Non-Gaussian Stochastic Systems, pp. 12230-12235.
Ghasemi Afshar, Puya — The Univ. of Manchester
Wang, Hong — the Univ. of Manchester

14:20-14:40 — ThB05.2
Direct Fuzzy Tracking Control of a Class of Nonaffine Stochastic Nonlinear Systems with Unknown Dead-Zone Input, pp. 12236-12241.
Yu, Jian Jiang — Southeast Univ.
Zhang, Kan_Jian — Southeast Univ.
Fei, Shumin — Southeast Univ.

14:40-15:00 — ThB05.3
Parallel Disturbance Force Compensator for Electrical Machines, pp. 12242-12247.
Zenger, Kai — Helsinki Univ. of Tech.
Sinervo, Anssi — Helsinki Univ. of Tech.
Orivuori, Juha — Helsinki Univ. of Tech.
Laiho, Antti — VTT Tech. Res. Centre of Finland
Tammi, Kari — VTT Tech. Res. Centre of Finland

15:00-15:20 — ThB05.4
Adaptive Control of Unknown Dynamic Hysteretic Systems, pp. 12248-12253.
Chen, Xinkai — Shibaura Inst. of Tech.
Hisayama, Takeshi — Shibaura Inst. of Tech.
Su, Chun-Yi — Concordia Univ.

15:20-15:40 — ThB05.5
Bayesian Paradigm and Fully Probabilistic Design, pp. 12254-12259.
Karny, Miroslav — Inst. of Information Theory And Automation, A V C R

15:40-16:00 — ThB05.6
Normalised Expression and Evaluation of PI Tuning Rules, pp. 12260-12265.
Leva, Alberto — Pol. di Milano
Donida, Filippo — Pol. di Milano

ThB06 — 310A
Modeling and Control in the Behavioral Framework (Invited Session)
Chair: Rapisarda, Paolo — Univ. of Southampton
Co-Chair: Takaba, Kiyotsugu — Kyoto Univ.
Organizer: Rapisarda, Paolo — Univ. of Southampton
Organizer: Takaba, Kiyotsugu — Kyoto Univ.

14:00-14:40 — ThB06.1
Linear Differential Behaviors Described by Rational Symbols (I), pp. 12266-12272.
Willems, Jan C. — K.U. Leuven
Yamamoto, Yutaka — Kyoto Univ.

14:40-15:00 — ThB06.2
Output Regulation in the Behavioral Framework (I), pp. 12273-12278.
Takaba, Kiyotsugu — Kyoto Univ.

15:00-15:20 — ThB06.3
On Linear Canonical Controllers within the Unfalsified Control Framework (I), pp. 12279-12284.
Kaneko, Osamu — Osaka Univ.

15:20-15:40 — ThB06.4
Why "state" Feedback? (I), pp. 12285-12290.
Rapisarda, Paolo — Univ. of Southampton
Markovsky, Ivan — Katholieke Univ. Leuven

15:40-16:00 — ThB06.5
Model Reduction of Dissipative Systems by Balanced Truncation (I), pp. 12291-12296.
Minh, Ha Binh — Univ. of Groningen
Trentelman, Harry L. — Univ. of Groningen
Rapisarda, Paolo — Univ. of Southampton

ThB07 — 310B
Evolutionary Algorithms (Regular Session)
Chair: Chang, Hyeong Soo — Sogang Univ.
Co-Chair: Chen, Jie — Beijing Inst. of Tech.

14:00-14:20 — ThB07.1
Fuzzy Controller Design by Clustering-Aided Ant Colony Optimization, pp. 12297-12302.
Juang, Chia-Feng — National Chung Hsing Univ.
Kang, Yu-Ping — ChungChou Inst. of Tech.
Chiang, Lo — National Chung-Hsing Univ.

14:20-14:40 — ThB07.2
A Unifed Approach to Control Design Using a Cooperative Co-Evolutionary Bisection Algorithm, pp. 12303-12311.
Farag, Adel Omran — El Fateh Univ.

14:40-15:00 — ThB07.3
Quantum Particle Swarm Optimization Based Network Intrusion Feature Selection and Detection, pp. 12312-12317.
Zhang, Hongmei — East China Univ. of Science and Tech.
Gao, Haihua — East China Univ. of Science and Tech.
Wang, Xingyu — East China Univ. of Science and Tech.

15:00-15:20 — ThB07.4
Supporting VHDL Design for Air-Conditioning Controller Using Evolutionary Computation, pp. 12318-12323.
Kojima, Kazuyuki — Saitama Univ.
Watanuki, Keiichi — Saitama Univ.

15:20-15:40 — ThB07.5
Solving Multi-Objective Linear Control Design Problems Using Genetic Algorithms, pp. 12324-12329.
Sanchez, Gustavo — Univ. Simón Bolívar
Villasana, Minaya — Univ. Simon Bolivar
Strefezza, Miguel — Univ. Simóm Bolívar

15:40-16:00 ThB07.6

A Multi-Objective Evolutionary Algorithm of Marriage in Honey Bees Optimization Based on the Local Particle Swarm Optimization, pp. 12330-12335.

Yang, Chenguang — Beijing Inst. of Tech.
Chen, Jie — Beijing Inst. of Tech.
Tu, Xuyan — Beijing Inst. of Tech.

ThB08 310C
Robust Time-Delay Systems I (Regular Session)

Chair: Kao, Chung-Yao — Univ. of Melbourne
Co-Chair: Bhattacharyya, Shankar P. — Texas A & M Univ.

14:00-14:20 ThB08.1

On Robustness of Discrete-Time LTI Systems with Varying Time Delays, pp. 12336-12341.

Kao, Chung-Yao — Univ. of Melbourne

14:20-14:40 ThB08.2

A Full-Block mathcal{S}-Procedure Application to Delay-Dependent mathcal{H}_infty State-Feedback Control of Uncertain Time-Delay Systems, pp. 12342-12347.

Briat, Corentin — INPG/ENSIEG
Sename, Olivier — INPG
Lafay, JeanFrancois — Ec. Centrale Nantes

14:40-15:00 ThB08.3

A Delay-Partitioning Projection Approach to Stability Analysis of Neutral Systems, pp. 12348-12353.

Du, Baozhu — Univ. of Hong Kong
Lam, James — Univ. of Hong Kong
Shu, Zhan — The Univ. of Hong Kong

15:00-15:20 ThB08.4

Robust Stability of Distributed Delay Systems, pp. 12354-12358.

Muenz, Ulrich — Univ. of Stuttgart
Rieber, Jochen M. — Astrium GmbH
Allgower, Frank — Univ. of Stuttgart

15:20-15:40 ThB08.5

Finite-Dimensional H_infinity Filter Design for Linear Systems with State Delay, pp. 12359-12364.

Basin, Michael V. — Autonomous Univ. of Nuevo Leon
Shi, Peng — Faculty of Advanced Tech.
Calderon Alvarez, Dario — Autonomous Univ. of Nuevo Leon
Wang, Jianfei — Nanjing Univ. of Aeronautics and Astronautics

15:40-16:00 ThB08.6

Finite-Dimensional H_infinity Filter Design for Linear Systems with Measurement Delay, pp. 12365-12370.

Basin, Michael V. — Autonomous Univ. of Nuevo Leon
Shi, Peng — Faculty of Advanced Tech.
Calderon Alvarez, Dario — Autonomous Univ. of Nuevo Leon
Wang, Jianfei — Nanjing Univ. of Aeronautics and Astronautics

ThB09 311C
Identification for Control (Regular Session)

Chair: Tsakalis, Kostas — Arizona State Univ.
Co-Chair: Zhang, Lifeng — Univ. of the West of England

14:00-14:20 ThB09.1

A New Robust-Control-Oriented System Identification Method, pp. 12371-12376.

Zhan, Charles — Honeywell Inc.
Tsakalis, Kostas — Arizona State Univ.

14:20-14:40 ThB09.2

A New Model Validity Monitoring Method for Nonlinear Recursive Identification, pp. 12377-12382.

Zhang, Lifeng — Univ. of the West of England
Zhu, Quanmin — Univ. of the West of England
Longden, Ashley — Univ. of the west of england

14:40-15:00 ThB09.3

Parameter Reduction of Nonlinear Least-Squares Estimates Via the Singular Value Decomposition, pp. 12383-12388.

Nagamune, Ryozo — Univ. of British Columbia
Choi, Jongeun — Michigan State Univ.

15:00-15:20 ThB09.4

PLS and Its Application within Model Predictive Controllers, pp. 12389-12394.

Shamekh, Awad — The Univ. of Manchester, UK
Lennox, Barry — Univ. of Manchester
Sandoz, David — Univ. of Manchester
Marjanovic, Ognjen — Univ. of Manchester

15:20-15:40 ThB09.5

Bayes Parameter Identification with Polynomial Asymmetrical Loss Function, pp. 12395-12400.

Kulczycki, Piotr — Pol. Acad. of Sciences
Mazgaj, Aleksander — Cracow Univ. of Tech.

15:40-16:00 ThB09.6

Intelligent Modelling of MIMO Nonlinear Dynamic Process Plants for Predictive Control Purposes, pp. 12401-12406.

Mohammadzaheri, Morteza — Univ. of Adelaide
Chen, Lei — Adelaide Univ.

ThB10 311B
Stochastic Modelling and Control (Regular Session)

Chair: Pota, Hemanshu — Univ. of New South Wales
Co-Chair: Fuchs, Jean Jacques — Univ. de Rennes

14:00-14:20 ThB10.1

Ship Motion Prediction for Maritime Flight Operations, pp. 12407-12412.

Yang, Xilin — Univ. of New South Wales at AustralianDenfenseForceAcademy
Pota, Hemanshu — Univ. of New South Wales
Garratt, Matthew — UNSW@ADFA
Ugrinovskii, Valery — Univ. of New South Wales

14:20-14:40 ThB10.2

Feedback Control of Internet Applications Involving the Tracking of Dynamic Data, pp. 12413-12418.

Shah, Shweta — Carnegie Mellon Univ.
Moudgalya, Kannan M. — I.I.T. Bombay
Ramamritham, Krithi — IIT Bombay

14:40-15:00 ThB10.3

Fault Detection and Diagnosis in the DAMADICS Benchmark Actuator System – a Hidden Markov Model Approach, pp. 12419-12424.

Almeida, Gustavo Matheus de — Federal Univ. of Minas Gerais
Park, Song Won — Univ. of Sao Paulo

15:00-15:20 ThB10.4

A Sparse Representation Criterion: Recovery Conditions and Implementation Issues., pp. 12425-12429.

Fuchs, Jean Jacques — Univ. de Rennes

15:20-15:40 ThB10.5

Parsimonious Representation of Signals Based on Scattering Transform, pp. 12430-12435.

Sorine, Michel — INRIA
Zhang, Qinghua — INRIA
Laleg, Taous-Meriem — The French Inst. on Res. in computer sciencesandcontrol
Crépeau, Emmanuelle — Univ. de Versailles Saint Quentin

15:40-16:00 ThB10.6

Non-Parametric Adaptive Estimation of a Multivariate Density, pp. 12436-12441.

Vasiliev, Vyacheslav — Univ. of Tomsk

ThB11 311A
Recent Advances in Iterative and Repetitive Learning Control I (Invited Session)

Chair: Ahn, Hyo-Sung — Gwangju Inst. of Science and Tech. (GIST)
Co-Chair: Moore, Kevin L. — Colorado School of Mines
Organizer: Ahn, Hyo-Sung — Gwangju Inst. of Science and Tech. (GIST)

14:00-14:20 ThB11.1

Discrete-Time Intermittent Iterative Learning Controller with Independent Data Dropouts (I), pp. 12442-12447.

Ahn, Hyo-Sung — Gwangju Inst. of Science and Tech. (GIST)
Moore, Kevin L. — Colorado School of Mines
Chen, YangQuan — Utah State Univ.

14:20-14:40 ThB11.2

A Study on the Effect of Variable Initial State Error in Average

Operator-Based Iterative Learning Control (I), pp. 12448-12453.
Park, Kwang-Hyun — Kwangwoon Univ.
Bien, Zeungnam — Korea Advanced Inst. of Science and Tech.

14:40-15:00 — ThB11.3
Frequency Domain Based Design of Iterative Learning Controllers for Monotonic Convergence (I), pp. 12454-12459.
Phan, Minh — Dartmouth Coll.
Brown, Hunter — Dartmouth Coll.
Lee, Soo Cheol — Daegu Univ.
Longman, Richard W. — Columbia Univ. MS 4703

15:00-15:20 — ThB11.4
On the Settling Time in Repetitive Control Systems (I), pp. 12460-12467.
Yeol, Joe W. — Columbia Univ.
Longman, Richard W. — Columbia Univ. MS 4703
Ryu, Yeong S. — State Univ. of New York at Farmingdale

15:20-15:40 — ThB11.5
Comparison Studies on Anti-Aliasing/Anti-Imaging Filtering and Signal Extension in Multi-Rate ILC (I), pp. 12468-12473.
Zhang, Bin — Nanyang Tech. Univ.
Wang, Danwei — Nanyang Tech. Univ.
Wang, Yigang — Nanyang Tech. Univ.
Ye, Yongqiang — Lakehead Univ.
Zhou, Keliang — TUDelft

15:40-16:00 — ThB11.6
A Note on Iterative Learning Control for Nonlinear Systems with Input Uncertainties (I), pp. 12474-12479.
Tan, Ying — The Univ. of Melbourne
Xu, Jian-Xin — National Univ. of Singapore

ThB12 — 313
Quantized Systems and Model Predictive Control of Hybrid Systems (Regular Session)
Chair: Sugie, Toshiharu — Kyoto Univ.
Co-Chair: Chiuso, Alessandro — Univ. of Padova

14:00-14:20 — ThB12.1
Input-To-State Stabilization of Nonlinear Systems with Quantized Feedback, pp. 12480-12485.
Kameneva, Tatiana — Univ. of Melbourne
Nesic, Dragan — Univ. of Melbourne

14:20-14:40 — ThB12.2
A Note on Estimation Using Quantized Data, pp. 12486-12491.
Chiuso, Alessandro — Univ. of Padova

14:40-15:00 — ThB12.3
State Estimation Using Quantized Measurements, pp. 12492-12497.
Fu, Minyue — Univ. of Newcastle
de Souza, Carlos E. — Lab. Nac. de Comp. Cientifica - LNCC

15:00-15:20 — ThB12.4
Optimal Dynamic Quantizers for 2D Systems with Discrete-Valued Input and Its Application to Generation of Binary Halftone Images, pp. 12498-12503.
Minami, Yuki — Kyoto Univ.
Azuma, Shun-ichi — Kyoto Univ.
Sugie, Toshiharu — Kyoto Univ.

15:20-15:40 — ThB12.5
Robust Output Feedback MPC for Linear Systems Via Interpolation Technique, pp. 12504-12509.
Sui, Dan — NUS
Feng, Le — The Norwegian Univ. of Science and Tech.
Hovd, Morten — Norwegian Univ. of Tech. and Science

15:40-16:00 — ThB12.6
Control of an Autonomous Hybrid System Using a Nonlinear Model Predictive Controller, pp. 12510-12515.
Prakash, Jagadeesan — Madras Inst. of Tech.
Patwardhan, Sachin — IIT Bombay
Shah, Sirish — Univ. of Alberta

ThB13 — 314
Kalman Filtering Techniques (Regular Session)
Chair: Guay, Martin — Queen's Univ.
Co-Chair: Oliveira, Paulo Jorge — Inst. Superior Técnico

14:00-14:20 — ThB13.1
Applications of Random Parameter Matrices Kalman Filtering in Uncertain Observation and Multi-Model Systems, pp. 12516-12521.
Luo, Dandan — Sichuan Univ.
Zhu, Yunmin — Sichuan Univ.

14:20-14:40 — ThB13.2
Kalman Filter Decomposition in the Time Domain Using Observability Index, pp. 12522-12527.
Kim, Yuri — Canadian Space Agency

14:40-15:00 — ThB13.3
Kalman and H Infinity Optimal Filtering for a Class of Kinematic Systems, pp. 12528-12533.
Batista, Pedro — Inst. Superior Técnico
Silvestre, Carlos — Inst. Superior Tecnico
Oliveira, Paulo Jorge — Inst. Superior Técnico

15:00-15:20 — ThB13.4
Integrating the Utkin Observer with the Unscented Kalman Filter, pp. 12534-12539.
Ongkosutjahjo, Martin — Univ. of Reading
Becerra, Victor — Univ. of Reading

15:20-15:40 — ThB13.5
Stochastic Flow Model Using Kalman Filters for Parameter Estimation, pp. 12540-12545.
Graton, Guillaume — Ec. Centrale de Marseille
Guay, Martin — Queen's Univ.
Arinez, Jorge — General Motors Res. & Development Center

15:40-16:00 — ThB13.6
Stochastic Robust Kalman Filtering for Linear Time-Varying Systems with a Multiplicative Measurement Noise, pp. 12546-12551.
Ra, Won-Sang — Agency for Defense Development
Whang, Ick Ho — The Agency For Defense Development

ThB14 — 318
Design and Analysis of Networked Control Systems (Invited Session)
Chair: Liu, Guoping — Univ. of Glamorgan
Co-Chair: Rees, David — Univ. of Glamorgan
Organizer: Liu, Guoping — Univ. of Glamorgan
Organizer: Rees, David — Univ. of Glamorgan

14:00-14:20 — ThB14.1
Co-Simulation Framework for Networked Control Systems Over Multi-Hop Mobile Ad-Hoc Networks (I), pp. 12552-12557.
Hasan, Mohammad Shahidul — Staffordshire Univ.
Yu, Hongnian — Staffordshire Univ.
Griffiths, Alison Louise — STAFFORDSHIRE Univ.
Yang, T. C. — Univ. of Sussex

14:20-14:40 — ThB14.2
Predictive Control Strategy for a Wireless Networked System (I), pp. 12558-12563.
Chai, Senchun — Univ. of glamorgan
Liu, Guoping — Univ. of Glamorgan
Rees, David — Univ. of Glamorgan

14:40-15:00 — ThB14.3
Delay-Distribution-Dependent Stability and Stabilization for Wireless Networked Control System with Data Quantization (I), pp. 12564-12569.
Yue, Dong — Nanjing Normal Univ.
Tian, Engang — Donghua Univ.
Zhang, Yijun — Donghau Univ.

15:00-15:20 — ThB14.4
Stabilization for Networked Control Systems with Nonlinear Perturbation, pp. 12570-12574.
Zhou, Lei — Nantong Univ.
Xiao, Xiaoqing — Nantong Univ.
Lu, Guoping — Nantong Univ.

15:20-15:40 — ThB14.5
A Simple State Feedback Controller Design Method of Networked Control Systems with Time Delay and Packet Dropout, pp. 12575-12580.

Li, HongBo Tsinghua Univ.
Sun, Zengqi Tsinghua Univ.
Chow, Mo-Yuen North Carolina State Univ.
Chen, Badong Tsinghua Univ.

15:40-16:00 ThB14.6
Stability of Model-Based Networked Control Systems with Intermittent Feedback, pp. 12581-12586.
Estrada, Tomas Univ. of Notre Dame
Antsaklis, Panos J. Univ. of Notre Dame

ThB15 317
Control Issues in Metabolic Engineering (Regular Session)
Chair: Moreno, Jaime A. Univ. Nacional Autonoma de Mexico-UNAM
Co-Chair: Strmcnik, Stanko Jozef Stefan Inst.

14:00-14:20 ThB15.1
Optimal Metabolic Pathway Activation, pp. 12587-12592.
Oyarzún, Diego A. National Univ. of Ireland, Maynooth
Ingalls, Brian P. Univ. of Waterloo
Middleton, Rick National Univ. of Ireland
Kalamatianos, Dimitrios National Univ. of Ireland, Maynooth

14:20-14:40 ThB15.2
An LMI Approach for Robust Stability of Genetic Networks, pp. 12593-12598.
Chesi, Graziano Univ. of Hong Kong
Hung, Yeung Sam The Univ. of Hong Kong

14:40-15:00 ThB15.3
Hybrid Approximation of Stochastic Process Algebras for Systems Biology, pp. 12599-12606.
Bortolussi, Luca Univ. of Trieste
Policriti, Alberto Univ. of Udine

15:00-15:20 ThB15.4
Robustness Analysis of Cellular Systems for in Silico Drug Discovery, pp. 12607-12612.
Perumal, Thanneer Malai National Univ. of Singapore
Wu, Yan National Univ. of Singapore
Gunawan, Rudiyanto National Univ. of Singapore

15:20-15:40 ThB15.5
Control of Overflow Metabolism Via Sliding Mode Reference Conditioning, pp. 12613-12618.
Picó, Jesús Tech. Univ. of Valencia
Garelli, Fabricio Univ. of La Plata
De Battista, Hernán Univ. of La Plata

15:40-16:00 ThB15.6
Neural Networks to Predict Protein Stability Changes Upon Mutation, pp. 12619-12624.
Grosfils, Aline Univ. Libre de Bruxelles
Dehouck, Yves Univ. Libre de Bruxelles
Gilis, Dimitri Univ. Libre de Bruxelles
Rooman, Marianne Univ. Libre de Bruxelles
Bogaerts, Philippe Univ. Libre de Bruxelles

ThB17 320A
Control Education: E-Learning (Regular Session)
Chair: Pereira, Carlos Eduardo Federal Univ. of Rio Grande do Sol
Co-Chair: Dormido, Sebastián UNED

14:00-14:20 ThB17.1
Educational Games in Control, pp. 12625-12630.
Muenz, Ulrich Univ. of Stuttgart
Schumm, Peter Univ. Stuttgart
Allgower, Frank Univ. of Stuttgart

14:20-14:40 ThB17.2
Student Competition in Multivariable Control Design - Education through E-Game, pp. 12631-12636.
Atanasijevic-Kunc, Maja Univ. of Ljubljana
Karba, Rihard Univ. of Ljubljana
Logar, Vito Faculty of Electrical engineering, Univ. of Ljubljana
Papi
;, Marko Univ. of Ljubljana
Bešter, Janez Univ. of Ljubljana

14:40-15:00 ThB17.3
Blended Learning Using GCAR-EAD Environment: Experiences and Application Results, pp. 12637-12642.
Schaf, Frederico Menine Univ. of Rio Grande do Sul
Pereira, Carlos Eduardo Federal Univ. of Rio Grande do Sol
Henriques, Renato Ventura Bayan Univ. of Rio Grande do Sul

15:00-15:20 ThB17.4
Design of Web-Based Real-Time Control Laboratory for Diversely Located Test Rigs, pp. 12643-12648.
Hu, Wenshan Univ. of Glamorgan
Liu, Guoping Univ. of Glamorgan
Rees, David Univ. of Glamorgan
Qiao, Yuliang Chinese Acad. of Sciences

15:20-15:40 ThB17.5
E-Learning System with a Real System and Graphical Simulator for Embedded System, pp. 12649-12654.
Yokota, Sho Tokyo Univ. of Tech.
Kazuya, Hiramatsu Tokyo Univ. of Tech.
Yasuhiro, Ohyama Tokyo Univ. of Tech.
She, Jin-Hua Tokyo Univ. of Tech.
Hashimoto, Hiroshi Tokyo Univ. of Tech.

15:40-16:00 ThB17.6
Multitasking Real-Time Control Systems in Easy Java Simulations, pp. 12655-12660.
Farias, Gonzalo U.N.E.D.
Cervin, Anton Lund Univ.
Arzen, Karl-Erik Lund Inst. of Tech.
Dormido, Sebastián UNED
Esquembre, Francisco Professor, Ph. D

ThB18 320B
Embedded Component Technology for Network Robot System (Invited Session)
Chair: Cho, Young-Jo ETRI
Co-Chair: Hamaguchi, Masafumi Shimane Univ.
Organizer: Cho, Young-Jo ETRI

14:00-14:20 ThB18.1
A Tele-Operated Gesture Recognition Mobile Robot Using a Stereo Vision (I), pp. 12661-12666.
Shin, H.C. Electronics and Telecommunications Res. Inst.
Kim, Y.G. Korea Univ. of Science and Tech.
Cho, J.I. Electronics and Telecommunications Res. Inst.
Cho, Young-Jo ETRI

14:20-14:40 ThB18.2
Damping Path Design for Liquid Container Transferred with Wheeled Mobile Robot Along Multiple Turn Sections, pp. 12667-12672.
Yoshida, Yu Shimane Univ.
Hamaguchi, Masafumi Shimane Univ.
Taniguchi, Takao Shimane Univ.

14:40-15:00 ThB18.3
Automated Bayesian Network Integration Based on Ontology for Reasoning Object Existence of Service Robot (I), pp. 12673-12678.
Song, Youn-Suk LG Electronics
Cho, Sung-Bae Yonsei Univ.

15:00-15:20 ThB18.4
Robot System Providing Fault-Tolerant Services: Research of Middleware Supporting Fault-Tolerance (I), pp. 12679-12684.
Baek, BumHyeon student
Choi, HyeongSeob student
Park, Hong Seong Kangwon National Univ.
Kim, Joong-Bae ETRI
Kim, Sunghoon ETRI

15:20-15:40 ThB18.5
The Software Architecture for Module-Based Robot System Supporting Heterogeneous Network Interfaces (I), pp. 12685-12690.
Lee, Kwang Koog Kangwon National Univ.
Kim, Seong Hoon Kangwon National Univ.
Vitaly, Li Kangwon National Univ.
Choe, Sun Hee Kangwon National Univ.
Park, Hong Seong Kangwon National Univ.

Kim, Sunghoon — ETRI
Kim, Joong-Bae — ETRI

15:40-16:00 — ThB18.6
Emotion Expression and Environment through Affective Interaction (I), pp. 12691-12696.
Park, Cheonshu — Electronics and Telecommunications Res. Inst.
Cho, Young-Jo — ETRI

ThB19 — 320C
Tele Robotics (Regular Session)
Chair: Basanez, Luis — Univ. Pol. de Catalunya
Co-Chair: Namerikawa, Toru — Kanazawa Univ.

14:00-14:20 — ThB19.1
Bilateral Teleoperation Experiments: Scattering Transformation and Passive Output Synchronization Revisited, pp. 12697-12702.
Nuńo, Emmanuel — Tech. Univ. of Catalonia
Basanez, Luis — Univ. Pol. de Catalunya
Rodriguez-Seda, Erick Joel — Univ. of Illinois at Urbana-Champaign
Spong, Mark W. — Univ. of Illinois at Urbana-Champaign

14:20-14:40 — ThB19.2
Predictive PD Control for Teleoperation with Communication Time Delay, pp. 12703-12708.
Yoshida, Kouei — Kanazawa Univ.
Namerikawa, Toru — Kanazawa Univ.

14:40-15:00 — ThB19.3
Determining Fixturing Points for Complex Objects, pp. 12709-12714.
Roa, Maximo — Tech. Univ. of Catalonia
Suarez, Raul — Univ. Pol. de Catalunya

15:00-15:20 — ThB19.4
Analysis and Design of Position-Force Teleoperation with Scattering Matrix, pp. 12715-12720.
Duong, Minh Duc — Toyohashi Univ. of Tech.
Miyoshi, Takanori — Toyohashi Univ. of Tech.
Terashima, Kazuhiko — Toyohashi Univ. of Tech.
Rodriguez-Seda, Erick Joel — Univ. of Illinois at Urbana-Champaign

15:20-15:40 — ThB19.5
Transparent Bilateral Control Architecture by State Convergence for Telerobotics, pp. 12721-12726.
Azorin, Jose M. — Univ. Miguel Hernandez de Elche
Aracil, Rafael — Univ. Pol. de Madrid
Sabater, Jose M. — Univ. Miguel Hernandez
Perez, Carlos — Univ. Miguel Hernández
Garcia, Nicolas M. — Univ. Miguel Hernandez

15:40-16:00 — ThB19.6
Nonlinear H_Infinity Control of a Bilateral Nonlinear Teleoperation System, pp. 12727-12732.
Razi, Kamran — Univ. of Tehran
Yazdanpanah, Mohammad Javad — Univ. of Tehran
Shiry Ghidary, Saied — Amirkabir Univ. of Tech.

ThB20 — 321C
Automation in Micro and Nano-Handling I (Invited Session)
Chair: Fatikow, Sergej — Fak.II, AMiR
Co-Chair: Li, Yangmin — Univ. of Macau
Organizer: Fatikow, Sergej — Fak.II, AMiR

14:00-14:20 — ThB20.1
Structure Improvement of an XY Flexure Micromanipulator for Micro/Nano Scale Manipulation (I), pp. 12733-12738.
Xu, Qingsong — Univ. of Macau
Li, Yangmin — Univ. of Macau

14:20-14:40 — ThB20.2
Development, Control and Evaluation of a Mobile Platform for Microrobots (I), pp. 12739-12744.
Edeler, Christoph — Univ. of Oldenburg
Jasper, Daniel — Univ. of Oldenburg
Fatikow, Sergej — Fak.II, AMiR

14:40-15:00 — ThB20.3
The SEM-FIB Workbench (I), pp. 12745-12750.
Kim, Kyunghwan — NT Res. Inc.
Klocke, Volker — Klocke Nanotechenik

15:00-15:20 — ThB20.4
Automated Nano-Assembly in the SEM I: Challenges in Setting up a Warehouse (I), pp. 12751-12756.
Wich, Thomas — Univ. of Oldenburg
Stolle, Christian — Univ. of Oldenburg
Frick, Oliver — Univ. of Oldenburg
Fatikow, Sergej — Fak.II, AMiR

15:20-15:40 — ThB20.5
Electromagnetic Parallel Microrobot for Micro and Nano-Handling (I), pp. 12757-12762.
Büttgenbach, Stephanus — Tech. Univ. of Braunschweig
Feldmann, Marco — Tech. Univ. of Braunschweig

ThB21 — 321B
Soft Computing/Computational Intelligence in Mechatronics (Invited Session)
Chair: Ang Jr, Marcelo H — National Univ. of Singapore
Co-Chair: Lee, Tong Heng — National Univ. of Singapore
Organizer: Ang Jr, Marcelo H — National Univ. of Singapore

14:00-14:20 — ThB21.1
Fault Detection and Accommodation Control for a Class of Nonlinear Systems (I), pp. 12763-12768.
Huang, Sunan — National Univ. of Singapore
Tan, Kok Kiong — National Univ. of Singapore
Tang, Kok Zuea — National Univ. of Singapore
Lee, Tong Heng — National Univ. of Singapore

14:20-14:40 — ThB21.2
Neural Network Based Control for a Class of Uncertain Robot Manipulator with External Disturbance, pp. 12769-12774.
Xian, Bin — Tian Jin Univ.
Cui, Cuijie — Tianjin Univ.
Huang, Mu — TianJin Univ.
Li, Dong — Tianjin Univ.
Yang, Kaiyan — Tianjin Univ.

14:40-15:00 — ThB21.3
The Operational Space Formulation with Neural-Network Adaptive Motion Control (I), pp. 12775-12780.
Soewandito, Dandy — National Univ. of Singapore
Oetomo, Denny Nurjanto — Monash Univ.
Ang Jr, Marcelo H — National Univ. of Singapore

15:00-15:20 — ThB21.4
Synchronization of Two Ball and Beam Systems with Neural Compensation, pp. 12781-12786.
Jiménez, Saúl — CINVESTAV-IPN
Yu, Wen — CINVESTAV-IPN
Li, Xiaoou — CINVESTAV-IPN

15:20-15:40 — ThB21.5
Evolutionary Univector Field-Based Navigation with Collision Avoidance for Mobile Robot (I), pp. 12787-12792.
Lim, Yusun — KAIST
Choi, Seung-Hwan — Korea Advanced Inst. of Science and Tech.
Kim, Jong-Hwan — Korea Advanced Inst. of Science and Tech.
Kim, Dong-Han — Kyung Hee Univ.

15:40-16:00 — ThB21.6
Sliding Mode Algorithm for On-Line Learning in Fuzzy Rule-Based Neural Networks (I), pp. 12793-12798.
Topalov, Andon Venelinov — Tech. Univ. Sofia, branch Plovdiv, Bulgaria
Kaynak, Okyay — Bogazici Univ.
Shakev, Nikola Georgiev — Tech. Univ. Sofia, branch Plovdiv
Hong, Suk Kyo — Ajou Univ.

ThB22 — 321A
Estimation, Detection and Diagnosis (Regular Session)
Chair: Koivisto, Hannu — Tampere Univ. of Tech.
Co-Chair: Badreddin, Essam — Univ. of Heidelberg

14:00-14:20 — ThB22.1
Behavior Based Estimation of Dependability for Autonomous Mobile Systems Using Particle Filter, pp. 12799-12804.
Rüdiger, Jan — Univ. of Heidelberg
Wagner, Achim — Univ. of Mannheim
Badreddin, Essam — Univ. of Heidelberg

14:20-14:40 ThB22.2
Detection of Safe and Harmful Bioaerosols by Means of Fuzzy Classifiers, pp. 12805-12812.
Pulkkinen, Pietari — Tampere Univ. of Tech.
Hytönen, Jarmo — Dekati Ltd.
Koivisto, Hannu — Tampere Univ. of Tech.

14:40-15:00 ThB22.3
Energy Based Mode Tracking of Hybrid Systems, pp. 12813-12818.
Arogeti, Shai — Nanyang Tech. Univ.
Wang, Danwei — Nanyang Tech. Univ.
Low, Chang Boon — Nanyang Tech. Univ.
Zhang, Jing Bing — Singapore Inst. of Manufacturing Tech.

15:00-15:20 ThB22.4
Design and Realization of Sensor Nodes for Dense Underwater Wireless Sensor Networks, pp. 12819-12824.
Lu, Chao — Chinese Acad. of Sciences
Wang, Shuo — Chinese Acad. of Sciences
Tan, Min — Inst. of Automation, Chinese Acad. of Sciences

15:20-15:40 ThB22.5
Diagnostic Fusion for in Vehicle Driver Vigilance Assessment, pp. 12825-12830.
Boverie, Serge — Siemens VDO Automotive
Giralt, Alain — Siemens VDO automotive
Le Quellec, Jean-Michel — Siemens VDO Automotive

15:40-16:00 ThB22.6
Driver Vigilance Diagnostic Based on Eyelid Movement Observation, pp. 12831-12836.
Boverie, Serge — Siemens VDO Automotive
Giralt, Alain — Siemens VDO automotive

ThB23 323
Production & Logistics Over Manufacturing Networking (Regular Session)
Chair: Chai, Tianyou — Northeastern Univ.
Co-Chair: Dolgui, Alexandre — Ec. des Mines de Saint Etienne

14:00-14:20 ThB23.1
Complete Modification Rescheduling Method and Its Application for Steelmaking and Continuous Casting, pp. 12837-12842.
Pang, Xinfu — Northeastern Univ.
Yu, Shengping — Northeastern Univ.
Zheng, Binglin — Northeastern Univ.
Chai, Tianyou — Northeastern Univ.

14:20-14:40 ThB23.2
Particle Swarm Optimization for Open Vehicle Routing Problem with Time Dependent Travel Time, pp. 12843-12848.
Zhao, Yanwei — Zhejiang Univ. of Tech.
Wu, Bin — Zhejiang Univ. of Tech.
Wang, Wanliang — Zhejiang Univ. of Tech.
Zhang, Jingling — Zhejiang Univ. of Tech.

14:40-15:00 ThB23.3
MRP Parameterization under Lead Time Uncertainties: A Branch and Cut Algorithm, pp. 12849-12854.
Dolgui, Alexandre — Ec. des Mines de Saint Etienne
Ould Louly, Aly Mohamed — King Saud Univ.

15:00-15:20 ThB23.4
Towards a Neuro-Fuzzy System for Time Series Forecasting in Maintenance Applications, pp. 12855-12860.
El Koujok, Mohamed — FEMTO-ST Inst. UMR CNRS 6174 - UFC / ENSMM / UTBM
Gouriveau, Rafael — FEMTO-ST Inst. UMR CNRS 6174 - UFC / ENSMM / UTBM
Zerhouni, Noureddine — FEMTO-ST Inst. UMR CNRS 6174 - UFC / ENSMM / UTBM

15:20-15:40 ThB23.5
New Approach to Prognostic System Failures, pp. 12861-12866.
Peysson, Flavien — Univ. Paul Cézanne, Aix-Marseille III
Ouladsine, Mustapha — Univ. d'aix marseille III
Noura, Hassan — United Arab Emirates Univ.
Leger, Jean-Baptiste — PREDICT
Allemand, Claude — DCN

15:40-16:00 ThB23.6
Online Change Detection and Conditional Maintenance, pp. 12867-12872.
Fouladirad, Mitra — Univ. Tech. of Troyes
Grall, Antoine — Univ. de Tech. de Troyes

ThB24 324
Architectures and Software Tools for Enterprise Integration and Networking in Manufacturing (Regular Session)
Chair: Molina, Arturo — Tecnologico de Monterrey
Co-Chair: Pingaud, Hervé — ENSTIMAC

14:00-14:20 ThB24.1
Methodology for Enterprise Interoperability, pp. 12873-12878.
Daclin, Nicolas — Univ. d eBordeaux
Chen, David — Univ. Bordeaux I
Vallespir, Bruno — Univ. of Bordeaux 1

14:20-14:40 ThB24.2
Multi-Screen View and GRAI GRIDS to Model Decisional Process of Manufacturing IS Alignment, pp. 12879-12884.
Goepp-Thiebaud, Virginie — Inst. National des Sciences Appliquées de Strasbourg
Kiefer, François — Inst. National des Sciences Appliquées de Strasbourg

14:40-15:00 ThB24.3
A UML Profile for Transforming GRAI Extended Actigrams into UML (I), pp. 12885-12890.
Grangel Seguer, Reyes — Univ. Jaume I
Cutting-Decelle, Anne-Françoise — Ec. Centrale de Lille
Bourey, Jean-Pierre — Ec. Centrale de Lille

15:00-15:20 ThB24.4
Analysis & Design of a Collaboration Opportunity Characterization Tool for Virtual Organisations Creation, pp. 12891-12898.
Concha, David — ITESM
Romero, Tania — ITESM
Romero, David — ITESM
Galeano, Nathalie — ITESM
Jimenez, Guillermo — ITESM
Molina, Arturo — Tecnologico de Monterrey

15:20-15:40 ThB24.5
An Approach for Evaluating Enterprise Organizational Interoperability Based on Enterprise Model Checking Techniques, pp. 12899-12904.
Chapurlat, Vincent — Ec. des Mines d'Alčs
Vallespir, Bruno — Univ. of Bordeaux 1
Pingaud, Hervé — ENSTIMAC

15:40-16:00 ThB24.6
Development of a Production Management System for Automated and Manual Process Mixed Manufacturing, pp. 12905-12910.
Ishii, Yoshikazu, — Hitachi, Ltd.
Morita, Kazunobu, — Hitachi, Ltd.
Shiga, Hiroyuki, — Hitachi Information & Control Solutions, Ltd.

ThB25 328
Design and Control (Regular Session)
Chair: Visioli, Antonio — Univ. of Brescia
Co-Chair: Bao, Jie — The Univ. of New South Wales

14:00-14:20 ThB25.1
Simultaneous Design and Control of the Tennessee Eastman Process, pp. 12911-12916.
Ricardez Sandoval, Luis Alberto — Univ. of Waterloo
Budman, Hector M. — Univ. of Waterloo
Douglas, Peter — Univ. of Waterloo

14:20-14:40 ThB25.2
Minimum-Time Feedforward Plus PID Control for MIMO Systems, pp. 12917-12922.
Piccagli, Stefano — Univ. degli Studi di Brescia
Visioli, Antonio — Univ. of Brescia

14:40-15:00 ThB25.3
Generic Optimal Temperature Profiles for a Class of Jacketed Tubular Reactors, pp. 12923-12928.
Logist, Filip — Katholieke Univ. Leuven
Van Erdeghem, Peter M.M. — KU Leuven
Smets, Ilse — Biotec - Bioprocess Tech. And Control

Van Impe, Jan F.M. — Katholieke Univ. Leuven

15:00-15:20 ThB25.4

Adaptive LQ Approach Used in Conductivity Control Inside Continuous-Stirred Tank Reactor, pp. 12929-12934.

Vojtesek, Jiri — Faculty of Applied Informatics, Tomas Bata Univ. in
Dostal, Petr — Tomas Bata Univ. In Zlin

15:20-15:40 ThB25.5

Efficient Branch and Bound Methods for Pairing Selection, pp. 12935-12940.

Kariwala, Vinay — Nanyang Tech. Univ.
Cao, Yi — Cranfield Univ.

15:40-16:00 ThB25.6

Operability Analysis for Process Systems with Recycle and Bypass Streams, pp. 12941-12946.

Setiawan, Ridwan — The Univ. of New South Wales
Bao, Jie — The Univ. of New South Wales
Rojas, Osvaldo J. — The Univ. of Newcastle
Lee, Peter L. — Curtin Univ. of Tech.

ThB26 327

Constraint and Security Monitoring and Control (Regular Session)

Chair: Malik, O.P. — The Univ. of Calgary
Co-Chair: Paoli, Andrea — Univ. of Bologna

14:00-14:20 ThB26.1

How Topology Affects Security: An Upper Bound of Electric Power Network Security, pp. 12947-12952.

Jia, Qing-Shan — Tsinghua Univ.
Zhao, Qianchuan — Tsinghua Univ.

14:20-14:40 ThB26.2

Monitoring a Gas-Cooled Nuclear Reactor Core Integrity, pp. 12953-12958.

Bonivento, Claudio — Univ. of Bologna
Grimble, Michael — Univ. of Strathclyde
Giovanini, Leonardo — Industrial Control Centre
Monari, Mattia — Univ. of Bologna
Paoli, Andrea — Univ. of Bologna

14:40-15:00 ThB26.3

A New Integrated Fault Diagnosis and Analysis System for Large-Scale Power Grid, pp. 12959-12964.

Zhou, Ziguan — China Electric Power Res. Inst.
Bai, Xiaomin — China Electric Power Res. Inst.

15:00-15:20 ThB26.4

DSA-Visualisation Monitoring and Ranking of System Dynamic Behaviour, pp. 12965-12970.

Lerch, Edwin — Siemens AG

15:20-15:40 ThB26.5

Low-Cost Embedded Solution for Measuring Power Quality Parameters, pp. 12971-12976.

Tomesc, Liviu — Tech. Univ. of Cluj-Napoca
Duma, Radu — Tech. Univ. of Cluj-Napoca
Abrudean, Mihai — Tech. Univ. of Cluj
Dobra, Petru — Tech. Univ. of Cluj

ThB27 326

Congestion Control in Internet (Regular Session)

Chair: Hill, David J. — The Australian National Univ.
Co-Chair: Onat, Ahmet — Sabanci Univ.

14:00-14:20 ThB27.1

Internet Congestion Control Subject to Node and Link Constraints, pp. 12977-12982.

Xia, Yongxiang — Australian National Univ.
Hill, David J. — The Australian National Univ.

14:20-14:40 ThB27.2

Adaptive Sliding Mode Congestion Control for DiffServ Network, pp. 12983-12987.

Zheng, Xiuping — Northeastern Univ.
Zhang, Nannan — Northeastern Univ.
Dimirovski, Georgi Marko — Dogus Univ. of Istanbul
Jing, Yuanwei — Northeastern Univ.

14:40-15:00 ThB27.3

Quick Kelly Control: A Nonlinear Congestion Control Method for High Speed Networks, pp. 12988-12993.

Xiang, Yanping — Chinese Acad. of Sciences Inst. of Automation
Yi, Jianqiang — Inst. of Automation, Chinese Acad. of Sciences
Zhao, Dongbin — Inst. of Automation, Chinese Acad. of Sciences

15:00-15:20 ThB27.4

Hopf Bifurcation and Oscillations in Homogeneous Communication Networks, pp. 12994-12999.

Yin, Huibing — Univ. of Illinois at Urbana-Champaign
Wang, Pang Paul — Univ. of Illinois
Alpcan, Tansu — Deutsche Telekom Lab.
Mehta, Prashant G. — Univ. of Illinois at Urbana-Champaign

15:20-15:40 ThB27.5

Model Based Predictive Networked Control Systems, pp. 13000-13005.

Onat, Ahmet — Sabanci Univ.
Naskali, Teoman — Sabanci Univ.
Parlakay, Emrah — Sabanci Univ.

15:40-16:00 ThB27.6

State-Space Model Based Generalized Predictive Control for Networked Control Systems, pp. 13006-13011.

Tang, Bin — Central South Univ.
Liu, Guoping — Univ. of Glamorgan
Gui, Weihua — Central South Univ.
Wang, Yalin — Central South Univ.

ThB28 330A

Guidance, Navigation and Control of Aerospace Vehicles (Regular Session)

Chair: Zhang, Shuguang — Beihang Univ.
Co-Chair: Alazard, Daniel — Univ. de Toulouse - ISAE

14:00-14:20 ThB28.1

Visual Servo Motion Control of a Spacecraft Around an Asteroid Using Feature Points, pp. 13012-13015.

Yanagi, Naoya — Univ. of Electro-Communications
Terui, Fuyuto — Japan Aerospace Exploration Agency

14:20-14:40 ThB28.2

Nonlinear Model Predictive Spread Acceleration Guidance with Impact Angle Constraint for Stationary Targets, pp. 13016-13021.

Das, Priya G. — Indian Inst. of Science
Padhi, Radhakant — Indian Inst. of Science

14:40-15:00 ThB28.3

Rapid Terminal Area Trajectory Planning for Reentry Vehicles (I), pp. 13022-13027.

Zhang, Shuguang — Beihang Univ.
Tang, Peng — Beihang Univ.

15:00-15:20 ThB28.4

Development and Testing of a Real-Time NDGPS/INS Avigation System for Helicopter Based on Artificial Vision, pp. 13028-13033.

Kim, JaeHyung — Korean Air
Lyou, Joon — Chungnam National Univ.

15:20-15:40 ThB28.5

A New Initial Alignment Algorithm for Strapdown Inertial Navigation System Using Sensor Output, pp. 13034-13039.

Kim, KwangJin — Doosan Infracore
Park, Chan Gook — Seoul National Univ.

ThB29 330B

Modeling and Control of Transportation Systems (Regular Session)

Chair: Hellendoorn, Hans — Delft Univ. of Tech.
Co-Chair: Ozguner, Umit — Ohio State Univ.

14:00-14:20 ThB29.1

Fast Parametric Estimation for Macroscopic Traffic Flow Model, pp. 13040-13045.

Abouaďssa, Hassane — Univ. of Artois
Fliess, Michel — Ec. Pol.
Join, Cédric — UHP-Nancy & ALIEN INRIA-Futurs

14:20-14:40 ThB29.2

Sliding Mode Control and Flatness-Based Concept for Real-Time Ramp Metering, pp. 13046-13051.

Iordanova, Violina — Univ. of Artois
Abouaďssa, Hassane — Univ. of Artois
Jolly, Daniel — Univ. of Artois

14:40-15:00 ThB29.3
Influencing Long-Term Route Choice by Traffic Control Measures - a Model Study, pp. 13052-13057.
Van Den Berg, Monique — Delft Univ. of Tech.
Hegyi, Andreas — Delft Univ. of Tech.
De Schutter, Bart — Delft Univ. of Tech.
Hellendoorn, Hans — Delft Univ. of Tech.

15:00-15:20 ThB29.4
A Model Predictive Control Approach for Decentralized Traffic Signal Control, pp. 13058-13063.
Yazici, Ahmet — Eskisehir Osmangazi Univ.
Ozguner, Umit — Ohio State Univ.
Seo, Gangdo — Korea Water Res. Corp.

15:20-15:40 ThB29.5
Freeway Traffic Management Using Linear Programming, pp. 13064-13069.
Jacquet, Denis — Protoptim

15:40-16:00 ThB29.6
A Multimodal Model for an Urban Traffic Control Policy, pp. 13070-13078.
Kachroudi, Sofiane — THE FRENCH NATIONAL Inst. FOR TRANSPORT AND SAFETY
Bhouri, Neila — THE FRENCH NATIONAL Inst. FOR TRANSPORT AND SAFETY

ThB30 330C
Transportation Logistics (Regular Session)
Chair: Stathopoulos, Antony — National Tech. Univ. of Athens
Co-Chair: Chi, Ronghu — Qingdao Univ. of Science and Tech.

14:00-14:20 ThB30.1
Modelling Dynamic Urban Road Networks Performance under Congestion Pricing Strategies, pp. 13079-13084.
Dimitriou, Loukas — Univ.
Stathopoulos, Antony — National Tech. Univ. of Athens

14:20-14:40 ThB30.2
Hybrid Predictive Control for the Vehicle Dynamic Routing Problem Based on Evolutionary Multiobjective Optimization (EMO), pp. 13085-13090.
Nuńez, Alfredo — Univ. de Chile
Saez, Doris — Univ. de Chile
Cortés, Cristián — Univ. de Chile

14:40-15:00 ThB30.3
Hybrid Heuristic Approaches for a Multi-Production Forward/reverse Logistics System Design Problem, pp. 13091-13096.
Liu, Changshi — Hunan Univ.

15:00-15:20 ThB30.4
Model and Algorithm for the Vendor-Warehouse Transportation and Inventory Problem in a Three-Level Distribution System, pp. 13097-13102.
Li, Jianxiang — Beijing Inst. of Tech.
Chu, Feng — Univ. of Tech. of Troyes
Chen, Haoxun — Tech. Univ. of Troyes

15:20-15:40 ThB30.5
Freeway Density Control Via Model-Free Adaptive Ramp Metering Approach, pp. 13103-13108.
Chi, Ronghu — Qingdao Univ. of Science and Tech.
Sui, Shulin — Qingdao Univ. of Science and Tech.
Yu, Lei — Qingdao Univ. of Science and Tech.

15:40-16:00 ThB30.6
Network Characteristics of Air Traffic in the Continental United States, pp. 13109-13114.
Sridhar, Banavar — NASA Ames Res. Center
Sheth, Kapil — NASA

ThB31 306
Guidance Navigation and Control (Video Session)
Chair: Chung, Wan Kyun — Pohang Univ. of Science & Tech.
Co-Chair: Song, Jae-Bok — Korea Univ.

14:00-14:20 ThB31.1
Balance and Tracking Control of Ball and Plate Systems, pp. 13115-13115. Attachment
Liao, Shian-Ching — National Cheng Kung Univ.
Tu, Yi-Wei — National Cheng Kung Univ.
Yang, Kuang-Shine — National Cheng Kung Univ.
Ho, Ming-Tzu — National Cheng Kung Univ.

14:20-14:40 ThB31.2
Visualization of Air Traffic Flow for Modeling and Control Applications, pp. 13116-13116. Attachment
Sridhar, Banavar — NASA Ames Res. Center
Sheth, Kapil — NASA

14:40-15:00 ThB31.3
Multi-Model Based Fault Detection and Diagnosis of a Hydraulic Servo Axis, pp. 13117-13117. Attachment
Muenchhof, Marco — Tech. Univ. Darmstadt

15:00-15:20 ThB31.4
Fault Detection of Actuators and Channel Transmission Using Virtual Simulation, pp. 13118-13118. Attachment
Fawaz, Khaled — LAGIS, UMR-CNRS 8146, Pol. Lille
Merzouki, Rochdi — Ec. Pol. de Lille
Ould bouamama, Belkacem — LAIL

15:20-15:40 ThB31.5
Driver Steering Assistance to Avoid Unintended Lane Departure by Lane Keeping and Steering Suggestions, pp. 13119-13119. Attachment
Minoiu Enache, Nicoleta — INRETS/LCPC - LIVIC Lab.
Netto, Mariana — LIVIC - LCPC/INRETS
Mammar, Said — LSC-CNRS-FRE2494
Lusetti, Benoit — INRETS/LCPC

15:40-16:00 ThB31.6
Hybrid Conveyance System with Automatic Path Planning and Power Assistance, pp. 13120-13120. Attachment
Miyoshi, Takanori — Toyohashi Univ. of Tech.
Miyashita, Yuuki — Toyohashi Univ. of Tech.
Yamamoto, Manabu — Toyohashi Univ. of Tech.
Niinuma, Ayumu — Toyohashi Univ. of Tech.
Kubo, Kazuya — Toyohashi Univ. of Tech.
Terashima, Kazuhiko — Toyohashi Univ. of Tech.

ThC02 304A
Output Feedback Control (Regular Session)
Chair: Yurkevich, Valery D. — Novosibirsk State Tech. Univ.
Co-Chair: Farza, Mondher — Univ. DE CAEN, ENSICAEN

16:30-16:50 ThC02.1
A Modified Design for the VS-MRAC Based on the Indirect Approach: Stability Analysis, pp. 13121-13126.
Barbosa, Josenalde, Oliveira — Agricultural School of Jundiaí
Araujo, Aldayr Dantas de — Federal Univ. of Rio Grande do Norte

16:50-17:10 ThC02.2
A LMI-Based Design of Dynamic Output Feedback Controller for T-S Fuzzy Systems, pp. 13127-13132.
Asemani, Mohammad Hassan — Tarbiat Modares Univ.
Zibaee Nejad, Mohammad Hadi — Tarbiat Modares Univ.
Majd, Vahid Johari — Tarbiat Modares Univ.

17:10-17:30 ThC02.3
Output Regulation of Uncertain Nonaffine in Control Systems Via Singular Perturbation Technique, pp. 13133-13138.
Yurkevich, Valery D. — Novosibirsk State Tech. Univ.
Hwang, Kab-Ju — Univ. of Ulsan

17:30-17:50 ThC02.4
Adaptive Output Feedback Controller for a Class of Uncertain Nonlinear Systems, pp. 13139-13144.
Maatoug, Tarak — ISET Gabčs
Farza, Mondher — Univ. DE CAEN, ENSICAEN
M'Saad, Mohammed — GREYC CNRS UMR 6072
Kamoun, Mohamed — ENIS, SFAX, TUNISIA
Koubaa, Yassine — ENIS SFAX

17:50-18:10 ThC02.5
Decentralized Output Feedback Control of Interconnected Systems Using Low Gain-High Gain Feedback Domination, pp. 13145-13150.

Frye, Michael — Univ. of the Incarnate Word
Qian, Chunjiang — Univ. of Texas at San Antonio
Colgren, Richard — Univ. of Kansas
Oh, Seyool — Univ. of Kansas

18:10-18:30 — ThC02.6
Spatial-Based Output Feedback Adaptive Feedback Linearization Repetitive Control of Uncertain Rotational Motion Systems Subject to Spatially Periodic Disturbances, pp. 13151-13156.
Chen, Cheng-Lun — National Chung Hsing Univ.
Yang, Yen-Hsiu — National Chung Hsing Univ.

ThC03 — 304B
MPC for Constrained Systems (Regular Session)
Chair: Allgower, Frank — Univ. of Stuttgart
Co-Chair: Löfberg, Johan — Linköping Univ.

16:30-16:50 — ThC03.1
Robust Output-Feedback MPC with Soft State Constraints, pp. 13157-13162.
Lřvaas, Christian — Univ. of Newcastle, Australia
Seron, Maria — The Univ. of Newcastle
Goodwin, Graham C. — Univ. of Newcastle

16:50-17:10 — ThC03.2
Explicit Model Predictive Control for Systems with Linear Parameter-Varying State Transition Matrix, pp. 13163-13168.
Besselmann, Thomas — ETH Zurich
Löfberg, Johan — Linköping Univ.
Morari, Manfred — Swiss Federal Inst. of Tech.

17:10-17:30 — ThC03.3
Piecewise Linear Steady–State Target Optimization for Control Systems with MPC: A Case Study, pp. 13169-13174.
Lawrynczuk, Maciej — Warsaw Univ. of Tech.
Marusak, Piotr Marek — Warsaw Univ. of Tech.
Tatjewski, Piotr — Warsaw Univ. of Tech.

17:30-17:50 — ThC03.4
A Robust Model Predictive Control Algorithm with a Reactive Safety Mode, pp. 13175-13181.
Carson, John M. — California Inst. of Tech. Jet Propulsion Lab.
Acikmese, Behcet — Jet Propulsion Lab.
Murray, Richard M. — California Inst. of Tech.
MacMynowski, Douglas G. — California Inst. of Tech.

17:50-18:10 — ThC03.5
Dynamic Model Predictive Control, pp. 13182-13187.
Martensson, Karl — Faculty of Engineering, Lund Univ.
Wernrud, Andreas — Lund Univ.

18:10-18:30 — ThC03.6
Desensitized Model Predictive Control Applied to a Structural Benchmark Problem, pp. 13188-13193.
Lana, Carlos — Purdue Univ.
Rotea, Mario — Univ. of Masschusetts - Amherst

ThC04 — 308
Fuzzy Control (Regular Session)
Chair: Duan, Suolin — Jiangsu Ploytechnic Univ.
Co-Chair: Simandl, Miroslav — Univ. of West Bohemia

16:30-16:50 — ThC04.1
New Approaches to H_infty Controller Designs for Discrete T-S Fuzzy System, pp. 13194-13199.
Pan, Juntao — Univ. of Three Gorges
Wang, Renming — Univ. of Three Gorges
Guerra, Thierry Marie — Univ. of Valenciennes
Tian, Dong — Wuhan Univ. of science and Tech.

16:50-17:10 — ThC04.2
A Fuzzy Sliding Mode Controller and Its Application, pp. 13200-13204.
Duan, Suolin — Jiangsu Ploytechnic Univ.
Zou, Ling — Jiangsu Pol. Univ.
Zhenghua, Ma — Jiangsu Pol. Univ.

17:10-17:30 — ThC04.3
Takagi-Sugeno Fuzzy Coordinated Control System with Original Plant Fuzzy State Observer for a Power Unit, pp. 13205-13210.
Luan, Xiu-chun — Harbin Engineering Univ.
Han, Wei-shi — Qingdao Univ. of Science and Tech.
Young, Ai-guang — Qingdao Univ. of Science and Tech.
Zhai, Yu — Harbin Univ. of Science and Tech.
Yu, Jiang — harbin engineering Univ.

17:30-17:50 — ThC04.4
A Practical Two-Input Single-Output Fuzzy Logic Controller with an Alpha-Beta Prefilter, pp. 13211-13216.
Lee, Ting-En — National Yunlin Univ. of Science and Tech.
Su, Juhng-Perng — National Yunlin Univ. of Secience and Tech.
Yu, Ker-Wei — National Kaohsiung Marine Univ.

17:50-18:10 — ThC04.5
Sensor Fault Compensation for Nonlinear Systems Using Fuzzy Adaptive Sliding Control, pp. 13217-13222.
Zhang, Yingwei — Northeastern Univ.
Qin, S. Joe — Univ. of Southern California

18:10-18:30 — ThC04.6
Robust Fuzzy Guaranteed Cost Controller Design Via Piecewise Lyapunov Function Approach, pp. 13223-13228.
Chen, Jun — Jiangnan Univ.
Liu, Fei — Jiangnan Univ.

ThC05 — 307
Applications of Adaptive Control Methods (Regular Session)
Chair: Fu, Li-Chen — National Taiwan Univ.
Co-Chair: Fatehi, Alireza — K.N. Toosi Univ. of Tech.

16:30-16:50 — ThC05.1
Indirect Adaptive Fuzzy Control of Unmanned Aerial Vehicle, pp. 13229-13234.
Salman, Shaaban Ali — Australian Defence Force Acdemy
Sreenatha, Anavatti G. — Australian Defence Force Acad.
Choi, Jin Young — Seoul National Univ.

16:50-17:10 — ThC05.2
Adaptive Attitude Tracking Control with L2-Gain Performance for an Orbiting Flexible Spacecraft, pp. 13235-13240.
Hu, Qinglei — Harbin Inst. of Tech.

17:10-17:30 — ThC05.3
Spatial Periodic Adaptive Control for Rotary Machine Systems, pp. 13241-13246.
Xu, Jian-Xin — National Univ. of Singapore
Huang, Deqing — National Univ. of Singapore

17:30-17:50 — ThC05.4
Application of a New Scheme for Adaptive Unfalsified Control to a CSTR, pp. 13247-13252.
Wonghong, Tanet — Process control Lab.
Engell, Sebastian — Univ. of Dortmund

17:50-18:10 — ThC05.5
Adaptive Control Approach for Speed Motion-Sensorless of Linear Induction Motor Unknown Resistance and Payload, pp. 13253-13258.
Huang, Chin_I — National Formosa Univ.
Fu, Li-Chen — National Taiwan Univ.

18:10-18:30 — ThC05.6
A Neuro-Fuzzy Controller for Rotary Cement Kilns, pp. 13259-13264.
Fallahpour, Maryam — K.N. Toosi Univ. of Tech.
Fatehi, Alireza — K.N. Toosi Univ. of Tech.
Araabi, Babak N. — Univ. of Tehran
Azizi, Morteza — Saveh Cement Co.

ThC06 — 310A
Complex Systems (Regular Session)
Chair: Niculescu, Silviu-Iulian — Lab. of Signals and Systems (L2S)
Co-Chair: Beghi, Alessandro — Univ. di Padova

16:30-16:50 — ThC06.1
Modeling, Simulation and Control of Large Scale Cryogenic Systems, pp. 13265-13270.
Bradu, Benjamin — CERN (European Organisation for Nuclear Res.
Gayet, Philippe — CERN
Niculescu, Silviu-Iulian — Lab. of Signals and Systems (L2S)

16:50-17:10 ThC06.2
A Dynamic Model for the Thermal-Hygrometric Simulation of Buildings, pp. 13271-13276.
Beghi, Alessandro — Univ. di Padova
Cecchinato, Luca — Univ. di Padova
De Carli, Michele — Univ. di Padova

17:10-17:30 ThC06.3
Effect of Heterogeneity on Synchronization in Complex Network, pp. 13277-13281.
Hao, Binbin — Northeastern Univ.
Jing, Qingshen — Peking Univ.
Wang, Dan — Northeastern Univ.
Zhang, Siying — Northeastern Univ.
Jing, Yuanwei — Northeastern Univ.

17:30-17:50 ThC06.4
Enhancing Complex Network Synchronization Based on the Node Betweeness, pp. 13282-13286.
Wang, Lifu — Northeastern Univ.
Wang, Qingli — Shenyang Inst. of Engineering
Jing, Yuanwei — Northeastern Univ.
Yu, Hao — Northeastern Univ.

17:50-18:10 ThC06.5
Observability of Complex Systems: Minimal Cost Sensor Network Design, pp. 13287-13292.
Chamseddine, Abbas — Univ. d'aix Marseille III
Noura, Hassan — United Arab Emirates Univ.
Ouladsine, Mustapha — Univ. d'aix marseille III
Raharijaona, Thibaut — Paul Cézanne Univ.

18:10-18:30 ThC06.6
Control of Evolutionary Processes, Topological Index and Deformation Theory, pp. 13293-13298.
Aleksandrov, A. G. — Inst. for Control Sciences, Russian Acad. of Sciences
Castro, Jr., Augusto Armando — Federal Univ. of Bahia (Univ. Federal da Bahia
Gruzman, Vladimir A. — Inst. for Control Sciences, Russian Acad. of Sciences

ThC07 310B
Methods in Optimal Control Design (Regular Session)
Chair: Inalhan, Gokhan — Istanbul Tech. Univ.
Co-Chair: Er, Meng Joo — NTU

16:30-16:50 ThC07.1
Optimal Estimation and Regulator: Risk-Sensitive Method, for Systems of First Degree, pp. 13299-13304.
Alcorta Garcia, Maria Aracelia — Autonomous Univ. of Nuevo Leon

16:50-17:10 ThC07.2
Measuring Optimization in Optimal Control of Flexible Aerospace Vehicles, pp. 13305-13309.
Brodsky, Sergey — SUAI, Saint-Petersburg StateUniversityofAerospaceInstrumentation
Nebylov, Alexander — State Univ. of Aerospace Inst.
Panferov, Alexander — SUAI, Saint-Petersburg State Univ. of Aerospace Inst.

17:10-17:30 ThC07.3
Large-Scale Task/Target Assignment for UAV Fleets Using a Distributed Branch and Price Optimization Scheme, pp. 13310-13317.
Karaman, Sertac — Massachusetts Inst. of Tech.
Inalhan, Gokhan — Istanbul Tech. Univ.

17:30-17:50 ThC07.4
Travelling Salesperson Problem for Dynamic Systems, pp. 13318-13323.
Itani, Sleiman — Student, Massachusetts Inst. of Tech.
Frazzoli, Emilio — Massachusetts Inst. of Tech.
Dahleh, Munther A. — Massachusetts Inst. of Tech.

17:50-18:10 ThC07.5
A Methodology for Integrated System Identification, PID Controller Tuning and Noncausal Feedforward Control Desig, pp. 13324-13329.
Carnevale, Claudio — Univ. of Brescia
Piazzi, Aurelio — Univ. of Parma
Visioli, Antonio — Univ. of Brescia

18:10-18:30 ThC07.6
Design and Analysis of Switch Mode Amplifier for Actuator Array Using MIMO Optimal Feedback Quantization, pp. 13330-13335.
Hu, Jwu-Sheng — National Chiao Tung Univ.
Chen, Keng-Yuan — National Chiao Tung Univ.

ThC08 310C
Robust Time-Delay Systems II (Regular Session)
Chair: Iftar, Altug — Anadolu Univ.
Co-Chair: Wu, Min — Central South Univ.

16:30-16:50 ThC08.1
Linear Quadratic Regulation for Discrete-Time Systems with Multiple Delays in Single Input Channel, pp. 13336-13341.
Liu, Shuai — Nanyang Tech. Univ.
Xie, Lihua — Nanyang Tech. Univ.
Zhang, Huanshui — HIT Campus Shenzhen Univ. Town

16:50-17:10 ThC08.2
Stability Crossing Surfaces for Systems with Three Delays, pp. 13342-13347.
Almodaresi, Elham — Yazd Univ.
Bozorg, Mohammad — Yazd Univ.

17:10-17:30 ThC08.3
Stable H-Infinity Controller Design for Systems with Multiple Time-Delays: The Case of Data-Communication Networks, pp. 13348-13354.
Unal, Hakki Ulas — Anadolu Univ.
Iftar, Altug — Anadolu Univ.

17:30-17:50 ThC08.4
New Delay-Dependent H_infty Control for Systems with a Time-Varying Delay, pp. 13355-13360.
He, Yong — Central South Univ.
Wu, Min — Central South Univ.
Liu, Guoping — Univ. of Glamorgan
She, Jin-Hua — Tokyo Univ. of Tech.

17:50-18:10 ThC08.5
Adaptive Backstepping Control of Uncertain Systems with Unknown Input Time-Delay, pp. 13361-13366.
Zhou, Jing — Norwegian Univ. of Science and Tech.
Wang, Wei — Nanyang Tech. Univ.
Wen, Changyun — Nanyang Tech. Univ.

18:10-18:30 ThC08.6
Inverting Control, a New Strategy on Time Delayed Systems, pp. 13367-13372.
Ergenc, Ali F. — Istanbul Tech. Univ.
Fazelinia, Hassan — Univ. of Connecticut
Olgac, Nejat — Univ. of Connecticut

ThC09 311C
Closed Loop Identification (Regular Session)
Chair: Chiuso, Alessandro — Univ. of Padova
Co-Chair: Katayama, Tohru — Doshisha Univ.

16:30-16:50 ThC09.1
A New Subspace Identification Method for Closed-Loop Systems Using Measurable Disturbance, pp. 13373-13378.
Katayama, Tohru — Doshisha Univ.
Ase, Hajime — JFE Engineering Corp.

16:50-17:10 ThC09.2
Bias-Compensated Least Squares Method in Closed Loop Environment, pp. 13379-13384.
Ikeda, Kenji — The Univ. of Tokushima

17:10-17:30 ThC09.3
Relay-Stabilization and Identification of Unstable Processes, pp. 13385-13389.
Co, Tomas B. — Michigan Tech. Univ.

17:30-17:50 ThC09.4
Modeling and Identification of a 3-DOF Planar Actuator with Manipulator, pp. 13390-13395.
Gajdusek, Michal — Tech. Univ. Eindhoven
Damen, Ad A. H. — Eindhoven Univ. of Tech.
van den Bosch, P. P. J. — Eindhoven Univ. of Tech.

17:50-18:10 ThC09.5
Identifiability of Variable Coefficients for Vibrating Systems by

Boundary Control and Observation in Finite Time Duration, pp. 13396-13401.
Guo, Bao-Zhu — The Chinese Acad. of Sciences
Chang, Jin-De — Ocean Univ. of China

18:10-18:30 ThC09.6
A Lagrangian Method for Model Reduction of Controlled Systems, pp. 13402-13407.
Weiland, Siep — Eindhoven Univ. of Tech.
Wildenberg, Jochem Sebastian — IPCOS B.V.
Ozkan, Leyla — IPCOS B.V.
Ludlage, Jobert — IPCOS B.V.

ThC10 311B
Vibration and Modal Analysis (Regular Session)
Chair: Guo, Lei — UMIST
Co-Chair: Goodall, R.M. — Loughborough Univ.

16:30-16:50 ThC10.1
Control of Adaptive Optics System: An H-Infinite Approach., pp. 13408-13413.
Baudouin, Lucie — LAAS-CNRS
Prieur, Christophe — LAAS-CNRS
Guignard, Fabien — Univ. de Toulouse
Arzelier, Denis — LAAS-CNRS

16:50-17:10 ThC10.2
Analysis and Control of Time Delayed Systems Via the Lambert W Function, pp. 13414-13419.
Yi, Sun — Univ. of Michingan
Nelson, Patrick W. — Univ. of Michingan
Ulsoy, A. Galip — Univ. of Michingan

17:10-17:30 ThC10.3
Vibration Analysis of Cavitation in Kaplan Water Turbines, pp. 13420-13425.
Lahdelma, Sulo — Univ. of Oulu
Juuso, Esko Kalevi — Univ. of Oulu

17:30-17:50 ThC10.4
Reduced-Order Active Control for Structural System with Nonlinear Uncertainty Based on Genetic Algorithm, pp. 13426-13431.
Li, Wenzhang — Southeast Univ.
Wu, Lingyao — Southeast Univ.
Guo, Lei — UMIST

17:50-18:10 ThC10.5
Dissipative State Formulations and Numerical Simulation of a Porous Medium for Boundary Absorbing Control of Aeroacoustic Waves, pp. 13432-13437.
Montseny, Emmanuel — Univ. of Toulouse
Casenave, Céline — LAAS-CNRS

18:10-18:30 ThC10.6
A Note on a Vibrating Beam That Made up of Smart Material, pp. 13438-13443.
Liu, C. — Tianjin Univ. of Tech.
Xu, Gen-Qi — Shanxi Univ.
Yung, Siu Pang — Univ. of Hong Kong
Lee, Richard C. H. — Univ. of Cambridge

ThC11 311A
Recent Advances in Iterative and Repetitive Learning Control II (Invited Session)
Chair: Ahn, Hyo-Sung — Gwangju Inst. of Science and Tech. (GIST)
Co-Chair: Rogers, Eric — Univ. of Southampton
Organizer: Ahn, Hyo-Sung — Gwangju Inst. of Science and Tech. (GIST)

16:30-16:50 ThC11.1
Iterative Learning Control of Upper Limb Reaching Using Functional Electrical Stimulation (I), pp. 13444-13449.
Freeman, Christopher Thomas — Univ. of Southampton
Davies, Iain — Univ. of Southampton
Lewin, Paul — Univ. of Southampton
Rogers, Eric — Univ. of Southampton

16:50-17:10 ThC11.2
Arm-Side Evaluation of ILC Applied to a Six-Degrees-Of-Freedom Industrial Robot (I), pp. 13450-13455.
Wallén, Johanna — Linköping Univ.
Norrlof, Mikael — Linköping Univ.
Gunnarsson, Svante — Linkoping Univ.

17:10-17:30 ThC11.3
On Robustness against Measurement Noise of Iterative Learning Control Based Identification (I), pp. 13456-13461.
Sugie, Toshiharu — Kyoto Univ.
Sakai, Fumitoshi — Nara National Coll. of Tech.

17:30-17:50 ThC11.4
Optimal Iterative Learning Control for Batch Processes with Model Parameter Variations Using Strong Tracking Filter (I), pp. 13462-13467.
Xu, Yixin — Tsinghua Univ.
Xiong, Zhihua — Tsinghua U, Beijing, P.R. China
Jiang, Yongheng — Tsinghua Univ.
Huang, Dexian — Tsinghua Univ.

17:50-18:10 ThC11.5
Successive Linearization-Based Stochastic Repetitive Control Technique and Its Applications to SMB and CATOFIN Processes (I), pp. 13468-13473.
Lee, Kwang Soon — Sogang Univ.
Yun, Woohyun — Sogang Univ.
Won, Wangyun — Sogang Univ.
Lee, Jay — Georgia Tech.

18:10-18:30 ThC11.6
Fast Iterative Learning Control for Delay Systems: A Predictive Approach, pp. 13474-13479.
Meng, Deyuan — Beihang Univ. (BUAA)
Jia, Yingmin — Beihang Univ.
Du, Junping — Beijing Univ. of Posts and Telecommunications
Yuan, Shiying — Henan Pol. Univ.

ThC12 313
Switching and Hybrid Stochastic Systems (Regular Session)
Chair: Hwang, Inseok — Purdue Univ.
Co-Chair: Costa, Oswaldo Luiz V. — Univ. of Sao Paulo

16:30-16:50 ThC12.1
Generalized Coupled Algebraic Riccati Equations for Discrete-Time Markov Jump with Multiplicative Noise Systems, pp. 13480-13485.
Costa, Oswaldo Luiz V. — Univ. of Sao Paulo
Paulo, Wanderlei Lima — Escola Pol. da Univ. de São Paulo

16:50-17:10 ThC12.2
State-Feedback H-Infty Control for Nonlinear Stochastic Systems with Markovian Jumps in Infinite Time Horizon, pp. 13486-13491.
Lin, Zhongwei — Beijing Univ. of Aeronautics and Astronautics
Lin, Yan — Beijing Univ. of Aeronautics and

17:10-17:30 ThC12.3
Generalized Mean-Variance Portfolio Selection Model with Regime Switching, pp. 13492-13497.
Costa, Oswaldo Luiz V. — Univ. of Sao Paulo
Araujo, Michael — Univ. de São Paulo

17:30-17:50 ThC12.4
Performance Analysis of Kalman Filter Based Hybrid Estimation Algorithms, pp. 13498-13503.
Seah, Chze Eng — Purdue Univ.
Hwang, Inseok — Purdue Univ.

17:50-18:10 ThC12.5
Hybrid Operating Regime Selection Algorithm in Local Modeling, pp. 13504-13508.
Uosaki, Katsuji — Fukui Univ. of Tech.
Hatanaka, Toshiharu — Osaka Univ.

18:10-18:30 ThC12.6
An Efficient Hybrid Estimator, pp. 13509-13514.
Pina, Luís — Inst. Superior Técnico, Tech. Univ. of Lisbon
Botto, Miguel Ayala — Tech. Univ. of Lisbon

ThC13 314
Robust and Nonlinear Estimation (Regular Session)
Chair: Yaz, Edwin — Marquette Univ.
Co-Chair: Fujimoto, Kenji — Nagoya Univ.

16:30-16:50 ThC13.1
Current Output Observer for Stochastic-Parameter Models and

Application to Sensor Failure, pp. 13515-13520.
Hounkpevi, Franck — Marquette Univ.
Yaz, Edwin — Marquette Univ.

16:50-17:10 — ThC13.2
Robust FILTERING FOR Ito STOCHASTIC Systems SUBJECT TO SENSOR NONLINEARITIES, pp. 13521-13526.
Ho, Daniel W. C. — City Univ. of Hong Kong
Niu, Yugang — East China Univ. of Science & Tech.
Li, C. W. — City Univ. of Hong Kong

17:10-17:30 — ThC13.3
Gaussian Filter Based on Deterministic Sampling for High Quality Nonlinear Estimation, pp. 13527-13532.
Huber, Marco F. — Univ. Karlsruhe (TH)
Hanebeck, Uwe — Univ. Karlsruhe

17:30-17:50 — ThC13.4
Discrete-Time H-Infinity Gaussian Filter, pp. 13533-13538.
Tahmasebi, Ali — Univ. of Windsor
Chen, Xiang — Univ. of Windsor

17:50-18:10 — ThC13.5
Set Membership State Estimation for Nonlinear Systems Using Contraction Theory, pp. 13539-13544.
Videau, Gaétan — Univ. Bordeaux1
Raissi, Tarek — Univ. Bordeaux 1
Zolghadri, Ali — Univ. Bordeaux I

18:10-18:30 — ThC13.6
Independent Component Analysis for Nonminimum Phase Systems Using H_infinity Filters, pp. 13545-13550.
Fukunaga, Shuichi — Nagoya Univ. Metropolitan Coll. of Industrial Tech.
Fujimoto, Kenji — Nagoya Univ.

ThC14 — 318
Fault Tolerance and Coordination in Networked Control Systems (Invited Session)
Chair: Patton, Ron J. — Univ. of Hull
Co-Chair: Franze', Giuseppe — Univ. della Calabria
Organizer: Patton, Ron J. — Univ. of Hull

16:30-16:50 — ThC14.1
Robust FDI for FTC Coordination in a Distributed Network System (I), pp. 13551-13556.
Klinkhieo, Supat — Univ. of Hull
Patton, Ron J. — Univ. of Hull
Kambhampati, C. — Univ. of Hull

16:50-17:10 — ThC14.2
Fault Detection for Networked Systems with Incomplete Measurements (I), pp. 13557-13562.
He, Xiao — Tsinghua Univ.
Wang, Zidong — Brunel Univ.
Zhou, Donghua — Tsinghua Univ.

17:10-17:30 — ThC14.3
Fault Tolerance Enhancement in Distribution Power Grids: A Voltage Set-Point Reconfiguration Approach (I), pp. 13563-13568.
Casavola, Alessandro — Univ. Della Calabria
Franze', Giuseppe — Univ. della Calabria
Patton, Ron J. — Univ. of Hull

17:30-17:50 — ThC14.4
Advanced Design Scheme for Fault Tolerant Distributed Networked Control Systems (I), pp. 13569-13574.
Ding, Steven X. — Univ. of Duisburg-Essen
Zhang, Ping — Univ. of Duisburg-Essen
Chihaia, Cristian Ionut — Univ. of Duisburg-Essen
Li, Wei — Univ. of Duisburg-Essen
Wang, Yongqiang — Tsinghua Univ.
Ding, E.L. — Univ. of Applied Sciences Gelsenkirchen

17:50-18:10 — ThC14.5
Design of Distributed Fault Tolerant Control Systems (I), pp. 13575-13580.
Sa da Costa, Jose — IST, TULisbon
Mendes, Mário J. G. C. — Inst. Superior de Engenharia de Lisboa, Pol. Inst.

18:10-18:30 — ThC14.6
Network Topology Design, pp. 13581-13586.
Fencl, Tomas — Czech Tech. Univ. in Prague, Faculty of Electrical Engi
Burget, Pavel — Czech Tech. Univ. in Prague, FEE
Bilek, Jan — Czech Tech. Univ. in Prague

ThC15 — 317
Control Issues in Biological Wastewater Treatment (Invited Session)
Chair: Pons, Marie-Noelle — ENSIC
Co-Chair: Brdys, Mietek M.A. — Univ. of Birmingham
Organizer: Pons, Marie-Noelle — ENSIC
Organizer: Brdys, Mietek M.A. — Univ. of Birmingham

16:30-16:50 — ThC15.1
Nonlinear PI Control for Dissolved Oxygen Tracking at Wastewater Treatment Plant (I), pp. 13587-13592.
Han, Yu — The Univ. of Birmingham
Brdys, Mietek M.A. — Univ. of Birmingham
Piotrowski, Robert — Gdansk Univ. of Tech.

16:50-17:10 — ThC15.2
Comparison of Sludge Wastage Control Strategies (I), pp. 13593-13598.
Pons, Marie-Noelle — ENSIC
Potier, Olivier — Nancy Univ.

17:10-17:30 — ThC15.3
Evaluation of Different Nitrogen Control Strategies for a Combined Pre and Post-Denitrification Plant (I), pp. 13599-13604.
Stare, Aljaž — Jožef Stefan Inst.
Hvala, Nadja — Jožef Stefan Inst.
Vre
;ko, Darko — Jožef Stefan Inst.
Strmcnik, Stanko — Jozef Stefan Inst.

17:30-17:50 — ThC15.4
Modeling and Monitoring of Microbial Diversity in Ecosystems - Application to Biological Wastewater Treatment (I), pp. 13605-13610.
Ramirez, Ivan — INRA
Volcke, Eveline — Ghent Univ. Dept. Applied Mathematics, Biometrics and Proc
Steyer, Jean-Philippe — INRA

17:50-18:10 — ThC15.5
Regulation of Volatile Fatty Acids and Total Alkalinity in Anaerobic Digesters (I), pp. 13611-13616.
Palacios-Ruiz, Bernardo — Univ. of Guadalajara
Méndez-Acosta, Hugo Oscar — Univ. of Guadalajara
Alcaraz-Gonzalez, Victor — Univ. of Guadalajara - CUCEI
Gonzalez-Alvarez, Victor — Univ. of Guadalajara
Pelayo-Ortiz, Carlos — Univ. of Guadalajara - CUCEI

18:10-18:30 — ThC15.6
Hierarchical Control Strategy for an Integrated Wastewater Treatment Plant, pp. 13617-13622.
Hoo, Karlene — Texas Tech. Univ.
Zhang, Xi — Texas Tech. Univ.

ThC17 — 320A
Control Education: Remote Laboratories (Regular Session)
Chair: Fontanili, Franck — Ec. des Mines d'Albi-Carmaux
Co-Chair: Navarro, Jose Luis — Univ. Pol. de Valencia

16:30-16:50 — ThC17.1
Inter-University Network of Remote Laboratories, pp. 13623-13628.
Dominguez Gonzalez, Manuel — Univ. de Leon
Fuertes Martinez, Juan Jose — Univ. de Leon
Reguera Acevedo, Perfecto — Univ. de Leon
Prada, Miguel Angel — Univ. de Leon
Moran Alvarez, Antonio — Univ. de Leon

16:50-17:10 — ThC17.2
Remote Laboratory for Control Engineering Degrees, pp. 13629-13633.
Grau, Antoni — Tech. Univ. of Catalonia, UPC
Bolea, Yolanda — Univ. Pol. de Catalunya (UPC)

17:10-17:30 — ThC17.3
An Experimental Platform for E-Manufacturing and Advanced Control, pp. 13634-13639.
Fontanili, Franck — Ec. des Mines d'Albi-Carmaux
van Oudenhove, Thomas — ARMINES - Ec. des Mines d'Albi-Carmaux

17:30-17:50 ThC17.4
Remote Labs and Resource Sharing in Control Systems Education, pp. 13640-13645.
Burget, Pavel — Czech Tech. Univ. in Prague, FEE
Fiala, OndY;ej — Czech Tech. Univ. in Prague, FEE
Fencl, Tomas — Czech Tech. Univ. in Prague, Faculty of Electrical Engi
Moc, Lukáš — Czech Tech. Univ. in Prague, FEE

17:50-18:10 ThC17.5
ARTIST: A Distributed Remote Control Lab, pp. 13646-13651.
Basso, Michele — Univ. di Firenze
Romagnoli, Marco — Univ. di Firenze
Innocenti, Giacomo — Univ. di Firenze

18:10-18:30 ThC17.6
Remote Fuzzy Control of a DC Motor, pp. 13652-13658.
Navarro, Jose Luis — Univ. Pol. de Valencia
Díez, José Luis — Univ. Pol. de Valencia
Valera, Angel — Univ. Pol. de Valencia
Valles, Marina — Assistant Professor

ThC18 320B
Robotics Vision (Regular Session)
Chair: Shimada, Akira — Pol. Univ.
Co-Chair: Zhuang, Yan — Dalian Univ. of Tech.

16:30-16:50 ThC18.1
Design and Implementation of a Visual Feedback Control System Driven by Wires, pp. 13659-13664.
Shimada, Akira — Pol. Univ.
Gotoh, Kazuyuki — Pol. Univ. Japan

16:50-17:10 ThC18.2
Autonomous Surgical Robot Using Visual Servoing in the Extended Image Plane, pp. 13665-13670.
Perez, Carlos — Univ. Miguel Hernández
Morales Vidal, Ricardo — Univ. Miguel Hernandez
Garcia, Nicolas M. — Univ. Miguel Hernandez
Azorin, Jose M. — Univ. Miguel Hernandez de Elche
Sabater, Jose M. — Univ. Miguel Hernandez
Cervera Mateu, Enric — Univ. Jaume I

17:10-17:30 ThC18.3
Robot Detecting System of Burnable Gun Bore Based on Radio Transmission, pp. 13671-13676.
Xu, Jun — Harbin Univ. of Science and Tech.
Cui, Juan — Harbin Univ. of Science and Tech.
You, Bo — Harbin Univ. of Science and Tech.
Li, Xin — Harbin Univ. of science and Tech.

17:30-17:50 ThC18.4
Towards Autonomous Fixed-Wing Unmanned Aerial Vehicle Landing: A Vision-Aided Inertial Navigation under Sensor Reconfiguration Scenario, pp. 13677-13682.
Joo, Sungmoon — Stanford Univ.
Al-Ali, Khalid M. — Carnegie Mellon Univ. - West
Ippolito, Corey — NASA Ames Res. Center
Yeh, Yoo Hsiu — Carnegie Mellon Univ. Coast Campus

17:50-18:10 ThC18.5
Monocular Vision Tracking Based on Hybrid Particle Filters for a Person Following Robot, pp. 13683-13688.
Zhuang, Yan — Dalian Univ. of Tech.
Wang, Wei — Dalian Univ. of Tech.
Liu, Yisha — Dalian Univ. of Tech.
Liu, Yang — Dalian Univ. of Tech.

18:10-18:30 ThC18.6
Analysis and Characterization of the PMD Camera for Application in Mobile Robotics, pp. 13689-13694.
Wiedemann, Matthias — Univ. of Wuerzburg
Sauer, Markus — Univ. of Würzburg
Driewer, Frauke — Univ. Würzburg
Schilling, Klaus — Univ. Wuerzburg

ThC19 320C
Intelligent Robotics Systems (Regular Session)
Chair: Dumitrache, Ioan — Univ. Pol. of Bucharest
Co-Chair: Salichs, Miguel A. — Univ. Carlos III

16:30-17:10 ThC19.1
Attackability in Games of Pursuit and Evasion with Antagonizing Players, pp. 13695-13700.
Ma, Hongbin — National Univ. of Singapore
Ge, Shuzhi Sam — National Univ. of Singapore
Lum, Kai-Yew — National Univ. of Singapore

17:10-17:30 ThC19.2
A Knowledge-Based Robot Searching for an Unpredictable Goal under Unknown Environment, pp. 13701-13706.
Wang, Huifang — Beijing Univ. of Tech.
Chen, Yangzhou — Beijing Univ. of Tech. Beijing, 100022,P.R.China

17:30-17:50 ThC19.3
An Order-Based Approach to Mission-Oriented Autonomous Robot Control: Managing Complexity, Merging Multiple Plans, and Performance Analysis Given Partial Probabilistic Information, pp. 13707-13712.
Li, Keyong — Boston Univ.
D'Andrea, Raffaello — Cornell Univ.

17:50-18:10 ThC19.4
Intelligent Control Via New Efficient Logics, pp. 13713-13718.
Vassilyev, Stanislav — Inst. of Control Sciences, Russian Acad. of Sciences
Davydov, Artem — Inst. for System Dynamics and Control Theory, SiberianBranch

18:10-18:30 ThC19.5
Agent-Based Theory Applied in Mobile Robotics, pp. 13719-13724.
Dumitrache, Ioan — Univ. Pol. of Bucharest
Dragoicea, Monica — Univ. Pol. of Bucharest

ThC20 321C
Automation in Micro and Nano-Handling II (Invited Session)
Chair: Fatikow, Sergej — Fak.II, AMiR
Co-Chair: Rakotondrabe, Micky — Univ. de Franche Comté
Organizer: Fatikow, Sergej — Fak.II, AMiR

16:30-16:50 ThC20.1
Robust Feedforward-Feedback Control of a Hysteretic Piezocantilever under Thermal Disturbance (I), pp. 13725-13730.
Rakotondrabe, Micky — Univ. de Franche Comté
Diouf, Mamadou — FEMTO-st
Lutz, Philippe — Univ. de Franche Comté

16:50-17:10 ThC20.2
Semi-Automated Control of AFM-Based Nanomanipulation Using Potential Fields (I), pp. 13731-13736.
Ladjal, Hamid — Univ. of Orléans
Ferreira, Antoine — Univ. d'Orléans- ENSI de Bourges

17:10-17:30 ThC20.3
A Nanomanipulation Platform for Semi Automated Manipulation of Nano-Sized Objects Using Mobile Microrobots Inside a Scanning Electron Microscope (I), pp. 13737-13742.
Canales, Christophe — EPFL

17:30-17:50 ThC20.4
Nanomanipulation and Nanoassembly of Carbon Nanotubes Inside Electron Microscopes (I), pp. 13743-13748.
Nakajima, Masahiro — Nagoya Univ.
Liu, Pou — Japan
Fukuda, Toshio — Nagoya Univ.

17:50-18:10 ThC20.5
Estimation of Electrical Cell–Capillary Admittance During Injection with Frequency Response Method (I), pp. 13749-13754.
Hirvonen, Juha Robert — Tampere Univ. of Tech.
Vilkko, Matti Kalervo — Tampere Univ. of Tech.
Roinila, Tomi — Tampere Univ. of Tech.
Kallio, Pasi — Tampere Univ. of Tech.

ThC21 321B
Human Cognition, Speech and Decision-Making (Regular Session)
Chair: Zuehlke, Detlef — TU Kaiserslautern
Co-Chair: Yoon, Wan Chul — Korea Advanced Inst. of Science and Tech.

16:30-16:50 ThC21.1
Neuro-Adaptive Motion Controller with Velocity Observer for Operational Space Formulation, pp. 13755-13760.
Soewandito, Dandy — National Univ. of Singapore
Oetomo, Denny Nurjanto — Monash Univ.

Ang Jr, Marcelo H — National Univ. of Singapore

16:50-17:10 — ThC21.2

Evolving a Hierarchical Decision Making Mechanism Using Fuzzy Logic, pp. 13761-13766.

Beldek, Ulas — Cankaya Univ.
Leblebicioglu, Kemal — Middle East Tech. Univ.

17:10-17:30 — ThC21.3

An Activity-Theoretic Approach to Intention Estimation, pp. 13767-13772.

Jipp, Meike — Univ. of Mannheim
Bartolein, Christian — Univ. of Mannheim
Badreddin, Essam — Univ. of Heidelberg

17:30-17:50 — ThC21.4

Face Detection with Colour Segmentation and Fuzzy Template Matching, pp. 13773-13778.

Boccioli, Marco — CERN
Panzieri, Stefano — Univ. di Roma Tre
Díez, José Luis — Univ. Pol. de Valencia

17:50-18:10 — ThC21.5

Methodologies on Brain-Machine Interaction, pp. 13779-13784.

Ge, Shuzhi Sam — National Univ. of Singapore
Pan, Yaozhang — National Univ. of Singapore
Mamun, Abdullah Al — National Univ. of Singapore

18:10-18:30 — ThC21.6

Personalized Use Models in Ambient Intelligence Environments, pp. 13785-13790.

Görlich, Daniel — Univ. of Kaiserslautern
Thiels, Nancy — German Res. Center of Artificial Intelligence
Meixner, Gerrit — German Res. Center for Artificial Intelligence

ThC22 — 321A

Sensing, Fault Detection and Control of Hydraulic Systems (Regular Session)

Chair: Muenchhof, Marco — Tech. Univ. Darmstadt
Co-Chair: Yao, Bin — Purdue Univ.

16:30-16:50 — ThC22.1

A Study on Hydraulic Load Simulator a Study on Hydraulic Load Simulator Using Self Tuning Grey Predictor – Fuzzy PID, pp. 13791-13796.

Dinh, Quang Truong — Univ. of Ulsan

16:50-17:10 — ThC22.2

Velocity Control for a Variable Displacement Hydraulic Servo System Using Adaptive Fuzzy Sliding-Mode Control, pp. 13797-13802.

Chiang, Mao-Hsiung — National Taiwan Univ.
Lee, Lian-Wang — National Taiwan Univ. of Science and Tech.
Chen, Chung-Chi — National Taiwan Univ. of Science and Tech.
Liu, Hsien-Hsueh — National Taiwan Univ. of Science and Tech.

17:10-17:30 — ThC22.3

Displacement Sensor Fault Tolerance for Hydraulic Servo Axis, pp. 13803-13808.

Muenchhof, Marco — Tech. Univ. Darmstadt

17:30-17:50 — ThC22.4

Model Adjustment and Multi-Model Based Fault Diagnosis for Hydraulic Servo Axis, pp. 13809-13814.

Muenchhof, Marco — Tech. Univ. Darmstadt
Beck, Mark — Tech. Univ. Darmstadt

17:50-18:10 — ThC22.5

Fault Detection, Identification and Accommodation for an Electro-Hydraulic System: An Adaptive Robust Approach, pp. 13815-13820.

Gayaka, Shreekant — Purdue Univ.
Yao, Bin — Purdue Univ.

18:10-18:30 — ThC22.6

Soil Estimation Based on Dissipation Energy During Autonomous Excavation, pp. 13821-13826.

Mohseni-Vahed, Shahram — King's Coll. London
Althoefer, Kaspar — King's Coll. London
Seneviratne, Lakmal D — King's Coll. London
Song, Xiaojing — King's Coll. London
Dai, J. S. — King's Coll. lLondon
Lam, H. K. — King's Coll. London

ThC23 — 323

Production and Logistics Structures As Complex Adaptive Systems (CASs) (Invited Session)

Chair: Monostori, Laszlo — Computer and Automation Res. Inst. Hungarian
Co-Chair: Verstraete, Paul — K.U.Leuven
Organizer: Monostori, Laszlo — Computer and Automation Res. Inst. Hungarian
Organizer: Valckenaers, Paul — K.U.Leuven
Organizer: Csáji, Balázs Csanád — MTA SZTAKI (Computer and Automation Res. Acad. of Sciences)

16:30-16:50 — ThC23.1

Intelligent Product = Intelligent Agent + Intelligent Being (I), pp. 13827-13832.

Valckenaers, Paul — K.U.Leuven
Saint Germain, Bart — K.U.Leuven
Verstraete, Paul — K.U.Leuven
Van Belle, Jan — K.U.Leuven
Hadeli, — K.U.Leuven
Van Brussel, Hendrik — K. U. Leuven

16:50-17:10 — ThC23.2

A Complexity Model for Networks of Collaborating Enterprises (I), pp. 13833-13838.

Csáji, Balázs Csanád — MTA SZTAKI (Computer and Automation Res.
Monostori, Laszlo — Computer and Automation Res. Inst. Hungarian

17:10-17:30 — ThC23.3

Correlation Analysis of TSUNAMI Effect and Failure Rate Fluctuation in Manufacturing System (I), pp. 13839-13844.

Nonaka, Youichi — Production Engineering Res. Lab. Hitachi, Ltd
Lengyel, Attila, — Production Engineering Res. Lab. Hitachi Ltd.
Sugimoto, Koichi, — Tokyo Inst. of Tech.

17:30-17:50 — ThC23.4

A Simulation-Based Decision-Support System : The Example of a Furniture Manufacturer (I), pp. 13845-13850.

Klein, Thomas — Nancy Univ.
Thomas, André — Nancy Univ.
Morel, Gerard — Nancy Univ.
El Haouzi, Hind — Nancy Univ.

17:50-18:10 — ThC23.5

Real-Time, Cooperative Enterprises for Customized Mass Production; Challenges and Solution Approaches (I), pp. 13851-13856.

Monostori, Laszlo — Computer and Automation Res. Inst. Hungarian
Váncza, Józsaf — MTA SZTAKI
Kis, Tamas — Computer and Automation Res. Inst.
Erdos, Gabor — SZTAKI
Karnok, David — MTA SZTAKI
Egri, Peter — Computer and Automation Res. Inst. HungarianAcademy of

ThC24 — 324

Internet of Services (Invited Session)

Chair: Mueller, Joerg — Tech. Univ. of Clausthal
Co-Chair: Panetto, Hervé — Nancy-Univ.
Organizer: Mueller, Joerg — Clausthal Univ. of Tech.
Organizer: Zhou, Xuan — SAP
Organizer: Panetto, Hervé — ESIAL - Nancy-Univ.

16:30-16:50 — ThC24.1

Model Tranformation of Collaborative Business Process into Mediation Information System (I), pp. 13857-13862.

Pingaud, Hervé — ENSTIMAC
Benaben, Frederick — Ec. des Mines d'Albi-Carmaux
Touzi, Jihed — Ec. des Mines d'Albi Carmaux

16:50-17:10 — ThC24.2

Graphical Languages for Business Processes and Manufacturing Operations (I), pp. 13863-13868.

Johnsson, Charlotta — Lund Univ.

17:10-17:30 ThC24.3

Using a Commercially Successful Empirical Enterprise Framework : Deterministic Service Oriented Architecture Service Levels (I), pp. 13869-13873.

McKeachie, Ian — Griffith Univ.
Vlacic, Ljubo — Griffith Univ.

17:30-17:50 ThC24.4

A Peer-To-Peer-Based Service Infrastructure for Distributed Power Generation (I), pp. 13874-13879.

Stäber, Fabian — Siemens AG
Gerdes, Christoph — Siemens AG
Mueller, Joerg — Clausthal Univ. of Tech.

17:50-18:10 ThC24.5

Semantics in Industrial Distributed Systems (I), pp. 13880-13887.

Obitko, Marek — Czech Tech. Univ.
Vrba, Pavel — Rockwell Automation
Marik, Vladimir — Rockwell Automation
Radakovic, Miloslav — Rockwell Automation

18:10-18:30 ThC24.6

MasDISPO_xt: Annealing Furnace Planning Inside the Supply Chain of Steel Production (I), pp. 13888-13892.

Jacobi, Sven — Saarstahl AG
Leon-Soto, Esteban — DFKI GmbH
Madrigal-Mora, Cristian — DFKI GmbH
Fischer, Klaus — DFKI GmbH

ThC25 328

Industrial Application Results of Process Control (Regular Session)

Chair: Bitmead, Robert — Univ. of California San Diego
Co-Chair: Won, Sangchul — Pohang Univ. of Science & Tech.

16:30-16:50 ThC25.1

Root Cause Diagnosis of Plant-Wide Oscillations Using the Adjacency Matrix, pp. 13893-13900.

Jiang, Hailei — Univ. of alberta
Patwardhan, Rohit — Matrikon Inc.
Shah, Sirish — Univ. of Alberta

16:50-17:10 ThC25.2

Hybrid NMPC of a Supermarket Refrigeration System Using Sequential Optimization, pp. 13901-13906.

Sonntag, Christian — Tech. Univ. Dortmund
Devanathan, Arvind — Univ. Dortmund
Engell, Sebastian — Univ. of Dortmund

17:10-17:30 ThC25.3

Stabilization of Gas-Lift Oil Wells Using Topside Measurements, pp. 13907-13912.

Scibilia, Francesco — NTNU
Hovd, Morten — Norwegian Univ. of Tech. and Science
Bitmead, Robert — Univ. of California San Diego

17:30-17:50 ThC25.4

Controlled Variables Selection for Liquefied Natural Gas Plant, pp. 13913-13918.

Singh, Arjun — Norwegian Univ. of Science and Tech.
Hovd, Morten — Norwegian Univ. of Tech. and Science
Kariwala, Vinay — Nanyang Tech. Univ.

17:50-18:10 ThC25.5

Managing Steam and Concentration Disturbances in Multi-Effect Evaporators Via Nonlinear Modelling and Control, pp. 13919-13924.

Adams, Gregory John — Univ. of Newcastle
Burke, Brendan — CSR
Goodwin, Graham C. — Univ. of Newcastle
Gravdahl, Jan Tommy — Norwegian Univ. of Science & Tech.
Peirce, Rob — CSR
Rojas, Alejandro J. — The Univ. of Newcastle

18:10-18:30 ThC25.6

Closed Loop Regulatory Control Strategies for a Fluidized Bed Reactor: An Industrial Case Study, pp. 13925-13931.

Shenoy, Arjun — National Inst. of Tech. Karnataka, Suratkal
Bhat, Chetan — National Inst. of Tech. Karnataka, Suratkal
Gundappa, Madhukar — Honeywell Tech. Solutions Lab.
Gudi, Ravindra — IIT Bombay

ThC26 327

Intelligent Control of Power Plants (Invited Session)

Chair: Lee, Kwang Y. — Baylor Univ.
Co-Chair: Malik, O.P. — The Univ. of Calgary
Organizer: Lee, Kwang Y. — Baylor Univ.

16:30-16:50 ThC26.1

Comparative Performance of Neuro-Fuzzy PSS Architectures with Adaptive Input Link Weights and Nonlinear Functions (I), pp. 13932-13937.

Ramirez-Gonzalez, Miguel — Univ. of Calgary
Malik, O.P. — The Univ. of Calgary

16:50-17:10 ThC26.2

Controller Design for a 1000 MW Ultra Super Critical Once-Through Boiler Power Plant (I), pp. 13938-13943.

Lee, Kwang Y. — Baylor Univ.
Van Sickel, Joel H. — Pennsylvania State Univ.
Hoffman, Jason A. — Pennsylvania State Univ.
Jung, Won-Hee — Doosan Heavy Industry and Construction Co.
Kim, Sung-Ho — Doosan Heavy Industry and Construction Co.

17:10-17:30 ThC26.3

Fuzzy Compensation of Power-Voltage Interaction in a Combustion Turbogenerator (I), pp. 13944-13949.

Hernandez-Rodriguez, Isaura — National Res. and Development Centre
Garduno-Ramirez, Raul — Electrical Res. Inst.
Garcia-Beltran, Carlos Daniel — National Res. and Development Centre

17:30-17:50 ThC26.4

Development of an Optimal Operational Planning System for Energy Plants in Steelworks (I), pp. 13950-13951.

Kitagawa, Shinji — Fuji Electric Advanced Tech.
Matsui, Tetsuro — Fuji Electric Advanced Tech.
Matsumoto, Koji — Fuji Electric Systems
Nishida, Hideyuki — Fuji Electric Systems
Fukuyama, Yoshikazu — Fuji Electric Systems
Tominaga, Futoshi — JFE Steel
Mizushima, Narihito — JFE Steel

17:50-18:10 ThC26.5

Carbon Reduction Potential with Intelligent Control of Power Systems (I), pp. 13952-13957.

Venayagamoorthy, Ganesh — Missouri Univ. of Science and Tech.
Braband, Gabriele — Simmons & Simmons

18:10-18:30 ThC26.6

Intelligent Control Solutions for Steam Power Plants to Balance the Fluctuation of Wind Energy (I), pp. 13958-13963.

Haase, Torsten — Univ. of Rostock
Weber, Harald — Univ. of Rostock

ThC27 326

Virtual Automation Networks (Invited Session)

Chair: Neumann, Peter — Inst. f. Automation und Kommunikation Magdeburg, Germany
Co-Chair: Jumar, Ulrich — ifak - Inst. f. Automation u. Kommunikation
Organizer: Neumann, Peter — Inst. f. Automation und Kommunikation Magdeburg, Germany
Organizer: Jumar, Ulrich — ifak - Inst. f. Automation u. Kommunikation

16:30-16:50 ThC27.1

Architectural Concept of Virtual Automation Networks (I), pp. 13964-13969.

Neumann, Peter — Inst. f. Automation und Kommunikation Magdeburg, Germany
Pöschmann, Axel — ifak
Messerschmidt, Ralf — ifak

16:50-17:10 ThC27.2

Evaluation of Real-Time Behaviour in Virtual Automation Networks (I), pp. 13970-13975.
Beran, Jan — Brno Univ. of Tech. Faculty of Electrical
Zezulka, Frantisek — VUT

17:10-17:30 ThC27.3
Secure Virtual Automation Networks Based on a Generic Procedure Model (I), pp. 13976-13981.
Wolframm, Mario — Teleport Sachsen-Anhalt GmbH
Adamczyk, Heiko — Inst. f. Automation und Kommunikation e.V. Magdeburg

17:30-17:50 ThC27.4
Wireless Network Integration into Virtual Automation Networks (I), pp. 13982-13987.
Rauchhaupt, Lutz — Res. Inst.
Lakkundi, Vishwas — Brno Univ. of Tech.

17:50-18:10 ThC27.5
Public Network and Telecontrol Concepts in Virtual Automation Networks (I), pp. 13988-13992.
Balzer, Dietrich — Company
Werner, Thomas — ifak
Messerschmidt, Ralf — ifak

18:10-18:30 ThC27.6
Engineering Concept of Virtual Automation Networks (I), pp. 13993-13998.
Diedrich, Christian — Otto-von-Guericke-Univ. Magdeburg
Hengster, Harry — Schneider Electric
Hoffmann, Martin — Otto-von-Guericke Univ. Magdeburg

ThC28 330A
Launch Vehicle and Missile Autopilot (Regular Session)
Chair: Padhi, Radhakant — Indian Inst. of Science
Co-Chair: Jun, Byung-Eul — Agency for Defense Development

16:30-16:50 ThC28.1
Implementation of Linear Homing Guidance Law on a Two-Part Homing Missile, pp. 13999-14004.
Özkan, Bülent — TUBITAK-SAGE
Mahmutyaz1;c1;o_;lu, Gökmen — TUBITAK-SAGE
Özgören, Kemal — Middle East Tech. Univ.

16:50-17:10 ThC28.2
Self-Scheduling Controller for a Launcher in Atmospheric Ascent, pp. 14005-14010.
Saussie, David Alexandre — Ec. Pol. de Montréal
Baldesi, Gianluigi — Univ. of Rome
Doll, Carsten — ONERA
Berard, Caroline — SUPAERO

17:10-17:30 ThC28.3
Gliding Strategy Design with the Use of Discrete Optimization, pp. 14011-14016.
Kowalczuk, Zdzislaw — Gdansk Univ. of Tech.
Olinski, Krzysztof E. — Gdansk Univ. of Tech.

17:30-17:50 ThC28.4
Absolutely Stable Region for Missile Guidance Loop, pp. 14017-14022.
Kim, Jong-Ju — Agency for Defense Development
Lyou, Joon — Chungnam National Univ.

17:50-18:10 ThC28.5
Energy-Insensitive Guidance of Solid Motor Propelled Long Range Flight Vehicles Using MPSP and Dynamic Inversion, pp. 14023-14028.
Kothari, Mangal — Univ. of Leicester, Leicester, UK
Padhi, Radhakant — Indian Inst. of Science

18:10-18:30 ThC28.6
A Nonlinear Roll Autopilot Based on 5-Dof Models of Missiles, pp. 14029-14035.
Jun, Byung-Eul — Agency for Defense Development

ThC29 330B
Small Satellites and Propulsion Systems (Invited Session)
Chair: Schilling, Klaus — Univ. Wuerzburg
Co-Chair: Nakasuka, Shinichi — Univ. of Tokyo
Organizer: Schilling, Klaus — Univ. Wuerzburg

16:30-16:50 ThC29.1
Attitude Determination for the Nano-Satellite UWE-2 (I), pp. 14036-14041.
Schilling, Klaus — Univ. Wuerzburg
Schmidt, Marco — Univ. Wuerzburg
Ravandoor, Karthik — Univ. Wuerzburg
Kurz, Oliver — Univ. Wuerzburg
Busch, Stephan — Univ. Wuerzburg

16:50-17:10 ThC29.2
Backstepping Based Approach for Controlling Spacecraft Micro Pump for Propulsion System (I), pp. 14042-14047.
Teodorescu, Catalin-Stefan — L'Ec. Supérieure d'Electricité SUPELEC
Siguerdidjane, Houria — SUPELEC
Arzande, Amir — SUPELEC
Vannier, Jean-Claude — SUPELEC
Gebbers, Pit — SUPELEC
Roux, Francois — CSTM

17:10-17:30 ThC29.3
System Design and Control Aspect of a Novel Satellite Concept Panel Extension Satellite (PETSAT) (I), pp. 14048-14053.
Nakasuka, Shinichi — Univ. of Tokyo

17:30-17:50 ThC29.4
Spacecraft Attitude Dynamics and Control in the Presence of Large Magnetic Residuals, pp. 14054-14059.
Corno, Matteo — Pol. di Milano
Lovera, Marco — Pol. di Milano

ThC30 330C
Automatic Control, Optimization, Real-Time Operations in Transportation (Regular Session)
Chair: Werner, Herbert — Hamburg Univ. of Tech.
Co-Chair: Papageorgiou, Markos — Tech. Univ. of Crete

16:30-16:50 ThC30.1
Distributed Controller Design for Dynamic Speed Limit Control against Shock Waves on Freeways, pp. 14060-14065.
Popov, Andrey — Hamburg Univ. of Tech.
Babuska, Robert — Delft Univ. of Tech.
Hegyi, Andreas — Delft Univ. of Tech.
Werner, Herbert — Hamburg Univ. of Tech.

16:50-17:10 ThC30.2
An Efficient Model for Urban Traffic Network Control, pp. 14066-14071.
Lin, Shu — Shanghai Jiao Tong Univ.
Xi, Yugeng — Shanghai Jiao Tong Univ.

17:10-17:30 ThC30.3
Model-Based Speed Limit Control with Different Traffic State Measurements, pp. 14072-14077.
Burger, Mernout — Norwegian Univ. of Science and Tech.
Hegyi, Andreas — Delft Univ. of Tech.
De Schutter, Bart — Delft Univ. of Tech.

17:30-17:50 ThC30.4
Dual EKF State and Parameter Estimation in Multi-Class First-Order Traffic Flow Models, pp. 14078-14083.
van Lint, Hans — Delft Univ. of Tech. Faculty of CivilEngineering andGeoscie
Hegyi, Andreas — Delft Univ. of Tech.
Hoogendoorn, Serge P. — Delft Univ. of Tech. Faculty of Civil Engineering and

17:50-18:10 ThC30.5
Integrated Ramp Metering and Variable Speed Limit Control of Motorway Traffic Flow, pp. 14084-14089.
Papamichail, Ioannis — Tech. Univ. of Crete
Kampitaki, Katerina — Tech. Univ. of Crete
Papageorgiou, Markos — Tech. Univ. of Crete
Messmer, Albert — - independent engineer -

18:10-18:30 ThC30.6
Adaptive Control of Generalised Dynamically Substructured Systems, pp. 14090-14095.
Stoten, David P. — Univ. of Bristol
Tu, Jia-Ying — Univ. of Bristol
Li, Guang — The Univ. of Bristol

ThC31 306

Intelligent Robotics (Video Session)

Chair: Chung, Wan Kyun — Pohang Univ. of Science & Tech.
Co-Chair: Song, Jae-Bok — Korea Univ.

16:30-16:50 ThC31.1
Feasibility Test Results of Bilateral Teleoperation Using the Energy-Bounding Algorithm, pp. 14096-14096. Attachment
Seo, Changhoon — Gwangju Inst. of Science and Tech. (GIST)
Kim, Jong-Phil — Korea Inst. of Science and Tech.
Lim, Yo-An — Gwangju Inst. of Science and Tech. (GIST)
Yoon, Joo Hong — Agency for Defense Development
Ryu, Jeha — Gwangju Inst. of Science and Tech. (GIST)

16:50-17:10 ThC31.2
Basketball Robot: Ball-On-Plate System without Visual Information, pp. 14097-14097. Attachment
Lee, Kwang-Kyu — TUM

17:10-17:30 ThC31.3
Block Type Modular Robot: Mom's Friend, pp. 14098-14098. Attachment
Ahn, Ho Seok — Seoul National Univ.
Baek, Young Min — Seoul National Univ.
Choi, Jin Young — Seoul National Univ.

17:30-17:50 ThC31.4
A Mascot-Type Facial Robot with a Linear Dynamic Affect-Expression Model, pp. 14099-14099. Attachment
Lee, Hui Sung — Korea Advanced Inst. of Science and Tech. (KAIST)
Park, Jeong Woo — KAIST
Jo, Su Hun — KAIST
Kim, Min-gyu — KAIST
Lee, Wonhyong — KAIST
Chung, Myung Jin — KAIST

17:50-18:10 ThC31.5
Sensor Fusion for Augmented Reality, pp. 14100-14100. Attachment
Gustafsson, Fredrik — Linköping Univ.
Schön, Thomas, Bo — Linköping Univ.
Hol, Jeroen — Linköping Univ.

FrPL1 Auditorium

SmartFactory - from Vision to Reality in Factory Technologies by Detlef Zuehlke (Plenary Session)

Chair: Nof, Shimon Y. — Purdue Univ.

09:00-10:00 FrPL1.1
SmartFactory - from Vision to Reality in Factory Technologies, pp. 14101-14108.
Zuehlke, Detlef — TU Kaiserslautern

FrA02 304A

Robust Nonlinear Control (Regular Session)

Chair: Scherer, Carsten W. — Delft Univ. of Tech.
Co-Chair: Shim, Hyungbo — Seoul National Univ.

10:30-10:50 FrA02.1
Output Feedback Stabilization for Systems Presenting Sector-Bounded Nonlinearities and Saturating Inputs, pp. 14109-14114.
Gomes Da Silva Jr., Joao Manoel — Univ. Federal do Rio Grande do Sul (UFRGS)
Corso, Jones — UFSC
Castelan, Eugenio B. — Univ. Federal de Santa Catarina

10:50-11:10 FrA02.2
Robust Controller Synthesis for the Attenuation of Non-Stationary Sinusoidal Disturbances with Uncertain Frequencies, pp. 14115-14120.
Koroglu, Hakan — Delft Univ. of Tech.
Scherer, Carsten W. — Delft Univ. of Tech.

11:10-11:30 FrA02.3
State Feedback Controller Design for a Class of Nonlinear Systems with General Criteria, pp. 14121-14124.
Jeong, Chung Seop — Marquette Univ.
Yaz, Edwin — Marquette Univ.
Yaz, Yvonne — Milwaukee School of Engineering

11:30-11:50 FrA02.4
Robust Output Feedback Controller Scheme for a Class of Uncertain Nonlinear Systems, pp. 14125-14130.
Kuvulmaz, Janset — yildiz Tech. Univ.
Zergeroglu, Erkan — Gebze Inst. of Tech.

11:50-12:10 FrA02.5
Robust Tracking Controller Backstepping Design for SISO Uncertain Nonlinear System, pp. 14131-14137.
Yu, Yao — Tsinghua Univ.
Zhong, Yi-Sheng — Tsinghua Univ.

12:10-12:30 FrA02.6
Control Lyapunov Functions: New Framework for Nonlinear Controller Design, pp. 14138-14143.
He, Yu-qing — Shenyang Inst. of Automation, Chinese Acad. ofSciences
Han, Jianda — Shenyang Inst. of Automation

FrA03 304B

Anti-Windup Strategies (Regular Session)

Chair: Turner, Matthew C. — Univ. of Leicester
Co-Chair: Pogromsky, A. Yu. — Eindhoven Univ. of Tech.

10:30-10:50 FrA03.1
Anti-Windup and the Preservation of Robustness against Structured Norm-Bounded Uncertainty, pp. 14144-14149.
Morales, Rafael Mauricio — The Univ. of Manchester
Li, Guang — The Univ. of Bristol
Heath, William Paul — Univ. of Manchester

10:50-11:10 FrA03.2
A New Perspective on Anti-Windup Design Based on Experimental Results, pp. 14150-14155.
van den Berg, R.A. — Eindhoven Univ. of Tech.
Pogromsky, A. Yu. — Eindhoven Univ. of Tech.
Rooda, J.E. — Eindhoven Univ. of Tech.

11:10-11:30 FrA03.3
Nonlinear Dynamic Inversion Based Anti-Windup - an Aerospace Application, pp. 14156-14161.
Menon, Prathyush P — Univ. of Leicester
Herrmann, Guido — Univ. of Bristol
Turner, Matthew C. — Univ. of Leicester
Lowenberg, Mark — Univ. of Bristol
Bates, Declan G. — Univ. of Leicester
Postlethwaite, Ian — the Univ. of Leicester

11:30-11:50 FrA03.4
Practical Approaches to Low-Order Anti-Windup Compensator Design: A Flight Control Comparison, pp. 14162-14167.
Kerr, Murray Lawrence — Leicester Univ.
Turner, Matthew C. — Univ. of Leicester
Postlethwaite, Ian — the Univ. of Leicester

11:50-12:10 FrA03.5
On the Tracking Problem for Linear Systems Subject to Control Saturation, pp. 14168-14173.
Vieira Flores, Jeferson — UFRGS
Eckhard, Diego — UFRGS
Gomes Da Silva Jr., Joao Manoel — Univ. Federal do Rio Grande do Sul (UFRGS)

12:10-12:30 FrA03.6
A Robust Algorithm against Actuator Saturation Using Integral Sliding Mode and Composite Nonlinear Feedback, pp. 14174-14179.
Bandyopadhyay, Bijnan — IIT Bombay
Fulwani, Deepak — Indian Inst. of Tech. Bombay India (IIT-Bombay)
Park, Youngjin — KAIST

FrA04 308

Discrete-Time Nonlinear Systems (Regular Session)

Chair: Petersen, Ian Richard — Univ. of New South Wales - ADFA
Co-Chair: Pakshin, Pavel — Arzamas Pol. Inst. of Nizhny Novgorod State Tech. Univ.

10:30-10:50 FrA04.1
Exponential Dissipativity of Discrete-Time Stochastic Systems and Robust Simultaneous Stabilization Via Output Feedback, pp. 14180-14185.
Pakshin, Pavel — Arzamas Pol. Inst. of Nizhny Novgorod State Tech.

Soloviev, Sergey — N.I. Lobachevsky Univ. of Nizhny Novgorod

10:50-11:10 — FrA04.2

Robust Control for Nonlinear Discrete-Time Systems with Quantitative Input to State Stability Requirement, pp. 14186-14191.

Huang, Shoudong — Univ. of Tech. Sydney
Su, Steven W. — Univ. of Tech. Sydney

11:10-11:30 — FrA04.3

Discretized PID Control and Robust Stabilization for Continuous Plants, pp. 14192-14198.

Okuyama, Yoshifumi — Humanitech Lab.

11:30-11:50 — FrA04.4

A Discrete-Time Integral Sliding Mode Control Approach for Output Tracking with State Estimation, pp. 14199-14204.

Xu, Jian-Xin — National Univ. of Singapore
Abidi, Khalid — National Univ. of Singapore

11:50-12:10 — FrA04.5

Discrete Time Robust H^infty Control of a Class of Nonlinear Uncertain Systems, pp. 14205-14210.

Ainikkal, Shaiju Johny — UNSW@ADFA
Petersen, Ian Richard — Univ. of New South Wales - ADFA

12:10-12:30 — FrA04.6

Integral Sliding Mode Output Tracking Controller for Sampled-Data Systems, pp. 14211-14216.

Xu, Jian-Xin — National Univ. of Singapore
Abidi, Khalid — National Univ. of Singapore

FrA05 — 307

Applications of Nonlinear Control Methods (Regular Session)

Chair: Chung, Chung Choo — Hanyang Univ.
Co-Chair: Ryvkin, Sergey — Trapeznikov Inst. of Control Sciences of RussianAcademy of Sciences

10:30-10:50 — FrA05.1

Control of HIV Infection Dynamics by the Enhancement of the Immune System, pp. 14217-14222.

Chang, H.J. — Imperial Coll. London
Astolfi, Alessandro — Imperial Col. London & Univ. of Rome Tor Vergata

10:50-11:10 — FrA05.2

Fixed-Point DSP Implementation of Nonlinear H-Infinity Controller for Large Gap Electromagnetic Suspension System, pp. 14223-14228.

Rocha, Paulo Henrique da — Brazilian Navy Tech. Center.
Ferreira, Henrique Cezar — Univ. of Sao Paulo
Porsch, Michael Cláudio — Brazilian Navy Tech. Center.
Sales, Roberto Moura — Escola Pol. da USP

11:10-11:30 — FrA05.3

Passive Actuators' Fault Tolerant Control for Affine Nonlinear Systems, pp. 14229-14234.

Benosman, Mouhacine — TL@National Univ. of Singapore
Lum, Kai-Yew — National Univ. of Singapore

11:30-11:50 — FrA05.4

Decentralized Robust PI Controller Design for an Industrial Utility Boiler - an IMC Method, pp. 14235-14240.

Labibi, Batool — K. N. Toosi Univ. of Tech.
Marquez, Horacio J. — Univ. of Alberta
Chen, Tongwen — Univ. of Alberta

11:50-12:10 — FrA05.5

Applications of Sliding Mode Control to Drive Systems Fed by a Three-Level Voltage-Source Inverter, pp. 14241-14246.

Ryvkin, Sergey — Trapeznikov Inst. of Control Sciences of RussianAcademyof S
Schmidt-Obermoeller, Richard — Ruhr-Univ. Bochum
Steimel, Andreas — Ruhr-Univ. Bochum

12:10-12:30 — FrA05.6

Stability Analysis of an Electric Parking Brake (EPB) Systems with a Nonlinear Proportional Controller, pp. 14247-14253.

Lee, Young Ok — Hanyang Univ.
Lee, Choong Woo — Hanyang Univ.
Chung, Chung Choo — Hanyang Univ.
Son, Youngseop — MANDO
Yoon, Paljoo — Mando Corp.
Hwang, In-Yong — Mando Corp.

FrA06 — 310A

Fractional Differentiation and Its Applications I (Invited Session)

Chair: Sabatier, Jocelyn — Univ. Bordeaux1
Co-Chair: Baleanu, Dumitru — Cankaya Univ. Faculty of Arts and Sciences
Organizer: Dugard, Luc — CNRS-INPG-UJF
Organizer: Sabatier, Jocelyn — Univ. Bordeaux1

10:30-11:10 — FrA06.1

An Overview of the CRONE Approach in System Analysis, Modeling and Identification, Observation and Control (I), pp. 14254-14265.

Oustaloup, Alain — Univ. Bordeaux 1 - ENSEIRB - ENSCBP
Sabatier, Jocelyn — Univ. Bordeaux1
Lanusse, Patrick — Univ. de Bordeaux
Malti, Rachid — Univ. Bordeaux 1
Melchior, Pierre — Univ. Bordeaux 1 - ENSEIRB - ENSCPB
Moze, Mathieu — Univ. Bordeaux 1

11:10-11:30 — FrA06.2

GPC Control of a Fractional-Order Plant: Improving Stability and Robustness (I), pp. 14266-14271.

Romero, Miguel — UNED
Vinagre, B. M. — Univ. de Extremadura
de Madrid, A. P. — UNED

11:30-11:50 — FrA06.3

Computation of Stability Margins for Uncertain Linear Fractional-Order Systems Using Interval Constraint Propagation (I), pp. 14272-14276.

Nataraj, P.S.V. — Indian Inst. of Tech.
Kalla, Rambabu — IIT Bombay
Deshpande, Manoj — Indian Inst. of Tech. Bombay, Mumbai , INDIA

11:50-12:10 — FrA06.4

Half-Order Modelling of Electrical Networks Application to Stability Studies (I), pp. 14277-14282.

Octavian, Enacheanu — Univ.
Delphine, Riu — Univ.
Nicolas, Retičre — Univ.

12:10-12:30 — FrA06.5

Synthesis of Havriliak-Negami Functions for Time-Domain System Identification (I), pp. 14283-14288.

Sommacal, Laurent — Univ. Bordeaux 1 - ENSEIRB
Melchior, Pierre — Univ. Bordeaux 1 - ENSEIRB - ENSCPB
Malti, Rachid — Univ. Bordeaux 1
Oustaloup, Alain — Univ. Bordeaux 1 - ENSEIRB - ENSCBP

FrA07 — 310B

Algorithm and Software for Optimal Control (Regular Session)

Chair: Werner, Herbert — Hamburg Univ. of Tech.
Co-Chair: Coulaud, Jean-Baptiste — Univ. Catholique de Louvain (UCL)

10:30-10:50 — FrA07.1

Improving Trajectory Constraints Processing in Some Optimal Control Algorithms, pp. 14289-14294.

Coulaud, Jean-Baptiste — Univ. Catholique de Louvain (UCL)
Campion, Guy — UCL-CESAME

10:50-11:10 — FrA07.2

An Accelerator for Packages Solving Discrete-Time Optimal Control Problems, pp. 14295-14300.

Chung, Hoam — Univ. of California, Berkeley
Polak, Elijah — Univ. of California
Sastry, Shankar — Univ. of California at Berkeley

11:10-11:30 — FrA07.3

Solving the Goddard Problem with Thrust and Dynamic Pressure Constraints Using Saturation Functions, pp. 14301-14306.

Graichen, Knut — Vienna Univ. of Tech.
Petit, Nicolas — Ec. des Mines de Paris

11:30-11:50 — FrA07.4

A Continuation Approach to State and Adjoint Calculation in Optimal Control Applied to the Reentry Problem, pp. 14307-14312.

Graichen, Knut — Vienna Univ. of Tech.

Petit, Nicolas — Ec. des Mines de Paris

11:50-12:10 FrA07.5

A Globally Convergent Conjugate Gradient Method for Minimizing Self-Concordant Functions on Riemannian Manifolds, pp. 14313-14318.

Ji, Huibo — Australian National Univ.
Manton, Jonathan H. — The Australian National Univ.
Moore, John B. — Australian National Univ.

12:10-12:30 FrA07.6

A Hybrid Gradient-LMI Algorithm for Solving BMIs in Control Design Problems, pp. 14319-14323.

Chughtai, Saulat Shuja — Tech. Univ. of Hamburg-Harburg
Abbas, Hossam — Hamburg Univ. of Tech.
Werner, Herbert — Hamburg Univ. of Tech.

FrA08 310C

Reachability, Estimation and Control Synthesis under Uncertainty I (Invited Session)

Chair: Kurzhanski, A.B. — Univ. of California, Berkeley
Co-Chair: Rakovic, Sasa V. — ETH Zurich
Organizer: Kurzhanski, A.B. — Univ. of California, Berkeley
Organizer: Rakovic, Sasa V. — ETH Zurich

10:30-10:50 FrA08.1

Dynamic Augmentation and Complexity Reduction of Set-Based Constrained Control (I), pp. 14324-14329.

Blanchini, Franco — Univ. degli Studi di Udine
Miani, Stefano — Univ. degli Studi di Udine
Savorgnan, Carlo — LAAS-CNRS

10:50-11:10 FrA08.2

Robust Stability and Synthesis of Nonlinear Discrete Control Systems under Uncertainty (I), pp. 14330-14335.

Kuntsevich, Vsevolod — Space Res. Inst. of NAS and NSA of Ukraine
Kuntsevich, Alexei — V.M.Glushkov Inst. of Cybernetics

11:10-11:30 FrA08.3

Stochastic Reachability and Measurement Feedback under Control-Dependent Noise (I), pp. 14336-14341.

Digailova, Irina — Moscow State (Lomonosov) Univ.
Kurzhanski, A.B. — Univ. of California, Berkeley
Varaiya, Pravin P. — Univ. of California at Berkeley

11:30-11:50 FrA08.4

Approximate Viability Using Quasi-Random Samples and a Neural Network Classifier (I), pp. 14342-14347.

Djeridane, Badis — ETH Zurich
Lygeros, John — ETH Zurich

11:50-12:10 FrA08.5

On Mismatch between Initializations at Coder/Decoder in Quantized Control (I), pp. 14348-14353.

Kameneva, Tatiana — Univ. of Melbourne
Nesic, Dragan — Univ. of Melbourne

12:10-12:30 FrA08.6

Target Problems under State Contraints for Anisotropic Affine Dynamics - a Numerical Analysis Based on Viability Theory (I), pp. 14354-14359.

Crück, Eva — Ec. Pol. / CNRS

FrA09 311C

Continuous Time System Identification (Regular Session)

Chair: Kim, Youngchol — Chungbuk National Univ.
Co-Chair: Wang, Liuping — RMIT Univ.

10:30-10:50 FrA09.1

Issues in Sampling and Estimating Continuous-Time Models with Stochastic Disturbances, pp. 14360-14365.

Ljung, Lennart — Linköping Univ.
Wills, Adrian George — Univ. of Newcastle

10:50-11:10 FrA09.2

Identification of First-Order Time-Delay Systems Using Two Different Pulse Inputs, pp. 14366-14371.

Leon de la Barra, Bernardo A. — Univ. of Tasmania
Jin, Lihua — Chungbuk National Univ.
Kim, Youngchol — Chungbuk National Univ.
Mossberg, Magnus — Karlstad Univ.

11:10-11:30 FrA09.3

State and Parameter Estimation for Systems in Non-Canonical Adaptive Observer Form, pp. 14372-14378.

Tyukin, Ivan — Univ. of Leicester
Steur, Erick — Tech. Univ. of Eindhoven
Nijmeijer, Hendrik — Eindhoven Univ. of Tech.
Van Leeuwen, Cees — Riken Brain Science Inst.

11:30-11:50 FrA09.4

An Optimal Instrumental Variable Method for Continuous-Time Fractional Model Identification, pp. 14379-14384.

Malti, Rachid — Univ. Bordeaux 1
Victor, Stephane, Stephane — Univ. Bordeaux1, IMS
Oustaloup, Alain — Univ. Bordeaux 1 - ENSEIRB - ENSCBP
Garnier, Hugues — Univ. Henri Poincaré, Nancy 1

11:50-12:10 FrA09.5

Parameter Estimation of Two-Dimensional Linear Differential Systems Via Fourier Based Modulation Function, pp. 14385-14390.

Sadabadi, Mahdiye Sadat — Amirkabir Univ. of Tech.
Shafiee, Masoud — Amirkabir Univ. of Tech.
Karrari, Mehdi — Amirkabir Univ. of Tech.

12:10-12:30 FrA09.6

Black-Box Identification and Simulation of Continuous-Time Nonlinear Systems with Random Processes, pp. 14391-14396.

Vinet, Sylvain — SUPELEC
Vazquez, Emmanuel — Supélec

FrA10 311B

Switching Control I (Regular Session)

Chair: Mosterman, Pieter — The MathWorks, Inc.
Co-Chair: Zhang, Weicun — Univ. of Science and Tech. Beijing

10:30-10:50 FrA10.1

Extensions of LaSalle's Invariance Principle for Switched Nonlinear Systems, pp. 14397-14402.

Wang, Jinhuan — Inst. of Systems Science,Chinese Acad. of Sciences
Cheng, Daizhan — Chinese Acad. of Sciences

10:50-11:10 FrA10.2

A Unified Analysis of Switching Multiple Model Adaptive Control Virtual Equivalent System Approach, pp. 14403-14408.

Zhang, Weicun — Univ. of Science and Tech. Beijing
Li, Xiaoli — Univ. of Science and Tech. Beijing
Choi, Jin Young — Seoul National Univ.

11:10-11:30 FrA10.3

Robust Stabilization of Nonlinear Sandwich Plants Containing Generalized Hysteresis Nonlinearities, pp. 14409-14414.

Manni, Andrea — Univ. of Lecce
Parlangeli, Gianfranco — Univ. degli studi di Lecce
Corradini, Maria Letizia — Univ. di Camerino

11:30-11:50 FrA10.4

Bumpless Transfer for Adaptive Switching Controls, pp. 14415-14420.

Cheong, Shin-Young — Univ. of Southern California
Safonov, Michael G. — Univ. of Southern California

11:50-12:10 FrA10.5

Chaotification for a Class of Nonlinear Systems with Backlash Functions, pp. 14421-14425.

Guan, Zhi-Hong — Huazhong Univ. of Science & Tech.
Liu, Na — Huazhong Univ. of Science & Tech.

12:10-12:30 FrA10.6

Sliding Mode Control and Feedback Linearization for Non-Regular Systems, pp. 14426-14431.

Zhang, Fu — The Mathworks
Fernandez, Benito — The Univ. of Texas at Austin
Mosterman, Pieter — The MathWorks, Inc.
Josserand, Timothy — The Univ. of Texas at Austin

FrA11 311A

Gain Scheduling (Regular Session)

Chair: Choi, Ho-Lim — Dong-A Univ.
Co-Chair: Iannelli, Luigi — Univ. of Sannio in Benevento

10:30-10:50 FrA11.1

A Discrete-Time Adaptive ILC for Systems with Random Initial Condition and Iteration-Varying Trajectory, pp. 14432-14437.

Chi, Ronghu — Qingdao Univ. of Science and Tech.

Sui, Shulin — Qingdao Univ. of Science and Tech.
Yu, Lei — Qingdao Univ. of Science and Tech.

10:50-11:10 FrA11.2
Analysis of Periodic Solutions in Piecewise Linear Feedback Systems Via a Complementarity Approach, pp. 14438-14443.
Iannelli, Luigi — Univ. of Sannio in Benevento
Vasca, Francesco — Univ. of Sannio

11:10-11:30 FrA11.3
Dissipative Control for Singularly Perturbed Fuzzy Systems, pp. 14444-14448.
Lo, Ji-Chang — National Central Univ.

11:30-11:50 FrA11.4
On Robust Position Control of DC Motors by epsilon-PID Controller and Its Application to Humanoid Robot Arms, pp. 14449-14453.
Choi, Ho-Lim — Dong-A Univ.
Lim, Jong-Tae — KAIST

11:50-12:10 FrA11.5
Stability Analysis - Multiconvexity Approach, pp. 14454-14459.
Lo, Ji-Chang — National Central Univ.

12:10-12:30 FrA11.6
Speed Control for a Biped Robot, pp. 14460-14466.
Tegegne, Brhanemedhn — Epic Systems
Homaifar, Abdollah — North Carolina A&T State Univ.
Sayyar-Rodsari, Bijan — Pavilion Tech.

FrA12 313
Supervisory Control Design and Applications (Invited Session)
Chair: Zhou, Meng Chu — New Jersey Inst. of Tech.
Co-Chair: Hanisch, Hans-Michael — Martin Luther Univ. Halle-Wittenberg
Organizer: Zhou, Meng Chu — New Jersey Inst. of Tech.
Organizer: Li, Zhiwu — Xidian Univ.

10:30-10:50 FrA12.1
A Siphon-Based Deadlock Prevention Policy for a Class of Petri Nets-S3PMR (I), pp. 14467-14472.
Yan, Mingming — Xidian Univ.
Zhu, Rongming — Xidian Univ.
Li, Zhiwu — Xidian Univ.
Wang, Anrong — Xidian Univ.
Zhou, Meng Chu — New Jersey Inst. of Tech.

10:50-11:10 FrA12.2
A Modular Synthesis Approach for Distributed Safety Controllers, Part A: Modelling and Specification (I), pp. 14473-14478.
Missal, Dirk — Martin Luther Univ. Halle-Wittenberg
Hanisch, Hans-Michael — Martin Luther Univ. Halle

11:10-11:30 FrA12.3
A Modular Synthesis Approach for Distributed Safety Controllers, Part B: Modular Control Synthesis (I), pp. 14479-14484.
Missal, Dirk — Martin Luther Univ. Halle-Wittenberg
Hanisch, Hans-Michael — Martin Luther Univ. Halle

11:30-11:50 FrA12.4
Fuzzy Petri Nets Based Rescheduling Model for Semiconductor Production and Its Application (I), pp. 14485-14489.
Qiao, Fei — Tongji Univ.
Wu, Qidi — Tongji Univ.
Li, Li — Tongji Univ. P.R.C
Wang, Zuntong — Tongji Univ.
Cao, Zhengcai — Tongji Univ.

11:50-12:10 FrA12.5
Enumeration Algorithms for Maximal Perfect-Resource-Transition Circuits and Strict Minimal Siphons in S3PR (I), pp. 14490-14495.
Xing, Keyi — Xi'an Jiaotong Univ.
Zhou, Meng Chu — New Jersey Inst. of Tech.

FrA13 314
Optimal Filtering and Estimation (Regular Session)
Chair: Nakamori, Seiichi — Kagoshima Univ.
Co-Chair: Han, Soo Hee — Seoul National Univ.

10:30-10:50 FrA13.1
Design of Quadratic Estimators Using Covariance Information in Linear Discrete-Time Stochastic Systems, pp. 14496-14501.
Nakamori, Seiichi — Kagoshima Univ.
Hermoso, Aurora — Granada Univ.
Linares-Perez, Josefa — Granada Univ.

10:50-11:10 FrA13.2
A Unified Solution to Unbiased Minimum-Variance Estimation for Systems with Unknown Inputs, pp. 14502-14509.
Hsieh, Chien-Shu — Ta Hwa Inst. of Tech.

11:10-11:30 FrA13.3
Closed Form Filtering for Linear Fractional Transformation Models, pp. 14510-14515.
Pasha, Syed Ahmed — The Univ. of New South Wales
Tuan, Hoang Duong — The Univ. of New South Wales

11:30-11:50 FrA13.4
Optimal Filtering for Systems with Multiple Random Measurement Delays, pp. 14516-14521.
Sun, Shuli — Heilongjiang Univ.

11:50-12:10 FrA13.5
Optimal Filter Design for Polynomial Systems, pp. 14522-14527.
Basin, Michael V. — Autonomous Univ. of Nuevo Leon
Shi, Peng — Faculty of Advanced Tech.
Calderon Alvarez, Dario — Autonomous Univ. of Nuevo Leon

12:10-12:30 FrA13.6
Optimal Estimation for Linear Singular Systems Using Moving Horizon Estimation, pp. 14528-14533.
Boulkroune, Boulaid — Nancy Univ.
Darouach, Mohamed — Univ. Henri Poincare-Nancy
Zasadzinski, Michel — Cran

FrA14 318
Management of Natural Resources I (Regular Session)
Chair: Mareels, Iven — The Univ. of Melbourne
Co-Chair: Feliu, Vicente — Univ. of Castilla-La Mancha

10:30-10:50 FrA14.1
Flood Forecasting for Heteroscedastic Streamflow Processes, pp. 14534-14539.
Pianosi, Francesca — Pol. di Milano
Raso, Luciano — Pol. di Milano

10:50-11:10 FrA14.2
On-Line Design of Water Reservoir Policies Based on Inflow Prediction, pp. 14540-14545.
Castelletti, Andrea — Pol. di Milano
De Rigo, Daniele — Pol. di Milano
Tepsich, Luca — Pol. di Milano
Soncini-Sessa, Rodolfo — Pol. di Milano
Weber, Enrico — Pol. di Milano

11:10-11:30 FrA14.3
Extended Ritz Method for Reservoir Management Over an Infinite Horizon, pp. 14546-14551.
Pianosi, Francesca — Pol. di Milano
Soncini-Sessa, Rodolfo — Pol. di Milano

11:30-11:50 FrA14.4
A Modelling Methodology for Natural Dam-River Network Systems, pp. 14552-14557.
Zhuan, Xiangtao — Univ. of Pretoria
Zheng, Guilin — Wuhan Univ.
Xia, Xiaohua — Univ. of Pretoria

11:50-12:10 FrA14.5
Fractional Ilalpha Controller Combined with a Smith Predictor for Effective Water Distribution in a Main Irrigation Canal Pool, pp. 14558-14563.
Castillo, Fernando J. — Univ. of Castilla La Mancha
Rivas Perez, Raul — Havana Pol. Univ.
Feliu, Vicente — Univ. of Castilla-La Mancha

12:10-12:30 FrA14.6
Gain-Scheduled Smith PID Controllers for LPV Systems with Time Varying Delay: Application to an Open-Flow Canal, pp. 14564-14569.
Bolea, Yolanda — Univ. Pol. de Catalunya (UPC)
Puig, Vicenc — Univ. Pol. de Catalunya
Blesa, Joaquim — Univ. Pol. de Catalunya (UPC)

FrA15 317
Bioprocess Control Applications (Regular Session)
Chair: Bai, Er-Wei — Univ. of Iowa
Co-Chair: Steyer, — INRA

Jean-Philippe

10:30-10:50 FrA15.1

Nonlinear Model Predictive Control Applied to E. Coli Cultures, pp. 14570-14575.

Hafidi, Ghizlane — supélec
Tebbani, Sihem — Supelec
Dumur, Didier — Ec. Superieure d'Electricite
Vande Wouwer, Alain — Faculté Pol. de Mons

10:50-11:10 FrA15.2

Modeling and Parameter Estimation of Endothelial Cells, pp. 14576-14581.

Bai, Er-Wei — Univ. of Iowa

11:10-11:30 FrA15.3

Estimation of Microalgal Photobioreactor Production Based on Total Inorganic Carbon in the Medium, pp. 14582-14587.

Becerra-Celis, Giuliana — SUPELEC
Tebbani, Sihem — Supelec
Joannis-Cassan, Claire — Ec. Centrale Paris
Isambert, Arsene — Ec. Centrale Paris
Boucher, Patrick — Ec. Superieure d'Electricite

11:30-11:50 FrA15.4

Optimal Feedback Control of Microalgal Growth Based on the Slow Reduction, pp. 14588-14593.

Papacek, Stepan — Univ. of South Bohemia
Celikovsky, Sergej — Inst. of Information Theory and Automation, Acad. of Science o
Ruiz-Leon, Javier — CINVESTAV Guadalajara

11:50-12:10 FrA15.5

Modeling the Temporal Evolution of the Drosophila Gene Expression, pp. 14594-14599.

Haye, Alexandre — Univ. Libre de Bruxelles
Dehouck, Yves — Univ. Libre de Bruxelles
Kwasigroch, Jean-Marc — Univ. Libre de Bruxelles
Bogaerts, Philippe — Univ. Libre de Bruxelles
Rooman, Marianne — Univ. Libre de Bruxelles

12:10-12:30 FrA15.6

Classification of Activated Sludge Settleability Using Linear and Nonlinear Classification Functions, pp. 14600-14605.

Gins, Geert — Katholieke Univ. Leuven
Vanlaer, Jef — Katholieke Univ. Leuven
Smets, Ilse — Biotec - Bioprocess Tech. And Control
Van Impe, Jan F.M. — Katholieke Univ. Leuven

FrA17 320A
Control Education: Simulation & Modelling Learning Tools (Regular Session)

Chair: Giarre', Laura — Univ. di Palermo
Co-Chair: Dormido, Sebastián — UNED

10:30-10:50 FrA17.1

Interactive Learning Module: Basic Modelling and Identification Concepts, pp. 14606-14611.

Guzman, Jose Luis — Univ. of Almeria
Astrom, Karl J. — Lund Inst. of Tech.
Dormido, Sebastián — UNED
Hagglund, Tore — Professor
Piguet, Yves — Calerga Sarl
Berenguel, Manuel — Univ. of Almeria

10:50-11:10 FrA17.2

Innovative Tools for Real-Time Simulation of Dynamic Systems, pp. 14612-14617.

Palli, Gianluca — Univ. of Bologna
Carloni, Raffaella — Univ. of Bologna
Melchiorri, Claudio — Univ. of Bologna

11:10-11:30 FrA17.3

A Unified Approach for Classroom and Laboratory Control Systems Education, pp. 14618-14623.

Kassas, Zaher — National Inst.
Dunia, Ricardo — National Inst.

11:30-11:50 FrA17.4

Learn2Control: A Web-Based Framework for Project-Oriented Control Education, pp. 14624-14629.

Tometzki, Thomas — Univ. Dortmund
Volker, Marten — Chair of Process Control
Christian, Blichmann — Univ. Dortmund
Ernesto, Elias-Nieland — Univ. Dormund
Sonntag, Christian — Univ. Dortmund
Engell, Sebastian — Univ. of Dortmund

11:50-12:10 FrA17.5

Blogging As a Research and Educational Tool: A Three Years Experience, pp. 14630-14635.

Giarre', Laura — Univ. di Palermo
Jaccheri, Letizia — Norwegian Univ. of Science and Tech.

12:10-12:30 FrA17.6

Advanced Modelling and Control Using a Laboratory Plant with Hybrid Processes, pp. 14636-14641.

Hlava, Jaroslav — Faculty of Mechatronics, Tech. Univ. of Liberec
Sulc, Bohumil — Czech Tech. Univ. in Prague

FrA18 320B
Localization and Mapping (Regular Session)

Chair: Devy, Michel — LAAS-CNRS
Co-Chair: Ribeiro, Carlos Henrique Costa — Tech. Inst. of Aeronautics

10:30-10:50 FrA18.1

Experimental Autonomous Flight of a Small-Scaled Helicopter Using Accurate Dynamics Model and Low-Cost Sensors, pp. 14642-14650.

Vissičre, David — DGA
Bristeau, Pierre-Jean — Ec. Pol.
Martin, Alain Pierre — DGA
Petit, Nicolas — Ec. des Mines de Paris

10:50-11:10 FrA18.2

SLAM and Data Fusion from Visual Landmarks and 3D Planes, pp. 14651-14656.

Zureiki, Ayman — LAAS-CNRS
Devy, Michel — LAAS-CNRS

11:10-11:30 FrA18.3

SLAM Using Single Laser Range Finder, pp. 14657-14662.

Aghamohammadi, Ali Akbar — K.N. Toosi Univ. of Tech.
Tamjidi, Amir Hossein — KN Toosi Univ. of Tech.
Taghirad, Hamid D. — K.N. Toosi U. of Tech.

11:30-11:50 FrA18.4

Mobile Robot Self-Localization and Local Map Alignment with a Dempster Shafer Sensor Fusion Algorithm, pp. 14663-14668.

Lee, Hyunki — KAIST
Song, Xingyong — KAIST
Cho, Hyung Suck — KAIST

11:50-12:10 FrA18.5

An Optimal Graph Theoretic Approach to Data Association in SLAM, pp. 14669-14674.

Huang, Guoquan — Univ. of Minnesota
Zhang, Xinzheng — The Hong Kong Pol. Univ.
Rad, A. B. — Simon Fraser Univ.
Wong, Y. K. — Hong Kong Pol. Univ.

12:10-12:30 FrA18.6

Map Matching Based on Paraconsistent Artificial Neural Networks, pp. 14675-14680.

Anjos da Silva, Anderson — Tech. Inst. of Aeronautics - ITA
Ribeiro, Carlos Henrique Costa — Tech. Inst. of Aeronautics

FrA19 320C
Haptics Technology: Current Trends and Potential of Haptics (Invited Session)

Chair: Kwon, Dong-Soo — KAIST
Co-Chair: Book, Wayne J. — Georgia Inst. of Tech.
Organizer: Kwon, Dong-Soo — KAIST
Organizer: Book, Wayne J. — Georgia Inst. of Tech.

10:30-10:50 FrA19.1

Control Strategies and Feedback Information in Mobile Robot Teleoperation (I), pp. 14681-14686.

Farkhatdinov, Ildar — Korea Univ. of Tech. and Education
Ryu, Jee-Hwan — Korea Univ. of Tech. and Education
Poduraev, Jury — Moscow State Univ. of Tech. STANKIN

10:50-11:10 FrA19.2

An Analog Input Shaper for Stability Enhancement of Haptic Interfaces and Its Application to Energy-Bounding Algorithm (I), pp. 14687-14692.

Lim, Yo-An — Gwangju Inst. of Science and Tech. (GIST)
Kim, Jong-Phil — Korea Inst. of Science and Tech.
Yoon, Joo Hong — Agency for Defense Development
Ryu, Jeha — Gwangju Inst. of Science and Tech. (GIST)

11:10-11:30 FrA19.3

Design of New Micro Actuator for Tactile Display (I), pp. 14693-14698.

Yang, Tae Heon — KAIST
Kwon, Dong-Soo — KAIST

11:30-11:50 FrA19.4

Control Issues of Digital Clay -- Massive Hydraulic Actuator Array for Man-Machine Communication (I), pp. 14699-14707.

Book, Wayne J. — Georgia Inst. of Tech.
Zhu, Haihong — Georgia Tech.
Huggins, James — Georgia Inst. of Tech.

11:50-12:10 FrA19.5

Thermo-Tactile Interaction Using Tactile Display Device, pp. 14708-14713.

Yang, Gi-Hun — KAIST
Kwon, Dong-Soo — KAIST

FrA20 321C
Advanced Intelligent System Based on Machine Vision (Invited Session)

Chair: Oda, Naoki — Chitose Inst. of Science and Tech.
Co-Chair: Murakami, Toshiyuki — Keio Univ.
Organizer: Domae, Yukiyasu — Hokkaido Univ.
Organizer: Murakami, Toshiyuki — Keio Univ.
Organizer: Oda, Naoki — Chitose Inst. of Science and Tech.
Organizer: Shibata, Masaaki — Seikei Univ.
Organizer: Komada, Satoshi — Mie Univ.
Organizer: Tao, Xiaodong — KAIST
Organizer: Takahashi, Satoru — Kagawa Univ.

10:30-10:50 FrA20.1

Image Feature Based Navigation of Nonholonomic Mobile Robots with Active Camera (I), pp. 14714-14719.

Komada, Satoshi — Mie Univ.
Kinoshita, Kousuke — Mie Univ.
Hirukawa, Tatsuhiko — Mie Univ.
Hirai, Junji — Mie Univ.

10:50-11:10 FrA20.2

Moving Object Detection for Active Camera Based on Optical Flow Distortion (I), pp. 14720-14725.

Shibata, Masaaki — Seikei Univ.
Yasuda, Yuichiro — Seikei Univ.
Ito, Masahide — Seikei Univ.

11:10-11:30 FrA20.3

Image Information Based Configuration Control of Redundant Manipulator in Bilateral System (I), pp. 14726-14731.

Murakami, Toshiyuki — Keio Univ.
Ohta, T. — Keio Univ.

11:30-11:50 FrA20.4

Vision-Based External Force Estimation for Mobile Robots (I), pp. 14732-14737.

Oda, Naoki — Chitose Inst. of Science and Tech.
Shimizu, Hiroyuki — Chitose Inst. of Science and Tech.

11:50-12:10 FrA20.5

Motion Stereo Including Tracking Stability Analysis for 3-D Cable Reconstruction (I), pp. 14738-14742.

Domae, Yukiyasu — Hokkaido Univ.
Okuda, Haruhisa — Mitsubishi Electric Corp.
Takauji, Hidenori — Hokkaido Univ.
Kaneko, Shun'ichi — Hokkaido Univ. Graduate School of Information Science and Tech.
Kimura, Yuta — Hokkaido Univ.

12:10-12:30 FrA20.6

An Adaptive Depth of Field Imaging System for Micromanipulation (I), pp. 14743-14748.

Tao, Xiaodong — Korea Advanced Inst. of Science and Tech.
Hong, Deokhwa — Korea Advanced Inst. of Science and Tech.
Cho, Hyung Suck — KAIST

FrA21 321B
Modeling Human Performance (Regular Session)

Chair: Boy, Guy — European Inst. of Cognitive Sciences and Engineering
Co-Chair: Yoon, Wan Chul — Korea Advanced Inst. of Science and Tech.

10:30-10:50 FrA21.1

Rapid Computation of Time-Optimal, Open-Loop Forearm Movement, pp. 14749-14754.

Shelton, Jeffrey N. — Purdue Univ.
Kwon, Oh-Sang — Purdue Univ.
Chiu, George T.-C. — Purdue Univ.

10:50-11:10 FrA21.2

Senseless Maneuver Optimal Washout Filter Design with Human Vestibular Based (HVB) for VR-Based Motion Simulator, pp. 14755-14760.

Huang, Chin_I — National Formosa Univ.
Fu, Li-Chen — National Taiwan Univ.

11:10-11:30 FrA21.3

Modelling of Human Haptic Skill: A Framework and Preliminary Results, pp. 14761-14766.

Wang, Zheng — Tech. Univ. of Munich
Yuan, Jun — Tech. Univ. of Munich
Buss, Martin — Tech. Univ. Muenchen

11:30-11:50 FrA21.4

Modeling of Pro-Supination for Forearm Skeleton Based on MRI, pp. 14767-14772.

Nojiri, Kousei — Kumamoto Univ.
Matsunaga, Nobutomo — Kumamoto Univ.
Kawaji, Shigeyasu — Kumamoto Univ.

11:50-12:10 FrA21.5

Recognition of the Surgeon's Motions During Endoscopic Operation by Statistics Based Algorithm and Neural Networks Based ANARX Models, pp. 14773-14778.

Nomm, Sven — Inst. of Cybernetics at TUT
Petlenkov, Eduard — Tallinn Univ. of Tech.
Vain, Jüri — Tallinn Univ. of Tech.
Belikov, Juri — Inst. of Cybernetics at TUT
Miyawaki, Fuijo — Tokyo Denki Univ.
Yoshimitsu, Kitaro — Tokyo Denki Univ.

12:10-12:30 FrA21.6

Individual Ability-Based System Design of Dependable Human-Technology Interaction, pp. 14779-14784.

Jipp, Meike — Univ. of Mannheim
Wagner, Achim — Univ. of Mannheim
Badreddin, Essam — Univ. of Heidelberg

FrA22 321A
Intelligent Controllers (Regular Session)

Chair: Yang, Zi-Jiang — Kyushu Univ.
Co-Chair: Christiansson, Anna-Karin — Univ. West

10:30-10:50 FrA22.1

Control Design for Automation of Robotized Laser Metal-Wire Deposition, pp. 14785-14791.

Heralic, Almir — Univ. West
Christiansson, Anna-Karin — Univ. West
Hurtig, Kjell — Univ. West
Ottosson, Mattias — Univ. West
Lennartson, Bengt — Chalmers Univ. of Tech.

10:50-11:10 FrA22.2

A General Adaptive Robust Nonlinear Motion Controller Combined with Disturbance Observer, pp. 14792-14797.

Yang, Zi-Jiang — Kyushu Univ.
Hara, Seiichiro — Kyushu Univ.
Kanae, Shunshoku — Kyushu Univ.
Wada, Kiyoshi — Kyushu Univ.
Su, Chun-Yi — Concordia Univ.

11:10-11:30 FrA22.3

Friction Compensation with Commonly-Used PD Control and Support Vector Machine, pp. 14798-14803.

Zheng, Chunhong — Xidian Univ.
Su, Y. X. — Xidian Univ.
Müller, Peter C. — Univ. of Wuppertal

11:30-11:50 FrA22.4

A New Translation Algorithm from Ladder Diagrams to Instruction Lists, pp. 14804-14809.

Yan, Yi — hangzhou dianzi Univ.
Zhang, Hangping — Hangzhou dianzi Univ.

11:50-12:10 FrA22.5

Fast Operating Bit-Byte PLC, pp. 14810-14815.

Chmiel, Miroslaw — Silesian Univ. of Tech.
Hrynkiewicz, Edward — Silesian Univ. of Tech.

12:10-12:30 FrA22.6

Visual Navigation of a Mobile Robot in a Cluttered Environment, pp. 14816-14821.

Gupta, Meenakshi — Indian Inst. of Tech. Kanpur
Uggirala, Balaji — Indian Inst. of Tech. Kanpur
Behera, Laxmidhar — Indian Inst. of Tech. Kanpur

FrA23 323

Manufacturing Plant Control (Regular Session)

Chair: Wang, Zhongjie — Tongji Univ.
Co-Chair: Dolgui, Alexandre — Ec. des Mines de Saint Etienne

10:30-10:50 FrA23.1

Manufacturing Process Planning for Laser Cutting Robotic Systems, pp. 14822-14827.

Dolgui, Alexandre — Ec. des Mines de Saint Etienne
Pashkevich, Anatol — Ec. des Mines de Nantes

10:50-11:10 FrA23.2

Position Tracking Control with Velocity from Accelerometer and Encoder, pp. 14828-14833.

Zhu, Wen-Hong — Canadian Space Agency
Lamarche, Tom — Canadian Space Agency

11:10-11:30 FrA23.3

Stability Analysis and Internal Dynamics of MIMO GMAW Process, pp. 14834-14839.

Eghtesad, Mohammad — Shiraz Univ.
Bazargan-Lari, Yousef — islamic azad Univ. branch
Assadsangabi, Babak — shiraz Univ.

11:30-11:50 FrA23.4

A New Method of Dynamic Bottleneck Detection for Semiconductor Manufacturing Line, pp. 14840-14845.

Wang, Zhongjie — Tongji Univ.
Chen, Jun — East China Normal Univ.
Wu, Qidi — Tongji Univ.

11:50-12:10 FrA23.5

Design and Experiment Research of Abrasive Water-Jet Cutting Machine Based on Phased Intensifier, pp. 14846-14851.

Xu, Jiazhong — Harbin Univ. of Science and Tech.
You, Bo — Harbin Univ. of Science and Tech.
Kong, Xiangbing — Harbin Univ. of Science and Tech.

12:10-12:30 FrA23.6

The Application of Lot Streaming to Assembly Job Shop under Resource Constraints, pp. 14852-14857.

Chan, Felix T. S. — The Univ. of Hong Kong
Wong, T. C. — The Univ. of Hong Kong
Chan, P.L.Y. — The Univ. of Hong Kong

FrA24 324

Job and Activity Scheduling I (Regular Session)

Chair: Meyer, Wolfgang — Hamburg Univ. of Tech.
Co-Chair: Allaoui, Hamid — Univ. of Artois

10:30-10:50 FrA24.1

Robust Scheduling of Cyclic Flow Shops Based on Stochastic Collision Functions, pp. 14858-14863.

Fiedler, Claudia — Hamburg Univ. of Tech.
Meyer, Wolfgang — Hamburg Univ. of Tech.

10:50-11:10 FrA24.2

Scheduling of Uncertain Multi-Product Batch Processes under Finite Intermediate Storage Policy, pp. 14864-14869.

Xu, Zhenhao — East China Univ. of Science and Tech.
Gu, Xingsheng — East China Univ. of Science and Tech.
Jiao, Bin — Shanghai Dianji Univ.

11:10-11:30 FrA24.3

The Coordinated Scheduling of Steelmaking with Multi-Refining and Tandem Transportation, pp. 14870-14875.

Guan, Jing — Northeastern Univ. Shenyang, China
Tang, Lixin — Northeastern Univ.
Liu, Jianchao — Shanghai Meishan Iron & Steel Limited Company, BaosteelComplex
Zhang, Rongpin — Shanghai Meishan Iron & Steel Limited Company, BaosteelComplex

11:30-11:50 FrA24.4

Best-Case Lower Bounds in a Group Sequence for the Job Shop Problem, pp. 14876-14881.

Pinot, Guillaume — EPUN
Mebarki, Nasser — IUT de Nantes

11:50-12:10 FrA24.5

A Coupled Transiently Chaotic Neural Network Approach for Scheduling Identical Parallel Machines with Sequence Dependent Setup Times, pp. 14882-14887.

Yu, Aiqing — East China Univ. of Science and Tech.
Gu, Xingsheng — East China Univ. of Science and Tech.
Jiao, Bin — Shanghai Dianji Univ.

12:10-12:30 FrA24.6

Bottlenecks in Production Lines with Rework: A Systems Approach, pp. 14888-14893.

Biller, Stephan — General Motors
Li, Jingshan — Univ. of Kentucky
Marin, Samuel — General Motors
Meerkov, Semyon M. — Univ. of Michigan
Zhang, Liang — Univ. of Michigan

FrA25 328

Monitoring and Performance Assessment (Regular Session)

Chair: Visioli, Antonio — Univ. of Brescia
Co-Chair: Shah, Sirish — Univ. of Alberta

10:30-10:50 FrA25.1

Extended Prediction Error Approach for MPC Performance Monitoring and Industrial Applications, pp. 14894-14899.

Zhao, Yu — Zhejiang Univ.
Gu, Yong — Zhejiang Univ.
Su, Hongye — Zhejiang Univ.
Huang, Biao — Univ. of Alberta

10:50-11:10 FrA25.2

A Technique for Abrupt Load Disturbance Detection in Process Control Systems, pp. 14900-14905.

Veronesi, Massimiliano — Univ. of Brescia
Visioli, Antonio — Univ. of Brescia

11:10-11:30 FrA25.3

Karnopp Friction Model Identification for a Real Control Valve, pp. 14906-14911.

Romano, Rodrigo Alvite — Univ. of São Paulo
Garcia, Claudio — Pol. School of The Univ. of Sao Paulo

11:30-11:50 FrA25.4

Controller Performance Analysis Technology for Industry: Implementation and Case Studies, pp. 14912-14919.

Lee, Kwanho — Univ. of Alberta
Xu, Fangwei — Syncrude Canada Ltd.
Huang, Biao — Univ. of Alberta
Tamayo, Edgar — Syncrude Canada Ltd.

11:50-12:10 FrA25.5

Assisted Monitoring and Maintenance of Control Systems, pp. 14920-14925.

Hansen, Ole Fink — Tech. Univ. of Denmark
Andersen, Nils A. — Tech. Univ. of Denmark
Ravn, Ole — Tech. Univ. of Denmark

12:10-12:30 FrA25.6

Model-Plant Mismatch Detection in MPC Applications Using Partial Correlation Analysis, pp. 14926-14933.
Badwe, Abhijit — Indian Inst. of Tech. Bombay
Shah, Sirish — Univ. of Alberta
Patwardhan, Sachin — IIT Bombay
Patwardhan, Rohit — Matrikon Inc.

FrA26 327
Intelligent Control of Power Systems (Invited Session)
Chair: Lee, Kwang Y. — Baylor Univ.
Co-Chair: Mori, Hiroyuki — Meiji Univ.
Organizer: Lee, Kwang Y. — Baylor Univ.

10:30-10:50 FrA26.1
Forecasting of Electricity Price and Demand Using Auto-Regressive Neural Networks (I), pp. 14934-14938.
Yamashita, Daiki — Waseda Univ.
Mohd Isa, Aishah — Waseda Univ.
Yokoyama, Ryuichi — Waseda Univ.
Niimura, Takahide — Waseda Univ.

10:50-11:10 FrA26.2
Optimal Power System Stabilizer Tuning in Multi-Machine System Via an Improved Differential Evolution (I), pp. 14939-14944.
Yang, Guang Ya — The Univ. of Queensland
Mishra, Yateendra — The Univ. of Queensland
Dong, Zhao Yang — The Univ. of Queensland
Wong, Kit Po — The Hong Kong Pol. Univ.

11:10-11:30 FrA26.3
Multi-Agent Based Dynamic Stability Control for Low-Frequency Global Mode of Oscillations (I), pp. 14945-14950.
Hiyama, Takashi — Kumamoto Univ.
Zhang, Wei — Kumamoto Univ.

11:30-11:50 FrA26.4
A Tabu Search Based Method for Optimal Allocation of D-FACTS in Distribution Systems (I), pp. 14951-14956.
Mori, Hiroyuki — Meiji Univ.
Tani, Hidenobu — Meiji Univ.

11:50-12:10 FrA26.5
Supplementary Damping Controller Design Using Direct Heuristic Dynamic Programming in Complex Power Systems (I), pp. 14957-14962.
Lu, Chao — Tsinghua Univ.
Si, Jennie — Arizona State Univ.

12:10-12:30 FrA26.6
Consideration of Wind Power and Demand Uncertainties in Unit Commitment Problem Using PSO (I), pp. 14963-14968.
Istvan, Erlich — Univ. Duisburg Essen
Pappala, Venkata Swaroop — Univ. Duisburg Essen

FrA27 326
Remote Sensor Data Acquisition (Regular Session)
Chair: Salichs, Miguel A. — Univ. Carlos III
Co-Chair: Rehm, Ansgar — Univ. of Applied Sciences Osnabrück

10:30-10:50 FrA27.1
Decentralized and Robust Target Tracking with Sensor Networks, pp. 14969-14975.
Bishop, Adrian — Deakin Univ.
Pathirana, Pubudu N. — Deakin Univ.
Savkin, Andrey V. — Univ. of New South Wales

10:50-11:10 FrA27.2
Multi-Person Pose Recognition Using a Zigbee Sensor Network, pp. 14976-14981.
Song, Kai-Tai — National Chiao Tung Univ.
Chen, Chun-Wei — National Chiao Tung Univ.

11:10-11:30 FrA27.3
Tree-Based Deployment Algorithm of Mobile Sensors in Ubiquitous Sensor Network, pp. 14982-14986.
Moon, Chongchun — Inha Univ.
Park, Jaehyun — Inha Univ.
Kim, Yoo-Sung — Inha Univ.

11:30-11:50 FrA27.4
Centralized Monitoring for Vehicle Dynamics Sensor Networks, pp. 14987-14991.
Rehm, Ansgar — Univ. of Applied Sciences Osnabrück

11:50-12:10 FrA27.5
Wireless Sensor Network Based Control System Concidering Communication Cost, pp. 14992-14997.
Iino, Yutaka — Tokyo Inst. of Tech.
Hatanaka, Takeshi — Tokyo Inst. of Tech.
Fujita, Masayuki — Tokyo Inst. of Tech.

12:10-12:30 FrA27.6
Passive Correction of Position Error in Internet-Based Teleoperation, pp. 14998-15003.
Fernández Villaverde, Alejandro — Univ. of Vigo
Barreiro, Antonio — Univ. of Vigo
Raimúndez, José Cesáreo — Univ. of Vigo

FrA28 330A
Marine System I (Regular Session)
Chair: Pascoal, Antonio M. — ISR-Inst. Superior Tecnico
Co-Chair: Katebi, Reza — Univ. of Strathclyde

10:30-10:50 FrA28.1
Frequency Domain Study of Longitudinal Motion Attenuation of a Fast Ferry Using a T-Foil, pp. 15004-15009.
Giron-Sierra, Jose M — Univ. Complutense de Madrid
Esteban, Segundo — Univ. COMPLUTENSE DE MADRID

10:50-11:10 FrA28.2
A Four-Quadrant Thrust Controller for Marine Propellers with Loss Estimation and Anti-Spin, pp. 15010-15015.
Pivano, Luca — Norwegian Uni. Science & Tech.
Bakkeheim, Jostein — Norwegian Univ. of Science and Tech.
Johansen, Tor Arne — Norwegian Univ. of Science and Tech.
Smogeli, Oyvind Notland — Norwegian Univ. of Science and Tech.

11:10-11:30 FrA28.3
Position and Velocity Navigation Filters for Marine Vehicles, pp. 15016-15021.
Batista, Pedro — Inst. Superior Técnico
Silvestre, Carlos — Inst. Superior Tecnico
Oliveira, Paulo Jorge — Inst. Superior Técnico

11:30-11:50 FrA28.4
Stable Schooling for Multiple Underactuated AUVs, pp. 15022-15027.
Li, Ji-Hong — Maritime and Ocean Engineering Res. Inst. KORDI
Lee, Pan-Mook — Korea Res. Inst. of Ships andOceanEngineering,KORDI

11:50-12:10 FrA28.5
Towards a Mission Control Language for AUVs, pp. 15028-15033.
Palomeras, Narcis — Univ. of Girona
Ridao, Pere — Univ. of Girona
Carreras, Marc — Univ. of Girona
Silvestre, Carlos — Inst. Superior Tecnico

12:10-12:30 FrA28.6
Modelling and Control of Offshore Marine Pipeline During Pipelay, pp. 15034-15039.
Jensen, Gullik Anthon — Norwegian Univ. of Science and Tech.
Transeth, Aksel Andreas — Norwegian Univ. of Science and Tech.
Nguyen, Tu Duc — Norwegian Univ. of Science and Tech.

FrA29 330B
Adaptive and Robust Control in Aerospace Vehicles (Regular Session)
Chair: Choi, Jae Weon — Pusan National Univ.
Co-Chair: Lauffenburger, Jean-Philippe — Univ. of Haute-Alsace

10:30-10:50 FrA29.1
Stabilizing Nonlinear Adaptive PID State Feedback Control for Spacecraft Capturing, pp. 15040-15045.
Ikeda, Yuichi — Kushiro National Coll. of Tech.
Kida, Takashi — Univ. of Electro-Communications
Nagashio, Tomoyuki — Univ. of Electro-Communications

10:50-11:10 FrA29.2
Novel Control Scheme for Helicopter Flight: Fuzzy Immune Adaptive Model Inversion Control, pp. 15046-15051.
Zhao, Jia — Beijing Univ. of Aeronautics and Astronautics
Chen, Shenggong — Beijing Univ. of Aeronautics and Astronautics
Shen, Gongzhang — Beijing Univ. of Aeronautics and Astronautics

11:10-11:30 FrA29.3
Active Shimmy Damping Using Direct Adaptive Fuzzy Control, pp. 15052-15057.
Huynh, Thai-Hoang — Univ. de Haute-Alsace
Pouly, Gaétan — Univ. de Haute-Alsace
Lauffenburger, Jean-Philippe — Univ. of Haute-Alsace
Basset, Michel — Univ. de Haute-Alsace

11:30-11:50 FrA29.4
Indirect Fuzzy Adaptive Control for Active Shimmy Damping, pp. 15058-15063.
Pouly, Gaétan — Univ. de Haute-Alsace
Huynh, Thai-Hoang — Univ. de Haute-Alsace
Lauffenburger, Jean-Philippe — Univ. of Haute-Alsace
Basset, Michel — Univ. de Haute-Alsace

11:50-12:10 FrA29.5
A Model Reference Adaptive Variable Structure Controller for Reconfigurable Flight Control Systems, pp. 15064-15069.
Sun, Weimeng — National Univ. of Defense Tech.
Han, Dapeng — National Univ. of Defense Tech.
Zheng, Zhiqiang — National Univ. of Defense Tech.
Peng, Xuefeng — National Univ. of Defense Tech.

12:10-12:30 FrA29.6
Robust LPV Control of UAV with Parameter Dependent Performance, pp. 15070-15075.
Chen, Jianchi — Univ. of Leicester
Gu, Dawei — Univ. of Leicester
Postlethwaite, Ian — the Univ. of Leicester
Natesan, Kannan — Univ. of Leicester

FrA30 330C
Non-Intrusive Human Monitoring (Invited Session)
Chair: Itoh, Makoto — Univ. of Tsukuba
Co-Chair: Szpytko, Janusz — AGH Univ. of Science and Tech.
Organizer: Itoh, Makoto — Univ. of Tsukuba

10:30-11:10 FrA30.1
Human Monitoring-Based Driving Support (I), pp. 15076-15087.
Itoh, Makoto — Univ. of Tsukuba

11:10-11:30 FrA30.2
Toward Cooperative and Human Error-Tolerant System, pp. 15088-15093.
Millot, Patrick — Univ. of Valenciennes
Vanderhaegen, Frédéric — Univ. of Valenciennes

11:30-11:50 FrA30.3
Mental Workloads Can Be Objectively Quantified in Real-Time Using VOR (Vestibulo-Ocular Reflex) (I), pp. 15094-15099.
Obinata, Goro — Nagoya Univ.
Tokuda, Satoru — Wichita State Univ.
Shibata, Naoki — Nagoya Univ.

11:50-12:10 FrA30.4
Human - Machine Interface Implementation in Designing Crane Control Based on Fuzzy Logic Algorithm, pp. 15100-15105.
Szpytko, Janusz — AGH Univ. of Science and Tech.

12:10-12:30 FrA30.5
Skill Assist Neuro-Fuzzy Control of Omni-Directional Wheelchair for Attendants Considering Rotation Center of Vehicle, pp. 15106-15113.
Terashima, Kazuhiko — Toyohashi Univ. of Tech.
Watanabe, Kaoru — Toyohashi Univ. of Tech.
Kondo, Yasumasa — Toyohashi Univ. of Tech.
Miyoshi, Takanori — Toyohashi Univ. of Tech.
Urbano, Juan — Toyohashi Univ. of Tech.
Kitamura, Sou — Toyohashi Univ. of Tech.
Kitagawa, Hideo — Gifu National Coll. of Tech.

FrB02 304A
Chaotic Systems and Bifurcations (Regular Session)
Chair: Bobtsov, Alexey — Saint-PetersburgStateUniversityofInformationTechnologiesMechanics andOptics
Co-Chair: Liu, Derong — Univ. of Illinois at Chicago

14:00-14:20 FrB02.1
Robust Impulsive Synchronization for a Class of Unified Chaotic Systems with Parameter Uncertainty, pp. 15114-15118.
Ma, Tiedong — Northeastern Univ.
Zhang, Huaguang — Northeastern Univ.
Liu, Derong — Univ. of Illinois at Chicago

14:20-14:40 FrB02.2
Hopf Bifurcations in Normal Forms of Third Order Nonlinear Affine Control Systems, pp. 15119-15124.
Innocenti, Giacomo — Univ. di Firenze
Tesi, Alberto — Univ. di Firenze
Genesio, Roberto — Univ. di Firenze

14:40-15:00 FrB02.3
A New Criterion for Synchronization in Deterministic Underdamped Ratchets, pp. 15125-15130.
Lu, Pingli — Peking Univ.
Yang, Ying — Peking Univ.
Huang, Lin — Peking Univ.

15:00-15:20 FrB02.4
Global Stabilization of Periodic Orbits in Chaotic Systems by Using Symbolic Dynamics, pp. 15131-15136.
Suzuki, Masayasu — Nagoya Univ.
Sakamoto, Noboru — Nagoya Univ.

15:20-15:40 FrB02.5
Synchronizing Chaotic Systems Based on Tridiagonal Structure, pp. 15137-15142.
Liu, Bin — Tsinghua Univ.
Min, Jiang — Tsinghua Univ.
Zengke, Zhang — Tsinghua Univ.

15:40-16:00 FrB02.6
Stabilization of a Chaotic Van Der Pole System, pp. 15143-15147.
Bobtsov, Alexey — Saint-PetersburgStateUniversityofInformationTechnologiesMechani
Pyrkin, Anton — Saint-Petersburg State Univ. of Information Tech. Mec
Slita, Olga — Baltic State Tech. Univ.
Nikolaev, Nikolay — Saint-Petersburg State Univ. of Information Tech. Me

FrB03 304B
Systems with Saturation (Regular Session)
Chair: Glad, Torkel — Linkoping Univ.
Co-Chair: Marconi, Lorenzo — Univ. di Bologna

14:00-14:20 FrB03.1
Saturated Root Locus: Theory and Application, pp. 15148-15153.
Ching, ShiNung — Univ. of Michigan
Kabamba, Pierre T. — Univ. of Michigan
Meerkov, Semyon M. — Univ. of Michigan

14:20-14:40 FrB03.2
Nonlinear Output Feedback Control for Linear Systems with Input Saturation, pp. 15154-15159.
Akasaka, Daisuke — Chiba Univ.
Liu, Kang-Zhi — Chiba Univ.

14:40-15:00 FrB03.3
Improved Multipliers for Input-Constrained Model Predictive Control, pp. 15160-15165.
Heath, William Paul — Univ. of Manchester
Li, Guang — The Univ. of Bristol

15:00-15:20 FrB03.4
Tracking Control with Saturating Actuators: A Method Based on State-Dependent Gain-Scheduling and Reference Management, pp. 15166-15171.
Wada, Nobutaka — Hiroshima Univ.
Saeki, Masami — Hiroshima Univ.

15:20-15:40 FrB03.5
Explicit Formulas for ISS Stabilization of Nonlinear Systems Subject to Bounded Inputs and Disturbances, pp. 15172-15178.
Nakamura, Hisakazu — Nara Inst. of Science &Tech.
Nakamura, Nami — Nara Inst. of Science and Tech.
Nishitani, Hirokazu — Nara Inst. of Sci. & Tech.

15:40-16:00 FrB03.6

Fast Robust Control of Linear Systems Subject to Actuator Saturation, pp. 15179-15184.

Jasniewicz, Boris — Tech. Univ. Darmstadt
Adamy, Jürgen — Tech. Univ. Darmstadt

FrB04 308

Topics in Control (Regular Session)

Chair: Qu, Zhihua — Univ. of Central Florida
Co-Chair: Kotta, Ülle — Inst. of Cybernetics at TUT

14:00-14:20 FrB04.1

Finite-Time Consensus for Multi-Agent Networks with Second-Order Agent Dynamics, pp. 15185-15190.

Wang, Xiaoli — Acad. of Mathematics and Systems Science
Hong, Yiguang — Chinese Acad. of Sciences

14:20-14:40 FrB04.2

Design Technique for Multi-Rate Linear Systems, pp. 15191-15196.

Cimino, Mauro — Oklahoma State Univ.
Pagilla, Prabhakar R. — Oklahoma State Univ.

14:40-15:00 FrB04.3

Transfer Function Approach to the Model Matching Problem of Nonlinear Systems, pp. 15197-15202.

Halas, Miroslav — Faculty of Electrical Engineering and InformationTechnology, Slo
Kotta, Ülle — Inst. of Cybernetics at TUT
Moog, Claude — CNRS

15:00-15:20 FrB04.4

Continuous Time-Varying Pure Feedback Control for Chained Nonholonomic Systems with Exponential Convergent Rate, pp. 15203-15208.

Yuan, Hongliang — Univ. of Central Florida
Qu, Zhihua — Univ. of Central Florida

15:20-15:40 FrB04.5

A Constant D-Scale Mu-Synthesis Approach Based on Nonsmooth Optimization, pp. 15209-15213.

Prempain, Emmanuel — Univ. of Leicester
Postlethwaite, Ian — the Univ. of Leicester

15:40-16:00 FrB04.6

Estimate of Attractive Regions for Systems Satisfying Polytopic Uncertainties in Given Regions, pp. 15214-15219.

Ohta, Yuzo — Kobe Univ.
Taguchi, Takaaki — Kobe Univ.

FrB05 307

Digital Control (Regular Session)

Chair: Whidborne, James F. — Cranfield Univ.
Co-Chair: Maciejowski, Jan — Univ. of Cambridge

14:00-14:20 FrB05.1

Optimal Finite-Precision Implementations of Linear Parameter Varying Controllers, pp. 15220-15225.

Whidborne, James F. — Cranfield Univ.
Chevrel, Philippe — IRCCyN / Ec. des Mines de Nantes

14:20-14:40 FrB05.2

A Sampled-Data Scheme for Disturbance Rejection of Nonlinear Systems in Output Feedback Form, pp. 15226-15231.

Wu, Buzhou — The Univ. of Manchester
Ding, Zhengtao — The Univ. of Manchester

14:40-15:00 FrB05.3

ell_{p}-Equivalence of Discretizations of Analog Controllers, pp. 15232-15237.

Zhang, Guofeng — Univ. of Electronic Science and Tech. of China
Chen, Xiang — Univ. of Windsor
Chen, Tongwen — Univ. of Alberta

15:00-15:20 FrB05.4

State Based Self-Triggered Feedback Control Systems with L2 Stability, pp. 15238-15243.

Wang, Xiaofeng — Univ. of Notre Dame
Lemmon, Michael — Univ. of Notre Dame

15:20-15:40 FrB05.5

Multicomputer Research Desks for Simulation and Development of Control Systems, pp. 15244-15249.

Dorri, Manucher — Inst. of Control Sciences RAS
Roschin, Alexander — Inst. of Control Sciences RAS

15:40-16:00 FrB05.6

Embedded Model Predictive Control (MPC) Using a FPGA, pp. 15250-15255.

Ling, Keck-Voon — Nanyang Tech. Univ.
Wu, Bing Fang — -
Maciejowski, Jan — Univ. of Cambridge

FrB06 310A

Fractional Differentiation and Its Applications II (Invited Session)

Chair: Sabatier, Jocelyn — Univ. Bordeaux1
Co-Chair: Baleanu, Dumitru — Cankaya Univ. Faculty of Arts and Sciences
Organizer: Dugard, Luc — CNRS-INPG-UJF
Organizer: Sabatier, Jocelyn — Univ. Bordeaux1

14:00-14:20 FrB06.1

Conservatism-Free Robust Stability Check of Fractional-Order Interval Linear Systems (I), pp. 15256-15261.

Ahn, Hyo-Sung — Gwangju Inst. of Science and Tech. (GIST)
Chen, YangQuan — Utah State Univ.

14:20-14:40 FrB06.2

Structural Properties of Linear Discrete-Time Fractional-Order Systems (I), pp. 15262-15266.

Bettayeb, Maamar — Univ. of Sharjah
Djennoune, Saďd — Univ. of Mouloud Mammeri, Tizi-Ouzou
Guermah, Saďd — Univ. of Tizi-Ouzou
Ghanes, Malek — ENSEA

14:40-15:00 FrB06.3

On Bounded Real Lemma for Fractional Systems (I), pp. 15267-15272.

Moze, Mathieu — Univ. Bordeaux 1
Sabatier, Jocelyn — Univ. Bordeaux1
Oustaloup, Alain — Univ. Bordeaux 1 - ENSEIRB - ENSCBP

15:00-15:20 FrB06.4

On the Fractional PID Control of a Laboratory Servo System (I), pp. 15273-15278.

Barbosa, Ramiro — Inst. of Engineering of Porto
Machado, J.A. Tenreiro — Inst. of Engineering of Porto
Jesus, Isabel S. — Inst. of Engineering of Porto

15:20-15:40 FrB06.5

Controller Design for Minimum-Phase Fractional Systems of Commensurate Order Based on Shaping the Sensitivity Function, pp. 15279-15284.

Merrikh-Bayat, Farshad — Sharif Uni. of Tech.
Karimi-Ghartemani, Masoud — Univ. of Toronto

15:40-16:00 FrB06.6

Fractional Order Control of an Unmanned Aerial Vehicle (UAV), pp. 15285-15290.

Monje, Concepción — Univ. Carlos III of Madrid
Liceaga-Castro, Eduardo — Univ. Carlos III of Madrid
Licéaga-Castro, Jesús Ulises — ITESM-CEM

FrB07 310B

Stochastic Optimal Control (Regular Session)

Chair: Lampe, Bernhard P. — Univ. of Rostock
Co-Chair: Krokavec, Dusan — Tech. Univ. of Kosice, Faculty of Electrical

14:00-14:20 FrB07.1

Control with Guaranteed Performance for Dual-Rate Sampled-Data Systems under Stochastic Disturbances, pp. 15291-15296.

Lampe, Bernhard P. — Univ. of Rostock
Polyakov, Konstantin — Associate Professor
Rybinskii, Vladislav — SMTU
Rosenwasser, Efim N. — Marine Tech. Univ. of Saint Petersburg

14:20-14:40 FrB07.2

Probabilistic Constrained MPC for Systems with Multiplicative and Additive Stochastic Uncertainty, pp. 15297-15302.

Cannon, Mark — Univ. of Oxford
Kouvaritakis, Basil — Oxford Univ.

Wu, Xingjian Univ. of Oxford

14:40-15:00 FrB07.3

Joint PDF Tracking Control for a Class of Multivariate Time-Varying Stochastic Descriptor Systems, pp. 15303-15308.

Guo, Lei UMIST
Yin, Liping Southeast Univ.

15:00-15:20 FrB07.4

Risk-Sensitivity Conditions for Stochastic Uncertain Model Validation, pp. 15309-15314.

Ugrinovskii, Valery Univ. of New South Wales

15:20-15:40 FrB07.5

Constrained Control of Discrete-Time Stochastic Systems, pp. 15315-15320.

Krokavec, Dusan Tech. Univ. of Kosice, Faculty of Electrical
Filasova, Anna Tech. Univ. of Kosice

15:40-16:00 FrB07.6

Mean-Variance Receding Horizon Control for Discrete Time Linear Stochastic Systems, pp. 15321-15326.

Cannon, Mark Univ. of Oxford
Kouvaritakis, Basil Oxford Univ.
Couchman, Paul Univ. of Oxford

FrB08 310C
Reachability, Estimation and Control Synthesis under Uncertainty II (Invited Session)

Chair: Rakovic, Sasa V. ETH Zurich
Co-Chair: Kurzhanski, A.B. Univ. of California, Berkeley
Organizer: Kurzhanski, A.B. Univ. of California, Berkeley
Organizer: Rakovic, Sasa V. ETH Zurich

14:00-14:20 FrB08.1

Approximate Reachability Analysis for Linear Discrete Time Systems Using Homothety and Invariance (I), pp. 15327-15332.

Rakovic, Sasa V. ETH Zurich
Fiacchini, Mirko Univ. de Sevilla

14:20-14:40 FrB08.2

On the Design of Robust Tube-Based MPC for Tracking (I), pp. 15333-15338.

Alvarado, Ignacio Univ. of Seville
Limon, Daniel Univ. de Sevilla
Alamo, Teodoro Univ. de Sevilla
Camacho, Eduardo Univ. of Seville

14:40-15:00 FrB08.3

Optimal Measurement Feedback Control of Finite-Time Continuous Linear Systems (I), pp. 15339-15344.

Dmitruk, Natalia Inst. of Mathematics, National Acad. of Sciences of Belaru
Findeisen, Rolf Otto-von-Guericke-Univ. Magdeburg
Allgower, Frank Univ. of Stuttgart

15:00-15:20 FrB08.4

Methods of Ellipsoidal Estimation for Linear Control Systems (I), pp. 15345-15348.

Ovseevich, Alexander Inst. for Problems in Mechanics, Russian Ac. Sc.
Chernousko, Felix L. Russian Acad. of Sciences

15:20-15:40 FrB08.5

Filtering with Nonrandom Noise: Invariant Ellipsoids Technique (I), pp. 15349-15352.

Polyak, Boris T. Moscow Inst. of Control Sciences
Topunov, Michael Inst. for Control Science

15:40-16:00 FrB08.6

Dynamic Optimization for Path Coordination Problems, pp. 15353-15358.

Sousa, Joao Fac. Engenharia Univ. do Porto (VAT nr. 600027716)

FrB09 311C
Frequency Domain System Identification (Regular Session)

Chair: Pintelon, Rik Vrije Univ. Brussel
Co-Chair: Akcay, Huseyin Anadolu Univ.

14:00-14:20 FrB09.1

Experimental Comparison of Methods for Multivariable Frequency Response Function Estimation, pp. 15359-15366.

Wernholt, Erik Linkoping Univ.
Moberg, Stig ABB AB - Robotics

14:20-14:40 FrB09.2

On the Completeness Problem for Fractional Rationals with Incommensurable Differentiation Orders, pp. 15367-15371.

Akcay, Huseyin Anadolu Univ.
Malti, Rachid Univ. Bordeaux1

14:40-15:00 FrB09.3

Frequency-Domain Gray-Box Identification of Industrial Robots, pp. 15372-15380.

Wernholt, Erik Linkoping Univ.
Moberg, Stig ABB AB - Robotics

15:00-15:20 FrB09.4

New Results on the Generalized Frequency Response Functions of Nonlinear Volterra Systems Described by NARX Model, pp. 15381-15386.

Jing, Xingjian Univ. of Sheffield
Lang, Z.Q. Univ. of Sheffield
Billings, Steve A. Univ. of Sheffield

15:20-15:40 FrB09.5

Topological Properties in Identification and Modeling Techniques, pp. 15387-15392.

Innocenti, Giacomo Univ. di Firenze
Materassi, Donatello Univ. degli Studi di Firenze

15:40-16:00 FrB09.6

Frequency Content in an Axially Impacted Bar Subject to Boundary Conditions, pp. 15393-15398.

Rensfelt, Agnes UppsalaUniversity
Soderstrom, Torsten Uppsala Univ.

FrB10 311B
Switching Control II (Regular Session)

Chair: Cheng, Daizhan Chinese Acad. of Sciences
Co-Chair: Bosukonda, Murali Mohan Indian Inst. of Tech. Kharagpur

14:00-14:20 FrB10.1

Mathematical Model of the Simplest Fuzzy PID Controller with Asymmetric Fuzzy Sets, pp. 15399-15404.

Bosukonda, Murali Mohan Indian Inst. of Tech. Kharagpur
Sinha, Arpita IIT-Kharagpur

14:20-14:40 FrB10.2

Non-Regular Feedback Linearization of Switched Nonlinear Systems, pp. 15405-15410.

Yuan, Yanyan Inst. of Systems Science, Chinese Acad. of Sciences
Cheng, Daizhan Chinese Acad. of Sciences

14:40-15:00 FrB10.3

Binary Control of Volterra Integral Equations, pp. 15411-15414.

Belbas, Stavros Univ. of Alabama

15:00-15:20 FrB10.4

Robust Delay Block Stabilization Via Integral Sliding Mode Control, pp. 15415-15420.

Loukianov, Alexander G. CINVESTAV IPN GDI
Espinosa Guerra, Omar Cinvestav
Castillo-Toledo, Bernardino CINVESTAV-GDL, Mexico

15:20-15:40 FrB10.5

Switching Difference Control of Parallel Streams Temperatures, pp. 15421-15426.

Wang, Xingxuan Fudan Univ.

15:40-16:00 FrB10.6

Rational Controllers in Computer/Communication Networks, pp. 15427-15432.

Kabamba, Pierre T. Univ. of Michigan
Lin, Wen-Chiao Univ. of Michigan
Meerkov, Semyon M. Univ. of Michigan
Tang, Choon Yik Honeywell

FrB11 311A
Autotuning (Regular Session)

Chair: Veres, Sandor M Univ. of Southampton
Co-Chair: Leva, Alberto Pol. di Milano

14:00-14:20 FrB11.1

Adaptive State Feedback Nash Strategies for Linear Quadratic Discrete-Time Games, pp. 15433-15438.

Shen, Dan Intelligent Automation, Inc

Cruz, Jose B — The Ohio State Univ.

14:20-14:40 — FrB11.2

Adaptive Temperature Control in a Freezer with On-Off Actuation, pp. 15439-15444.

Leva, Alberto — Pol. di Milano
Piroddi, Luigi — Pol. di Milano
Boer, Alessandro — WHIRLPOOL EUROPE s.r.l

14:40-15:00 — FrB11.3

Fast Autotuning of Process Cascade Controls, pp. 15445-15450.

Leva, Alberto — Pol. di Milano

15:00-15:20 — FrB11.4

Learning from Data Using XCS, pp. 15451-15456.

Ayele, Elias — North Carolina A&T State Univ.
Homaifar, Abdollah — North Carolina A&T State Univ.
Esterline, Albert — North Carolina A&T State Univ.
Dean, Robert — GDRS
Rodgers, Dan — GDRS

15:20-15:40 — FrB11.5

Learning and Adaptation of Skills in Autonomous Physical Agents, pp. 15457-15462.

Veres, Sandor M — Univ. of Southampton
Veres, Aron Gabor — SysBrain Ltd

15:40-16:00 — FrB11.6

MIMO Frequency Domain Iterative Tuning for Tracking Control, pp. 15463-15468.

Luo, Jian — Univ. of Southampton
Veres, Sandor M — Univ. of Southampton

FrB12 — 313

Stochastic Hybrid Systems (Regular Session)

Chair: Chang, Hyeong Soo — Sogang Univ.
Co-Chair: Ramdani, Nacim — INRIA

14:00-14:20 — FrB12.1

Learning Algorithm for LQG Model with Constrained Control, pp. 15469-15474.

Xu, Yankai — Tsinghua Univ.
Chen, Xi — Tsinghua Univ.

14:20-14:40 — FrB12.2

Stochastic Iterative Approximation for Parallel Rollout and Policy Switching, pp. 15475-15479.

Chang, Hyeong Soo — Sogang Univ.

14:40-15:00 — FrB12.3

A Unifying Formulation of the Fokker-Planck-Kolmogorov Equation for General Stochastic Hybrid Systems, pp. 15480-15485.

Bect, Julien — Supelec

15:00-15:20 — FrB12.4

Sporadic Control of Scalar Systems with Delay, Jitter and Measurement Noise, pp. 15486-15492.

Cervin, Anton — Lund Univ.
Johannesson, Erik — Lund Univ.

15:20-15:40 — FrB12.5

Stability and Stabilization of Markovian Jump Linear Systems with Partly Unknown Transition Probabilities, pp. 15493-15498.

Zhang, Lixian — Ec. Pol. de Montreal
Boukas, El-Kebir — Ec. Pol. de Montreal

15:40-16:00 — FrB12.6

The Markovian Jump Contour Tracker, pp. 15499-15504.

Cordeiro Junior, Albino — Lab. Nacional de Computação
Adriano Alves — Científica
Fragoso, Marcelo — LNCC / MCT
Georganas, Nicolas D. — Univ. of Ottawa
de Oliveira, Jauvane C. — Lab. Nacional de Computação Científica

FrB14 — 318

Management of Natural Resources II (Regular Session)

Chair: Tamura, Hiroyuki — Kansai Univ.
Co-Chair: Puig, Vicenc — Univ. Pol. de Catalunya

14:00-14:20 — FrB14.1

Modeling and Policy Assessment of Carbon Tax and Emissions Trading for Preserving Global Environment, pp. 15505-15510.

Tamura, Hiroyuki — Kansai Univ.
Kimura, Takashi — Kansai Univ.

14:20-14:40 — FrB14.2

Formalizing and Solving the PM10 Control Problem, pp. 15511-15516.

Carnevale, Claudio — Univ. of Brescia
Pisoni, Enrico — Univ. of Brescia
Volta, Marialuisa — Univ. of Brescia

14:40-15:00 — FrB14.3

Global Stability in a General Impulsive Biological Control Model with Harvest, pp. 15517-15522.

Nundloll, Sapna — INRIA - Project team COMORE
Mailleret, Ludovic — INRA, UR 880
Grognard, Frederic — INRIA Sophia-Antipolis

15:00-15:20 — FrB14.4

Meta-Model of an Irrigation District Distributed-Parameter Model, pp. 15523-15528.

Galelli, Stefano — Pol. di Milano
Pianosi, Francesca — Pol. di Milano
Soncini-Sessa, Rodolfo — Pol. di Milano

15:20-15:40 — FrB14.5

A Primer Discussion for the Application of Automatic Control to Assist Coastal Land-Water Management in the Mekong Delta, pp. 15529-15534.

Nguyen, Tho — Univ. of Washington

15:40-16:00 — FrB14.6

Robust Fractional Order PI Controller for a Main Irrigation Canal Pool, pp. 15535-15540.

Rivas Perez, Raul — Havana Pol. Univ.
Feliu, Vicente — Univ. of Castilla-La Mancha
Sanchez Rodriguez, Luis — Univ. de Castila-La Mancha
Castillo, Fernando J. — Univ. of Castilla La Mancha
Linares Saez, Antonio — Construcción y Tecnologia Ambiental S.A. BEFESA

FrB15 — 317

Nonlinear Control and Estimation in Bioprocesses (Invited Session)

Chair: Ferreira, Eugenio — Univ. of Minho
Co-Chair: Farza, Mondher — Univ. DE CAEN, ENSICAEN
Organizer: Ferreira, Eugenio — Univ. of Minho
Organizer: Farza, Mondher — Univ. DE CAEN, ENSICAEN

14:00-14:20 — FrB15.1

Robust Nonlinear Controllers for Bioprocesses (I), pp. 15541-15546.

Bedoui, Anes — ENIT
Farza, Mondher — Univ. DE CAEN, ENSICAEN
M'Saad, Mohammed — GREYC CNRS UMR 6072
Ksouri, Mekki — Tunisia National School of Engineers "ENIT"

14:20-14:40 — FrB15.2

A High/low Gain Bundle of Observers: Application to the Input Estimation of a Bioreactor Model (I), pp. 15547-15552.

Moisan, Marcelo — INRIA Sophia Antipolis
Bernard, Olivier — Inria
Gouze, Jean-Luc — INRIA

14:40-15:00 — FrB15.3

Design of a Robust Nonlinear Receding-Horizon Observer - Application to a Biological System (I), pp. 15553-15558.

Goffaux, Guillaume — Faculté Pol. de Mons
Vande Wouwer, Alain — Faculté Pol. de Mons

15:00-15:20 — FrB15.4

Observer Design for Bioprocesses Using a Dissipative Approach (I), pp. 15559-15564.

Moreno, Jaime A. — Univ. Nacional Autonoma de Mexico-UNAM

15:20-15:40 — FrB15.5

Implementation of a Specific Rate Controller in a Fed-Batch E. Coli Fermentation (I), pp. 15565-15570.

Rocha, Isabel — Univ. of Minho
Veloso, Ana — Univ. of Minho
Carneiro, Sonia — Univ. of Minho
Ferreira, Eugenio — Univ. of Minho
Costa, Rafael — Univ. of Minho

15:40-16:00 — FrB15.6

Interval-Based Diagnosis of Biological Systems – Application to an Anaerobic Digestion Pilot Plant (I), pp. 15571-15576.

Lopez-Bańuelos, Ruben — Univ. of Guadalajara - CUCEI

Horacio
Alcaraz-Gonzalez, Victor — Univ. of Guadalajara-CUCEI
Steyer, Jean-Philippe — INRA
Méndez-Acosta, Hugo Oscar — Univ. of Guadalajara
Gonzalez-Alvarez, Victor — Univ. of Guadalajara
Pelayo-Ortiz, Carlos — Univ. of Guadalajara - CUCEI

FrB17 — 320A
Mechatronics Education (Invited Session)
Chair: Chen, Xiaoqi — Univ. of Canterbury
Co-Chair: Dimirovski, Georgi Marko — Dogus Univ. of Istanbul
Organizer: Chen, Xiaoqi — Univ. of Canterbury
Organizer: Dimirovski, Georgi Marko — Dogus Univ. of Istanbul

14:00-14:20 — FrB17.1
Multi-Disciplinary Tutoring for Project-Based Mechatronics Learning (I), pp. 15577-15582.
Vassura, Gabriele — Univ. of Bologna
Macchelli, Alessandro — Univ. of Bologna - Italy

14:20-14:40 — FrB17.2
Mechatronics Management a Bsc Program (I), pp. 15583-15588.
Kopacek, Peter — Vienna Univ. of Tech.
Ceccarelli, Marco — Univ. of cassino
Stapleton, Larry — School of Science, Waterford Inst. of Tech.
Hajrizi, Edmond — Univ. for Business and Tech.

14:40-15:00 — FrB17.3
Modelling and Simulation of Robot Arm Interaction Forces Using Impedance Control (I), pp. 15589-15594.
de Gea, Jose — Univ. of Bremen
Kirchner, Frank — Univ. of Bremen

15:00-15:20 — FrB17.4
Collaborating with a Mobile Robot: An Augmented Reality Multimodal Interface (I), pp. 15595-15600.
Green, Scott A. — Univ. of Canterbury
Chen, Xiaoqi — Univ. of Canterbury
Billinghurst, Mark — Univ. of Canterbury
Chase, J. Geoffrey — Univ. of Canterbury

15:20-15:40 — FrB17.5
Globalization Prospect of Credit Transfer System in Educating Control Engineers: A Developing Country Experience (I), pp. 15601-15605.
Kolemisevska-Gugulovska, Tatjana — SS Cyril and Methodius Univ.
Stankovski, Mile — SS Cyril and Methodius Univ.
Andreeski, Cvetko — Faculty of Tourism and Hospitality

15:40-16:00 — FrB17.6
A Project-Based Mechatronics Program to Reinforce Mechatronic Thinking – a Restructuring Experience from the University of Canterbury (I), pp. 15606-15611.
Chen, Xiaoqi — Univ. of Canterbury
Gaynor, Paul — Univ. of Canterbury
King, Richard — Univ. of Canterbury
Chase, J. Geoffrey — Univ. of Canterbury
Bones, Phil — Univ. of Canterbury
Gough, Peter — Univ. of Canterbury
Duke, Richard — Univ. of Canterbury

FrB18 — 320B
Mechatronics for Special Feature Robots (Regular Session)
Chair: Yen, Jia-Yush — National Taiwan Univ.
Co-Chair: Ivanescu, Mircea — Univ. of Craiova, Romania

14:00-14:20 — FrB18.1
Modular Design and Simulation Study of Biomimetic Snake Robots (I), pp. 15612-15617.
Lian, Feng-Li — National Taiwan Univ.
Yeh, Shang-Wei — National Taiwan Univ.

14:20-14:40 — FrB18.2
Power Reduction by Controlling Joint Compliance for the Propulsion of a Biomimetic Underwater Vehicle (I), pp. 15618-15623.
Guo, Jenhwa — National Taiwan Univ.
Yen, Wei-Kuo — National Taiwan Univ.

14:40-15:00 — FrB18.3
Sensor Fusion in a Six-Legged Bio-Mimicking Robot (I), pp. 15624-15629.
Liu, Shu-Hung — National Taiwan Univ.
Yen, Jia-Yush — National Taiwan Univ.
Chen, Yi-Ting — National Taiwan Univ.

15:00-15:20 — FrB18.4
Design of the Octabot Self-Reconfigurable Robot, pp. 15630-15635.
Shiu, Ming-Chiuan — National Taiwan Univ. Hsiuping Inst. ofTechnology
Lee, Hou-Tsan — Takming Univ. of Science and Tech.
Lian, Feng-Li — National Taiwan Univ.
Fu, Li-Chen — National Taiwan Univ.

15:20-15:40 — FrB18.5
Backstepping Based PID Control Strategy for an Underactuated Aerial Robot, pp. 15636-15641.
Mian, Ashfaq Ahmad — Nanjing Univ. of Aeronautics and Astronautics
Mian, Ilyas Ahmad — Imperial Coll. London
Wang, Daobo — Nanjing Univ. of Aeronautics and Astronautics

15:40-16:00 — FrB18.6
A Distributed Force and Position Control for a Tentacle Manipulator, pp. 15642-15647.
Ivanescu, Mircea — Univ. of Craiova, Romania
Florescu, Mihaela Cecilia — Univ. of Craiova, Romania
Popescu, Nirvana — Univ. Pol. Bucharest, Romania
Popescu, Decebal — Univ. Pol. Bucharest, Romania

FrB19 — 320C
Putting Energy Back in Robotics (Invited Session)
Chair: Macchelli, Alessandro — Univ. of Bologna - Italy
Co-Chair: Secchi, Cristian — Univ. of Modena and Reggio Emilia
Organizer: Macchelli, Alessandro — Univ. of Bologna - Italy
Organizer: Secchi, Cristian — Univ. of Modena and Reggio Emilia

14:00-14:20 — FrB19.1
Compensation of Position Errors in Passivity Based Teleoperation Over Packet Switched Communication Networks (I), pp. 15648-15653.
Secchi, Cristian — Univ. of Modena and Reggio Emilia
Stramigioli, Stefano — Univ. of Twente
Fantuzzi, Cesare — Univ. of Modena and Reggio Emilia

14:20-14:40 — FrB19.2
Stable Teleoperation with Time Domain Passivity Approach (I), pp. 15654-15659.
Ryu, Jee-Hwan — Korea Univ. of Tech. and Education

14:40-15:00 — FrB19.3
A New Proportional Controller for Nonlinear Bilateral Teleoperators (I), pp. 15660-15665.
Nuńo, Emmanuel — Tech. Univ. of Catalonia
Ortega, Romeo — LSS-SUPELEC
Basanez, Luis — Univ. Pol. de Catalunya
Barabanov, Nikita E. — North Dakota State Univ.

15:00-15:20 — FrB19.4
Energy Conservative Limit Cycle Oscillations (I), pp. 15666-15671.
Stramigioli, Stefano — Univ. of Twente
van Dijk, Michel — Univ. of Twente

15:20-15:40 — FrB19.5
Port-Based Simulation of Flexible Multi-Body Systems (I), pp. 15672-15677.
Macchelli, Alessandro — Univ. of Bologna - Italy
Melchiorri, Claudio — Univ. of Bologna

15:40-16:00 — FrB19.6
Iterative Feedback Tuning for Hamiltonian Systems (I), pp. 15678-15683.
Fujimoto, Kenji — Nagoya Univ.
Koyama, Ikuo — Nagoya Univ.

FrB20 — 321C
Electrical Machine Control and Applications (Invited Session)

Chair: Gan, Wai-Chuen — ASM Assembly Automation Hong Kong Ltd
Co-Chair: Qiu, Li — Hong Kong Univ. of Sci. & Tech.
Organizer: Gan, Wai-Chuen — ASM Assembly Automation Hong Kong Ltd
Organizer: Qiu, Li — Hong Kong Univ. of Sci. & Tech.

14:00-14:20 FrB20.1
An Adaptive Sinusoidal Disturbance Rejection Controller for Single-Input-Single-Output Systems (I), pp. 15684-15689.
Gan, Wai-Chuen — ASM Assembly Automation Hong Kong Ltd
Qiu, Li — Hong Kong Univ. of Sci. & Tech.

14:20-14:40 FrB20.2
Disturbances Rejection for Precise Position Control of Linear Switched Reluctance Motors (I), pp. 15690-15695.
Zhao, Shi Wei — Hong Kong Pol. Univ.
Cheung, Norbert — Hong Kong Pol. Univ.

14:40-15:00 FrB20.3
The Feedforward Friction Compensation of Linear Motor Using Genetic Learning Algorithm, pp. 15696-15701.
Chen, Chin-Sheng — National Taipei Univ. of Tech.

15:00-15:20 FrB20.4
On Control of Planar Switched Reluctance Motor (I), pp. 15702-15707.
Yang, Jin Ming — South China Univ. of Tech.
Zhong, Qing — South China Univ. of Tech.
Cheung, Norbert — Hong Kong Pol. Univ.
Zhao, Shi Wei — Hong Kong Pol. Univ.

15:20-15:40 FrB20.5
Robust Control of a High Precision 4-DOF Parallel Manipulator (I), pp. 15708-15713.
Cheung, Jacob W.F. — ASM Assembly Automation Ltd
Hung, Yeung Sam — The Univ. of Hong Kong

15:40-16:00 FrB20.6
A New Concept for Motion Control of Industrial Robots, pp. 15714-15715.
Björkman, Mattias — ABB AB
BrogÍrdh, Torgny — ABB AB
Hanssen, Sven — ABB Automation Tech.
Lindström, Sven-Erik — ABB AB
Moberg, Stig — ABB AB - Robotics
Norrlöf, Mikael — ABB AB

FrB21 321B
Human-Robot Interaction (Regular Session)
Chair: Tervo, Kalevi — Helsinki Univ. of Tech.
Co-Chair: Riera, Bernard — Reims Univ.

14:00-14:40 FrB21.1
Computational Approaches to Human Arm Movement Control – a Review, pp. 15716-15723.
Campos, Francisco M. M. O. — ISEL - Inst. Superior de Engenharia de Lisboa
Calado, Joăo M. F. — ISEL - Inst. Superior de Engenharia de Lisboa

14:40-15:00 FrB21.2
Improving Operator Skills with Productivity Model Feedback, pp. 15724-15729.
Tervo, Kalevi — Helsinki Univ. of Tech.
Palmroth, Lauri — Tampere Univ. of Tech.
Hölttä, Vesa — Helsinki Univ. of Tech.
Putkonen, Aki — John Deere Forestry

15:00-15:20 FrB21.3
Assisting Upper Extremity Motion through the Use of the Potential Method, pp. 15730-15735.
Nishiwaki, Kenji — Gifu Univ.
Yano, Ken'ichi — Gifu Univ.

15:20-15:40 FrB21.4
Human-Machine Systems Concepts Applied to Education, pp. 15736-15741.
Marange, Pascale — Univ. of Reims
Gellot, François — Univ. of REIMS
Riera, Bernard — Reims Univ.

15:40-16:00 FrB21.5
Hybrid Impedance Control of Human Skin Muscle by Multi-Fingered Robot Hand, pp. 15742-15749.
Terashima, Kazuhiko — Toyohashi Univ. of Tech.
Mouri, Keisuke — Toyohashi Univ. of Tech.
Minyong, Panya — Pathumwan Inst. of Tech.
Kitagawa, Hideo — Gifu National Coll. of Tech.
Miyoshi, Takanori — Toyohashi Univ. of Tech.

FrB22 321A
Structural Components (Regular Session)
Chair: McLoone, Sean F. — National Univ. of Ireland, Maynooth
Co-Chair: Jung, Hyung-Jo — KAIST

14:00-14:20 FrB22.1
On the Stability and Biasedness of the Cross-Relation Blind Thermocouple Characterisation Method, pp. 15750-15755.
McLoone, Sean F. — National Univ. of Ireland, Maynooth
Hung, Peter C. F. — National Univ. of Ireland, Maynooth
Irwin, George W. — Queen's Univ. of Belfast
Kee, Robert J. — Queen's Univ. Belfast

14:20-14:40 FrB22.2
Semiactive Control System Based on MR Damper for Suppressing Vibration of Stay Cable under Wind Load (I), pp. 15756-15761.
Jung, Hyung-Jo — KAIST
Jang, Dong-Doo — KAIST
Lee, Heon-Jae — KAIST
Kim, In-Ho — Sejong Univ.
Lee, Seung-Woo — KAIST

14:40-15:00 FrB22.3
Damage Detection of Bridge Structures Using Modal Flexibility under Temperature Variations (I), pp. 15762-15767.
Koo, Ki Young — KAIST
Lee, Jong Jae — Sejong Univ.
Yun, Chung-Bang — KAIST

15:00-15:20 FrB22.4
Extended Kalman Filter for Identification of Nonlinear Earthquake Responses of Bridges (I), pp. 15768-15773.
Lee, Kyoung Jae — Daelim Industrial Co. Ltd.
Yun, Chung Bang — KAIST

15:20-15:40 FrB22.5
MultiRate Predictive Control of Piezoelectric Actuators, pp. 15774-15779.
Habibollahi, Hossein — Amirkabir Univ.
Rezaie, Seyed Mehdi — Amirkabir Univ.
Shiry Ghidary, Saied — Amirkabir Univ. of Tech.
Zareinejad, Mohammad — Amirkabir Univ. of Tech.
Seifabadi, Reza — Amirkabir Univ. of Tech.
Razi, Kamran — Univ. of Tehran
Saadat, Mozafar — Univ. of Birmingham

15:40-16:00 FrB22.6
A Highly-Directional Ultrasonic Range Sensor Using a Stepped-Plate Transducer, pp. 15780-15785.
Je, Yub — Pohang Univ. of Science and Tecnology
Park, Jong-Kyu — Pohang Univ. of science and Tech.
Lee, Haksu — Pohng Univ. of Science and Tech.
Yi, Dong hoon — Phang Univ. of Science and Tech.
Moon, WonKyu — Pohang Univ. of Science and Tech.

FrB23 323
Intelligent Manufacturing Systems (Regular Session)
Chair: Torres, Fernando — Univ. of Alicante
Co-Chair: Hsieh, Fu-Shiung — Chaoyang Univ. of Tech.

14:00-14:20 FrB23.1
Development of a Flexible and Agile Multi-Robot Manufacturing System, pp. 15786-15791.
Hoshino, Satoshi — Tokyo Inst. of Tech.
Seki, Hiroya — Tokyo Inst. of Tech.
Naka, Yuji — Tokyo Inst. of Tech.

14:20-14:40 FrB23.2
Reconfiguration Mechanism for Holonic Manufacturing Systems, pp. 15792-15798.
Hsieh, Fu-Shiung — Chaoyang Univ. of Tech.

14:40-15:00 FrB23.3
Pull System Control for Job Shop Via a Holonic, Isoarchic & Multicriteria Approach, pp. 15799-15804.
Pujo, Patrick — Aix Marseille Univ.
Ounnar, Fouzia — Aix Marseille Univ.

15:00-15:20 FrB23.4
Assembly/disassembly Strategies for Service Applications, pp. 15805-15810.
Puente, Santiago T. — Univ. of Alicante
Torres, Fernando — Univ. of Alicante
Diaz, Carolina — Univ. of Alicante

15:20-15:40 FrB23.5
Modern Ability of Optimization-Simulation Approach, pp. 15811-15816.
Antonova, Galina — Inst. of Control Sciences
Tsvirkun, Anatoly — Inst. of Control Sciences

15:40-16:00 FrB23.6
Are Automated Planners up to Solve Real Problems?, pp. 15817-15824.
Sette, Fernando — Univ. of Sao Paulo
Vaquero, Tiago Stegun — Univ. of Sao Paulo
Park, Song Won — Univ. of Sao Paulo
Silva, José Reinaldo — Univ. of São Paulo

FrB24 324
Job and Activity Scheduling II (Regular Session)
Chair: Allaoui, Hamid — Univ. of Artois
Co-Chair: Meyer, Wolfgang — Hamburg Univ. of Tech.

14:00-14:20 FrB24.1
Optimum Steelmaking Charge Plan with Unknown Charge Number Based on the Pseudo TSP Model, pp. 15825-15830.
Xue, Yuncan — Hohai Univ.
Zhou, Zhentao — Hohai Univ.
Liu, Fei — Jiangnan Univ.
Yang, Qiwen — Hohai Univ.

14:20-14:40 FrB24.2
Sensitivity Analysis for the Configuration of a Multi-Purpose Machines Workshop, pp. 15831-15836.
Aubry, Alexis — Grenoble INP
Rossi, André — European Univ. of Brittany
Jacomino, Mireille — Grenoble INP

14:40-15:00 FrB24.3
Hybrid Model for Crane Scheduling, pp. 15837-15842.
Del Vecchio, Carmen — Univ. Del Sannio
Barbarisi, Osvaldo — Univ. of Sannio
Parisio, Alessandra — Univ. del Sannio

15:00-15:20 FrB24.4
Scheduling N Jobs and Preventive Maintenance in a Single Machine Subject to Breakdowns to Minimize the Expected Total Earliness and Tardiness Costs, pp. 15843-15848.
Allaoui, Hamid — Univ. of Artois
Elmaghraby, Salah — North Caroline Univ.
Artiba, Hakim — SUPMECA PARIS
Goncalves, Gilles — Univ. of Artois

15:20-15:40 FrB24.5
Multi-Objective Optimization Issues in Short-Term Batch Scheduling, pp. 15849-15854.
Gudi, Ravindra — IIT Bombay
Bhushan, Mani — Indian Inst. of Tech. Bombay
Kotecha, Prakash — Indian Inst. of Tech. Bombay
Kapadi, Mangesh — Honeywell Tech. Solutions

15:40-16:00 FrB24.6
Hybrid Particle Swarm Optimization for Stochastic Flow Shop Scheduling with No-Wait Constraint, pp. 15855-15860.
Liu, Bo — Centre for World Food Studies,VU Univ. Amsterdam
Wang, Ling — Tsinghua Univ. Beijing, 100084, China
Qian, Bin — Tsinghua Univ. Beijing 100084, China
Jin, Yihui — Tsinghua Univ.

FrB25 328
Control Mechanisms in Systems Biology (Invited Session)
Chair: Ogunnaike, Babatunde A. — Univ. of Delaware
Co-Chair: Hahn, Juergen — Texas A&M Univ.
Organizer: Ogunnaike, Babatunde A. — Univ. of Delaware
Organizer: Hahn, Juergen — Texas A&M Univ.

14:00-14:20 FrB25.1
Analysis of Feedback Mechanisms in Cell-Biological Systems (I), pp. 15861-15866.
Waldherr, Steffen — Univ. of Stuttgart
Eissing, Thomas — Univ. of Stuttgart
Allgower, Frank — Univ. of Stuttgart

14:20-14:40 FrB25.2
Fuzzy Modeling of Signal Transduction Networks (I), pp. 15867-15872.
Huang, Zuyi (Jacky) — Texas A&M Univ.
Hahn, Juergen — Texas A&M Univ.

14:40-15:00 FrB25.3
An Approximate Internal Model Principle: Applications to Nonlinear Models of Biological Systems (I), pp. 15873-15878.
Andrews, Burton — The Johns Hopkins Univ.
Sontag, Eduardo D. — Rutgers Univ.
Iglesias, Pablo A. — Johns Hopkins Univ.

15:00-15:20 FrB25.4
Structural Sensitivity Analysis of Metabolic Networks (I), pp. 15879-15884.
Uhr, Markus — ETH Zurich
Stelling, Joerg — ETH Zurich

15:20-15:40 FrB25.5
A Control System Hypothesis of the N-Methyl-D-Aspartate Glutamate Receptor's Role in Alcoholism and Alcohol Withdrawal (I), pp. 15885-15890.
McDonald, Mary K. — Univ. of Delaware
Schwaber, James S. — Thomas Jefferson Univ.
Ogunnaike, Babatunde A. — Univ. of Delaware

15:40-16:00 FrB25.6
Systems Analysis of the Insulin Signaling Pathway (I), pp. 15891-15896.
Kwei, Eric — Univ. of California, Santa Barbara
Sanft, Kevin — Univ. of California, Santa Barbara
Petzold, Linda — Univ. of California Santa Barbara
Doyle, Francis — Univ. of California at Santa Barbara

FrB26 327
AI Applications in Power Plants (Regular Session)
Chair: Mori, Hiroyuki — Meiji Univ.
Co-Chair: Zhang, Ruiyou — Northeastern Univ.

14:00-14:20 FrB26.1
Discrete-Time Backstepping Synchronous Generator Stabilisation Using a Neural Observer, pp. 15897-15902.
Alanis, Alma Y. — Cinvestav
Sanchez, Edgar N. — CINVESTAV
Loukianov, Alexander G. — CINVESTAV IPN GDl

14:20-14:40 FrB26.2
An LMI Design of an Observer Based Fuzzy PSS, pp. 15903-15908.
Soliman, Mahmoud — Banha Univ.
Elshafei, Abdel Latif — Cairo Univ.

14:40-15:00 FrB26.3
A Simulation Model of Spray Flash Desalination System, pp. 15909-15914.
Goto, Satoru — Saga Univ.
Yamamoto, Yuji — Saga Univ.
Sugi, Takenao — Saga Univ.
Yasunaga, Takeshi — Saga Univ.
Ikegami, Y. — Saga Univ. Japan
Nakamura, Masatoshi — Graduate School of Science and Engineering, Saga Univ.

15:00-15:20 FrB26.4
Intelligent Control of a Fuel Cell Power Plant, pp. 15915-15920.
Choi, Tae-Il — Pennsylvania State Univ.
Lee, Kwang Y. — Baylor Univ.

15:20-15:40 FrB26.5
A New Methodology to the Control Problem of Horizontal Axis Wind Power Plants Using Adaptive Neural Network, pp. 15921-15926.
Bati, Akram — Univ. of Tech.

Rashid, Kasim — RMC, Kingston, Ontario, Canada
Al-Rubaiee, Safa — Univ. of Tech.

15:40-16:00 FrB26.6
Power-Grid-Partitioning Model and Its Tabu-Search-Embedded Algorithm for Zonal Pricing, pp. 15927-15932.
Zhang, Ruiyou — Northeastern Univ.
Wang, Dingwei — Northeastern Univ.
Yun, Won Young — Pusan National Univ.

FrB27 326
Remote and Distributed Control (Regular Session)
Chair: Schilling, Klaus — Univ. Wuerzburg
Co-Chair: Salichs, Miguel A. — Univ. Carlos III

14:00-14:20 FrB27.1
Process Control Via Network, pp. 15933-15938.
Yliniemi, Maija Leena — Docent

14:20-14:40 FrB27.2
A Petri Net Model of Distributed Control in a Holonic Manufacturing Execution System, pp. 15939-15944.
Demongodin, Isabel — Univ. Paul Cézanne
Hennet, Jean-Claude — LSIS Information and Systems Science Lab.

14:40-15:00 FrB27.3
Stability Analysis of Multi-Input and Multi-Output Networked Control Systems, pp. 15945-15950.
Ma, Weiguo — Dalian Univ. of Tech.
Shao, Cheng — Dalian Univ. of Tech.

15:00-15:20 FrB27.4
Multi-Agent Control System of a Kraft Recovery Boiler, pp. 15951-15956.
Herrera Sosa, Ivan Raul — Univ. of São Paulo
Park, Song Won — Univ. of Sao Paulo
Silva, José Reinaldo — Univ. of São Paulo

15:20-15:40 FrB27.5
Two Ways for Remote Plant Control, pp. 15957-15962.
Zakova, Katarina — Slovak Univ. of Tech.
Huba, Mikulas — Slovak Univ. of Tech.

15:40-16:00 FrB27.6
On the Source-Channel Coding Tradeoff in Networked Control, pp. 15963-15966.
Johansson, Mikael — Royal Inst. of Tech.

FrB28 330A
Marine System II (Regular Session)
Chair: Silvestre, Carlos — Inst. Superior Tecnico
Co-Chair: Bitmead, Robert — Univ. of California San Diego

14:00-14:20 FrB28.1
Identification of Longitudinal and Trasnversal Dynamics of a Fast Ferry, pp. 15967-15972.
Muńoz-Mansilla, Rocío — UNED
Aranda, Joaquin — Univ. Nacional de Educación a Distancia
Díaz, Jose Manuel — UNED
Chaos, Dictino — UNED
de la Cruz, Jesús M — Complutense Univ.

14:20-14:40 FrB28.2
Improving Aiding Techniques for USBL Tightly-Coupled Inertial Navigation System, pp. 15973-15978.
Morgado, Marco — Inst. Superior Técnico
Oliveira, Paulo Jorge — Inst. Superior Técnico
Silvestre, Carlos — Inst. Superior Tecnico
Vasconcelos, José Fernandes — Inst. Superior Técnico

14:40-15:00 FrB28.3
Model Predictive Control with State Dependent Input Weight: An Application to Underwater Vehicles, pp. 15979-15984.
Marafioti, Giancarlo — Norwegian Univ. of Science and Tech.
Bitmead, Robert — Univ. of California San Diego
Hovd, Morten — Norwegian Univ. of Tech. and Science

15:00-15:20 FrB28.4
A Totally Stable Adaptive Control for Path Tracking of Time-Varying Autonomous Underwater Vehicles, pp. 15985-15990.
Jordan, Mario A. — IADO-CONICET, DIEC-UNS
Bustamante, Jorge Luis — Argentinean Inst. of Oceanography

15:20-15:40 FrB28.5
Neural Network-Based Underwater Image Classification for Autonomous Underwater Vehicles, pp. 15991-15995.
Kim, Tae Won — STI Medical Systems
Yu, Son-Cheol — Univ. of Hawaii
Yuh, Junku — US Embassy Tokyo

15:40-16:00 FrB28.6
Compliant Coordination and Control of Multiple Vehicles with Discrete-Time Periodic Communications, pp. 15996-16001.
Almeida, João — Inst. Superior Técnico
Silvestre, Carlos — Inst. Superior Tecnico
Pascoal, Antonio M. — ISR-Inst. Superior Tecnico

FrB29 330B
Cooperative Motion Control of Multiple Autonomous Vehicles (Invited Session)
Chair: Pascoal, Antonio M. — ISR-Inst. Superior Tecnico
Co-Chair: Aguiar, A. Pedro — Inst. Superior Tecnico
Organizer: Pascoal, Antonio M. — ISR-Inst. Superior Tecnico
Organizer: Aguiar, A. Pedro — Inst. Superior Tecnico

14:00-14:20 FrB29.1
Decentralized Control of Swarms with Collision Avoidance Implications (I), pp. 16002-16007.
Niccolini, Marta — Univ. of Pisa
Pollini, Lorenzo — Univ. of Pisa
Innocenti, Mario — Univ. of Pisa

14:20-14:40 FrB29.2
Ship Formation Control: A Guided Leader-Follower Approach (I), pp. 16008-16014.
Breivik, Morten — Norwegian Univ. of Science and Tech.
Hovstein, Vegard E. — Maritime Robotics AS
Fossen, Thor I. — NTNU

14:40-15:00 FrB29.3
Coordinated Path Following of Multiple UAVs for Time-Critical Missions in the Presence of Time-Varying Communication Topologies (I), pp. 16015-16020.
Aguiar, A. Pedro — Inst. Superior Tecnico
Kaminer, Isaac — Naval Postgraduate School
Ghabcheloo, Reza — Inst. Superior Técnico
Pascoal, Antonio M. — ISR-Inst. Superior Tecnico
Hovakimyan, Naira — Virginia Pol. Inst.
Cao, Chengyu — Virginia Pol. & State Univ.
Dobrokhodov, Vladimir — Naval Postgraduate School
Xargay, Enric — Virginia Pol. Inst. and State Univ.

15:00-15:20 FrB29.4
Cooperative Control of Underwater Glider Fleets by Fault Tolerant Decentralized MPC (I), pp. 16021-16026.
Longhi, Sauro — Univ. Pol. delle Marche
Monteriů, Andrea — Univ. Pol. delle Marche
Vaccarini, Massimo — Univ. Pol. delle Marche

15:20-15:40 FrB29.5
Leaderless Formation Control Using Dynamic Extension and Sliding Control (I), pp. 16027-16032.
Zheng, Zhibo — Columbia Univ.
Girard, Anouck — Univ. of Michigan, Ann Arbor
Spry, Stephen — Univ. of California, Berkeley

15:40-16:00 FrB29.6
Distributed Control Design for Underwater Vehicles, pp. 16033-16038.
Balderud, Jonas — Univ. of Strathclyde
Giovanini, Leonardo — Industrial Control Centre
Katebi, Reza — Univ. of Strathclyde

FrB30 330C
Control Design for Transportation Vehicles and Systems (Regular Session)
Chair: Panferov, Alexander — SUAI, Saint-Petersburg State Univ. of Aerospace Inst.
Co-Chair: Li, Pingkang — Beijing Jiaotong Univ.

14:00-14:20 FrB30.1
Torque Observer Modelling for Vehicle Transmission Shifting Processing Based on Neural Networks, pp. 16039-16044.

Li, Pingkang — Beijing Jiaotong Univ.
Jin, Taotao — Beijing Jiaotong Univ.
Du, Xiuxia — Beijing Jiaotong Univ.

14:20-14:40 FrB30.2

Traffic Control of Internal Tractors in Port Container Terminal Using Simulation, pp. 16045-16050.

Lau, Henry — The Univ. of Hong Kong
Lee, Nicole — The Univ. of Hong Kong

14:40-15:00 FrB30.3

Wheelslide and Wheelskid Protection for a Single-Wheel Drive and Brake Module (SDBM) for Rail Vehicles, pp. 16051-16056.

Stuetzle, Thorsten — RWTH Aachen Univ.
Engelhardt, Thomas — RWTH Aachen Univ.
Enning, Manfred — RWTH Aachen Univ.
Abel, Dirk — RWTH-Aachen Univ.

15:00-15:20 FrB30.4

Modeling and Straight Transfer Transformation Control of Shipboard Crane Considering Ship Sway, pp. 16057-16064.

Ito, Ryuji — Toyohashi Univ. of Tech.
Hieda, Kazuya — Toyohashi Univ. of Tech.
Terashima, Kazuhiko — Toyohashi Univ. of Tech.
Kaneshige, Akihiro — Tokuyama Coll. of Tech.

15:20-15:40 FrB30.5

Integrated-Equilibrium Routing of Traffic Flows with Congestion, pp. 16065-16070.

Li, Zhenlong — Beijing Univ. of Tech.
Zhao, Xiaohua — Beijing Univ. of Tech.

15:40-16:00 FrB30.6

Mathematical Modeling, Simulation and Control of Flexible Vehicles, pp. 16071-16076.

Panferov, Alexander — SUAI, Saint-Petersburg State Univ. of Aerospace Inst.
Nebylov, Alexander — State Univ. of Aerospace Inst.
Brodsky, Sergey — SUAI, Saint-Petersburg StateUniversityofAerospaceInstrumentation

Book of Abstracts

MoPL1 Auditorium (301)
Reduced Complexity Control Systems by Roger Brockett
(Plenary Session)

Chair: Kwon, Wook Hyun — Seoul National Univ.

08:00-09:00 MoPL1.1
Reduced Complexity Control Systems, pp. 1-6
Brockett, Roger — Harvard Univ.

This paper discusses methods for extending available analysis and design techniques to systems of greater complexity, such as highly autonomous robotic systems. We focus on the role that feedback can play in simplifying analysis and design and, in particular, the extent to which elementary feedback rules based on finite state automata can be used to reduce the complexity of systems.

MoPL2 Auditorium (301)
Overview of Potential Evolutions of Technologies Applied in Commercial Transport Airplanes by Etienne Tarnowski
(Plenary Session)

Chair: Isidori, Alberto — Univ. of Rome

09:00-10:00 MoPL2.1
Overview of Potential Evolutions of Technologies Applied in Commercial Transport Airplanes, pp. 7-21
Tarnowski, Etienne — AIRBUS

The first decade of the XX1st century is an outstanding period for Commercial Transport Aviation. Indeed due to a continuous economic growth and reduced air fares, the passenger traffic is continuously growing: between 2000 and 2007 the total number of passengers has increased by some 36%, whereas the cargo traffic stimulated by the global e-commerce and manufacturing trends, is actually growing even faster. Consequently, the Network airlines and the Low Cost Carriers have ordered and are ordering an unprecedented number of airplanes to face this demand. In the next 20 years, the air traffic is predicted to double, which leads to an expected demand of over 24000 aircraft in that time frame. The first problem industry has and will have to face, is the saturation of some airspaces and the congestion of airports. Today, 64% of the worldwide traffic is concentrated on 93 airports! Yes, traffic will grow, will double but airport capacity will not. The second problem industry will have to face, is the environmental problems: noise levels at Take off and in Approach, gas emissions (CO2, Nox…), but also hazardous materials. Yes airplanes must be “Greener”, and the goal of the “vision 2020” program is a cut off 50% CO2 emissions. The third problem industry will have to face is economics: the fuel cost today participates to some 36% of the operating costs (and there is no obvious reason to see its price going down with the rarefaction of the fuel feed stocks), whereas the staff cost participates to some 20% of that cost. It is estimated that over 13500 airplanes will have to be replaced by more economical models in the next 20 years. The existing response to those challenges is the A380; this Very Large and very long range Aircraft (VLA), already answers to some of these problems, since it is able to carry more passengers, with less flights, with less fuel consumption, with less CO2 emissions and with less noise.Considering the A380 as the starting point of evolutions, an overview of the potential technological step forwards in automation, structure, engines, aerodynamics, but also in crew layout…will highlight the tremendous challenges to be taken by the aeronautical industry in order to make the Commercial Air transpor

MoA01 Atlantic Hall
Automotive & Manufacturing Systems (Poster Session)

Chair: Nielsen, Lars — Linköping Univ.
Co-Chair: Nof, Shimon Y. — Purdue Univ.

10:30-12:30 MoA01.1
A Control Software Development Method Using IEC 61499 Function Blocks, Simulation and Formal Verification, pp. 22-27
Cengic, Goran — Chalmers Univ. of Tech.
Akesson, Knut — Chalmers Univ. of Tech.

A new control software development method is presented. It uses IEC 61499 function blocks for control software programming and provides tools for simulation, execution, automatic model generation and formal verification of the control code during the development. Simulation and execution are supported by the same tool, the Fuber runtime environment. Formal modeling is done using extended finite automata (EFA) and an automatic model generation tool. Formal verification shows the behavior of the closed-loop system. i.e. when control code is executed against the model of the process. The model can use a non-deterministic execution control chart (ECC) in the process model block. The control code and the process model are expressed using the IEC 61499 language in order to avoid maintenance of the process model and control code in different languages, thus making it easier to use the formal verification in the control software development.

10:30-12:30 MoA01.2
Complex Automation of Technological Processes with Involving Event Model in Feedback Control Scheme, pp. 28-33
Ambartsumian, Alexander — Russian Acad. of Sciences Inst. of Control Sciences
Kazansky, Dmitry — PLC_Systems

This paper introduces a method of technological process control for manufactures with continuous structure. This method assumes using of three-leveled event logical manufacture model. This model allows generating the technological process structure on the basis of the current and targeted structure formal description analysis. It provides the subsequent extraction of required structure from knowledge base or interactive construction by means of involving the operator into the process of creation the required structure. The next control step is the realization of the chosen structure and automatic adjusting the necessary settings for involved technological aggregates. Such an approach provides a possibility of the system protection from the personnel’s errors by the means of restricts insertion on his actions in the form of a dialogue scheme. The work is supplied by the RFFR RAS fond. The grant ą06-08-01619-ŕ.

10:30-12:30 MoA01.3
New Approach for Risk Analysis Update Based on Maintenance Events, pp. 34-39
Mili, Aymen — INP Grenoble - France
Bassetto, Samuel — INP Grenoble - France

This paper will focus on the management and improvement of equipment availability with better prevention of failures. It is focused on one of process control tasks: preliminary risks analysis. The result from this study is a method which empowered engineers and managers decision about actions to implement regarding negative events in their manufacture. The article proposes a risk based maintenance method, which relies on the regular and automatic update of equipments’ risk analyses including equipment failure history. The associated aided decision tool is presented. The article is structured in four parts. After a risk management domain literature overview, the paper presents the new risk based maintenance method. A case study in semiconductor industry shows that FMECA can be employed in a dynamic way for managing maintenance activities. The alternative model simplifies and makes more reliable risks identification and estimation. Results and a short discussion end the article.

10:30-12:30 MoA01.4
Stability Analysis of a Closed-Loop Thermoforming Reheat Process Using an Affine Quadratic Stability Test, pp. 40-45
Azarnoush, Hamed — McGill Univ.
Boulet, Benoit — McGill Univ.

The process of manufacturing plastic parts by heating polymer sheets and forming them on a mold is called thermoforming. The heating stage of the thermoforming process is nonlinear and parameter-varying. The heater temperature setpoints are usually determined by trial and error. A control design for this system can improve quality, reduce scrap and allow for temperature zoning. In this paper, the problem of stability analysis for a thermoforming process controlled by a static output feedback controller is addressed. An affine quadratic stability (AQS) test is chosen for this analysis. The AQS test requires a number of linear matrix inequalities (LMIs) to hold in order for the system to be stable. There is only one varying parameter in the thermoforming oven model, and as a result the number of LMIs to be computed is limited to five, which makes the AQS test practical. A parameter-dependent Lyapunov function is developed to prove the stability of the system.

10:30-12:30 MoA01.5
Fuzzy Soft Sensors for Chemical and Oil Refining Processes, pp. 46-50
Bakhtadze, Natalia — Inst. of Control Sciences of Russian Acad. ofSciences

The paper offers an approach to soft sensors design for chemical and oil refining processes. The approach proposed is based on virtual models and associative search techniques. Takagi-Sugeno fuzzy model is applied in combination with production knowledgebase to compensate for the lack of lab data

10:30-12:30 MoA01.6

Throughput Optimization of Automated Flats Sorting Machines, pp. 51-56

Tarau, Alina	Delft Univ. of Tech.
De Schutter, Bart	Delft Univ. of Tech.
Hellendoorn, Hans	Delft Univ. of Tech.

Large letters, journals, magazines, plastic wrapped mail items of A4 size are called flats. In order to be able to handle the large volumes of flats that have to be processed state-of-the-art post sorting centers are equipped with dedicated flats sorting machines. The throughput of a flats sorting machine is crucial when dealing with a continually increasing number of items to be sorted in a certain time. But, the throughput is limited by the mechanical constraints. We propose to optimize the efficiency of this sorting system by making several design changes and implementing advanced model-based control methods such as optimal control and model predictive control. In this paper we determine an event-based model of the flats sorting system. The considered control methods are compared for several scenarios. Results indicate that using the proposed approaches the throughput can be increased with up to 52.62%, the computation of the optimal velocity being performed in real-time.

10:30-12:30 MoA01.7

An Approach for Re-Ordering and Scheduling of Feature-Based NC Program, pp. 57-62

Berger, Ulrich	Brandenburg Univ. of Tech. Cottbus
Kretzschmann, Ralf	Brandenburg Univ. of Tech. Cottbus
Aner, Matthias	Daimler AG

Nowadays, significant deficiencies exist in the information flow and access along the NC (Numerical Control) process chain. These deficiencies are overcome insufficiently by introducing CAD/CAM systems and feature-oriented specification languages. In contrast to that, the application of new production and new machining systems require an intensive information exchange. The introduced approach enables the preparation for feature-based work plans using methods known from the graph theory. Therefore, the work plan will be mapped into a directed graph in a mathematically defined way. Now it is possible to use algorithms to find the shortest path and a Hamiltonian path inside this directed graph according to given requirements. Thus, the work plan will be re-ordered and scheduled. At the end, the corresponding NC paths will be generated and distributed to the machinery. Thence in this paper, the mathematics, the requirements and the work flow in such a system will is described. A preliminary prototype is introduced as well. As conclusion the transfer of this approach into other production technologies will be discussed.

10:30-12:30 MoA01.8

A Quantum Genetic Based Scheduling Algorithm for Stochastic Flow Shop Scheduling Problem with Random Breakdown, pp. 63-68

Gu, JinWei	East China Univ. of Science and Tech. 200237,Shanghai
Gu, Xingsheng	East China Univ. of Science and Tech.
Jiao, Bin	Shanghai Dianji Univ.

A Quantum Genetic Based Scheduling Algorithm (QGBSA) for stochastic flow shop scheduling with random breakdown and random repair time is proposed in this paper, which combines stochastic programming and stochastic simulation theory, quantum compute and genetic algorithm together. In the QGBSA, the Q-bit based representation in discrete 0-1 hyperspace is employed, which is then converted into decimal scheduling code, and quantum gate is used to update the current generation. Meanwhile, catastrophe operator is added to avoid premature. In order to improve the effectiveness of scheduling scheme, the stochastic programming theory is used to set up a stochastic flow shop scheduling model without breakdown. Then we consider two different working modes—preemptive-resume and preemptive-repeat under breakdown. The former processes the rest part of interrupted job while the later reprocesses the interrupted job. Under each working mode, the situations where breakdown happened at any time or at machine's life-span time were discussed. Finally, compared with traditional Genetic Algorithm (GA), computational results show the feasibility and effectiveness of QGBSA policy.

10:30-12:30 MoA01.9

Hierarchical Control Architectures in Industrial Automation: A Design Approach Based on the Generalized Actuator Concept, pp. 69-76

Faldella, Eugenio	Univ. of Bologna
Paoli, Andrea	Univ. of Bologna
Sartini, Matteo	Univ.
Tilli, Andrea	Univ. of Bologna

In this paper an effective design approach to the design of hierarchical control architectures for the automation industrial plants is presented. The main characteristic of the solution is the clear and structural separation between "policies" and "actions" deriving from the use of a novel abstract entity in modelling automation plants: the Generalized Actuator. Particular attention is paid to illustrate how to define generalized actuators starting from a "bare plant". The potentialities of this method are emphasized by means of a case study.

10:30-12:30 MoA01.10

Defects Detection of Billet Surface Using Optimized Gabor Filters, pp. 77-82

Yun, Jong Pil	POSTECH
Choi, SungHoo	POSTECH
Seo, Boyeul	POSTECH
Park, Chang Hyun	POSTECH
Kim, Sang Woo	Pohang Univ. of Sicence And Tech.

This paper deals with a defects detection algorithm for billet surface. To get good performance,detection algorithm has to solve several difficult problems such as shape of a billet, many kinds of defects, much scale. Especially, the scale, that is a metallic oxide on steel surface, makes worse severely the performance of detection. To solve above problems, this paper presents a new effective defects detection algorithm based on Gabor filters optimized by Genetic Algorithm. The experimental results conducted on real billet surface images and demonstrate the good performance of the proposed algorithm.

10:30-12:30 MoA01.11

A 3-Axis 12-Bit CAN-Compatible MEMS Inertial Sensor Cluster for Vehicle Dynamics Control, pp. 83-84

Ahn, Taedong	SML Electronics Inc.
Yoo, Kwangho	SML Electronics, Inc.
Ko, Hyoungho	Seoul National Univ.
Choi, Byoung-Doo	Seoul Univ.
Cho, Dong-il Dan	Seoul National Univ.
Han, Cheolkyu	SNU
Park, Minha	Hyundai autonet
Lee, Jeongpyo	Hyundai autonet
Jeong, Deog-kyoon	Seoul National Univ.

A 3-axis 12-bit CAN-compatible MEMS inertial sensor cluster for vehicle dynamics control is presented. The sensor cluster can measure the x/y-axis accelerations and z-axis rotation. The MEMS sensing elements are fabricated using the sacrificial bulk micromachining (SBM) process. The sensor interface circuit is fabricated using a standard 0.18-Ľ;m CMOS process. The input capacitive amplifier adopts a fully-differential, chopper-stabilized switched capacitor (SC) architecture to obtain low noise characteristics. The output of input amplifier, modulated with the chopping frequency, is converted to a digital signal by 12-bit algorithmic analog-to-digital converter (ADC), to achieve a high resolution while maintaining a low power. The digital signal is demodulated in a digital demodulator, which removes non-ideal behaviors of a multiplier. The white-noise level of the demodulated signal is effectively reduced by a subsequent decimation filter, and then 16-bit acceleration and rotation signals are obtained. And then through the MCU which integrated on PCB, the sensor cluster can interface with 12-bit CAN network to enhance the user-connectivity. The fabricated system is applicable for automotive systems, such as vehicle dynamic control (VDC).

10:30-12:30 MoA01.12

Diagnosis of Engine Misfiring Based on the Adaptive Line Enhancer, pp. 85-89

Kim, Ho-Wuk	Inha Univ.
Lee, Sang Kwon	Inha Univ.

In an automotive engine impulsive sounds and vibration are induced by faults or design constraints which degrade the sound quality of the engine. Thus it is important for an NVH engineer to detect and analyse impulsive sound and vibration signals for both fault diagnosis and also for sound quality assessment. However it is often difficult to detect and identify impulsive signals because of interfering signals such as those due to engine firing, harmonics of crankshaft speed and broadband noise components. These interferences hinder the early detection of faults and improvement of sound quality. In order to overcome this difficulty we present a two-stage ALE (Adaptive Line Enhancer) which is capable of enhancing impulsive signals embedded in background noise.

10:30-12:30 MoA01.13

Optimal Velocity Control Method in Path Following Control Problem, pp. 90-95

Okajima, Hiroshi — Kumamoto Univ.
Asai, Toru — Osaka Univ.
Kawaji, Shigeyasu — Kumamoto Univ.

Path following control problem is treated in recent years. In many past results of path following control, it is assumed the plant has single-input and the velocity of the plant is considered as constant value. However, when we have to reduce traveling time, we must control velocity of the plant in tracking problem. In this paper, velocity control and path following task are achieved at the same time by optimal control. To achieve these tasks, we assume multi-input plants are given. Since sum of reaching time and input costs is used as a cost, we can obtain good acceleration and deceleration input. By a constraint for the cost function, the error from the plant to a given reference path goes to zero when time goes to infinity. The effectiveness of the proposed method is examined by numerical examples of an automobile model.

10:30-12:30 MoA01.14

Suitable Two Wheeled Vehicle Dynamics Synthesis for Interactive Motorcycle Simulator, pp. 96-101

Hima, Salim — IBISC Lab. Evry val d'essone Univ.
Nehaoua, Lamri — Evry Univ.
Séguy, Nicolas — Evry Val d'Essonne Univ.
Arioui, Hichem — Evry Val d'Essonne Univ.

This paper describes a modelling technique for deriving the motorcycles equation of motion. Based on the recursive Newton-Euler approach adapted to tree structure with floating base multibody systems, the derived model presents a low number of arithmetic operations, and hence, is suitable for implementation into a two wheeled vehicles simulator and other model based real-time application. The synthesized model takes in consideration the main forces and moments affecting the behavior of the motorcycle such as: pneumatic, aerodynamic, suspensions, contact constraints and control inputs.

10:30-12:30 MoA01.15

An Adaptive Sub-Optimal Energy Management Strategy for Hybrid Drive-Trains, pp. 102-107

van Keulen, Thijs Adriaan Cornelis — Tech. Univ. Eindhoven
Steinbuch, Maarten — Eindhoven Univ. of Tech.
de Jager, Bram — Tech. Univ. Eindhoven

Typically the energy management problem of a hybrid vehicle is formulated as an optimization problem, where the optimal power split between the prime mover and the secondary power converter is calculated off line based on a given driving cycle and solved numerically with dynamic programming techniques. An important constraint is that the energy level of the secondary power source at the end is the same as in the beginning. In real live the future driving cycle is not known a priori, making it difficult to calculate the exact optimal power split beforehand. To arrive at a practical real time control algorithm, a sub-optimal control law can be applied, where the end-point constraint is replaced by a term in the cost function that accounts for the change in energy; in case of a hybrid electric vehicle it represents the fuel equivalence of the stored reversible energy. In this paper it is reasoned that the reversible energy contains also kinetic and potential energy of the vehicle as well as energy stored in the secondary power source. By feedback control of the state of energy of the secondary power source, the amount of stored energy can be kept on a trajectory, such that the total amount of reversible energy remains constant. Kinetic and potential energy is proportional with vehicle mass, therefore this trajectory is adaptive to vehicle loading. In this paper simulations of an on-line strategy are included that show fuel consumption improvements of a distribution truck, close to those obtained with dynamic programming, validating the reasoning.

10:30-12:30 MoA01.16

Performance Indices Based Self Tuning for Si-Engine Control Optimization, pp. 108-110

Jeinsch, Torsten — IAV GmbH
Yang, Guojun — Univ. of Duisburg-Essen
Ding, Steven X. — Univ. of Duisburg-Essen
Weinhold, Nick — IAV GmbH
Schultalbers, Matthias — IAV GmbH, Ingenieurgesellschaft Auto und Verkehr

The calibration of today's spark ignition (SI) engine control systems is a complex and cost-intensive procedure. To cope with increasing demands in performance issues on the one hand and lowering costs on the other hand – a design procedure combining an approximate simulation model with a self tuning algorithm has been developed. In this paper a performance indices based self tuning method for SI-Engine control optimization is presented. This method has been implemented in an Electronic Control Unit (ECU) for tuning controller parameters in the rail pressure control loop. Results from the validation on an engine test bench at IAV GmbH are shown.

10:30-12:30 MoA01.17

Initial State Iterative Learning for Final State Control in Motion Systems, pp. 111-116

Xu, Jian-Xin — National Univ. of Singapore
Huang, Deqing — National Univ. of Singapore

In this work, an initial state iterative learning control (ILC) approach is proposed for final state control of motion systems. ILC is applied to learn the desired initial states in the presence of system uncertainties. Four cases are considered where the initial position or speed are manipulated variables and final displacement or speed are controlled variables. Since the control task is specified spatially in states, a state transformation is introduced such that the final state control problems are formulated in the phase plane to facilitate spatial ILC design and analysis. An illustrative example is provided to verify the validity of the proposed ILC algorithms.

10:30-12:30 MoA01.18

PWARX Traffic Network Hybrid Controller Based on 0-1 Classification, pp. 117-122

Kim, YoungWoo — Nagoya Univ.
Kato, Tatsuya — Nagoya Univ.
Okuma, Shigeru — Nagoya Univ.
Narikiyo, Tatsuo — Toyota Tech. Inst.

In this paper, we propose a new design method for the traffic network hybrid feedback controller. In the proposed method, the PWARX classifier describes the nonlinear feedback control law of the traffic control system that the output of the previously developed controller is reproduced applying the 0-1 classifications of the PWARX systems. The proposed method is a hierarchical classification procedure, where the cluster splitting process is follows by the piecewise fitting process to compute the cluster guard and dynamics, and the cluster updating process to find new center points of the clusters. The usefulness of the proposed method is verified through some numerical experiments.

10:30-12:30 MoA01.19

Control and Sensor Fault-Tolerance of Vehicle Lateral Dynamics, pp. 123-128

Oudghiri-Bentaie, Mohammed — Univ. of Picardie Jules Verne
Chadli, Mohammed — Univ. de Picardie-Jules Verne
El Hajjaji, Ahmed — Univ. de Picardie-Jules Verne

In this paper, fault tolerant control (FTC) system is developed for lateral vehicle dynamics by combining static output feedback control and sliding mode observers for improving vehicle handling and stability under sensors faults. The system consists of three blocks: fault detection and isolation (FDI) block, a static output feedback controller block and a switcher block. The nonlinear two degrees of freedom vehicle motion (bicycle model) is described by a Takagi-Sugeno (T-S) fuzzy model. The strategy of the FDI method is based on a bank of observers, each one is constructed using sliding mode design techniques to estimate the system state vector. Thus the diagnostic signal-residuals are generated by the comparison of measured and estimated outputs and the faulty sensor is isolated. Simulations demonstrate that the vehicle maintains acceptable performance after either set of yaw rate sensor and lateral velocity sensor has failed.

10:30-12:30 MoA01.20

Robust Output H_; Fuzzy Control for Active Fault Tolerant Vehicle Stability, pp. 129-134

Oudghiri-Bentaie, Mohammed — Univ. of Picardie Jules Verne
Chadli, Mohammed — Univ. de Picardie-Jules Verne
El Hajjaji, Ahmed — Univ. de Picardie-Jules Verne

This paper presents an active Fault Tolerant Control (FTC) strategy for vehicle lateral dynamics. A bicycle vehicle model using small angle approximations is used to represent vehicle behavior. Firstly, the nonlinear lateral vehicle dynamics is approximated by a Takagi-Sugeno fuzzy model with parametric uncertainties and sensor faults. Secondly a robust H_; output controller is used. A method based on a bank of observers is used for detection and isolation of sensor faults. The effectiveness of the proposed strategy have been illustrated in simulation.

10:30-12:30 MoA01.21

Performance Analysis of an Optical Distance Sensor for Roll Angle Estimation in Sport Motorcycles, pp. 135-140

Boniolo, Ivo — Pol. di Milano
Norgia, Michele — Pol. di Milano
Tanelli, Mara — Pol. di Milano
Svelto, Cesare — Pol. di Milano
Savaresi, Sergio — Pol. di Milano

The roll angle is a crucial parameter for motorcycle dynamics. The ability of measuring it reliably in real time is an enabling technology for active control systems design for two-wheeled vehicles and for tire performance assessment. Nonetheless, it is quite difficult to devise the best trade-off between cost and precision and to choose the most appropriate sensor technology and lay-out. This paper analyzes if low-cost non contact optical distance sensors are a viable solution for measuring the roll angle. To use this method in sport applications some basic requirements must be satisfied, first of all the distance measurement must be reliable even at very high speed and under different lighting conditions. Our aim is to test a low cost optical triangulator with a single LED emitter and to show how the interference due to asphalt roughness in a condition of solar lighting and high speed affects the quality of its output.

10:30-12:30 MoA01.22

Nonlinear Output Robust Regulation of Ground Vehicles in Presence of Disturbances and Parameter Uncertainties, pp. 141-146

Di Gennaro, Stefano — Univ. di L'Aquila
Castillo-Toledo, Bernardino — CINVESTAV-GDL, Mexico
Acosta Lua, Cuauhtemoc — Centro de Investigación y Estudios Avanzados del I.P.N.

In this paper a controller based on the so-called robust or structurally stable regulation theory is designed. The ground vehicle motion control is reformulated as a tracking problem of a desired reference, generated by an external system. Moreover, the disturbance acting on the vehicle is supposed to be modeled, i.e. unknown but with a known structure, as happens in many typical situations. The use of immersion techniques eliminates the dependence of the controller on parameters, so obtaining a controller ensuring zero tracking error. Since an immersion for the designed control law can not be easily determined, in this paper we consider the immersion of an approximate expression of the control, so obtaining a bounded tracking error.

10:30-12:30 MoA01.23

Engine Simulator for ECMs Diagnosis, pp. 147-151

Huertas Cardozo, José Ignacio — Inst. Tecnológico y de Estudios Superiores de Monterrey
Navarrete Alzate, Natalia Andrea — Inst. Tecnológico y de Estudios Superiores de Monterrey

Currently, the number of companies that provide diagnosis, repair and maintenance services to the electronic control modules – ECMs of the vehicles is very limited. Even though the demand of the service is still unsatisfied, the possibility of expansion of the existing companies is limited by the need of an engine simulator to semi-automate the ECMs diagnosis process. To fulfill this requirement, the present paper describes the design, implementation and testing of an electronic device that simulates the electrical signals generated by the sensors and transducers commonly installed on engines. The device was programmed to simulate different models of commercial engines and to perform automatically the standard procedures followed to identify the most common failures of the ECMs.

This device incorporates systems to guarantee the safety of the information gathered during the diagnosis process and the physical integrity of the ECMs being diagnosed.

10:30-12:30 MoA01.24

Estimation of Electropneumatic Clutch Actuator Load Characteristics, pp. 152-157

Langjord, Hege — NTNU
Johansen, Tor Arne — Norwegian Univ. of Science and Tech.
Snare, Sten Roar — Kongsberg Automotive
Bratli, Christian — Kongsberg Automotive ASA

This paper propose a dynamic model of an electropneumatic clutch actuator system for heavy duty trucks. The focus is set on modeling of the clutch load characteristic which should be parameter affine, and the main purpose of the modeling task in this paper is to prepare for on-line adaption of this load characteristics. The knowledge of the clutch load characteristic is important for being able to estimate the pressure in the system online, when this is not measurable. In this paper off-line estimation is used to find parameters such that the model is a good representation of the system. The resulting 5^{th} order model is verified by comparison to actual truck measurements.

10:30-12:30 MoA01.25

Comprehensive Vehicle Motion Analysis Using Optical Flow Optimization Based on Pulse-Coupled Neural Network, pp. 158-163

Cao, Yanpeng — Univ. of Manchester
Renfrew, Alasdair — Univ. of Manchester
Cook, Peter — The Univ. of Manchester

This paper presents the application of a novel optical flow optimization algorithm for a comprehensive on-road vehicle motion analysis. Optical flow, which contains abundant local motion information, has been extensively studied for vehicle motion estimation in the last decades. How to generate a reliable optical flow at a low computation cost is always a challenging task. The primary aim of this paper is to enhance the accuracy and efficiency of optical flow estimation for a reliable vehicle motion analysis. In the paper, an innovative optical flow optimization algorithm is proposed based on a 3-D Pulse-Coupled Neural Network (PCNN) model. Because of the excellent information clustering ability of PCNN, the proposed algorithm can significantly improve the quality of optical flow. Moreover, a sparse motion flow field is generated to boost the computation efficiency. We employ a preliminary processing to detect the Region of Interest (ROI) in the image, and optical flow is only calculated and optimized in the ROI to save computation resources. Finally, the improved sparse optical flow field is exploited for a systematic on-road vehicle motion analysis. The proposed methodology has been evaluated under various challenging traffic situations to demonstrate its excellent performance.

10:30-12:30 MoA01.26

Control of Steer-By-Wire Vehicles with Passivity Approach, pp. 164-169

Im, Jaesung — Kumamoto Univ.
Ozaki, Fuminori — Omron Corp.
Matsunaga, Nobutomo — Kumamoto Univ.
Kawaji, Shigeyasu — Kumamoto Univ.

Steer-by-wire system (SBW), in which the conventional mechanical linkages between the steering wheel and the front wheel are removed, is suited to active steering control, improving vehicle stability, dynamics and maneuverability. And SBW is applied to autonomous steering control to assist the driver. Conventional controller for SBW system is designed by general feedback control method. However, in this method, the driver can not exactly feel the reaction torque generated from tire. And the stability of control system can not guarantee in spite of highly variable human operators and environment dynamics. The goals of this paper are considered as follows: The one is a reproduction of environmental impedance in steering wheel. The other is the improved maneuverability for SBW system. Moreover, the stability of control system must be satisfied. This paper, first, reviews bilateral control scheme using disturbance observer proposed by us. Secondly, this paper proposes a novel bilateral control scheme with passive approach. We also examine the performance of the proposed

control scheme and compare with bilateral control scheme using disturbance observer. The effectiveness of proposed method is demonstrated by experiment with electronic vehicle.

10:30-12:30 MoA01.27

Hardware Implementation of Aircraft Landing Controller by Evolutionary Computation and DSP, pp. 170-175

Juang, Jih-Gau — National Taiwan Ocean Univ.
Chiou, Hou-Kai — National Taiwan Ocean Univ.

This paper presents a hybrid control scheme for the aircraft automatic landing system. PID control law is adopted in the controller design. Disturbance adaptive capability is demonstrated through hardware in the loop simulations. The control scheme uses PID controller with evolutionary computation technique. Control gains are selected by real-valued genetic algorithms. Different crossover methods are utilized to improve the performance of conventional automatic landing system. Hardware implementation of this intelligent controller is performed by a DSP with VisSim platform. The proposed intelligent controllers can successfully expand the controllable environment in severe wind shear conditions.

MoA02 304A

Nonlinear H_infty Control and Disturbance Rejection (Regular Session)

Chair: Anderson, Brian D.O. — Australian National Univ.
Co-Chair: Lim, Myo-Taeg — Korea Univ.

10:30-10:50 MoA02.1

Rejection of Fixed Direction Disturbances in Multivariable Electromechanical Motion Systems, pp. 176-181

Boerlage, Matthijs — Tech. Univ. Eindhoven
Middleton, Rick — National Univ. of Ireland
Steinbuch, Maarten — Eindhoven Univ. of Tech.
de Jager, Bram — Tech. Univ. Eindhoven

This work discusses rejection of disturbances with known directions in multivariable control systems. It is shown how frequency domain tradeoffs in multivariable control motivate a design based on disturbance directions. A multivariable design method is presented to design centralized controllers that reject disturbances only in relevant directions. A model of an industrial motion system is used to demonstrate the theory. It is shown how the proposed design method resembles the solution of a competing Hinf design and offers the ability to interpret Hinf centralized control solutions, and understand the tradeoffs inherent in such a design.

10:50-11:10 MoA02.2

Clarification of Free Parameters of State-Dependent Coefficient Form: Effect on Solving State-Dependent Riccati Inequality, pp. 182-187

Sakayanagi, Yoshihiro — Toyota Motor Corp. / Tokyo Inst. of Tech.
Nakayama, Daisuke — Tokyo Inst. of Tech.
Nakaura, Shigeki — Tokyo Inst. of Tech.
Sampei, Mitsuji — Tokyo Inst. of Tech.

Recently, nonlinear H-infinity control theory has been paid attention for the powerful design method for a robust stabilization. The solvable condition of nonlinear H-infinity control problem is given by the Hamilton Jacobi Inequality (HJI). The HJI is the partial differential inequality which is quite difficult to solve, so some numerical approaches have been researched. The approach to solve the HJI based on State-dependent Riccati Inequality (SDRI) is proposed. The SDRI is derived from the HJI with a State-dependent Coefficient form (SDC form) of a nonlinear system under an integrability constraint. Here, since the SDC form for a nonlinear system is not unique,free parameters of the SDC form can be considered. In this paper, a new expression of free parameters to completely express the SDC form is proposed. Using free parameters, a desirable numerical solution of the SDRI can be calculated. We focus on a constant solution of the SDRI because the integrability constraint can be neglected. Finally, numerical examples to verify the advantage of the free parameters of SDC form are given.

11:10-11:30 MoA02.3

Nonlinear H-Infinity Control and the Hamilton-Jacobi-Isaacs Equation, pp. 188-193

Ferreira, Henrique Cezar — Univ. of Sao Paulo
Rocha, Paulo Henrique da — Brazilian Navy Tech. Center.
Sales, Roberto Moura — Escola Pol. da USP

This paper considers two aspects of the nonlinear H-infinity control problem: the use of weighting functions for performance and robustness improvement, as in the linear case, and the development of a Galerkin approximation method for the solution of the Hamilton-Jacobi-Isaacs Equation (HJIE) that arises in the output feedback case. Design of nonlinear H-infinity controllers obtained by Taylor approximation and by the proposed Galerkin approximation method applied to a magnetic levitation system are presented.

11:30-11:50 MoA02.4

Disturbance Attenuation in Hamiltonian Systems Via Direct Discrete-Time Design, pp. 194-199

Yalcin, Yaprak — Istanbul Tech. Univ.
Goren-Sumer, Leyla — Istanbul Tech. Univ.

The discrete-time disturbance attenuation problem for a class of Hamiltonian systems is considered. In order to give a sufficient condition for the solution of the considered problem, firstly an appropriate discrete gradient is proposed, which enables the derivation of the discrete-time version of the given Hamiltonian systems. The disturbance attenuation problem characterised by means of L2 gain is redefined in the discrete-time setting. The proposed direct discrete-time design method is used to solve the disturbance attenuation problem for the double pendulum system in simulations.

11:50-12:10 MoA02.5

An Iterative Procedure to Solve HJBI Equations in Nonlinear H Infinity Control, pp. 200-205

Feng, Yantao — Australian National Univ.
Rotkowitz, Michael — The Univ. of Melbourne
Anderson, Brian D.O. — Australian National Univ.

In this paper, an iterative algorithm to solve a special class of Hamilton-Jacobi-Bellman-Isaacs (HJBI) equations is proposed. By constructing two series of nonnegative functions, we replace the problem of solving an HJBI equation by the problem of solving a sequence of Hamilton-Jacobi-Bellman (HJB) equations whose solutions can be approximated recursively by existing methods. The local convergence of the algorithm is guaranteed. A numerical example is provided to demonstrate the accuracy of the proposed algorithm.

12:10-12:30 MoA02.6

H_; Control for Singularly Perturbed Bilinear Systems with Parameter Uncertainties Using Successive Galerkin Approximation, pp. 206-211

Kim, Young-Joong — Korea Univ.
Lim, Myo-Taeg — Korea Univ.

This paper presents a new algorithm for the closed-loop H_; composite control of singularly perturbed bilinear systems with time-varying parameter uncertainties and exogenous disturbance using the successive Galerkin approximation (SGA). The singularly perturbed bilinear system is decomposed into two subsystems of a slow-time scale and a fast-time scale via singular perturbation theory, and then two H_; control laws are obtained for each subsystem. H_; control theory guarantees robust closed-loop performance but the resulting problem is di_cult to solve for bilinear systems. In order to overcome the di_culties inherent in the H_; control problem, the suitable robust H_; feedback control law can be constructed in term of the approximated solution to a Hamilton-Jacobi-Isaac equation using SGA. The composite control law consists of H_; control laws for each subsystem.

MoA03 304B

Geometric Control (Regular Session)

Chair: Celikovsky, Sergej — Inst. of Information Theory and Automation, Acad. of Science of the Czech Republic; Faculty of EE, Czech Tech. Univ.
Co-Chair: Yung, Chee-Fai — National Taiwan Ocean Univ.

10:30-10:50 MoA03.1

Gradient Based Discrete-Time Modeling and Control of Hamiltonian Systems, pp. 212-217

Goren-Sumer, Leyla — Istanbul Tech. Univ.
Yalcin, Yaprak — Istanbul Tech. Univ.

A gradient based discrete-time model of continuous Hamiltonian systems with input is proposed and a procedure is given to construct the discrete-time model. The model validation for both separable and non-separable case is done considering the energy relation, additionally stabilizability condition is given and the model is also tested especially for the well-known nonseparable Hamiltonian systems by simulations. After then, the discrete-time counterpart of PBC technique is developed for n-degree of freedom mechanical systems using this proposed discretetime model. The discrete-time control rules which correspond to potential energy shaping and damping assignment are designed directly using the discrete time model of the desired system and the discrete time model of the open loop systems. To illustrate the effectiveness of the proposed method, two non-separable examples are investigated and the simulation results are given.

10:50-11:10 MoA03.2

Distributed Geometric Control of Wave Equation, pp. 218-223

Maidi, Ahmed	ENSIC
Diaf, Moussa	Univ. Mouloud MAMMERI
Corriou, Jean-Pierre	ENSIC

An approach for the geometric control of a one-dimensional non-autonomous linear wave equation is presented. The idea consists in reducing the wave equation to a set of first-order linear hyperbolic equations. Then based on geometric control concepts, a distributed control law that enforces stability and output tracking in the closed-loop system is designed. The presented control approach is applied to obtain a distributed control law that brings a stretched uniform string, modeled by a wave equation with Dirichlet boundary conditions, to rest in infinite time by considering the displacement of the middle point of the string as the controlled output. The controller performances have been evaluated in simulation.

11:10-11:30 MoA03.3

On the Geometric Structure of the H-Infinity Central Controller, pp. 224-229

Wu, Po-Feng	National Taiwan Ocean Univ.
Yung, Chee-Fai	National Taiwan Ocean Univ.

This paper shows that the controllable and unobservable subspaces of the H-infinity central controller for a linear continuous-time system can be characterized by the image and kernel spaces of two matrices ZL and WL, where ZL and WL are positive semidefinite solutions of two pertinent Lyapunov equations whose coefficients involve Xinfinity and Zinfinity, the stabilizing solutions of two celebrated algebraic Riccati equations used in solving the H-infinity control problem. Furthermore, under this characterization, it is shown that the unobservable subspace of the central controller contains the intersection of KerXinfinity and the unobservable subspace of the plant. In addition, it is also shown that the central controller's controllable subspace is a subspace of the sum of ImZinfinity and the plant's controllable subspace. A numerical example is also given for illustration. In terms of geometric language, all the results and proofs given are clear and simple.

11:30-11:50 MoA03.4

H2 Preview Control: A Geometric Approach in the Discrete-Time Domain, pp. 230-235

Zattoni, Elena	Univ. of Bologna

H2 preview control in the discrete-time domain is approached in a strict geometric perspective. The original formulation in the frequency domain is recast in the time domain. Then, it is shown how the problem in the time-domain can be reduced to the combination of elementary subproblems. This approach requires a structural analysis of the properties of the singular Hamiltonian system associated to the H2 control problem.

11:50-12:10 MoA03.5

Structural Properties of Inverse Models Represented by Bond Graph, pp. 236-241

El Feki, Mariem	école centrale de lyon
Di Loreto, Michael	INSA de Lyon
Bideaux, Eric	INSA of Lyon
Thomasset, Daniel	INSA de Lyon
Ngwompo, Roger Fotsu	Univ. of Bath

Inverse models are widely used for control or design purposes. In both cases, the maximum order of differentiation of each output appearing in the model inversion constitutes relevant information since it characterizes the regularity of the trajectory to be followed. Although this property can be determined from algebraic manipulation of the model, this paper shows how it can be obtained directly from the bond graph model using graphical procedures.

12:10-12:30 MoA03.6

Control Design with Guaranteed Ultimate Bound for Feedback Linearizable Systems, pp. 242-247

Kofman, Ernesto	UNR
Fontenla, Fernando	FCEIA - Univ. Nacional de Rosario
Haimovich, Hernan	Univ. Nacional de Rosario
Seron, Maria	The Univ. of Newcastle

For a class of perturbed feedback linearizable nonlinear systems, we consider the computation and assignment of prescribed ultimate bounds on the system states. We employ a recently proposed componentwise bound computation procedure, which directly takes into account both the system and perturbation structures by performing componentwise analysis. We first derive sufficient conditions to ensure that the trajectories originating from initial conditions in an appropriate set are ultimately bounded. Secondly, and most importantly, for state-feedback-linearizable nonlinear systems with matched perturbations, we provide a systematic design procedure to compute a state feedback control that ensures a prescribed ultimate bound for the closed-loop system states. The procedure combines nonlinear state-feedback-linearizing control with a state-feedback matrix computed via an eigenstructure assignment method previously reported by the authors. A simulation example illustrates the simplicity and systematicity of the proposed design method.

MoA04 308

Time Delay Systems (Regular Session)

Chair: Ge, Shuzhi Sam	National Univ. of Singapore
Co-Chair: de Souza, Carlos E.	Lab. Nac. de Comp. Cientifica - LNCC

10:30-10:50 MoA04.1

Adaptive Neural Control of SISO Time-Delay Nonlinear Systems with Unknown Hysteresis Input, pp. 248-253

Lee, Tong Heng	National Univ. of Singapore
Ren, Beibei	National Univ. of Singapore
Ge, Shuzhi Sam	National Univ. of Singapore

In this paper, adaptive variable structure neural control is investigated for a class of SISO nonlinear systems in a Brunovsky form with state time-varying delays and unknown hysteresis input. The unknown time-varying delay uncertainties are compensated for using appropriate Lyapunov-Krasovskii functionals in the design. The effect of theunknown hysteresis with the Prandtl-Ishlinskii model is mitigated using the proposed adaptive control. By utilizing the integral-type Lyapunov function, the closed-loop control system is proved to be semi-globally uniformly ultimately bounded. Simulation results demonstrate the effectiveness of the approach.

10:50-11:10 MoA04.2

New Delay-Dependent Stability Criteria for T-S Fuzzy Systems with a Time-Varying Delay, pp. 254-258

Liu, Fang	Central South Univ.
Wu, Min	Central South Univ.
He, Yong	Central South Univ.
Zhou, Yicheng	TEPCO SYSTEMS Corp.
Yokoyama, Ryuichi	Waseda Univ.

This paper deals with the asymptotic stability problem of uncertain T-S fuzzy systems with time-varying delay by employing a further improved free-weighting matrix approach. The relationship among the time-varying delay, its upper bound and their difference is taken into account. As a result, some less conservative LMI-based delay-dependent stability criteria are obtained without ignoring any useful terms in the derivative of Lyapunov-Krasovskii functional. Finally, two numerical examples are given to demonstrate the effectiveness and the merits of the proposed methods.

11:10-11:30 MoA04.3

Control of Unstable Delayed Systems with Input Saturations and Measurement Constraints: An Electrical Cart Application, pp. 259-264

Sanahuja, Guillaume	Univ. de Tech. de Compičgne
Garcia Gil, Pedro José	Univ. Pol. de Valencia
Castillo, Pedro	Univ. De Tech. De Compiegne
Albertos, Pedro	Univ. Pol. de Valencia

This paper deals with the position control of a mobile vehicle. The main constraints refer to the lack of measurements, presence of input/output delays and actuator saturations. Position measurement of this vehicle is given by a vision system, which frequency is limited due to picture computation, whereas the control action can be applied at a faster rate. Not only the measurement rate is low, also a conversion delay must be considered. Additional delays can also appear in the control action updating, where actuator saturations should be considered. This paper demonstrates that the use of a prediction-observer scheme, based on a linear model of the system and executed at a high rate, can stabilize the system. This is done even if the control law is non linear, due to the appearance of saturations, also coping with the input/output delays.

11:30-11:50 MoA04.4

Delay-Dependent Regional Stability of a Class of Uncertain Nonlinear State-Delayed Systems, pp. 265-270

de Souza, Carlos E. — Lab. Nac. de Comp. Cientifica - LNCC
Coutinho, Daniel F — Pont. Uni. Cat. do Rio Grande do Sul

This paper proposes a convex approach to regional stability analysis of a class of nonlinear state-delayed systems subject to convex-bounded parameter uncertainty. Delay-dependent conditions are developed to ensure the system robust local stability and obtain an estimate of a domain of attraction of the origin inside a given polytopic region of the state-space. The proposed approach is based on a Lyapunov-Krasovskii functional with polynomial dependence on the system state and uncertain parameters and is formulated in terms of linear matrix inequalities. Numerical examples illustrate the potentials of the derived results.

11:50-12:10 MoA04.5

Delay-Range-Dependent Exponential Stability of Singular Systems with Multiple Time-Varying Delays, pp. 271-276

Haidar, Ahmad — Ec. Olytechnique de Montreal
Boukas, El-Kebir — Ec. Pol. de Montreal

This paper deals with the class of continuous-time singular linear systems with multiple time-varying delays in a range. The global exponential stability problem of this class of systems is addressed. Delay-range-dependent sufficient conditions such that the system is regular, impulse free and alpha-stable are developed in the linear matrix inequality (LMI) setting. Moreover, an estimate of the convergence rate of such stable systems is presented. A numerical example is employed to show the usefulness of the proposed results.

12:10-12:30 MoA04.6

Dynamic Non-Rational Anti-Windup for Time-Delay Systems with Saturating Inputs, pp. 277-282

Ghiggi, Ilca Maria — UFRGS
Bender, Fernando Augusto — Univ. Federal do Rio Grande do Sul
Gomes Da Silva Jr., Joao Manoel — Univ. Federal do Rio Grande do Sul (UFRGS)

This paper addresses the design of dynamic anti-windup compensators for time-delay systems under amplitude control constraints. Considering that the system is subject to the action of L2 bounded disturbances, a method for computing a non-rational dynamic anti-windup compensator in order to guarantee both that the trajectories of the system are bounded and a certain L2 performance level is achieved by the regulated outputs, is proposed. Based on Lyapunov-Krazovskii functionals, the use of a modified sector condition, and a classical change of variables, sufficient LMI conditions, both in local as well as global contexts, are derived to ensure the input-to-state and the internal stability of the closed-loop system. From these conditions, LMI-based optimization problems are proposed in order to minimize the L2 gain, or in order to maximize the bound on the admissible disturbances for which the trajectories are bounded. The results apply to both stable and unstable open-loop systems and, in particular, for systems presenting delayed states.

MoA05 307

Identification in Systems Biology: Methods and Applications
(Invited Session)

Chair: Bullinger, Eric — Univ. of Strathclyde
Co-Chair: Ferrari-Trecate, Giancarlo — Univ. degli Studi di Pavia
Organizer: Bullinger, Eric — Univ. of Strathclyde
Organizer: Ferrari-Trecate, Giancarlo — Univ. degli Studi di Pavia
Organizer: Findeisen, Rolf — Univ. of Stuttgart

10:30-10:50 MoA05.1

Identifiability Problems of Time-Delay HIV Models (I), pp. 283-288

Zhang, Jiangfeng — Univ. of Pretoria
Xia, Xiaohua — Univ. of Pretoria

In vivo modelling of the pathogenesis of HIV-1 in plasma captures the interplay of the virus and CD4 cells in the cell-free viral spread process. Modelling is also done for both in vitro cell-to-cell and cell-to-free viral spread of HIV-1 and its kinetics in tissue cultures. Upon infection with HIV-1, there is a short intracellular “eclipse phase” or “latency”, during which the cell is infected but has not yet begun producing virus. One approach to account for the “eclipse phase” or “latency” is to introduce an intracellular delay in the models. This paper focuses on the identifiability of the parameters in the most popular HIV models with time delay, in vivo and in vitro. The identifiability of such parameters as the time-delay parameter; the effective reproductive rate of healthy cells; death rate of infected cells; average life time of productively infected cells; viral burst size; etc, is studied by the linear algebraic method based on differential 1-form. Medical interpretation for the identifiability results is given, and it provides guidelines in data collection for the identification of these parameters.

10:50-11:10 MoA05.2

Identification of Intra-Cellular Feedback Loops by Intermittent Step Perturbation Method (I), pp. 289-294

Dong, Chaoyi — 1.Korea Univ. Seoul, 136-713, Korea 2.InnerMongoliaUnivers
Cho, Kwang-Hyun — Korea Advanced Inst. of Science and Tech.
Yoon, Tae-Woong — Korea Univ.

Feedback loops play pivotal roles in the regulation and control of many important cellular processes such as gene transcription, signal transduction, and metabolism. Hence, identification of feedback loops embedded in biomolecular regulatory networks is crucial to understanding the regulatory mechanisms underlying various cellular processes. In this paper, we introduce an identification method called the intermittent step perturbation method (ISPM) that can efficiently identify and locate feedback connectivities among reacting biomolecules. In particular, a sort of stochastic function called an intermittent step perturbation is applied to excite a given network. Then, we employ a statistical algorithm to analyze the resulting time-series data, thereby discerning any causal connection with a circular causal property. This circular causal property implies the existence of a feedback loop in the regulatory network. Finally, the proposed ISPM is demonstrated through an insulin signal transduction pathway model.

11:10-11:30 MoA05.3

Identification of Optimality and Robustness in Dictyostelium External Signal Receptors (I), pp. 295-300

Kim, Jongrae — Univ. of Glasgow
Heslop-Harrison, J. S. — Univ. of Leicester
Postlethwaite, Ian — the Univ. of Leicester
Bates, Declan G. — Univ. of Leicester

Robust optimal performance of ligand and receptor interaction networks in cellular systems is essential in order for organisms to react appropriately to external stimulation. Recent studies have proposed that certain generic structural properties are highly conserved among the many different types of ligand/receptor interaction networks found in nature. In this paper, we show that the ligand/receptor interaction network employed to relay external cAMP signals in aggregating Dictyostelium discoideum cells exhibits such generic structural characteristics. We also show that the network parameters for the ligand bound cell receptors which are distributed on the outer shell of Dictyostelium discoideum cells are highly optimised, in the sense that the response speed is the fastest possible while ensuring that no overshoot occurs for step changes in external signals. Finally, we show that the response of the network to external signals is extremely robust to variations in the relevant kinetic parameters of the network, the cell volume and the number of receptors present on the surface of the cell.

11:30-11:50 MoA05.4

Identification of Genetic Regulatory Networks: A Stochastic Hybrid

Approach (I), pp. 301-306
Cinquemani, Eugenio — ETH Zurich
Milias-Argeitis, Andreas — ETH Zürich
Lygeros, John — ETH Zurich

Genetic regulatory networks are families of biochemically interacting genes that regulate most functions of a living cell via the synthesis of proteins and other essential molecules. In this paper we introduce a piecewise deterministic model of genetic network and devise a systematic procedure for the identification of the model parameters from experimental observations of the protein concentration dynamics. Numerical results on simulated data are presented to show the effectiveness of our method.

11:50-12:10 MoA05.5
Identification of PieceWise Affine Models of Genetic Regulatory Networks: The Data Classification Problem (I), pp. 307-312
Porreca, Riccardo — Univ. di Pavia
Ferrari-Trecate, Giancarlo — Univ. degli Studi di Pavia

In this paper we consider the identification of PieceWise Affine (PWA) models of Genetic Regulatory Networks (GRNs) and focus on data classification that is a task of the whole identification process. By assuming that gene expression profiles have been split into segments generated by a single affine mode, data classification amounts to group together segments that have been produced by the same mode. In particular, this operation must be performed in a noisy setting and without using any knowledge on the number of modes excited in the experiment. At a mathematical level, classification amounts to find all partitions of the set of segments that verify a statistical criterion and as such it has a combinatorial nature. In order to minimize the computational complexity we propose a pruning strategy for reducing the dimension of the search space. In particular, our approach hinges on a new algorithm for generating in an efficient way all partitions of a finite set that verify a bound on a monotone cost function.

12:10-12:30 MoA05.6
Parameter Estimation in Kinetic Reaction Models Using Nonlinear Observers Facilitated by Model Extensions, pp. 313-318
Fey, Dirk — Univ. of Strathclyde
Findeisen, Rolf — Univ. of Stuttgart
Bullinger, Eric — Univ. of Strathclyde

An essential part of mathematical modelling is the accurate and reliable estimation of model parameters. In biology, the required parameters are particularly difficult to measure due to either shortcomings of the measurement technology or a lack of direct measurements. In both cases, parameters must be estimated from indirect measurements, usually in the form of time-series data. Here, we present a novel approach for parameter estimation that is particularly tailored to biological models consisting of nonlinear ordinary differential equations. By assuming specific types of nonlinearities common in biology, resulting from generalised mass action, Hill kinetics and products thereof, we can take a three step approach: (1) transform the identification into an observer problem using a suitable model extension that decouples the estimation of non-measured states from the parameters; (2) reconstruct all extended states using suitable nonlinear observers; (3) estimate the parameters using the reconstructed states. The actual estimation of the parameters is based on the intrinsic dependencies of the extended states arising from the definitions of the extended variables. An important advantage of the proposed method is that it allows to identify suitable measurements and/or model structures for which the parameters can be estimated. Furthermore, the proposed identification approach is generally applicable to models of metabolic networks, signal transduction and gene regulation.

MoA06 310A
Plug and Play Process Control (Invited Session)
Chair: Stoustrup, Jakob — Aalborg Univ.
Co-Chair: De Persis, Claudio — Sapienza Univ. of Rome
Organizer: Stoustrup, Jakob — Aalborg Univ.
Organizer: De Persis, Claudio — Sapienza Univ. of Rome

10:30-10:50 MoA06.1
Proportional and Proportional-Integral Controllers for a Nonlinear Hydraulic Network (I), pp. 319-324
De Persis, Claudio — Sapienza Univ. of Rome
Kallesře, Carsten Skovmose — Grundfos Management A/S

We consider the problem of regulating to a reference value pressures across components in a nonlinear hydraulic network of a reduced-size yet meaningful district heating system with two end-users. Exploiting the analogy between electrical and hydraulic networks, we derive a nonlinear model for the system. Then we design and analyze a proportional and a proportional-integral controller which guarantee semi-global practical and, respectively, asymptotic regulation of the pressures.

10:50-11:10 MoA06.2
Plug and Play Process Control Applied to a District Heating System (I), pp. 325-330
Knudsen, Torben — Aalborg Univ.
Trangbaek, Klaus — Aalborg Univ.
Kallesře, Carsten Skovmose — Grundfos Management A/S

The general ideas within plug and play process control (PTC) are to initialize and reconfigure control systems just by plug and play.In this paper these ideas are applied to a district heating pressure control problem. First of all this serves as a concrete example of PTC, secondly some of the first techniques developed in the project to solve the problems in PTC are presented. These are in the area of incremental modelling and control and they make it possible to ``plug'' in a new sensor and actuator and make it ``play'' automatically.

11:10-11:30 MoA06.3
Stable Controller Reconfiguration through Terminal Connections (I), pp. 331-335
Trangbaek, Klaus — Aalborg Univ.
Stoustrup, Jakob — Aalborg Univ.
Bendtsen, Jan Dimon — Aalborg Univ.

Often, when new sensor and/or actuator hardware becomes available for use in a control system, it is desirable to retain the existing controllers and apply the new control capabilities in a gradual, online fashion rather than decommissioning the entire existing system and replacing it with the new system. This paper presents a novel method of introducing new control components in a smooth manner, providing stability guarantees during the transition phase, and which retains the original control structure.

11:30-11:50 MoA06.4
Plug-And-Play Process Control: Improving Control Performance through Sensor Addition and Pre-Filtering (I), pp. 336-341
Bendtsen, Jan Dimon — Aalborg Univ.
Trangbaek, Klaus — Aalborg Univ.
Stoustrup, Jakob — Aalborg Univ.

An important issue in the area of reconfigurable systems is how to respond correctly if new components are added. We consider the problem of improving control performance for a system where a new set of sensors becomes available. It is assumed that a complete re-design of the control system is undesirable for various reasons. The sensor dynamics are unknown and must be identified via experiments. The paper demonstrates how new sensor information can be fused with existing sensor information and fed to the existing control system, either based on knowledge of the existing plant or in an entirely data-driven fashion. The method is illustrated on a numerical example.

11:50-12:10 MoA06.5
Towards Automatic Model Based Controller Design for Reconfigurable Plants (I), pp. 342-346
Michelsen, Axel Gottlieb — Aalborg Univ.
Stoustrup, Jakob — Aalborg Univ.
Izadi-Zamanabadi, Roozbeh — Aalborg Univ.

This paper introduces model-based Plug and Play Process Control, a novel concept for process control, which allows a model-based control system to be reconfigured when a sensor or an actuator is plugged into a controlled process. The work reported in this paper focuses on composing a monolithic model from models of a process to be controlled and the actuators and sensors connected to the process, and propagation of tuning criteria from these sub-models, thereby accommodating automatic controller synthesis using existing methods. The developed method is successfully tested on an industrial case study from Danfoss A/S, where the process to be controlled is the indoor temperature of a house and the actuators acting on the process are a floor heating system and an electric radiator.

12:10-12:30 MoA06.6
On Propagating Requirements and Selecting Fuels for a Benson

Boiler (I), pp. 347-352

Kragelund, Martin — Aalborg Univ.
Wisniewski, Rafal — Aalborg Univ.
Mřlbak, Tommy — DONG Energy
Nielsen, Rene Just — DONG Energy A/S
Edlund, Kristian — Dong Energy

In this paper, the problem of optimal choice of sensors and actuators is addressed. Given a functional encapsulating information of the desired performance and production economy the objective is to choose a control instrumentation from a given set to comply with its minimum. The objective of the work is twofold: reformulation of the business objectives into mathematical terms and providing solution to the given optimization.Commonly, there exist overall business objectives which dictate how a plant should be instrumented and operated either directly or indirectly. The work shows how to propagate a global objective to local subsystems. Particular focus is on a boiler in a power plant operated by DONG Energy - a danish energy supplier. The business objectives have been propagated to the actuator level to allow for selection of an actuator configuration.

MoA07 310B
Control of Time Invariant Linear Systems (Regular Session)

Chair: Ozbay, Hitay — Bilkent Univ.
Co-Chair: Davison, Edward J. — Univ. of Toronto

10:30-10:50 MoA07.1
The Servomechanism Problem for Unknown SISO Positive LTI Systems Via Tuning Regulators and Clamping, pp. 353-358

Roszak, Bartek — Univ. of Toronto
Davison, Edward J. — Univ. of Toronto

In this paper we consider the servomechanism problem for SISO positive LTI systems. In particular, we solve the robust servomechanism problem of nonnegative constant reference signals for stable SISO positive unknown LTI systems with constant nonnegative unmeasurable disturbances under strictly nonnegative control inputs, using a clamping tuning regulator.

10:50-11:10 MoA07.2
Strongly Stabilizing Controller Synthesis for a Class of MIMO Plants, pp. 359-363

Ozbay, Hitay — Bilkent Univ.
Gundes, A. Nazli — Univ. of California

The strong stabilization problem (i.e., stabilization by a stable feedback controller) is studied for unstable MIMO plants with arbitrary number of finitely many poles but no more than two blocking zeros in the extended right half plane. Simple strongly stabilizing controllers, of order not exceeding that of the plant, are obtained for such plants satisfying the parity interlacing property. Connections with earlier design methods are illustrated: for this particular class of plants, it is shown that a sufficient condition appearing in earlier publications is equivalent to the parity interlacing property and hence it is also necessary for the existence of strongly stabilizing controllers. The results are illustrated with numerical examples.

11:10-11:30 MoA07.3
Necessary and Sufficient Conditions for Perfect Command Following and Disturbance Rejection in Fractional Order Systems, pp. 364-369

Merrikh-Bayat, Farshad — Sharif Uni. of Tech.
Karimi-Ghartemani, Masoud — Univ. of Toronto

The aim of this paper is to present a modified explanation of the classic internal model principle for certain class of finite-dimensional, time-invariant, deterministic fractional-order systems commonly known as fractional systems of commensurate order. The necessary and sufficient conditions for perfect command tracking and disturbance rejection are provided. The difficulty of applying the classic internal model principle to fractional-order systems is due to the difference between integer-order and fractional-order systems from the zero-pole cancellation point of view. The notion of zero-pole cancellation is discussed for the systems under consideration in a well posed mathematical framework. It is also shown that fractional elements can be used for command tracking and disturbance rejection purposes which provides more flexibility for controller design applications. Two illustrative examples confirm the applicability of the proposed theorems.

11:30-11:50 MoA07.4
Stability Analysis and Controller Design of Repetitive Control System Based on 2D Hybrid Model, pp. 370-375

Wu, Min — Central South Univ.
Lan, Yong-Hong — Central South Univ.
She, Jin-Hua — Tokyo Univ. of Tech.
He, Yong — Central South Univ.

This paper concerns stability analysis and controller design for repetitive control. First, a two-dimensional (2D) continuous-discrete hybrid model of a repetitive control system is established. Next, new criteria for the asymptotic stability of the system are presented based on the model. Then, these criteria are extended to calculate lower bounds on stability margins to design a suitable controller. Unlike existing methods, the one in this paper employs a 2D hybrid model to independently handle the two different types of actions involved in repetitive control: continuous control and discrete learning. A numerical example demonstrates that this approach provides good performance.

11:50-12:10 MoA07.5
Hit-And-Run: New Design Technique for Stabilization, Robustness and Optimization of Linear Systems, pp. 376-380

Polyak, Boris T. — Moscow Inst. of Control Sciences
Gryazina, Elena — Moscow Inst. of Physics and Tech.

New randomized algorithms for stabilization and optimal control for linear systems are proposed. They are based on Hit-and-Run method, which allow generating random points in convex or nonconvex domains. These domains are either stability domain in the space of feedback controllers, or quadratic stability domain, or robust stability domain, or level set for a performance specification. By generating random points in the prescribed domain one can optimize some additional performance index. The approach demonstrated its high efficiency for numerous classical examples of design problems.

MoA08 310C
Probabilistic Robustness (Regular Session)

Chair: Tempo, Roberto — Pol. di Torino
Co-Chair: Campi, Marco — Univ. of Brescia

10:30-11:10 MoA08.1
The Scenario Approach for Systems and Control Design, pp. 381-389

Campi, Marco — Univ. of Brescia
Garatti, Simone — Pol. di Milano
Prandini, Maria — Pol. di Milano

The ‘scenario approach’ is an innovative technology that has been introduced to solve convex optimization problems with an infinite number of constraints, a class of problems which often occurs when dealing with uncertainty. This technology relies on random sampling of constraints, and provides a powerful means for solving a variety of design problems in systems and control. The objective of this paper is to illustrate the scenario approach at a tutorial level, focusing mainly on algorithmic aspects. Specifically, its versatility and virtues will be pointed out through a number of examples in model reduction, robust and optimal control.

11:10-11:30 MoA08.2
RACT: Randomized Algorithms Control Toolbox for MATLAB, pp. 390-395

Tremba, Andrey — Inst. of Control Sciences
Calafiore, Giuseppe — Pol. di Torino
Dabbene, Fabrizio — Pol. di Torino
Gryazina, Elena — Moscow Inst. of Physics and Tech.
Polyak, Boris T. — Moscow Inst. of Control Sciences
Shcherbakov, P.S. — Moscow Inst. of Control Sciences
Tempo, Roberto — Pol. di Torino

This paper introduces a new Matlab package, RACT, aimed at solving a class of probabilistic analysis and synthesis problems arising in control. The package offers a convenient way for defining various types of structured uncertainties as well as formulating and analyzing the ensuing robustness analysis tasks from a probabilistic point of view. It also provides a full-featured framework for LMI-formulated probabilistic synthesis problems, which includes sequential probabilistic methods as well as scenario methods for robust design. The RACT package is freely available at http://ract.sourceforge.net, and only requires the YALMIP toolbox to be installed in the Matlab environment.

11:30-11:50 MoA08.3

Stochastic Ellipsoid Methods with Multiple Cuts, pp. 396-401

Wada, Takayuki — Kobe Univ.
Fujisaki, Yasumasa — Kobe Univ.

Robust control systems synthesis is generally recast as a class of robust feasibility problems which is to find a solution satisfying a set of parameter-dependent convex constraints for all possible parameter values. For this class of the problems, a stochastic ellipsoid method with multiple cuts each of which corresponds to each of the constraint is proposed, where a new update rule is presented for constructing a smaller ellipsoid which contains the intersection of a previous ellipsoid and half spaces determined by given multiple subgradients. Moreover, we show an explicit relation between the volume of the ellipsoid updated by the original method and that of the proposed method. A quantitative analysis of the volume of the updated ellipsoid is also provided, which leads to a further modification of the algorithm for achieving fast convergence.

11:50-12:10 MoA08.4

Probabilistic Sorting and Stabilization of Switched Systems, pp. 402-407

Ishii, Hideaki — Tokyo Inst. of Tech.
Tempo, Roberto — Pol. di Torino

We consider Lyapunov stability of switched linear systems whose switching signal is constrained to a subset of indices. We propose a switching rule that chooses the most stable subsystem among those belonging to the subset. This rule is based on an ordering of the subsystems using a common Lyapunov function. We develop randomized algorithms for finding the ordering as well as for finding a subset of systems for which a common Lyapunov function exists. We show that the class of Las Vegas randomized algorithms is useful in the design.

12:10-12:30 MoA08.5

A Robust Approach to Markov Decision Problems with Uncertain Transition Probabilities, pp. 408-413

Paschalidis, Ioannis — Boston Univ.
Kang, Seong-Cheol — Boston Univ.

This paper considers a discrete-time infinite horizon discounted cost Markov decision problem in which the transition probability vector for each state-control pair is uncertain. A popular approach to this problem has been to find a policy that performs best in the worst-case scenario. A policy obtained in this manner, however, tends to be conservative. We construct a robust formulation for the problem, which produces a less conservative policy. We characterize the performance of the robust formulation via the probability that the optimal cost of a random instance of the problem is at most that of the robust formulation. A congestion-dependent pricing problem for network services is examined as a numerical example.

MoA09 311C

Identification of Dynamic Errors-In-Variables Models (Invited Session)

Chair: Garnier, Hugues — Univ. Henri Poincaré, Nancy 1
Co-Chair: Wang, Liuping — RMIT Univ.
Organizer: Garnier, Hugues — Univ. Henri Poincaré, Nancy 1
Organizer: Gilson, Marion — Univ. Henri Poincaré, Nancy 1
Organizer: Wang, Liuping — RMIT Univ.

10:30-10:50 MoA09.1

Comparison of Three Frisch Methods for Errors-In-Variables Identification (I), pp. 414-419

Hong, Mei — Uppsala Univ.
Soderstrom, Torsten — Uppsala Univ.
Soverini, Umberto — Univ. of Bologna
Diversi, Roberto — Univ. of Bologna

The errors–in–variables framework concerns static or dynamic systems whose input and output variables are affected by additive noise. Several estimation methods have been proposed for identifying dynamic errors–in–variables models. One of the more promising approaches is the so–called Frisch scheme. This paper decribes three different estimation criteria within the Frisch context and compares their estimation accuracy on the basis of the asymptotic covariance matrices of the estimates. Some numerical examples support well the theoretical results.

10:50-11:10 MoA09.2

Statistical Analysis of a Third-Order Cumulants Based Algorithm for Discrete-Time Errors-In-Variables Identification (I), pp. 420-425

Thil, Stéphane — Nancy-Univ.
Hong, Mei — Uppsala Univ.
Soderstrom, Torsten — Uppsala Univ.
Gilson, Marion — Univ. Henri Poincaré, Nancy 1
Garnier, Hugues — Univ. Henri Poincaré, Nancy 1

This paper deals with identification of dynamic discrete-time errors-in-variables systems. The statistical accuracy of a least squares estimator based on third-order cumulants is analyzed. In particular, the asymptotic covariance matrix of the estimated parameters is derived. The results are supported by numerical simulation studies.

11:10-11:30 MoA09.3

On Instrumental Variable-Based Methods for Errors-In-Variables Model Identification (I), pp. 426-431

Thil, Stéphane — Nancy-Univ.
Gilson, Marion — Univ. Henri Poincaré, Nancy 1
Garnier, Hugues — Univ. Henri Poincaré, Nancy 1

In this paper, the problem of identifying stochastic linear discrete-time systems from noisy input/output data is addressed. The input noise is supposed to be white, while the output noise is assumed to be coloured. Some methods based on instrumental variable techniques are studied and compared to a least squares bias compensation scheme with the help of Monte Carlo simulations.

11:30-11:50 MoA09.4

Identification of ARARX Models in Presence of Additive Noise (I), pp. 432-437

Diversi, Roberto — Univ. of Bologna
Guidorzi, Roberto — Univ. of Bologna
Soverini, Umberto — Univ. of Bologna

The identification of dynamic processes can be performed by means of different classes of models relying on different stochastic environments to describe the misfit between the model and process observations. This paper introduces a new class of models by considering additive error terms on the observations of the input and output of ARARX models and proposes a three-step identification procedure for their identification. ARARX + noise models extend the traditional ARARX or ARMAX ones and can be seen as errors-in-variables models where both measurement errors and process disturbances are taken into account. The results of Monte Carlo simulations show the good performance of the proposed identification procedure.

11:50-12:10 MoA09.5

Application of Non-Stationary EIV Methods to Transient Electromagnetic Mineral Exploration (I), pp. 438-443

Lau, Katrina — The Univ. of Newcastle
Braslavsky, Julio H. — The Univ. of Newcastle
Aguero, Juan C — The Univ. of Newcastle
Goodwin, Graham C. — Univ. of Newcastle

In this paper, we apply a non-stationary errors-in-variables model estimation technique to a problem arising in transient electromagnetic mineral exploration. The proposed technique is used to estimate a model which is deployed for noise cancellation. Alternative methods for noise cancellation in these systems rely on specific signal characteristics, and are thus not readily transferable to other applications. The proposed technique produces an estimated model that agrees well with those obtained using alternative methods, and achieves noise reduction levels similar to those achieved via the alternative methods. This is shown by performance comparisons on experimental data. An advantage of the proposed technique is that it is more readily transferable to other applications.

12:10-12:30 MoA09.6

Identifiability of EIV Dynamic Systems with Non-Stationary Data (I), pp. 444-449

Aguero, Juan C — The Univ. of Newcastle
Goodwin, Graham C. — Univ. of Newcastle

This paper presents novel results related to the identifiability of EIV dynamic systems based on exploiting properties of non-stationary data. We analyze single-input single-output systems using second order properties. Our results show that, it is possible to establish identifiability of EIV systems under mild conditions when the data is non-stationary.

MoA10 311B
Prediction, Filtering and Smoothing I (Regular Session)

Chair: Van den Hof, Paul M.J. — Delft Univ. of Tech.
Co-Chair: McKelvey, Tomas — Chalmers Univ. of Tech.

10:30-10:50 MoA10.1
Robust H_infty Filtering by Means of Lead-Lag Controller, pp. 450-455

Neveux, Philippe — Univ. d'Avignon et des Pays de Vaucluse
Blanco, Eric — AMPERE Lab.

In the present paper, a new strategy for robust filtering problem of linear time-invariant (LTI) continuous time system is proposed. The key idea consists in generalizing the structure of a linear state estimator of the Luenberger class. As a matter of fact, the closed loop form of this class of state estimator can be assimilated to a closed loop control problem. Then, the standard correction term can be viewed as a Proportional controller. In this paper, we propose a more general form of controller in order to obtain the robustness. An example shows the efficiency of the proposed approach.

10:50-11:10 MoA10.2
Robust Kalman Filter and Smoother for Errors-In-Variables Model with Observation Outliers, pp. 456-461

ALMutawa, Jaafar — King Fahd Univ. of Petroleum & Minerals

In this paper, we propose a robust Kalman filter and smoother for the errors-in-variables (EIV) state space model subject to observation noise with outliers. We introduce the EIV problem with outliers and then we present the minimum covariance determinant (MCD) estimator which is highly robust estimator to detect outliers. As a result, a new statistical test to check the existence of outliers which is based on the Kalman filter and smoother has been formulated. Since the MCD is a combinatorial optimization problem the randomized algorithm has been proposed in order to achieve the optimal estimate. However, the uniform sampling method has a high computational cost and may lead to biased estimate, therefore we apply the sub-sampling method. A Monte Carlo simulation result shows the efficiency of the proposed algorithm.

11:10-11:30 MoA10.3
Direct Design of Optimal Filters from Data, pp. 462-467

Novara, Carlo — Pol. di Torino
Ruiz, Fredy — Pol. di Torino
Milanese, Mario — Pol. di Torino

In the literature on filter design, the system whose state has to be estimated is usually assumed known. However, in most practical situations, this assumption does not hold, and a two-step procedure is adopted: 1) a model is identified from a set of noise-corrupted data; 2) on the basis of the identified model, a Kalman filter is designed. In this paper, the idea of directly identifying the filter from data is investigated. In previous works by the authors, it has been shown that the direct identification of the filter may be more convenient than the two-step design. In this paper, an approach for the direct design of optimal filters is proposed, where optimality refers to the minimization of a suitable worst-case estimation error. It is also shown that the Kalman filter is a particular case of the proposed approach.

11:30-11:50 MoA10.4
Estimating Cutting Forces in Micromilling by Input Estimation from Closed-Loop Data, pp. 468-473

Blom, Rogier S. — Delft Univ. of Tech.
Van den Hof, Paul M.J. — Delft Univ. of Tech.

Estimation of cutting forces in micromilling from the signals of a spindle with Active Magnetic Bearings (AMB) is treated as an input estimation problem. For the closed-loop AMB system, a minimum mean square error input estimator with an adjustable delay is derived. This filter is based on the Wiener filter, where the unknown input is treated as white noise filtered by known dynamics and the controller is assumed to be known. It is shown that controller knowledge can be replaced by a perfect measurement of the control signal. Simulation results demonstrate the applicability of the presented approach.

11:50-12:10 MoA10.5
UKF Based Nonlinear Filtering for Parameter Estimation in Linear Systems with Correlated Noise, pp. 474-479

Xu, Jiahe — Northeastern Univ.
Kolemisevska-Gugulovska, Tatjana — SS Cyril and Methodius Univ.
Zheng, Xiuping — Northeastern Univ.
Jing, Yuanwei — Northeastern Univ.
Dimirovski, Georgi Marko — Dogus Univ. of Istanbul

Based on the Unscented Kalman Filter (UKF), the nonlinear filter is presented for parameter estimation in linear system with correlated noise where the unknown parameters are estimated as a part of an enlarged state vector. To avoid the computational burden in determining the state estimates when only the parameter estimates are required, a new form of UKF, where the state consists only of the parameters to be estimated, is proposed. The algorithm is based on the inclusion of the computed residuals in the observation matrix of a state representation of the system. Convergence properties of the proposed algorithm are analyzed and ensured. The algorithm is verified by using Matlab simulations on the vehicle navigation systems with aided GPS.

12:10-12:30 MoA10.6
Multi-Sensor Distributed Fusion Filter for Discrete Stochastic Multi-Delayed Systems with Correlated Noise, pp. 480-484

Sun, Shuli — Heilongjiang Univ.
Lv, Nan — Heilongjiang Univ.

This paper is concerned with the distributed fusion estimation problem for discrete-time linear stochastic multi-delayed systems with multiple sensors and correlated noise. Firstly, a new optimal filter in the least mean square sense is presented for discrete stochastic multi-delayed systems with a single sensor, where the white noise filter is used to obtain the optimal state estimate. Then, a distributed optimal scalarweighted fusion filter is given for discrete-time linear stochastic multi-delayed systems with multiple sensors. A recursive formula for the estimation error cross-covariance matrix between any two local optimal estimates is derived. Compared with the centralized filter, it has a little accuracy loss but better reliability. At last, a simulation example shows the effectiveness of the proposed algorithms.

MoA11 311A
Nonlinear Systems I (Regular Session)

Chair: Nakamura, Nami — Nara Inst. of Science and Tech.
Co-Chair: Morin, Pascal — INRIA Sophia Antipolis

10:30-10:50 MoA11.1
Extended Moore-Spence Equations Based Reduced Method for Computing Bifurcation Points of Power System Model, pp. 485-490

An, Yichun — Northeastern Univ.
Zhang, Qingling — Northeastern Univ.
Li, Qin — Northeastern Univ.
Zhang, Daqing — Northeastern Univ.
Duan, Xiao-dong — Dalian Nationalities Univ.
Zheng, Meng — Northeastern Univ.

For differential-algebraic power systems, saddle-noddle bifurcation and Hopf bifur- cation are both of universally existent phenomena in power systems. Usually Newton iteration method could be applied to the Moore-Spence system to compute saddle-noddle and Hopf bifurcation points directly. But the Moore-Spence system has very high dimension and causes much complexity in Jacobian matrix factorization. By introducing an auxiliary variable and an auxiliary equation to form an extended Moore-Spence system, this paper derives an exective matrix reduction technique. The high dimensionality of Jacobian matrix can thus be reduced and the complexity involved in matrix factorization can be simplified.

10:50-11:10 MoA11.2
On Convergence Rate of Second-Order Sliding Mode Control Algorithms, pp. 491-497

Boiko, Igor — IMB Controls

Transient processes in the systems controlled by second-order sliding mode (SOSM) algorithms are analyzed in the frequency domain. A methodology of the frequency-domain analysis of transient processes that feature a decaying oscillation of variable frequency is developed. A simple criterion of the existence of finite-time convergence is proposed. It is shown that the convergence rate in a system controlled by a relay or SOSM controller depends on the angle between the high-frequency asymptote of the Nyquist plot of the plant and the low-amplitude asymptote of the negative reciprocal of the describing function of the controller, which is called the phase deficit. Examples of analysis are given.

11:10-11:30 MoA11.3

Nonlinear Modeling of Double-Loop Hysteretic Systems, pp. 498-502

Pozo, Francesc — Univ. Pol. de Catalunya
Acho, Leonardo — EUETIB-Univ. Pol. of Catalunya
Rodriguez Tsouroudkdissian, Arturo — Pol. Univ. of Catalunya

This paper presents two new dynamic hysteresis models obtained from the Bouc-Wen model by incorporating position and acceleration information. On one hand, the model employing position information is rate-independent and it is able to reproduce some kind of double hysteretic loops unable to be reproduced with the original Bouc-Wen model. On the other hand, the model employing acceleration information is insensitive to linear time-scale variations. Double hysteretic loops have been experimentally reported and seen in shape memory alloys, reinforced concrete structures, wood structures and lightweight steel shear wall structures. The proposed hysteretic models represent a prominent use in the field of structural dynamics and earthquake engineering because they can capture the non-linear dynamics of the materials and structures presented earlier when they are subjected to dynamic loads as an earthquake excitation, using the position and acceleration information, being the last one an available source in the field with the use of accelerometers.

11:30-11:50 MoA11.4

Transformation from Real Homogeneous Systems of Degree L to Complex Homogeneous Systems of Degree (l, 0), pp. 503-507

Nakamura, Nami — Nara Inst. of Science and Tech.
Nakamura, Hisakazu — Nara Inst. of Science &Tech.

In eigenvalue analysis, transformation from real systems to complex systems is very important. First, we clarify a necessary and sufficient condition that solutions of real nonlinear systems coincide with solutions of transformed complex nonlinear systems in the real subspace. Moreover, we propose a complex transformation such that a) real homogeneous systems of degree l with respect to r are transformed to complex homogeneous systems of degree (l,0) with respect to r and b) solutions of real systems coincide with solutions of transformed complex systems in the real subspace. Then, we show examples.

11:50-12:10 MoA11.5

Stabilization of Trajectories for Systems on Lie Groups. Application to the Rolling Sphere, pp. 508-513

Morin, Pascal — INRIA Sophia Antipolis
Samson, Claude — INRIA Sophia Antipolis

This paper addresses the stabilization of admissible reference trajectories generated with constant inputs for driftless systems on Lie groups. The general expression of the linear approximation of the tracking error system is derived from the system's constants of structure and a necessary condition for the controllability of this approximation is specified in terms of the growth of the filtration of the Lie Algebra generated by the system's vector fields. This condition is illustrated with examples of mechanical systems whose control inputs correspond to velocity variables. By contrast with nonholonomic mobile robots whose kinematic equations can be transformed into the chained form, the linearized system associated with the rolling sphere is never controllable. Consequences of this lack of controllability as for stabilization problems are discussed from a general viewpoint and addressed more specifically for the rolling sphere. Finally, a practical stabilizer for this system based on the transverse function approach is proposed.

12:10-12:30 MoA11.6

Stability Analysis on Kuramoto Model of Coupled Oscillators, pp. 514-518

Wang, Wenxue — Texas Tech. Univ.
Ghosh, Bijoy — Texas Tech. Univ.

In this paper we study the problem of stability for one of the most popular models of coupled phase oscillators, the Kuramoto model. The Kuramoto model is used to describe the phenomenon of collective synchronization, in which an enormous system of oscillators spontaneously locks to a common frequency although the oscillators have distinct natural frequencies. In the paper we consider the stability of the Kuramoto model of coupled oscillators with identical natural frequency and provide a stability analysis of phase difference equilibrium. The stability of the phase difference equilibrium make it possible to apply the Kuramoto model in pattern recognition.

MoA12 313

Discrete Event Systems and Petri Nets (Regular Session)

Chair: Cao, Xi-Ren — Hong Kong Univ. of Sci. & Tech.
Co-Chair: Giua, Alessandro — Univ. di Cagliari

10:30-10:50 MoA12.1

Observability of Timed Continuous Petri Nets: A Class of Hybrid Systems, pp. 519-524

Mahulea, Cristian — Univ. of Zaragoza
Recalde, Laura — Univ. De Zaragoza
Silva, Manuel — Univ. De Zaragoza

Timed continuous Petri net systems with infinite server semantics are piecewise linear systems. This paper addresses several problems regarding the state observability of these systems. We assume that the initial marking/state is not known and measuring some places we want to estimate all the others. First, a study of the different linear systems corresponding to a continuous Petri net system is performed. It is shown that in some cases, some of them are redundant, and so can be disregarded. The notion of distinguishable configurations is introduced. It helps to give a necessary and sufficient criterion for the observability in infinitesimal time. Using results from linear structured systems, the concept of generic observability is introduced and it is studied in the case of join free nets.

10:50-11:10 MoA12.2

The Verification of Real Time Systems Using the TINA Tool, pp. 525-530

González del Foyo, Pedro Manuel — Univ. de São Paulo
Silva, José Reinaldo — Univ. of São Paulo

In this paper, we propose a method for building a Timed Transition Graph (TTG) that uses a single clock from the state class graph of a bounded time Petri Net (TPN). To build this TTG a special state class construction - available in Tina - is used. This structure can be used to calculate "quantitative" temporal properties for the worst case scenario. It is possible to check efficiently several properties over the same TTG if no design modifications are made. Such properties are represented by a framework proposed in the literature were TCTL properties are defined on TPN.

11:10-11:30 MoA12.3

Some New Results on Supervisory Control of Petri Nets with Decentralized Monitor Places, pp. 531-536

Basile, Francesco — Univ. Degli Studi Di Salerno
Giua, Alessandro — Univ. di Cagliari
Seatzu, Carla — Univ. of Cagliari

This paper presents two new results on the problem of determining a set of decentralized controllers for place/transition nets to enforce a global specification on the net behavior. Both the global specification and the decentralized specifications are given in terms of Generalized Mutual Exclusion Constraints (GMECs). First, an algorithm to select a decentralized specification that finds a compromise between fairness among variables and the maximal cardinality is proposed assuming that the support of each decentralized GMEC is a singleton. Then, a maximal solution in terms of permissiveness and fairness among places is proposed removing the previous assumption.

11:30-11:50 MoA12.4

Predictability of Sequence Patterns in Discrete Event Systems, pp. 537-543

Jeron, Thierry — INRIA
Marchand, Herve — IRISA/INRIA Rennes
Genc, Sahika — Univ. of Michigan
Lafortune, Stephane — Univ. of Michigan

The problem of predicting the occurrences of a pattern in a partially-observed discrete-event system is studied. The system is modeled by a labeled transition system. The pattern is a set of event sequences modeled by a finite-state automaton. The occurrences of the pattern are predictable if it is possible to infer about any occurrence of the pattern before the pattern is completely executed by the system. A novel off-line algorithm to verify the property of predictability is presented. The verification is polynomial in the number of states of the system. An on-line algorithm to track the execution of the pattern during the operation of the system is also presented. This algorithm is basedon theuse of a diagnoser automaton.

11:50-12:10 MoA12.5

Modeling of Asynchronous Discrete-Event Systems As Networks of Input-Output Automata, pp. 544-549

Drueppel, Sebastian — Robert Bosch GmbH, Corp. Sector Res. and Advance Enginee
Lunze, Jan — Ruhr-Univ. Bochum
Fritz, Martin — Robert Bosch GmbH

A new approach for component-oriented modeling of asynchronous discrete-event systems is presented where input-output (I/O) automata are used for representing the components. Coupling signals are introduced to describe the interactions among the components. The resulting network of I/O-automata has a direct correspondence to the block diagram. By using the parallel composition rule known from standard automata modeling as an example, it is shown that the new model is applicable for at least the same class of asynchronous discrete-event systems as the known modeling formalisms.

12:10-12:30 MoA12.6

A Simulation Study of a Reconfigurable Database, pp. 550-555

Metzler, James — Air Force Res. Lab.
Wu, Neng Eva — Binghamton Univ.

The effect of supervisory control on a redundant database unit representing a command and control (C2) system that supports air operations is investigated through simulation. Several supervisory control policies are considered. They authorize restoration and/or routing upon the failure of a server in the system. The performance of the modeled system under these policies is evaluated based on the measures of system mean-time-to-failure (MTTF), steady-state availability, expected response time, and overhead. The system is modeled as a discrete event system using a simulation tool. In addition, a system update process is implemented to ensure the currency of the information contained in the database unit.

MoA13 314

Distributed Control and Coordination (Regular Session)

Chair: Jumar, Ulrich — ifak - Inst. f. Automation u. Kommunikation
Co-Chair: Hu, Xiaoming — Royal Inst. of Tech.

10:30-10:50 MoA13.1

Systematic Design of Distributed Controllers for Sewer Networks, pp. 556-561

Alex, Jens — ifak Inst. für Automation und Kommunikation e.V.
Schuetze, Manfred — ifak Magdeburg
Ogurek, Michael — ifak Inst. für Automation und Kommunikation e.V. Magdeburg
Jumar, Ulrich — ifak - Inst. f. Automation u. Kommunikation

A novel concept for a systematic design procedure of a distributed controller network for global control of a sewer network is proposed. This concept is based on two simple controller types (local throttle controller, supervisory controller) which are connected systematically based on the structure of the sewer network and the available throttle and storage structures. The controllers are based on simple algorithms (nonlinear P-control, simple prediction models) which can be implemented in standard programmable logic controllers (PLCs). Design rules for the controller parameters are available. An appropriate simulation system allowing the design, test and validation of the developed concept which has been set up. The simulation system allows the description of the controllers using a standard PLC programming language (IEC 61131 ST). Finally, an example is presented to demonstrate the ability of the control concept to utilise a high percentage of the theoretically available improvement potential for automatic control. The approach presented is expected to be easily applicable in real cases and to reduce the typical effort required for the application of automatic control to sewer networks by at least one order of magnitude.

10:50-11:10 MoA13.2

Boundedness of Multi-Dimensional Systems Over a Prescribed Frequency Domain, pp. 562-567

Zhou, Tong — Tsinghua Univ.

On the basis of a parameterization of the span of a multivariate matrix polynomial, a sufficient condition is derived in this paper for a multi-dimensional multi-input multi-output (MIMO) IIR system being upper bounded over a cuboid frequency domain. This condition is expressed through a linear matrix inequality (LMI) and can be computationally verified. Moreover, by means of parameter dependent LMIs, two necessary and sufficient conditions are also obtained for this boundedness verification problem, which are again expressed by LMIs. Furthermore, LMI based conditions are derived for system output matrix and direct transmission matrix. Numerical examples are included to illustrate the efficiency and characteristics of the derived theoretical results.

11:10-11:30 MoA13.3

A Robust Control Method for Electrostatic Microbeam Dynamic Shaping with Capacitive Detection, pp. 568-573

Kharrat, Chady — CEA
Colinet, Eric — CEA
Besancon-Voda, Alina — LAG-ENSIEG

A robust closed-loop control and observation methodology for a microbeam electrostatic dynamic shaping using N small separate electrodes is described. After decomposing the displacements vector on the n eigenmodes using the modal analysis, n controllers are designed to control the dynamic coefficients of each mode and deliver the stresses that must be distributed throughout the beam. In a previous work, we considered direct access to non noisy displacement measurements. In this paper, we investigate the capacitive measurement of the local displacements done by each small electrode, which gives a noisy readout. Robust control methodology applied on extended standard model allows the design of n observers associated to n controllers and guarantees a precise shape tracking, free from noise and robust against parameters incertitude.

11:30-11:50 MoA13.4

Distributed Control with Integral Quadratic Constraints, pp. 574-580

Fang, Hui — Univ. of Notre Dame
Antsaklis, Panos J. — Univ. of Notre Dame

In this paper, stability conditions for distributed systems with general Integral Quadratic Constraints (IQC) on the interconnections are derived. These results take the form of coupled Linear Matrix Inequalities (LMIs), where the multipliers are shaped by the underlying IQCs. It is further shown how these results can be exploited to design distributed controllers in a way similar to the gain-scheduling controller design in Linear Parameter Varying (LPV) systems.

11:50-12:10 MoA13.5

Connectivity Constrained Multi-UGV Surveillance, pp. 581-586

Anisi, David A. — Royal Inst. of Tech. (KTH)
Hu, Xiaoming — Royal Inst. of Tech.
Ogren, Petter — Swedish Defence Res. Agency (FOI)

This paper addresses the problem of connectivity constrained surveillance of a given polyhedral area with obstacles using a group of Unmanned Ground Vehicles (UGVs). The considered communication restrictions may involve both line-of-sight constraints and limited sensor range constraints. In this paper, the focus is on dynamic information graphs which are required to be kept recurrently connected. The main motivation for introducing this weaker notion of connectivity is security and surveillance applications where the sentry vehicles may have to split temporary in order to complete the given mission efficiently but are required to establish contact recurrently in order to exchange information or to make sure that all units are intact and well-functioning. From a theoretical standpoint, recurrent connectivity is shown to be sufficient for exponential convergence of consensus filters for the collected sensor data.

12:10-12:30 MoA13.6

Cooperative Surveillance of a Moving Target Using a Formation Framework, pp. 587-592

Woo, Sangbum — Univ.
Jayasuriya, Suhada — Texas A&M Univ.

In this paper we address the formation control problem of generating a formation for a group of nonholonomic mobile agents. The formation control scheme which is proposed in this paper is based on a fusion of leader-follower and the virtual referenced approaches. This scheme gives a formation error representation that is independent of the number of agents in the formation and the resulting control algorithm is scalable. The proposed controller is based on feedback linearization, and formation errors are guaranteed to be globally asymptotically stable. As a possible application, the proposed algorithm is implemented on the cooperative ground moving target surveillance problem. The controller design algorithm is verified through computer simulations.

MoA14 — 318
Networked Systems: Sensing, Estimation, Consensus and Control Over Networks (Invited Session)

Chair: Shi, Ling — California Inst. of Tech.
Co-Chair: Johansson, Karl Henrik — Royal Inst. of Tech.
Organizer: Shi, Ling — California Inst. of Tech.
Organizer: Johansson, Karl Henrik — Royal Inst. of Tech.
Organizer: Murray, Richard M. — California Inst. of Tech.

10:30-10:50 — MoA14.1
Biologically-Inspired Navigation Strategies for Swarm Intelligence Using Spatial Gaussian Processes (I), pp. 593-598

Choi, Jongeun — Michigan State Univ.
Lee, Joonho — Michigan State Univ.
Oh, Songhwai — Univ. of California, Berkeley

This paper presents a novel class of self-organizing sensing agents that form a swarm and learn the static spatial process of interest through noisy measurements from neighbors for various global goals. The spatial phenomenon of interest is modeled by a Gaussian process. Each sensing agent maintains its own prediction of the Gaussian process based on measurements from neighbors. A set of biologically inspired navigation strategies are derived by exploiting the predictive posterior statistics. A unified way to prescribe a global goal for the group of agents so that a high-level behavior builds on a set of low-level simple behavior modules. As a result, collective mobility of agents emerges from a specified global goal. The proposed cooperatively learning control consists of motion coordination based on the recursive estimation of an unknown field of interest with measurement noise. The convergence properties of the proposed coordination algorithm for different situations and global goals are investigated by a simulation study.

10:50-11:10 — MoA14.2
Stabilizing Sampled-Data Linear Systems with Markovian Packet Losses and Random Sampling (I), pp. 599-604

Xie, Li — Beijing Inst. of Thchnology
Xie, Lihua — Nanyang Tech. Univ.

We consider the stability properties and stabilizing problem of sampled-data networked controlled linear systems with Markovian packet losses. A binary Markov chain is used to characterize the packet loss phenomenon of the network. Then with the Markovian packet loss assumption, we obtain a discrete-time augmented Markov jump linear system which describes the continuous-time linear system evolving in deterministic discrete time. Furthermore, we show that the sampled-data system under consideration can also be considered as a randomly sampled system with an i.i.d. random sampling period. A number of necessary and sufficient conditions for the stochastic stability properties are established by using the known results of Markov jump linear systems and randomly sampled systems. Those conditions are based on the relationships of stability properties between the systems evolving in deterministic continuous time, deterministic discrete time, and random discrete time. In addition, the asymptotic stability of the system is also studied by using Lyapunov exponent method. Numerical examples are used to illustrate the main results of the paper.

11:10-11:30 — MoA14.3
Estimation Over Wireless Sensor Networks: Tradeoff between Communication, Computation and Estimation Qualities (I), pp. 605-611

Shi, Ling — California Inst. of Tech.
Johansson, Karl Henrik — Royal Inst. of Tech.
Murray, Richard M. — California Inst. of Tech.

In this paper we consider a state estimation problem over a wireless sensor network. A fusion center dynamically forms a local multi-hop tree of sensors and fuses the data into a state estimate. It is shown that the optimal estimator over a sensor tree is given by a Kalman filter of certain structure. Using estimation quality as a metric, two communication schemes are studied and compared. In scheme one, sensor nodes communicate measurement data to their parent nodes, while in scheme two, sensor nodes communicate their local state estimates to their parent nodes. We show that under perfect communication links, the two schemes produce the same estimate at the fusion center with unlimited computation at each sensor node; scheme one is always better than scheme two with limited computation. When data packet drops occur on the communication links, we show that scheme two always outperforms scheme one with unlimited computation; with limited computation, we show that there exists a critical packet arrival rate, above which, scheme one outperforms scheme two. Simulations are provided to demonstrate the two schemes under various circumstances.

11:30-11:50 — MoA14.4
Using Hierarchical Decomposition to Speed up Average Consensus (I), pp. 612-618

Epstein, Michael — Caltech
Lynch, Kevin M. — Northwestern Univ.
Johansson, Karl Henrik — Royal Inst. of Tech.
Murray, Richard M. — California Inst. of Tech.

We study the continuous-time consensus problem where nodes on a graph attempt to reach average consensus. We consider communication graphs that can be decomposed into a hierarchical structure and present a consensus scheme that exploits this hierarchical topology. The scheme consists of splitting the overall graph into layers of smaller connected subgraphs. Consensus is performed within the individual subgraphs starting with those of the lowest layer of the hierarchy and moving upwards. Certain “leader” nodes bridge the layers of the hierarchy. By exploiting the increased convergence speed of the smaller subgraphs, we show how this scheme can achieve faster overall convergence than the standard single-stage consensus algorithm running on the full graph topology. The result presents some fundamentals on how the communication architecture influences the global performance of a networked system. Analytical performance bounds are derived and simulations provided to illustrate the effectiveness of the scheme.

11:50-12:10 — MoA14.5
Experimental Evaluation of Power Control Algorithms for Wireless Sensor Networks (I), pp. 619-624

Park, Pan Gun — School of Electrical Engineering, KTH
Fischione, Carlo — Royal Inst. of Tech.
Johansson, Karl Henrik — Royal Inst. of Tech.

The main contribution of this paper is the implementation and experimental evaluation of thee radio power control algorithms for wireless sensor networks. We illustrate the necessity of lightweight radio power control algorithms for the deployment of wireless sensor networks in realistic situations. Furthermore, based on a simple loss model, we develop an algorithm that optimizes the transmit power while guaranteeing a desired packet error probability. The simple power control strategy is also compared with two other strategies in experiments using Tmote Sky sensor nodes. A component-based software implementation in the Contiki operating system is used.

12:10-12:30 — MoA14.6
Networked Stabilization of Multi-Input Systems with Channel Resource Allocation (I), pp. 625-630

Gu, Guoxiang — Louisiana State Univ.
Qiu, Li — Hong Kong Univ. of Sci. & Tech.

In this paper, we study the problem of stabilizing a linear time-invariant discrete-time system with information constraints in the input channels. The information constraint in each input channel is modelled as a sector uncertainty. Equivalently, the transmission error of an input channel is modelled as an additive system uncertainty with a bound in the induced norm. We attempt to find the least information required, or equivalently the largest allowable uncertainty bound, in each input channel which renders the stabilization possible. The solution for the single-input case, which gives a typical H-infinity optimal control problem, is available in the literature and is given analytically in terms of the Mahler measure or topological entropy of the plant. The main purpose of this paper is to address the multi-input case. In the multi-input case, if the information constraint in each input channel is given a priori, then our stabilization problem turns out to be a so-called mu synthesis problem, a notoriously hard problem. In this paper, we assume that the information constraints in the input channels are determined by the network resources assigned to the channels and they can be allocated subject to a total recourse constraint. With this assumption, the resource allocation becomes part of the design problem and a modified mu synthesis problem arises. Surprisingly, this modified mu-synthesis problem can be solved analytically and the solution is also given in terms of the Mahler measure or topological entropy as in the single-input case.

MoA15 317

Monitoring & Sensing in Agriculture (Regular Session)

Chair: Blanke, Mogens — Tech. Univ. of Denmark
Co-Chair: Kaizu, Yutaka — Hokkaido Univ.

10:30-10:50 MoA15.1

On-Line Microwave Measurement of the Moisture Content of Wheat, pp. 631-635

Mellmann, Jochen — Leibniz-Inst. für Agrartechnik Potsdam-Bornim e.V. (ATB)

In continuous grain drying fluctuations of the moisture content at dryer entrance are still a major problem resulting in under- or over-drying due to uneven moisture distribution at the discharge and, hence, lead to quality and economic losses. Recently, grain dryer producers increasingly apply direct on-line grain moisture measuring systems to improve dryer control. In the present study results of laboratory measurements of grain moisture content are presented based on the microwave resonator technique. These measurements carried out with wheat as test material are aimed to develop a new on-line grain moisture measuring system for dryer control.

10:50-11:10 MoA15.2

Potential of Vis/NIR Spectroscopy in Estimating ATP Content Per Protoplast As an Indicator of Freshness of Spinach, pp. 636-640

Ye, Xujun — The Univ. of Tokyo
Oshita, Seiichi — The Univ. of Tokyo
Jin, Xiannu — The Univ. of Tokyo
Makino, Yoshio — The Univ. of Tokyo
Kawagoe, Yoshinori — The Univ. of Tokyo

The possibility of using ATP content per protoplast as an indicator of freshness was studied in spinach (Spinacia oleracea). The ATP content per protoplast of spinach was determined and compared during 3 days of storage at 25 °C. ATP content increased rapidly at the early stages of storage, reaching a peak level after 24 h. After one day (24 h) of storage, the ATP content decreased with the storage time. Overall, the ATP content changed as a quadratic polynomial function of storage time. This phenomenon, which is likely to be an expression of the loss of protoplast viability, is a useful indicator, allowing the prediction of spinach deterioration during storage. In addition, the correlation between ATP content and Vis/NIR spectra during storage was excellent (R2=0.8245 for transmittance at 681 nm, and R2 =0.9008 for the first derivative of transmittance at 760 nm). These results demonstrate the possibility of evaluating the freshness of spinach through estimation of the ATP content per protoplast with Vis/NIR spectroscopy after approximately 30 hours of the harvested plant storage.

11:10-11:30 MoA15.3

Image Processing and Roughness Analysis As a Tool for Quantification of Physiological Well-Being in Plants: Results for Sunagoke Moss, pp. 641-646

Ondimu, Stephen Nyarindo — Osaka Prefecture Unversity (Phd-student)

The general appearance of a plant is the most obvious indicator of its physiological well-being. This study was premised on the assumption that image roughness values can be used to quantify well-being in plants. We hypothesize that the highest level of well-being in the plant corresponds to a given minimum level of its surface roughness. Beyond this point the roughness increases. A set of 511 images of Sunagoke moss (Rhacomitrium canescens) samples at water states of, 5.0gg-1, 4gg-1, 3gg-1, 2.0gg-1, 1.0gg-1 and 0gg-1 were analyzed for roughness parameters. Water state here was defined as the amount of water available for the plant at the beginning of a given day in grams per gram of its dry weight. The results demonstrated that different water states have a strong effect on the surface roughness in Sunagoke moss. It was found that the higher the surface roughness of a plant the lower the level of its well-being and vice-versa. The highest level of well-being was found to be at 2gg-1 water state for the Sunagoke moss used in this study. We concluded that roughness analysis can be used to quantify well-being in plants. Based on the results of this study, we propose a speaking organism system concept which allows plants to self-regulate their own bio-production environment based on roughness parameters fused with other image analysis results.

11:30-11:50 MoA15.4

Incorporating Artificial Human Mentality (Kansei) in Intelligent Monitoring of Production Scheme for Customized Agro-Industrial Produce, pp. 647-652

Ushada, Mirwan — Osaka Prefecture Univ. Japan, Graduate School of Lifeand En

A novel Customized Agro-industrial Produce Design (CAPD) scheme is highlighted to monitor the plant factory production systems. The expected outcome is to provide every consumer with a produce that matches his or her unique mentality. The new challenges of CAPD are consisting of non-linear and complex interaction between the bio-response parameters and human mentality process involved. As the solution, the intelligent modeling of Bayesian Belief Network (BBN) and Artificial Neural Network (ANN) were proposed. Artificial human mentality was generated using BBN by Kansei approach. Kansei is defined as consumer mentalities which solicit their preferences reasoning. ANN was utilized to incorporate the mentality in the monitoring of production scheme. The implementation of CAPD scheme is demonstrated via a case study of Eco-produce of moss greening (Rhacomitrium canescens). The produce choices were harvested using the specific modules. The research objectives are: 1) to model the artificial human mentality using BBN by Kansei approach; 2) to incorporate the artificial human mentality in CAPD scheme using ANN. The result indicated that BBN attained satisfied accuracy. ANN was able to classify the modules using the mentality and choices. The modules were characterized by textural features and Likert scale's criteria. Both of the models were trained and validated based on benchmarking analysis (For BBN), sensitivity analysis (For ANN), minimum learning error and inspection data. Generally, the proposed CAPD is possibly applied for learning, mental simulation and monitoring in the early phase of customized produce development. Specifically it is applicable for Agro-industrial and Eco-produce design.

Keywords: Information technologies and ergonomics in agriculture, AI in agriculture, Plant factories.

11:50-12:10 MoA15.5

Spatial Information Analysis of Grass-Land Using Information Technology, pp. 653-657

Kang, Tae-Hwan — Hokkaido Univ.
Hayami, Atsuro — Hokkaido Univ.
Kaizu, Yutaka — Hokkaido Univ.
Noguchi, Noboru — Hokkaido Univ.

The objective of this research is to develop grass-land reclamation criteria using an information technology. To develop the grass-land reclamation criteria, the terrain of grass-land was resolved into the spatial frequency by discrete Fourier transform (DFT) using the digital elevation model (DEM). The DEM was generated by the measurements before and after the grass-land reclamation. Then, the geographical features and the spatial frequency information in the same field were compared. To make a GIS map based on terrain information, absolute location of the grass-land surface is essential. To measure the elevation efficiently, a tractor-based survey system was developed. A farm tractor equipped with a real-time kinematical global positioning system (RTK-GPS) and an inertial measurement unit (IMU) was used. As a result, the spatial frequency which shows a large change was in the range of 0.02^;0.05[1/m]. Moreover, smooth geographical features of grass-land was obtained by deleting the spatial frequency of 0.02^;0.05[1/m] from the actual geographical features before the grass-land reclamation.

12:10-12:30 MoA15.6

Oestrus Detection in Dairy Cows Using Likelihood Ratio Tests, pp. 658-663

Jónsson, Ragnar Ingi — Tech. Univ. of Denmark
Björgvinsson, Trausti — Tech. Univ. of Denmark
Blanke, Mogens — Tech. Univ. of Denmark
Poulsen, Niels K. — The Tech. Univ. of Denmark
Hřjsgaard, Sřren — Aarhus Univ.
Munksgaard, Lene — Univ. of Aarhus

This paper addresses detection of oestrus in dairy cows using methods from statistical change detection. The activity of the cows was measured by a necklace attached sensor. Statistical properties of the activity measure were investigated. Using data sets from 17 cows, diurnal activity variations were identified for the ensemble and for the individual cows. A diurnal filter was adapted to remove the daily variation of the individual. Change detection algorithms were designed for the actual probability densities, which were Rayleigh distributed with individual parameters for each cow. A generalized likelihood ratio algorithm was derived for the compensated activity signal and detection algorithm was tested on 2323 days of activity, which contained 42 oestruses on 12 cows in total. The application of statistical change detection methods is a new approach for detecting oestrus in dairy cows and the results are shown to outperform earlier approaches in respect to combined statistics of false alarms and missed detections.

MoA16 — 316
Economic and Management Systems I (Regular Session)
Chair: Iggidr, Abderrahman — INRIA & Univ. of Metz
Co-Chair: Miyamoto, Toshiyuki — Osaka Univ.

10:30-10:50 — MoA16.1
An Energy Distribution Decision Method in Distributed Energy Management Systems with Several Agents, pp. 664-669
Sugimoto, Yohei — Osaka Univ.
Miyamoto, Toshiyuki — Osaka Univ.
Kumagai, Sadatoshi — Osaka Univ.
Mori, Kazuyuki — Mitsubishi Electric Corp.
Kitamura, Shoichi — Mitsubishi Electric Corp.
Yamamoto, Takaya — Mitsubishi Electric Corp.

The need to control CO2 emissions, which are the main factor of global warming, is one of the most important problems in the 21st century. Therefore, the efficient supply and use of energy are indispensable. We have studied distributed energy management systems (DEMSs), in which we target to optimal plans that minimize costs through electrical and thermal energy trading under CO2 emissions regulation. Previously, a trading method in which the Market Oriented Programming (MOP) is applied to DEMSs was proposed. However, this trading method can be used in the DEMSs consisted of a single consumer and several producers. In this paper, extending this method, we propose a trading method that can be used in DEMSs which consist of several consumers and several producers. Experimental results show that the method is effective in the DEMSs with several consumers and several producers.

10:50-11:10 — MoA16.2
Hierarchical Nash-Cournot Q-Learning in Electricity Markets, pp. 670-675
Sahraei Ardakani, Mostafa — CIPCE, School of Ec. Coll. of Engineering, Univ. of Tehr
Rahimi-Kian, Ashkan — Univ. of Tehran
Nili Ahmadabadi, Majid — Tehran Univ.

The problem of designing supplier bidding-agents for electricity markets using reinforcement learning (RL) algorithm is studied. The agents try to discover the Nash-Cournot equilibrium among their continuous domain of bidding by means of hierarchical learning in just a small subset of their bidding area. These agents have no information about the system demand, market clearing mechanism, transmission network constraints, and their rivals' cost functions. Each agent only observes the benefits of all the players in each market period. Using the observed profits, a hierarchical algorithm for finding the Nash-Cournot equilibrium is developed. Several simulation studies are presented to show how learning influences the bidding strategies of suppliers in an electricity market.

11:10-11:30 — MoA16.3
A Nonlinear Observer for a Fishery Model, pp. 676-681
Guiro, Aboudramane — Univ. of Ouagadougou
Iggidr, Abderrahman — INRIA & Univ. of Metz
Ngom, Diene — Univ. Gaston Berger
Toure, Hamidou — Univ. of Ouagadougou

The aim of this paper is to apply some tools of observability theory to an age-structured model of a harvested fish population in order to estimate the stock state. We construct an observer that uses the data of caught fish and gives a dynamical estimation of the number of fish by stage.

11:30-11:50 — MoA16.4
Investigation into the Use of Autoencoder Neural Networks, Principal Component Analysis and Support Vector Regression in Estimating Missing HIV Data, pp. 682-689
Marivate, Vukosi Ntsakisi — Univ. of the Witwatersrand
Nelwamondo, Fulufhelo Vincent — Univ. of the Witwatersrand
Marwala, Tshilidzi — The Univ. of the Witwatersrand

Data collection often results in records that have missing values or variables. This investigation compares 3 different data imputation models and identifies their merits by using accuracy measures. Autoencoder Neural Networks, Principal component analysis and Support Vector regression are used for prediction and combined with a genetic algorithm to then impute missing variables. The use of PCA improves the overall performance of the autoencoder network while the use of support vector regression shows promising potential for future investigation. Accuracies of up to 97.4 % on imputation of some of the variables were achieved.

11:50-12:10 — MoA16.5
Modelling of Business System Development on the Bases of Petri Nets and Graphs of Increments, pp. 690-694
Yuditskiy, Semen — Inst. of Control Sciences RAS
Zheltova, Ludmila — Case Western Res. Univ.
Muradyan, Igor — Inst. of Control Sciences

We suggest a formal dynamic model designed to represent the processes of business system development. The model consists of three working units: the objectives unit, the evaluation unit, and the operations unit. The theoretical bases of the suggested triad model are Petri nets. In this paper, we articulate the functioning of the triad model, as well as the conditions that allow us to establish a balance in the transition process. We have developed an algorithm of preliminary analysis for a system's performance based on the triad model.

12:10-12:30 — MoA16.6
Some Models of Dynamic Cognitive Maps with Qualitative Scales of Factors Values, pp. 695-699
Markovskii, Alexei — Trapeznikov Inst. of Control Sciences, Russian Acad.

Some models of dynamic cognitive maps with linearly ordered qualitative scales of factors values are considered. Notions of vague values and increments in such scales and operations with them are defined. Main effects of behaviour in these models are described. Sources and forms of decrease of certainty of data in these models, the means of monitoring of this phenomenon, limits of the modelling process reliability are defined.

MoA17 — 320A
Steel Making (Highlight Session)
Chair: Asano, Kazuya — JFE R&D Corp.
Co-Chair: Lee, Dukman — POSCO

10:30-10:50 — MoA17.1
Control Issues in Continuous Casting of Steel (I), pp. 700-705
Furtmueller, Christian — Johannes Kepler Univ. Linz
Del Re, Luigi — Johannes Kepler Univ.

Continuous casting plants are highly complex plants whose performance requires reliable mold level control system. Several effects greatly influence the surface quality of the final product and if these are not suppressed sufficiently by the mold level control system, than the production speed, hence the productivity has to be lowered. This paper analyses the most important disturbance and their effects on the control system design, and presents a new solution for the most critical case, mold level hunting.

10:50-11:10 — MoA17.2
Study on Mold Level Stabilization Techniques in Continuous Casting Machine (I), pp. 706-707
Lee, Dukman — POSCO
Kim, GooHwa — POSCO
Park, Haedoo — POSCO

: In this paper, major factors for mold level variations are analyzed in detail by using the logged data according to the data characteristics(periodic and a periodic), and the cause and the counteraction of each factor are discussed. In order to minimize these disturbances, new controllers with the advanced control logics are introduced in real caster in POSCO. The effects and limitation of these trials are also addressed

11:10-11:30 MoA17.3

Rapid Oxide Inclusion Determination Method for Steel (I), pp. 708-709

Shin, Yong_Tae — Tech. Res. Lab. POSCO

In order to inspect the quality of engine valve spring steel, a new algorithm for rapid determination of inclusion characteristics is studied. Principal factor that decides high-grade steel quality depends on size distribution of oxide inclusion or total oxygen in steel. Element composition and size distribution of inclusion can't be determined by the current method of oxide inclusion determination at the same time. A new technology for inclusion determination should be developed since the analyzing time of inclusion in engine valve spring steel takes a long time. In this paper, the determination of alumina inclusion size distribution, inclusion composition, and steel cleanness for the engine valve spring steel are studied by the PDA(pulse discrimination analysis)_OES method.

11:30-11:50 MoA17.4

A Novel Flow Rate Estimation Method Using Extended Kalman Filter and Sensor Dynamics Compensation with Automatic Casting Pouring Process (I), pp. 710-715

Noda, Yoshiyuki — Toyohashi Univ. of Tech.
Matsuo, Yusuke — Toyohashi Univ. of Tech.
Terashima, Kazuhiko — Toyohashi Univ. of Tech.
Zheng, Yufan — Univ. of Melbourne

We describe here a method for estimating the pouring flow rate for tilting-ladle-type automatic pouring systems used in casting industries. To precisely pour molten metal into the mold, controlling the flow rate of liquid flowing out of the ladle is mandatory. However, it is difficult to directly measure the pouring flow rate by using a conventional flow meter, because the flow meter is damaged by the molten metal. Therefore, in this study, we used a soft sensing technique as part of the pouring flow rate estimation system. For estimation of the flow rate, the weight of liquid in the ladle and the tilting angle of the ladle are measured by a load cell and an encoder, respectively. Then, the flow rate is estimated by using an extended Kalman filter and sensor dynamics of the load cell, since in this study, the flow rate model was built as a nonlinear model. The advantage of the proposed system is that the flow rate can be precisely estimated by the load cell and the encoder. The system is easy to construct, and the load cell is not damaged easily, because it does not come in direct contact with the molten metal. The effectiveness of the proposed flow rate estimation method is demonstrated through experiments.

11:50-12:10 MoA17.5

Modeling of Critical Carbon Content in Decarburization in BOF and Its Application to Dynamic Control Model (I), pp. 716-717

Iwamura, Ken — Sumitomo Metal IndustriesLtd.
Sakai, Kouichi — Sumitomo Metal IndustriesLtd
Kikuchi, Jun — Sumitomo Metal IndustriesLtd.
Kitada, Hiroshi — Sumitomo Metal Ind., Ltd.

We developed the critical carbon content estimation model using the sequential quadratic programming method (SQP method) so that the standard critical carbon content obtained from the conventional knowledge matches the calculated critical carbon content in satisfying the balance equation of oxygen. We made use of the calculated critical carbon content in the estimation of carbon content at the end point. The accuracy of carbon content was improved compared to the dynamic control model which used the fixed critical carbon content.

12:10-12:30 MoA17.6

Advanced Process Manipulation of Magnesia Sintering, pp. 718-723

Kostial, Imrich — Tech. Univ. of Kosice
Mikula, Jan — Tech. Univ. of Kosice
Spisak, Jan — Tech. Univ. of Kosice
Glocek, Jan — Tech. Univ. of Kosice
Nemcovsky, Pavol — Tech. Univ. of Kosice
Terpak, Jan — Tech. Univ. of Kosice

Manipulation process is connecting of our macroscopic world to the microscopic or nanoscopic one. Manipulation can occur in a variety of ways. Outside manipulation take control over the process by external forces. Inside process manipulation is becoming a part of the process. This process manipulation is called as advanced process manipulation (APM). Possibility of process manipulation may substantially enhance the process effectiveness. In this paper methods of advanced process manipulation are presented. An incremental manipulation process will be defined as a sequence of basic operations. Process manipulation generally requires custom-built system capable of performing of manipulation procedures. The progress in manipulation techniques can extend the application of the manipulated system. We have developed a simulation based system which was successfully implemented for designing of APM systems and control process in ways that are not conventionally possible. The developed system was applied on magnesia sintering process in shaft and rotary furnaces

MoA18 320B

Ubiquitous Robotic Companion (Highlight Session)

Chair: You, Bum-Jae — Korea Inst. of Science and Tech. (KIST)
Co-Chair: Yu, Wonpil — ETRI
Organizer: You, Bum-Jae — Korea Inst. of Science and Tech. (KIST)

10:30-10:50 MoA18.1

Network-Based Humanoids 'MAHRU' As Ubiquitous Robotic Companion (I), pp. 724-729

You, Bum-Jae — Korea Inst. of Science and Tech. (KIST)
Kim, ChangHwan — Korea Inst. of Science and Tech.
Oh, Yonghwan — Korea Inst. of Science & Tech. Korea
Jeong, Mun-Ho — Korea Inst. of Science and Tech.
Kim, Doik — Korea Inst. of Science and Tech. (KIST)
Oh, Sang-Rok — Korea Inst. of Science and Tech.

The paper proposes 'Network-based Humanoid', that is, a humanoid endowed with its perception capability and intelligence by an external computer system connected with wireless network. The network-based humanoid is composed of humanoid test-bed, an internal control system and an external computer system. The internal distributed control system is composed of two parts. One is responsible for motion control of the humanoid following commands from the external computer system while the motion control is done by a CAN-based distributed motor controller. The other is for real-time data transmission of image data, voice data, and sensor data for motion control by wireless network to the external computer system. The external computer system, a network-based distributed control system, processes the transmitted data, decides the final action command for the humanoid, and transmits the action command to the internal control system. A network-based humanoid, whose name is 'MAHRU', is developed successfully. Its whole DOF is 35 while its height and weight are 150 cm and 67 Kg, respectively. The robot is equipped with sensors including a stereo camera system, a microphone, force/torque sensors, a three-dimensional pose sensor. The humanoid can walk using two legs with the maximum speed of 0.9 Km/h. Especially, it is noted that the humanoid can recognize faces, gestures of human beings in real-time, three-dimensional objects, and 100 voice words with the help of the external computer system connected through wireless network. And, the humanoid interacts with human beings via a stereo camera, a microphone, and force/torque sensors.

10:50-11:10 MoA18.2

Imitation Learning of Robot Movement Using Evolutionary Algorithm (I), pp. 730-735

Park, Galam — 1) korea Univ. seoul 2) Korea Inst. ofScienceandTechno
Ra, Syungkwon — Korea Inst. of Science and Tech.
Kim, ChangHwan — Korea Inst. of Science and Tech.
Song, Jae-Bok — Korea Univ.

This paper presents a new framework to generate human-like movement of a humanoid robot in real time using the movement primitive database of a human. The framework consists of two processes: (1) the offline motion imitation learning based on Evolutionary Algorithm and (2) the movement generation of a humanoid robot using the database updated by the motion imitation learning. For the offline process, the initial database contains the kinetic characteristics of a human, since it is full of human's captured motions. The database then develops through the proposed framework of motion learning based on Evolutionary Algorithm, having characteristics of a humanoid in aspect of minimal torque. The humanoid generates a human-like movement corresponding to a given task in real-time by linearly interpolating the primitive movements in the developed database. The proposed framework is a systematic methodology for a humanoid robot to learn human motions, considering the dynamics of the robot. The experiment of catching a ball thrown by a man is performed to show the feasibility of the proposed framework.

11:10-11:30 MoA18.3

An Online Optimal Path Decoder for HMM towards Connected Hand Gesture Recognition (I), pp. 736-741

Mazumdar, Monalisa	Korea Inst. of Science and Tech.
Jeong, Mun-Ho	Korea Inst. of Science and Tech.
You, Bum-Jae	Korea Inst. of Science and Tech. (KIST)

In this paper, we model the recognition problem for hand gesture as that of finding an optimal path through a Hidden Markov Model (HMM) state graph. To determine this optimal path, we present a novel online method which decodes the observed gesture pattern and evaluates the optimal graph node at each time frame of the continuously deepening HMM state graph. The temporal signature is subsequently handled by introducing a rejection threshold which acts as a depth-wise sliding window for pruning the unnecessary graph nodes. The functional depth of the graph is defined by this depth rejection threshold. Experimental comparison of our algorithm with other HMM-based search algorithms demonstrates the effectiveness and robustness of our method.

11:30-11:50 MoA18.4

Localization Algorithm for a Mobile Robot Using Igs (I), pp. 742-747

Seo, DaeGeun	Pusan National Univ.
Lee, JangMyung	Pusan National Univ.

As an absolute positioning system, iGS is designed based on ultrasonic signals whose speed can be formulated clearly in terms of time and room temperature, which is utilized for mobile robot localization. The iGS is composed of an RFID receiver and an ultra-sonic transmitter, where an RFID is designated to synchronize the transmitter and receiver of the ultrasonic signal. The traveling time of the ultrasonic signal has been used to calculate the distance between the iGS system and a beacon which is located at a pre-specified location. This paper suggests an effective operation method of iGS to estimate position of the mobile robot working in an unstructured environment. To expand recognition range and to improve accuracy of the system, two strategies are proposed: auto-calibration of beacons belonging to neighboring blocks and removal of the environment-reflected ultrasonic signals. As the results, the ubiquitous localization system based on the iGS as a pseudo-satellite system has been developed successfully with a low cost, a high update rate, and relatively high precision.

11:50-12:10 MoA18.5

Development of Industrial Autonomous Mobile Robot for Part Handling in Machine Tool Industry (I), pp. 748-749

Won, Jong Beom	SMEC Co. LTD
Byun, Kyung Seok	Mokpo National Univ.
Lee, Sung-uk	Korea Atomic Energy Res. Inst.
Choi, Jong Kap	SMEC Co. LTD

The purpose of this paper is to introduce an autonomous robot for part handling in machine tool industry. It is developed for practical industrial application. Based on task analysis of part handling application, specifications and features of the robot are determined. Major features of the robot are omni-directional platform and dual arms. Omni-directional platform has three omni-wheels and arms are parallel and antagonist mechanism. These features are explained in detail.

MoA19 320C

Robotic Mechanism I (Regular Session)

Chair: Marchand, Nicolas	GIPSA-Lab. CNRS
Co-Chair: Hoshi, Yoshikatsu	Musashi Inst. of Tech.

10:30-10:50 MoA19.1

Motion Control of a Three-Dimensional Eel-Like Robot without Pectoral Fins, pp. 750-755

El Rafei, Maher	GIPSA-Lab.
Alamir, Mazen	Gipsa-Lab. (CNRS-Univ. of Grenoble)
Marchand, Nicolas	GIPSA-Lab. CNRS
Porez, Mathieu	IRCCyN
Boyer, Frederic	Ec. des Mines de Nantes

In this paper, recent advances in the design of feedback laws for the 3D movement of an Eel-like robot are presented. Such a robot is under construction in the context of a national French robotic project. The proposed feedback enables the tracking of a desired 3D position of the Eel head as well as the stabilization of the rolling angle without using pectoral fins. We build on a previous work in which we proposed a complete control scheme for robot's 3D movement using its pectoral fins. The controller is tested on a recently developed complete 3D model in order to assess its efficiency in tackling 3D manoeuvres.

10:50-11:10 MoA19.2

Analysis and Control of a Capsubot, pp. 756-761

Liu, Yang	Staffordshire Univ.
Yu, Hongnian	Staffordshire Univ.
Yang, T. C.	Univ. of Sussex

In this paper, a special underactuated system – a capsule robot, also called capsubot, is studied to investigate the tracking control issue of underactuated dynamic systems. A seven-step motion strategy of the capsubot is proposed. A trajectory profile is designed based on the proposed motion strategy. By using this profile, the capsubot can move effectively in a desired direction. Three control approaches are investigated: an open-loop control approach, a closed-loop control approach using partial feedback linearization technique, and a simple switch control approach. Extensive simulation studies are conducted to demonstrate the proposed approaches.

11:10-11:30 MoA19.3

A Marsupial Robotic Fish System, pp. 762-766

Zhou, Chao	Inst. of Automation,Chinese Acad. of Sciences
Cao, Zhiqiang	Inst. of Automation,Chinese Acad. of Sciences
Wang, Shuo	Chinese Acad. of Sciences
Tan, Min	Inst. of Automation, Chinese Acad. of Sciences

A marsupial robotic fish system including a mother robotic fish and a daughter robotic fish is proposed. The mother robotic fish, with strong ability of movement, can transport the daughter robotic fish in its cabin. The structures of these two robotic fish are presented and fish-like motions are introduced. A dynamic light source tracking method of the daughter robotic fish is given to follow the mother, and a heterogeneous communication-based finite state machine is presented for the cooperative task modeling. Experiments are carried out to verify the system.

11:30-11:50 MoA19.4

Analysis of Coupled Van Der Pol Oscillators and Implementation to a Myriapod Robot, pp. 767-772

Kuwata, Naoki	Musashi Inst. of Tech.
Hoshi, Yoshikatsu	Musashi Inst. of Tech.
Nohara, Ben T.	Musashi Inst. of Tech.

According to the study of nervous system ethology, it is thought that a walk movement of an animal is controlled by Central Pattern Generator (CPG). There are a lot of studies to try the control of the leg type robot based on CPG principle. However, most of the studies consider two or four leg type robots, and there are not many studies performed for robots more than six legs. One of its factor is probably difficulty of constituting stable and periodic CPG in the case of many number of the legs. Therefore, this paper proposes the novel CPG model which is based on coupled van del Pol oscillators. And this paper reports the analysis of proposed coupled van del Pol oscillators model and the implementation result to an actual myriapod robot.

11:50-12:10 MoA19.5

The Artificial Muscle As an Innovative Actuator in Rehabilitation Robotics, pp. 773-778

Knestel, Markus	Univ. of Ulm

This paper presents the application of artificial pneumatic muscle actuators in a novel motorized orthosis for an intensive home-based gait training in patients with neurological disorders. Owing to the inherent elasticity of these actuators, they are an ideal choice in realizing a soft and tractable assistance to aid the physiological movements of the lower extremities. Special focus is paid to the modeling of the dynamic nonlinear force characteristics of the muscles as a steerable mass-damper system, and to the approximation of the variation of muscle volume under different operating conditions. The model description uses polynomial functions for which coefficients are identified by minimizing a quadratic performance index. Based on the mechanical model of the knee joint of the apparatus, a nonlinear stability-oriented backstepping control supported by observer-based disturbance compensation is derived and applied to the prototype of the rehabilitation robot.

12:10-12:30 MoA19.6

An Aerostat Positioning System with Cable Control, pp. 779-784

Lambert, Casey — Tokyo Univ.
Nahon, Meyer — McGill Univ.

The capabilities of a tri-tethered aerostat positioning system are investigated using simulations of a comprehensively validated dynamics model. The physical system studied consists of a payload supported by a helium filled aerostat and attached to three anchored ground tethers actuated using winches. Closed-loop control is achieved by feeding back the position of a payload located at the confluence point of the tethers. The dynamics model of the system is used to simulate the behavior of the closed-loop system. In a comparison of PID and optimal LQG control, a 50% improvement is achieved with the LQG controller. Both the LQG and PID feedback controllers were shown to benefit considerably from the addition of a feedforward control term that exploits measurements of the system's main disturbance force.

MoA20 321C

Flying Robot I (Regular Session)

Chair: Sasiadek, Jurek Z — Carleton Univ.
Co-Chair: Kendoul, Farid — Univ. of Tech. of Compičgne

10:30-10:50 MoA20.1

Yaw Control of RUAVs _; an Adaptive Robust H_; Control Method, pp. 785-790

Zhao, Xingang — Shenyang Inst. of Automation,CAS
Han, Jianda — Shenyang Inst. of Automation

The problem of robust H_; tracking control is considered for a class of linear system with time-varying uncertainties. The bounds of varying uncertainty ellipsoidal are obtained by set membership identification method. Using adaptive method, a new variable gain controller is designed to compensate the effect of uncertainty on systems. Then an application of this result to rotorcraft-based unmanned Aerial Vehicles (RUAVs) mounted on an experiment platform has demonstrated the effectiveness of the proposed method.

10:50-11:10 MoA20.2

Nonlinear Control for UAV Formation Flying, pp. 791-796

Sasiadek, Jurek Z — Carleton Univ.
Necsulescu, Dan Sorin — Univ. of Ottawa

Unmanned Aerial Vehicles (UAVs) became a technology that have attracted considerable interest in the commercial markets for the military and civilian uses, such as surveillance and reconnaissance, aerial surveys for natural sources, traffic monitoring, early forest fire detection etc. This paper deals with Nonlinear and Model Predictive Control (MPC) of Unmanned Aerial Vehicles (UAV) flying in formation. Although UAVs present numerous advantages over the manned aircrafts, they face challenges in various aspects of control in autonomous mode, and even more, in formation flying. An advanced control system is demonstrated as a possible solution to improve and increase the level of the autonomous mode and flying capabilities of UAVs. This paper deals with advanced control system of Unmanned Aerial Vehicles (UAV) flying in formation.

11:10-11:30 MoA20.3

Adaptive Vision-Based Controller for Small Rotorcraft UAVs Control and Guidance, pp. 797-802

Kendoul, Farid — Univ. of Tech. of Compičgne
Fantoni, Isabelle — Univ. de Tech. de Compiegne
Lozano, Rogelio — Univ. de Tech. de Compiegne

The design of a reliable control and guidance system for aerial vehicles based only on visual information and Inertial Measurement Unit (IMU) data possesses many unsolved challenging problems, ranging from hardware and software development to pure controltheoretical issues. Theses issues have been addressed by proposing a bio-inspired adaptive autopilot for self-localization, obstacles detection and control of small autonomous rotorcraft using optic flow and IMU measurements. This paper focuses particulary on the design of a hierarchical adaptive control system. Adaptive control tools have been used to recover the absolute aircraft velocities and real distances to obstacles. These estimates are then exploited by a multipurpose hierarchical controller for achieving various navigational tasks such as takeoff, hovering, trajectory tracking and vertical landing. Furthermore, the asymptotic stability of the entire closed-loop system has been established using connected systems control theories. Simulation results over various ranges of the flight envelope illustrate that the proposed autopilot performs very well and allows a simulated rotorcraft UAV to achieve interesting flight behaviours.

11:30-11:50 MoA20.4

Autonomous Hovering of a Noncyclic Tiltrotor UAV: Modeling, Control and Implementation, pp. 803-808

Sanchez, Anand — Univ. de Tech. de Compiegne
Escareńo-Castro, Juan — Univ. of Compiegne
Garcia-Salazar, Octavio — Univ. de Tech. de Compičgne
Lozano, Rogelio — Univ. de Tech. de Compiegne

The aim of this paper is to present a mini tilt-rotor unmanned aerial vehicle which is capable to perform hover flight. Unlike conventional full-scale tiltrotors, in our design we avoid the use of swashplate and we propose a simpler mechanical design which use only the tilting rotors to stabilize the vehicle dynamics. A detailed mathematical model is derived via the Newton Euler formalism. A nonlinear control scheme, incorporating bounded smooth function, is obtained from the decoupled dynamics and applied to real prototype for controlling hover flight.

11:50-12:10 MoA20.5

Tail-Sitter UAV Having One Tilting Rotor: Modeling, Control and Real-Time Experiments, pp. 809-814

Garcia-Salazar, Octavio — Univ. de Tech. de Compičgne
Sanchez, Anand — Univ. de Tech. de Compiegne
Escareńo-Castro, Juan — Univ. of Compiegne
Lozano, Rogelio — Univ. de Tech. de Compiegne

In this paper we address the development of a single-rotor tail-sitter Unmanned Aerial Vehicle (UAV), whose configuration provides structural benefits for flight stabilization. The mathematical model of the vertical take-off landing (VTOL) aircraft is obtained through the Newton-Euler approach. In order to stabilize the vehicle we employ a control algorithm based on separated saturation functions. To perform an on board control, we have designed and manufactured a customized embedded system. The simulation and experimental results show the good performance of the aircraft in autonomous hover flight, even in the presence of external perturbations.

12:10-12:30 MoA20.6

Dynamic-Fuzzy-Neural-Networks-Based Control of an Unmanned Aerial Vehicle, pp. 815-820

Tang, Zhe — Nanyang Tech. Univ.
Er, Meng Joo — NTU
Zhou, Yi — Singapore Pol.

In this paper, hierarchical control of an UAV (unmanned aerial vehicle) is proposed. The proposed controller is made up of two sub-systems, namely inner-loop controller and outer-loop controller. The inner-loop controller is an attitude control system while the outer-loop control system is a trajectory control system. In the proposed architecture, a DFNN-(dynamic-fuzzy-neural-network-) based reference model controller is deployed. Hover motion has been implemented to demonstrate the effectiveness of the proposed controller. Both the PD controller and BP (back propagation) NN-based controller have been developed for the control of an UAV. The input of the DFNN is the position of an UAV while the output is the desired force to control the UAV. Simulation results show that the DFNN has faster convergence speed than the PD and the BPNN. Furthermore, the DFNN is able to produce the desired force to achieve hover motion at any positions in a given area.

MoA21 321B

Servo Control for Storage Systems and Precision Devices I (Invited Session)

Chair: Yamaguchi, Takashi — Hitachi Global Storage Tech.
Co-Chair: Messner, William — Carnegie Mellon Univ.
Organizer: Yamaguchi, Takashi — Hitachi Global Storage Tech.

10:30-11:10 MoA21.1

HDD Servo Control Technologies - What We Have Done and Where We Should Go - (I), pp. 821-826

Yamaguchi, Takashi — Hitachi Global Storage Tech.
Atsumi, Takenori — Hitachi, Ltd.

Since 1986 when digital servo was introduced in mass production HDDs, various kinds of control theories have been applied to HDD servo system, and the performances had improved dramatically. A 3.5-inch HDD capacity, which was 251 MB in 1988, has 1,000,000 MB (1 TB) capacity in 2007. The Fast access (high quality motion control), very precise positioning (nanometer scale), and robustness against environment changes, various kinds of disturbances, and plant dynamics fluctuations, have been required in HDD servo system to achieve the capacity increase. In this paper, some of key topics of recent HDD servo research are described and an integrated servo mechanical design based on detail understanding of plant dynamics and disturbance is described in detail as one of recent outstanding activities to improve positioning accuracy.

11:10-11:30 MoA21.2

Disturbance Suppression Beyond Nyquist Frequency in Hard Disk Drives (I), pp. 827-832

Atsumi, Takenori — Hitachi, Ltd.

In conventional hard disk drives, a control system compensates for vibration in which the frequency is higher than the Nyquist frequency by using a multi-rate filter that decreases the gain above the Nyquist frequency. However, such a control system can only avoid instability and cannot suppress disturbances above the Nyquist frequency. In response to this problem, a control system design method that suppresses disturbances beyond the Nyquist frequency is proposed. This method uses frequency responses of a controlled object and a digital controller to calculate the gain of the sensitivity function in a sampled-data system without requiring complex calculations involving matrices, and realizes a stable resonant filter that decreases the gain of the sensitivity function above the Nyquist frequency. When the method was applied to the head-positioning system of a hard disk drive, the experimental results showed that the control system suppressed disturbances above the Nyquist frequency.

11:30-11:50 MoA21.3

A μ-Synthesis Approach to Guaranteed Cost Control of Track-Following Servos (I), pp. 833-838

Conway, Richard — Univ. of California, Berkeley
Horowitz, Roberto — Univ. of California at Berkeley

This paper presents a new control synthesis approach for dual-stage track-following servo systems with multi-rate sensing and actuation. For these systems, the robust track-following problem can be formulated as a periodic time-varying guaranteed cost control problem. To reduce the conservatism of the guaranteed cost control framework, uncertainty scalings such as those used in the D-K iteration heuristic for μ-synthesis are introduced. Although this results in a non-convex optimization problem, it is shown that it lends itself to a methodology similar to D-K iteration. Using this methodology, a controller is designed for a set of hard disk drives which minimizes the worst-case l2 semi-norm performance of the system.

11:50-12:10 MoA21.4

An Iterative Learning Control Design for Self-Servowriting in Hard Disk Drives (I), pp. 839-844

Wu, Shang-Chen — Univ. of California at Berkeley
Tomizuka, Masayoshi — Univ. of California, Berkeley

This paper considers the modeling and compensator design for Self-ServoWriting (SSW) in disk drives. An Iterative Learning Control (ILC) based scheme is established to deal with radial error propagation and improve the quality of written tracks. In the proposed scheme, a feedback controller for track following is first designed to achieve good disturbance attenuation. Then, an ILC structure is applied to generate an external signal, which is injected into the feedback loop in order to compensate for the written-in errors in the previous track while the next track is written. As a result, the error propagation can be contained. The learning controller is synthesized by solving Linear Matrix Inequality (LMI) equations to ensure the stability and monotonic convergence of the control algorithm. Simulation results show the effectiveness of the proposed schemes on the error containment which results in good quality written tracks.

12:10-12:30 MoA21.5

Position Error Signal Based Control Designs for Control of Self-Servo Track Writer (I), pp. 845-850

Oh, Sehoon — the Univ. of Tokyo
Hori, Yoichi — Univ. of Tokyo

Among the many problems in the Self-servo Track Writer (SSTW), the error propagation problem is discussed in this paper. To deal with the error propagation problem, we take two approaches: estimation of the absolute head position and reference correction design using the Position Error Signal (PES) in the previous track. To improve the estimation of absolute position of the head with regard to the whole disc, Kalman filter is designed and removes the estimation error caused by the sensor noise in PES. For the reference correction design problem, a transition matrix which can describe the error propagation characteristics of SSTW is derived and utilized for reference correction for the next servowriting. Simulations results verify the effectiveness of two suggestions.

MoA22 321A

Design and Control of Mechatronic Machines (Regular Session)

Chair: Singhose, William E. — Georgia Inst. of Tech.
Co-Chair: Lee, Ju-Il — Seagate Res.

10:30-10:50 MoA22.1

Educational Strategy Based on Active Learning for Mechatronics Labs, pp. 851-856

Ramirez-Cadena, Miguel — Monterrey Inst. of Tech. (ITESM)
Vargas-Rodrigez, Rodrigo — Tecnológico de Monterrey
Morales-Menendez, Ruben — Tecnologico de Monterrey, Campus Monterrey
Guedea, Federico — Univ. of Waterloo, ITESM

This paper presents an educational strategy for Mechatronics laboratories education which integrates the ITESM Educational Model, industrial technologies and equipment, hands-on activities, laboratory equipment based on Design for Mechatronics Learning (DFML) and an e-Learning platform to improve communication between teachers and students. An Automation of Manufacturing System Laboratory course is described where an industrial Flexible Manufacturing Cells (FMC) is used by the students. This industrial FMC was designed based on academic goals for mechatronics engineering students. Students have an intensive active participation in the experimental sessions. Students can integrate new sensors and actuators with industrial equipments such as Robot, CNC, ASRS, and so on. This feature allows students many independents layout combinations that are typical in industrial environments. The proposed educational strategy, based on industrial equipment designed to mechatronics practice, let to students how to deal with situations that may arise by multidisciplinary working teams to face conflictive problems in industrial environments. A final poll was applied to the student to assess the performance of use industrial equipment with design for mechatronics learning principles join with didactic learning techniques in an engineering course. The poll results let to come to a conclusion of this proposal improve the learning of engineering practice.

10:50-11:10 MoA22.2

Design and Control of an Electromagnetically Actuated Punch, pp. 857-862

Dagen, Matthias — Leibniz Univ. Hannover
Heimann, Bodo — Univ. of Hannover
Javadi, Mohsen — Univ. of Hannover
Behrens, Bernd-Arno — Inst. of Metal Forming and Metal-Forming Machines

In this paper a new electromechanically actuated punch (EAP) is presented. This punch can apply forces up to 10kN and has a stroke up to 4mm. Due to the high dynamics drive-concept, the ram's kinematics is changeable during the punch process and backlashes are non-existent. Therefore, the punch is especially qualified for manufacturing micro-components demanding high accuracy and high stroke rates. A control concept is introduced, which can handle constraints and windup effects. Finally, experimental results are given.

11:10-11:30 MoA22.3

A Mechatronic System Architecture for the Development of Flexible Materials Handling Systems, pp. 863-868

Walker, Anthony John — Univ. of KwaZulu-Natal
Bright, Glen — Univ. of KwaZulu Natal

Mass production of customised products requires materials handling architectures to be flexible enough to accommodate varying geometries, masses and volumes of materials. Multi-agent control and coordination structures are under development to provide flexible and scalable transportation systems. In this paper the concept of Mechatronics has been used to develop a Flexible Materials Handling architecture to aid the development of mass customisation during product manufacture. Materials handling was provided by the cooperation of multiple differential drive platforms fitted with servo operated and articulated conveyors.

11:30-11:50 MoA22.4

A New Control Strategy for Trajectory Tracking of Fire-Rescue Turntable Ladders, pp. 869-874

Zimmert, Nico — Univ. of Stuttgart
Kharitonov, Alexander — Univ. of Stuttgart
Sawodny, Oliver — Univ. of Stuttgart

Modern fire-rescue turntable ladders are constructed in a lightweight mode to increase their maximum operation velocities, maximum length, and outreach respectively. Hence, the ladder has a limited stiffness and will be more and more subject to oscillations of deflection along with dominant overtones. This paper deals with the active oscillation damping of such ladders. A new feedforward and feedback control strategy is applied. The feedforward control is calculated through system inversion of a multi-body system utilizing its differentially flatness. The design of the feedback is based on partial differential equations (PDE) describing a Euler-Bernoulli model of a beam with a concentrated point mass at the end. The modal representation of the system is constructed based on the analytical form of the eigenfunctions. For active oscillation damping by feedback without a dynamical observer the ladder was equipped with a gyroscope additionally to strain gauges. Due to computational efforts and measurement noise a reduced state vector is disposed for stabilization. The proposed control approach allows damping the fundamental oscillation as well as the first dominant overtone and asymptotically stabilizing the system around the reference trajectory. Measurement results from the IVECO DLK 55 CS fire-rescue turntable ladder validate the good performance of the control.

11:50-12:10 MoA22.5

Passivity Based Control and Time Optimal Trajectory Planning of a Single Mast Stacker Crane, pp. 875-880

Staudecker, Martin — Johannes Kepler Univ. Linz
Schlacher, Kurt — Johannes Kepler Univ. of Linz
Hansl, Rudolf — TGW Transportgeraete GmbH

This paper is concerned with feedforward control and active rejection of vibrations of a single mast stacker crane used for the automatic storage or retrieval of load carries in high bay racks. Based on an infinite dimensional mathematical model the trajectory planning and tracking problems are discussed. It turns out that the theory of differential flatness in combination with a finite dimensional approximation of the system is a suitable tool to obtain an open loop control law and to derive time optimal trajectories. The application of backstepping to the infinite dimensional model leads to a passivity based controller for the stabilization of the tracking error. Finally, measurement results show the feasibility of this approach.

12:10-12:30 MoA22.6

A Multi-Operational-Mode Anti-Sway and Positioning Control for an Industrial Bridge Crane, pp. 881-888

Sorensen, Khalid — Georgia Inst. of Tech.
Fisch, Hannes — Zurich Univ. of applied Sciences
Dickerson, Stephen L. — Georgia Inst. of Tech.
Singhose, William E. — Georgia Inst. of Tech.
Glauser, Urs — Zurich Univ. of Applied Sciences

A 30-ton industrial bridge crane located at an aluminum sheet manufacturer has been equipped with a crane manipulation system enabling swing-free motion, disturbance rejection, and precise positioning. Previous investigations of anti-sway, positioning, and crane control have yielded important contributions in these areas. These advancements are combined into the uni_;ed crane manipulation system described here. An overview of this system is presented, along with experimental results, and a description of how human operators use the crane.

MoA23 323

Large Scale and Complex Systems: Applications I (Regular Session)

Chair: Borne, Pierre — Lail
Co-Chair: Dourado, Antonio — Univ. of Coimbra

10:30-10:50 MoA23.1

Transfer Functions for Natural Gas Pipeline Systems, pp. 889-894

Aalto, Hans Rauno Mikael — Neste Jacobs Oy

Natural gas pipeline systems typically have very complex dynamic characteristics. However, extracting “basic” dynamic parameter values, like gains and time constants is sometimes necessary. Looking at the complex dynamical models of pipeline systems, this is not straightforward, and a method providing those linear model parameters is needed. The method described in the paper is based on discretization of a Partial Differential Equation model followed by linearization of the resulting Ordinary Differential Equation model of high order. Balanced truncation is applied on the linearized model, resulting in a radically reduced order linear state space model from which transfer functions and finally the gains and time constants are obtained.

10:50-11:10 MoA23.2

Coordination of Cooperative Search and Rescue Robots for Disaster Relief, pp. 895-900

Lau, Henry — The Univ. of Hong Kong

This paper describes the use of modular robots as the next generation search and rescue robots for humanitarian logistics and developed an immunity-based control framework called General Suppression Control Framework (GSCF) for controlling these robots. The application of GSCF on heterogeneous-distributed robotics systems is studied where the behaviors of the search and rescue agents are mirror images of the immunological cell behaviors when the immune system is under attack. While the goal of these agents are to perform rescue tasks, the motivation behind the study was to show GSCF can work equally well on heterogeneous-distributed systems.

11:10-11:30 MoA23.3

Proposition of Completeness Property to Perform the Plant Modelling for Manufacturing Applications, pp. 901-906

Rohee, Benoit — Univ. de Reims
Carre-Menetrier, Veronique — UFR SCIENCES EXACTES ET NATURELLES DE REIMS - Univ. DE REIM
Riera, Bernard — Reims Univ.

Research dealing with control behavior determination often needs plant modelling to use formal methods. However, plant models are difficult to obtain because a manufacturing application is composed of a huge set of components with numerous interactions each other. The goal of this paper is to propose and demonstrate a property to improve the designer’s confidence in his plant model. The property is used a posteriori from plant model design. The completeness property tests whether a plant model is able to respond to specification solicitations. The application on several examples shows the usefulness of the verification in the context of independence of the plant model according to control behavior. Property can be used before control synthesis application design to determine if a plant model is able to respond to all control changes.

11:30-11:50 MoA23.4

Maintenance Decision Making Tool Reaching a Compromise between Maintainability and Reliability Performances, pp. 907-912

Thomas, Edouard — Univ.
Levrat, Eric — Univ.
Iung, Benoît — Nancy Univ.

An original maintenance decision making tool based on Bruss theorem has previously been investigated by the authors to select the optimal last production stoppage convenient to operate a maintenance action on a component according to its conditions of degradation. This stoppage is optimal with respect to the combination of antagonistic criteria such as maintainability and reliability. The approach is also opportunistic as maintenance is developed during production stoppages already planned. However the optimality with respect to the separate criteria alone has not been taken into account to find this global optimal stoppage. The present work aims at providing, for this tool, a way to eliminate stoppages a priori unacceptable for one criterion, so that this stoppage cannot be proposed as the final global solution. This will be done with the help of a maintenance expert. Case studies are presented and commented. Two criteria have been considered, namely maintainability and reliability. These criteria will also be used for emphasis on the difference between local optimal decisions and a global optimal decision.

11:50-12:10 MoA23.5

Real Time Balancing of Complex Disassembly Lines, pp. 913-918

Duta, Luminita — Valahia State Univ.
Filip, Florin Gheorghe — Romanian Acad.
Caciula, Ion — Valahia State Univ.

The objective of the Disassembly Line Balancing Problem (DLBP) is to use the resources of the disassembly line as efficiently as possible while meeting the demand. This issue is hard to attempt due to the inherent uncertainties that occur during the process. Starting from real industrial examples, this article presents a simple-to-apply method to accomplish the balancing of complex disassembly lines in real time. The basic idea of this method is to use mixed integer quadratic programming and branch and cut algorithm on the disassembly precedence graph. Results of simulations for disassembling two industrial products are presented.

12:10-12:30 MoA23.6

Dealing with Mutual Exclusion Sections in Production Systems: From Shared Resources to Parallel TEG's, pp. 919-924

Boutin, Olivier — École Centrale de Nantes
Cottenceau, Bertrand — Univ. of Angers, FRANCE
L'Anton, Anne — IUT de Nantes

This paper deals with the disambiguation of the behaviour of Petri nets including shared resources. In the production management context, they are often used for the modelling of manufacturing cells. But this representation has a poor transposition into dioid algebra. In this article, we design a method to describe such a phenomenon in a dioid of interval. The latter expresses this class of Petri nets models in a formal way. Their input/output behaviours are guaranteed to be greater than the lower bound of the reference model set and lower than the upper bound of this set. In fact, the resource sharing problem is turned into a time uncertainty problem, concerning the access to the shared resource. In this new problem, time uncertainties are bounded and can be described by intervals. Both bounds “confining” the behaviours of the studied production systems in intervals can be manipulated in the scope of the Z max algebra, even though the original systems are not Z max linear by essence.

MoA24 324

Control and Monitoring of Semiconductor Manufacturing (Invited Session)

Chair: Ho, Weng Khuen — National Univ. of Singapore
Co-Chair: Adomaitis, Raymond — Univ. of Maryland
Organizer: Ho, Weng Khuen — National Univ. of Singapore
Organizer: Qin, S. Joe — Univ. of Southern California

10:30-10:50 MoA24.1

Critical Dimension and Real-Time Temperature Control for Warped Wafers (I), pp. 925-930

Ho, Weng Khuen — National Univ. of Singapore
Tay, Arthur — National Univ. of Singapore
Fu, Jun — National Univ. of Singapore
Chen, Ming — National Univ. of Singapore
Feng, Yong — National Univ. of Singapore

In this paper, we present the experimental results on Critical Dimension (CD) control via real-time temperature control for warped wafers. As opposed to run-to-run control where information from the previous wafer or batch is used for control of the current wafer or batch, the approach here is real-time and make use of current information for control of the current wafer CD. In this paper we demonstrate that real-time control of the post-exposure bake temperature to give nonuniform temperature distribution across the warped wafer can reduce CD nonuniformity across the wafer.

10:50-11:10 MoA24.2

Uniformity Control in Planetary Chemical Vapor Deposition Reactor Systems (I), pp. 931-935

Adomaitis, Raymond — Univ. of Maryland

A simplified model of the spatially dependent deposition profile in chemical vapor deposition reactors with planetary wafer rotation is developed. The model focuses on reactors operated in “depletion” mode, a situation where the precursor species have undergone a sequence of gas-phase decomposition reactions leaving only the deposition species to diffuse to and react on the substrate surface, generating the thin film. The model is used to identify the reactor design and operating parameters that influence the shape of the deposition profile. By projecting the deposition profile onto the rotating wafers, the thickness uniformity as a function of reactor system operating parameters also is examined.

11:10-11:30 MoA24.3

EWMA Controller Tuning and Performance Evaluation in a High Mixed System (I), pp. 936-939

Ma, Mingda — Harbin Inst. of Tech.
Chang, Chun-Cheng — National Tsing-Hua Univ.
Wong, David, S.H. — National Tsing-Hua Univ.
Jang, Shi-Shang — National Tsing-Hua Univ.

The exponentially weighted moving average (EWMA) controller is a very popular run-to-run (RtR) control scheme in semiconductor industry. However, in any typical step of semiconductor process, many different products are produced on parallel tools. RtR control is usually implemented with a "threaded" control framework, i.e.: different controllers are used for different combinations of tools and products. In this paper, the problem of EWMA controller tuning and performance evaluation in a mixed product system is investigated by simulation and time series analysis. It was found that as the product frequency changed, the tuning guidelines of a threaded EWMA controller were different for different types of tool disturbances. For a stationary ARMA(1,1) noise, the tuning parameter should be increased as product frequency decreases. If the tool exhibits non-stationary tool dynamics, e.g. ARIMA(1,1,1) noise, the tuning parameter should increase as the product frequency decreases.

11:30-11:50 MoA24.4

Information Flow Based Decomposition of Decision-Making Problems Involving Partial Observability (I), pp. 940-945

Agrawal, Rakshita — Georgia Inst. of Tech.
Lee, Jay — Georgia Tech.
Realff, Matthew J. — Georgia Inst. of Tech.

Industrial planning and scheduling decisions are often inter-dependent. For example, planning level capacity allocation decisions affect production scheduling. While independent decision rules fail to address the above mentioned inter-dependence, simultaneous consideration of all interactions leads to a very large problem, which is oftentimes computationally intractable. In this study, we demonstrate, in the context of a machine maintenance problem for a reentrant flow system, a middle-ground approach by recognizing paths of strong information flow and then systematically decomposing the problem to be able to obtain a computationally tractable problem yielding a near-optimal decision policy. In the process, we make combined use of rigorous probability theories, approximate dynamic programming and simulation based rules.

11:50-12:10 MoA24.5

Temperature Cycling for Photoresist Processing (I), pp. 946-951

Wang, Yuheng — National Univ. of Singapore
Chua, HuiTong — The Univ. of Western Australia
Tay, Arthur — National Univ. of Singapore
Fang, Zhong Ping — Singapore Insititute of Manufacturing Tech.

A programmable multizone thermal processing module together with a model-based feedback control method are developed to achieve temperature uniformity of a silicon wafer throughout the processing temperature cycle of ramp, hold and quench in post-exposure bake (PEB) step of lithography. The module comprises of numerous small thermoelectric devices (TEDs) capable of precise substrate spatial temperature control. The detailed thermal modeling of the module is presented and the simulation results are compared with the experimental results to verify its feasibility. A model-based PID feedback control method is employed to minimize temperature nonuniformity across the wafer. With the method, temperature nonuniformity could be controlled less than 0.1degC throughout the entire thermal cycle. Advanced applications are enabled due to the proposed system.

MoA25 328
Applications of Nonlinear Optimization Based and Predictive Control (Invited Session)

Chair: Engell, Sebastian — Univ. of Dortmund
Co-Chair: Findeisen, Rolf — Univ. of Stuttgart
Organizer: Findeisen, Rolf — Univ. of Stuttgart
Organizer: Engell, Sebastian — Univ. of Dortmund

10:30-10:50 MoA25.1
Hybrid Predictive Control of a Solar Air Conditioning Plant (I), pp. 952-957

Rodriguez, Miguel — Univ. of Valladolid
de Prada, Cesar — Univ. of Valladolid
Capraro, Flavio — Univ. Nacional de San Juan (UNSJ)
Cristea, Smaranda — Univ. of Valladolid
De Keyser, Robin M.C. — Ghent Univ.

This paper presents a hybrid controller for a solar air conditioning plant, located at the University of Seville, Spain, and used as a benchmark for the HYCON NoE of the EU. The plant uses two sources of energy: solar and gas, plus a set of accumulation tanks and an absorption tower to provide conditioned air to an university building. The hybrid control is based on a model predictive control strategy developed with the objective of operating the air conditioning system using the smaller amount of energy from gas. A novel approach incorporating an internal model with embedded logic control is used to transform the hybrid problem in a continuous-nonlinear one. Simulation results are presented, showing promising results.

10:50-11:10 MoA25.2
Robust Control of the Distributed Solar Collector Field ACUREX Using MPC for Tracking. (I), pp. 958-963

Alvarado, Ignacio — Univ. of Seville
Limon, Daniel — Univ. de Sevilla
Alamo, Teodoro — Univ. de Sevilla
Arahal, Manuel R. — Univ. de Sevilla
Camacho, Eduardo — Univ. of Seville

This paper presents the application of a robust model predictive control for tracking of piece-wise constant references (RMPCT) to a distributed collector field, ACUREX, at the solar power plant of PSA (Solar Plant of Almer´1;a). The main characteristic of a solar power plant is that the primary energy source, solar radiation, cannot be manipulated. Solar radiation varies throughout the day, causing changes in plant dynamics and strong disturbances in the process. The real plant is assumed to be modeled as a linear system with additive bounded uncertainties on the states. Under mild assumptions, the proposed RMPCT can steer the uncertain system in an admissible evolution to any admissible steady state, that is, under any change of the set point. This allows us to reject constant disturbances compensating the effect of then changing the setpoint.

11:10-11:30 MoA25.3
Engineering of Online Optimizing Control - a Case Study: Reactive SMB Chromatography (I), pp. 964-969

Kuepper, Achim — Biochemical anc Chemical Engineering, Univ. Dortmund
Engell, Sebastian — Univ. of Dortmund

This contribution discusses the application of the idea of online optimizing control to a complex process from chemical engineering. The idea of online optimizing control is to minimize an economic objective over a finite moving horizon during plant operation based upon a rigorous nonlinear dynamic model. Plant limitations and product specifications are included in the optimization as constraints. The process discussed here is the so-called Hashimoto SMB process that combines reaction and continuous chromatographic separation in one plant. The degrees of freedom (flow rates and the switching time) are used to minimize the solvent consumption and to keep the product purity and product recovery above the specified values. The emphasis of this paper is on the modifications of the formulation of the optimization problem in order to cope with plant/model mismatch.

11:30-11:50 MoA25.4
Model Based Control Approach for Batch Crystallization Product Design (I), pp. 970-975

Nagy, Zoltan K. — Loughborough Univ.

The paper presents a novel control approach for crystallization processes, which can be used for designing the shape of the crystal size distribution to robustly achieve desired product properties. The method is implemented in a hierarchical structure. On the lower level a supersaturation control approach is used that drives the system in the phase diagram according to a concentration versus temperature trajectory. On the higher level a robust model-based optimization algorithm adapts the setpoint of the supersaturation controller to counteract the effects of changing operating conditions. The process is modelled using the population balance equation (PBE), which is solved using a novel efficient approach that combines the quadrature method of moment (QMOM) and method of characteristics (MOC). The control approach is corroborated through simulations and laboratory experiments. The results illustrate the importance of judicious combination of state-of-the art process analytical technology tools and efficient optimization algorithms for the successful implementation of the on-line model based control approach.

11:50-12:10 MoA25.5
On Useful Redundancy in Dynamic Inverse Problems Related Optimization (I), pp. 976-981

Alamir, Mazen — Gipsa-Lab. (CNRS-Univ. of Grenoble)

In this paper, it is pointed-out that inverse problems arising in nonlinear control sys- tems design such as state reconstruction and/or parameter estimation are naturally redundant. It is also shown that this redundancy can be used to enhance avoiding singularity heuristics. Some related algorithms are discussed and illustrated on a simple example of chemical reactors. These algorithms can be added to any optimization algorithm in order to enforce the singularity avoidance capabilities.

12:10-12:30 MoA25.6
An Industrial Implementation of a Generic NMPC Controller with Application to a Batch Process (I), pp. 982-987

Pluymers, Bert — IPCOS
Ludlage, Jobert — IPCOS B.V.
Ariaans, Leon — IPCOS
Van Brempt, Wim — IPCOS

In the last decade a lot of attention was given to non-linear model predictive control. On one hand, in many applications linear MPC does not suffice to achieve the control goals over a wide range of operating conditions, while on the other hand many academic challenges remained in the area of NMPC, such as stability, computational complexity, etc... This paper discusses the industrial implementation of an NMPC controller at IPCOS and the different trade-offs made during the design, with the aim of clarifying the different criteria that are used in an industrial context. Results are illustrated on a chemical batch reactor.

MoA26 327
Cold Rolling and Tension Control (Regular Session)

Chair: Craig, Ian — Univ. of Pretoria
Co-Chair: Knittel, Dominique — IPST - Univ. Strasbourg I

10:30-10:50 MoA26.1
Optimum Feedback Controller Design for Tandem Cold Metal Rolling, pp. 988-993

Pittner, John — Univ. of Pittsburgh
Simaan, Marwan A. — Univ. of Pittsburgh

Controlling the tandem cold rolling of metal strip is a significant challenge to the control engineer. This is due mostly to complex interactions between the process variables, nonlinearities that change with process conditions, and long speed-dependent time delays. The present technology is limited in its capability for improvement in performance. This paper describes a new control strategy that is based on solving a state-dependent algebraic Riccati equation pointwise to establish a control law for a MIMO controller that is augmented by appropriate trimming functions. Simulation testing showed that the tolerance in mill exit thickness compares favorably to the tolerances using existing techniques.

10:50-11:10 MoA26.2
Modelling and Control of Consumable Double-Electrode Gas Metal Arc Welding Process, pp. 994-999

Li, Kehai — Univ. of Kentucky

Zhang, Y. M. — Univ. of Kentucky

Consumable double-electrode gas metal arc welding (DE-GMAW) is an innovative process, which offers unique advantages to increase productivity and reduce heat distortion. However, it must be appropriately feedback controlled for any practical use. To this end, the authors identified two critical variables as outputs for the control system to be developed. The control variables were then selected to ease the modeling and control design through establishing two decoupled SISO subsystems. Each SISO subsystem was modeled as an interval model, whose parameters were unknown but bounded by known intervals. The intervals were obtained through a set of designed step response experiments. A prediction based interval model control algorithm was then implemented to control the resultant interval models. Closed-loop control experiments verified the effectiveness of the developed control system for this novel welding process.

11:10-11:30 — MoA26.3

Grinding Mill Circuits - a Survey of Control and Economic Concerns, pp. 1000-1005

Wei, Donghui — Univ. of Pretoria, South Africa
Craig, Ian — Univ. of Pretoria

A worldwide survey on grinding mill circuits in the mineral processing industry was conducted. The aims of this survey are to determine how milling circuits are currently controlled, and to find out how key process variables are linked to economic benefits. The survey involves background information on the circuits, the choice of controlled and manipulated variables, the economic impact of the controlled variables, adopted control technologies, and assessment of control performance. 68 responses were received as a whole. Survey results are contrasted to the milling control literature.

11:30-11:50 — MoA26.4

Improved Drive Control for Multi-Stand Cold Rolling Mills, pp. 1006-1011

Soler, Nicolas — Univ. of Tech. Darmstadt
Isermann, Rolf — Univ. of Tech. Darmstadt
Feldmann, Frank — ABB Automation GmbH

In multi-stand cold rolling mills an accurate synchronization of the mill drives is necessary for a good product quality and for a safe process operation. During the standard commissioning procedure the control performance of each drive is optimized individually. However, in normal operation mode the performance is then not always optimal due to the coupling of the drives by the strip being rolled. Based on a model of the drives and the strip tension force the control performance of the coupled drives is analyzed. A linear observer is proposed to support the standard PI speed controllers. Thus control performance can be improved with a minimum of additional effort. The observer needs only a few parameters and can cover all operating points of a tandem cold rolling mill.

11:50-12:10 — MoA26.5

Modeling and H-Infinty Low Order Control of Web Handling Systems with a Pendulum Dancer, pp. 1012-1017

Vedrines, Marc — INSA Strasbourg
Knittel, Dominique — IPST - Univ. Strasbourg I

The plant considered in this paper is an unwinding - winding system with pendulum dancer mechanism for elastic webs. First, a non linear mathematical model of the web process line is presented. A state space model is deduced which helps in the synthesis of the H-infinity controllers around the set points given by the reference signals. Industrials systems typically use decentralized PI controllers. In this paper, performances of PI and low order H-infinity controllers for such systems are analyzed

12:10-12:30 — MoA26.6

H-Infinity-Based PI-Observers for Web Tension Estimation in Industrial Unwinding - Winding Systems, pp. 1018-1023

Gassmann, Vincent — Univ. of Strasbourg
Knittel, Dominique — IPST - Univ. Strasbourg I

The system under study is a web handling machine composed of an unwinder, several traction motors, several idlers with or without load cells and a winder. All flexible materials such as textiles, papers, polymers or metals are handled on rollers during their processing. Maintaining strip tension in the entire processing line while increasing web speed is a key factor for achieving good final product quality. Due to sources of disturbance and the high coupling introduced by elastic webs, robust multivariable control strategies such H_infinity-controllers require the knowledge of web tension in each span of the process. Estimators or observers represent a cost-effective method in order to limit the number of load cells or dancers. After a summary of the main laws used for system modeling, two different approaches to design tension observers in a section of a process line are presented and discussed. The first approach is based on a PI-observer calculated in a H_infinity sense thanks to optimization techniques. The second approach uses Kalman filtering theory. Both approaches underline the importance of friction in estimation accuracy and propose alternatives to face this issue. This friction on rollers are generally neglected or assumed to be well-modeled in the literature. The proposed observers are also analyzed and discussed with variations in friction torques and nominal set points of the web velocity and tension. Both observers have the major advantage of being easily understandable for industrial applications and can be rapidly programmable in industrial plant controllers.

MoA28 — 330A

Benchmark for Engine Cold Start (Invited Session)

Chair: Shen, Tielong — Sophia Univ.
Co-Chair: Jimbo, Tomohiko — Toyota Central R&D Lab. inc.
Organizer: Shen, Tielong — Sophia Univ.
Organizer: Ohata, Akira — Toyota Motor Corp.

10:30-10:50 — MoA28.1

Physical-Model-Based Control of Engine Cold Start Via Role State Variables (I), pp. 1024-1029

Jimbo, Tomohiko — Toyota Central R&D Lab. inc.
Hayakawa, Yoshikazu — Nagoya Univ.

The present paper describes a model representation of multi-cyclic phenomena for a multi-cylinder engine system. The model is simplified for implementation as a practical engine controller. The simplified model with physically meaningful variables can be used in design considering practical objectives and constraints more effectively. The proposed approach consists of two steps. First, an approximate analytical discrete crank angle model (i.e., a periodically time-varying state space model) is derived from the conservation laws. Second, the concept of role state variables is proposed to transform the periodically time-varying state space model into a time-invariant state space model. The stabilizability and optimality of the time-invariant state space model imply those of the periodically time-varying state space model. The time-invariant state space model is used to design cold start feedforward and feedback controllers.

10:50-11:10 — MoA28.2

The Cold Starting Control of Engine Using Large Scale Database-Based Online Modelling (I), pp. 1030-1035

Ogawa, Masatoshi — Waseda Univ.
Ogai, Harutoshi — Professor (Waseda Univ.

In order to solve the environmental pollution problem and the energy depletion problem in recent years, a control technology that improves the quality of engine in automobile is demanded. However, thanks to the developments of electrical and electronic mounting technology, advanced control of the power train has become possible. This paper presents an application of “Large scale database-based Online Modeling (LOM)” for the cold starting control of SI engine. LOM is a local modeling technique based on the database to predict and control a large-scale process. The intake air mass flow in cylinder is predicted in order to reach the desired engine speed in cold starting by using LOM, and adequate fuel injection quantity is derived from the intake air mass flow and the fuel injection model.

11:10-11:30 — MoA28.3

Starting Speed Control of SI Engine Based on Extremum Seeking Control (I), pp. 1036-1041

Sugihira, Shigehiro — Keio Univ.
Kitazono, Shinya — Keio Univ.
Ohmori, Hiromitsu — Keio Univ.

The extremum seeking controller (ESC) that minimizes the unknown performance index is applied to the control of SI (spark ignition) engines in the idle speed region. The proposed control system consists in the three parts, fuel-jet mount controller, ignition-timing controller and engine speed controller. The ESC applied to the engine speed controller should be modified in order to improve the efficiency of the perturbation signal. Moreover, to decrease the overshoot of the engine speed in starting time, the new control technique of the ignition timing is proposed. Finally to show the effectiveness of the proposal method, the numerical simulations are shown using the mathematical model of a six cylinders SI engine that admission is implemented intermittently.

11:30-11:50 MoA28.4

Model-Based Cold-Start Speed Control Design for SI Engines (I), pp. 1042-1047

Zhang, Jiangyan — Sophia Univ.
Shen, Tielong — Sophia Univ.
Marino, Riccardo — Univ. di Roma Tor Vergata

This paper presents a feedback deign approach to the cold-start speed control for spark ignition (SI) engines. First, in order to ensure successful combustion in the transient mode, a fuel injection controller is given based on the air charge estimation with inverse dynamics of fuel path, which is a dual sampling rate system, i.e. the estimation for the air charge is performed TDC-based, and the fuel injection command is delivered cycle-based, respectively. Then, a speed control scheme is proposed that provides a coordination between the spark advance (SA) and the throttle operation. A supervisor is exploited to management the multi-control laws. Finally, simulation results will be demonstrated which are carried out on a full scale 6-cylinder engine system simulator provided by the SICE benchmark problem.

11:50-12:10 MoA28.5

Introduction to the Benchmark Challenge on SICE Engine Start Control Problem (I), pp. 1048-1053

Ohata, Akira — Toyota Motor Corp.
Shen, Tielong — Sophia Univ.
Ito, Kazuhisa — Tottori Univ.
Kako, Junichi — Toyota Motor Corp.

The speed control during cold start for SI engines is a challenging topic due to the difficulties in handling the dramatic change of the engine dynamics. The SICE Research Committee on Advanced Powertrain Control Theory provides a V6 SI engine model and the benchmark problem of cold start control focusing on the engine speed behavior when the engine model starts. The control design specification is explained in detail and a traditional control is also shown in this paper. Finally, a brief review is given on intermediate results of the challengers.

MoA29 330B

Model-Based Development for Automotive Control Systems (Invited Session)

Chair: Ohata, Akira — Toyota Motor Corp.
Co-Chair: Oho, Shigeru — Hitachi Ltd.
Organizer: Ohata, Akira — Toyota Motor Corp.

10:30-10:50 MoA29.1

High-Level Physical Modeling Description and Symbolic Computing (I), pp. 1054-1055

Bakus, Jan — Maplesoft
Bernardin, Laurent — Maplesoft
Gerhard, Juergen — Maplesoft
Kowalska, Kaska — Maplesoft
Léger, Mathieu — Maplesoft
Wittkopf, Allan — Maplesoft

We present a high-level modeling formulation based on a conserved quantities approach, with the goal of making the physical modeling process reliable and repeatable. The systems of equations generated as a result of this formulation will, in general, be non-linear differential algebraic equations (DAEs). We make use of symbolic reduction techniques in order to eliminate spurious, non-physical solutions as well as to reduce to a system of ordinary differential equations, if possible.

10:50-11:10 MoA29.2

Verification and Validation Integrated within Processes Using Model-Based Design (I), pp. 1056-1061

Hayhurst, Chris — The MathWorks
Murphy, Brett — The MathWorks
Anderson, Richard — The MathWorks
Mohtadi, Coourous — The MathWorks
Friedman, Jon — The MathWorks
Mosterman, Pieter — The MathWorks, Inc.

Verification and Validation have always been a key part of the process for producing embedded control systems. With the advent of Model-Based Design as an alternative method for generating embedded software, the need for verification and validation remains and, up to the present, conventional approaches for doing verification and validation have largely been followed. However, conventional and new techniques fully integrated into Model-Based Design have the potential for greater returns, and will be presented in this paper.

11:10-11:30 MoA29.3

Improving Model-Based Design for Automotive Control Systems Development (I), pp. 1062-1065

Ohata, Akira — Toyota Motor Corp.
Butts, Kenneth R. — Toyota Tech. Center, USA

A Model-Based Development (MBD) Framework is proposed in this brief-paper. The paper motivates the need for integrating automotive control system development activities and describes engineering roles in such an environment. It also outlines the features of an integrated development environment designed to support these roles.

11:30-11:50 MoA29.4

Excitation Signals for Nonlinear Dynamic Modeling of Combustion Engines (I), pp. 1066-1067

Baumann, Wolf — IAV
Schaum, Steffen — IAV GmbH
Roepke, Karsten — IAV GmbH
Knaak, Mirko — IAV GmbH

A crucial point in nonlinear dynamic modeling is the design of a suited excitation signal. It has to fulfill several criteria, like coverage of important amplitude levels and of important frequency range, and for multichannel systems an orthogonal or at least as orthogonal as possible design is desired. Differing from theoretically optimal excitation signals, we suggest the use of smooth signals, better suited for real world automotive applications.

11:50-12:10 MoA29.5

Model-Based Implementation Design of Automotive Controllers (I), pp. 1068-1069

Oho, Shigeru — Hitachi Ltd.

Model-based development was introduced to implementation design of automotive electronic controllers. The goals and issues of implementation design were discussed, and a model-based approach of processor-in-the-loop simulation was proposed as a method to meet the design goals. An application example of electronic throttle control of automotive engines was demonstrated with the processor-model.

MoA30 330C

Low Altitude Flight and Landing Control (Invited Session)

Chair: Nebylov, Alexander — State Univ. of Aerospace Inst.
Co-Chair: Silvestre, Carlos — Inst. Superior Tecnico
Organizer: Nebylov, Alexander — State Univ. of Aerospace Inst.

10:30-10:50 MoA30.1

Wig-Craft Marine Landing Control at Rough Sea (I), pp. 1070-1075

Nebylov, Vladimir — State Univ. of Aerospace Inst.
Nebylov, Alexander — State Univ. of Aerospace Inst.

Wing-in-Ground Effect vehicle (WIG-craft) or ekranoplane landing direction optimization criteria is suggested which heeds the irregular sea waves features and provides the minimal mechanical strain on the vehicle body at hydrodynamic braking. The problem of automatic choice of the landing trajectory direction regarding the main direction of sea waves spread is under consideration. The peculiarities of marine landing at different characteristics of three-dimensional irregular model of sea waves and flying vehicle characters are investigated1. Recommendations concerning the implementation of ekranoplane soft landing depending on the number of sea roughness, wind velocity and vehicle landing velocity are given

10:50-11:10 MoA30.2

Terrain Avoidance Model Predictive Control for Autonomous Rotorcraft (I), pp. 1076-1081

Guerreiro, Bruno Joao Nogueira — Inst. Superior Tecnico
Silvestre, Carlos — Inst. Superior Tecnico
Cunha, Rita — Inst. Superior Técnico, Inst. for

Systems and

This paper presents a terrain avoidance control methodology for autonomous rotorcraft. A model predictive control formulation is used to adequately address the terrain avoidance problem, which involves stabilizing a nonlinear highly coupled dynamic model, while avoiding collisions with the terrain and preventing input and state saturations. Computing the model predictive control law amounts to solving a finite horizon open-loop optimal control problem subject to the state difference equations that describe the rotorcraft nonlinear dynamic model. State and input saturations are added to the optimization cost functional as penalties and terrain avoidance is achieved by penalizing the distance between the vehicle and the closest point on the terrain, yielding smooth and collision-free trajectories. Simulation results, obtained with a simplified version of a small-scale helicopter nonlinear dynamic model, are presented to assess the performance of the methodology with different reference paths and terrain profiles, including the extreme case where a desired path leads to collision with the terrain.

11:10-11:30 MoA30.3

Wing-In-Ground Effect Flight Control: New Role of Automatic Systems (I), pp. 1082-1087

Nebylov, Alexander — State Univ. of Aerospace Inst.

A trouble-free flight at low altitude over the disturbed sea surface and also marine landing require the application of the special methods and means of motion control which are capable to solve the corresponding specific problems. Methods of stability provision and solving some other problems of WIG flight by means of automatic control are analyzed . The requirements of motion control systems are analyzed and the criteria for their improvement are given. The statement of the main problems of equipment and software design for flight control at small altitude above the disturbed surface is performed. The aim of investigation is to define the way for operational performance improvement of the vehicles of advanced design. An important way is by implementation of modern navigation and motion control systems. The experience and achievements in this field of high technology are described. Probable areas of the most effective application of vehicles with such equipment are indicated.

11:30-11:50 MoA30.4

Development of an Automatic Height Control System for Wig Crafts (I), pp. 1088-1092

Davila, Daniel — National Armed Forces Univ. of Venezuela

A WIG craft takes advantage of the ground effect phenomenon, where this kind of craft are designed to fly at low altitudes close to the ground (between 0.05 – 0.5 of the wing cord) to experience an increase in lift, while drag decreases, this result in an enhanced lift-to-drag ratio and hence greater flight efficiency. However to achieve an ideal flying altitude and a safety low flight is necessary to implement an automatic height control system capable of sustaining the WIG craft stable. The concept is to take out the “hand of the man” from the control of the altitude, so that the system will take over the control of the elevator and correct the flying altitude until the ideal level is reached and maintain it there. In addition, this system can also be used to provide accurate flight altitude.

11:50-12:10 MoA30.5

Glidepath Command Generation and Tracking for Longitudinal Autolanding, pp. 1093-1098

Ju, Hann-Shing — National Chung-Hsing Univ.
Tsai, Ching-Chih — National Chung-Hsing Univ.

This paper describes a glidepath command generator for indirect altitude control and presents an auto-landing controller for glide-slope tracking and flare maneuver via adaptive backstepping, in order to provide precise altitude trajectories for auto-landing of unmanned aerial vehicles. The proposed glide-slope tracking and flare maneuver control law is quite different from conventional guidance and control loops separately designed in autopilot. Simulation results demonstrate that the adaptive auto-landing controller is capable of effectively guiding the aircraft along the glidepath command under the presence of the wind disturbances and microburst.

12:10-12:30 MoA30.6

Sliding Mode Control of Pitch-Rate of an F-16 Aircraft, pp. 1099-1104

Promtun, Ekprasit — San Diego State Univ.
Seshagiri, Sridhar — San Diego State Univ.

The control of the longitudinal flight dynamics of an F-16 aircraft is challenging because the system is highly nonlinear, and also non-affine in the input. We consider a sliding mode control design based on linearization of the aircraft, with the the altitude h and velocity V (Mach number) as the trim variables. The design further exploits the modal decomposition of the dynamics into its short-period and phugoid approximations. The primary design objective is model-following of the pitch rate q, which is the preferred system for aircraft approach and landing. Regulation of the aircraft velocity V (or the Mach-hold autopilot) is also considered, but as a secondary objective. It is shown that the inherent robustness of the SMC design provides a convenient way to design controllers without gain scheduling, with a steady-state response that is comparable to that of a conventional gain-scheduled approach with integral control, but with improved transient performance. Finally, we apply the recently developed technique of conditional integrators to achieve asymptotic regulation with constant exogenous signals, without degrading the transient response. Through extensive simulation on the nonlinear multiple-input multiple-output (MIMO) longitudinal model of the F-16 aircraft, we show that the conditional integrator design outperforms the one based on the conventional approach, without requiring any scheduling.

MoB02 304A

Stability Analysis (Regular Session)

Chair: Monnigmann, Martin — Tech. Univ. Braunschweig
Co-Chair: Kim, Kyung-Soo — Korea Advanced Inst. of Science and Tech.

14:00-14:20 MoB02.1

French Champagne and Belgian Chocolate Problems in Simultaneous Stabilization of Linear Systems, pp. 1105-1110

He, Guannan — Chinese Acad. of Sciences
Wang, Long — Peking Univ.
Yu, Wensheng — Chinese Acad. of Sciences

This paper considers two open problems associated with simultaneous stabilization of linear systems, namely French champagne problem and Belgian chocolate problem. Based on the recent development in automated inequality-type theorem proving, the explicit bounds which guarantee the existence of stabilizing controllers with fixed order are determined. In addition, two conjectures concerning the Belgian chocolate problem are formulated. Some numerical examples are worked out.

14:20-14:40 MoB02.2

Polynomial Lyapunov Functions for Exponential Stability of Nonlinear Systems on Bounded Regions, pp. 1111-1116

Peet, Matthew M — INRIA - Rocquencourt
Bliman, Pierre-Alexandre J — INRIA-Rocquencourt

This paper presents a proof that the use of polynomial Lyapunov functions is not conservative for studying exponential stability properties of nonlinear ordinary differential equations on bounded regions. The main result implies that if there exists an n-times continuously differentiable Lyapunov function which proves exponential decay on a bounded subset of R_n, then there exists a polynomial Lyapunov function which proves that same rate of decay on the same region. Our investigation is motivated by the use of semidefinite programming to construct polynomial Lyapunov functions for delayed and nonlinear systems of differential equations.

14:40-15:00 MoB02.3

Positive Invariance Tests with Efficient Hessian Matrix Eigenvalue Bounds, pp. 1117-1122

Monnigmann, Martin — Tech. Univ. Braunschweig

We investigate two simple sufficient criteria for positive invariance of sets in the domain of n-dimensional nonlinear autonomous discrete time systems. These criteria are derived from the exact Taylor expansion with linear and quadratic remainder terms. By a simple example we demonstrate that systems exist for which positive invariance can be established with the second order criterion but not with the first order criterion. Since the second order criterion requires the Hessian matrices of the model equations, this criterion is computationally expensive. We show, however, that the second order criterion can be evaluated at a surprisingly low computational cost. Specifically, we show that the computational complexity is an order of magnitude lower than the calculation of the Hessian matrices.

15:00-15:20 MoB02.4

On Stability Properties of Nonlinear Time-Varying Systems by Semi-Definite Time-Varying Lyapunov Candidates, pp. 1123-1128

Wang, Zhi Ming — East China Normal Univ.
Tan, Ying — The Univ. of Melbourne
Wang, Gexia — East China Normal Univ.
Nesic, Dragan — Univ. of Melbourne

Stability properties (uniform stability/uniform asymptotic stability) of nonlinear time-varying systems are explored using positive semi-definite time-varying Lyapunov candidates whose derivative along trajectories is either non-positive or negative semi-definite. Once these positive semi-definite time-varying Lyapunov candidates are available, conditional stability properties on some specific sets can be used to ensure stability properties (unform stability and unform asymptotic stability) of nonlinear time-varying systems.

15:20-15:40 MoB02.5

A Lyapunov Approach for Discrete-Time Sliding Hyperplane Design and Robust Sliding Mode Control Using MROF, pp. 1129-1134

Kim, Kyung-Soo — Korea Advanced Inst. of Science and Tech.
Bandyopadhyay, Bijnan — IIT Bombay

In this paper, we propose a generalized method to design sliding hyperplane for variable structure control in the discrete time domain. The well-known Lyapunov inequality of full order will be used for generating the {it stable} sliding hyperplanes without loss of generality, which shows the necessary and sufficient condition for the existence of stable sliding hyperplane for multi-input-multi-output systems. Also, we derive a desirable reaching law that guarantees the attractiveness of the boundary layer. Then, it will be shown that the results (obtained with full state feedback information) can be generalized for the discrete time output feedback case by adopting multi-rate output feedback (MROF).

15:40-16:00 MoB02.6

Design of ISS-Lyapunov Functions for Discrete-Time Linear Uncertain Systems, pp. 1135-1140

Muńoz de la Peńa, David — Univ. de Sevilla
Alamo, Teodoro — Univ. de Sevilla
Lazar, Mircea — Eindhoven Univ. of Tech.
Heemels, Maurice — Tech. Univ. Eindhoven

In this work we consider robust control of discrete-time linear systems affected by time-varying additive disturbance inputs. We present a linear matrix inequality (LMI) based design technique that takes into account in an explicit manner, by means of a Minkowski function, the shape of the set in which the disturbances are bounded. This technique allows one to obtain tight bounds on the performance of the closed-loop system.

MoB03 304B

Control of Constrained Systems I (Regular Session)

Chair: Turner, Matthew C. — Univ. of Leicester
Co-Chair: Akasaka, Noriyuki — Kurume National Coll. of Tech.

14:00-14:20 MoB03.1

Design of Piecewise Linear LQ Control for Linear Systems with Rate Saturations Using LMI Optimization, pp. 1141-1146

Akasaka, Noriyuki — Kurume National Coll. of Tech.

A model of the servomechanism used for high-powered actuators in mechanical systems consists of a position feedback loop around the cascade connection of a memoryless saturation function with an integrator with a large time constant. The saturation function in the servomechanism has a linear high gain characteristics for a small input and so the equivalent time constant of the actuator servomechanism becomes small.As the input to the saturation function becomes larger than the linear range for a drastic control demand, the output of the saturation function becomes constant irrespective of the input magnitude and the actuator response has a rate saturation determined by the large time constant of the integrator and so the time lag of the actuator response behind the demand results in the actual plant input much different from the demand and the plant may exhibit an undesirable behavior of the system. Therefore in this paper we consider a control method for a system with rate saturations in the actuator servomechanisms to keep stable by switching the controller gain according to the input magnitudes to the saturation functions so that the inputs to the saturation functions are controlled within the permissible maximum absolute values which are decided according to each level of LQ controller gain groups determined beforehand to ensure the local absolute stability of the total system whose conditions are expressed as a linear matrix inequalities optimization problem by introducing a Lure-type Lyapunov function.In a piecewise linear control the switching function selects a controller gain group by on-line monitoring the inputs to the saturation functions in the actuator servomechanisms. The effectiveness of the design method is illustrated with a practical example of dynamic positioning(DP) system.

14:20-14:40 MoB03.2

Probabilistic Assurance of Constraint Fulfillment against Model Uncertainties and Disturbances, pp. 1147-1152

Hatanaka, Takeshi — Tokyo Inst. of Tech.
Takaba, Kiyotsugu — Kyoto Univ.

This paper addresses computations of a robustly safe region on the state space for uncertain constrained systems subject to disturbances based on a probabilistic approach. We first define a probabilistic output admissible (POA) set. This set is a subset of the state space which excludes with high probability initial states violating the constraint. Then, an algorithm for computing the POA set is developed based on a randomized technique. The utility of the POA set is demonstrated through a numerical simulation.

14:40-15:00 MoB03.3

Robust Control for Uncertain Linear Systems with State and Control Constraints, pp. 1153-1158

Ayad, Hassan — Univ. caddi ayyad Faculty of Sciences and Tech.
Mesquine, Fouad — Cadi Ayyad Univ.
Ait Rami, Mustapha — Facultad de Ciencias, Univ. de Valladolid

The paper is devoted to the stabilization of linear uncertain systems having restricted states and controls. Two classes of uncertainties, namely norm bounded and polytopic, are studied for continuous time systems. Sufficient LMI conditions are given for the derivation of robust state-feedback controllers driving the system asymptotically to the origin without violating the constraints. Further, the determination of a large region of attraction for these systems is addressed. Moreover, numerical algorithms are provided for the enlargement of the volume of attraction region of the uncertain system. The approach is illustrated by an example for each case of uncertainties.

15:00-15:20 MoB03.4

Stabilizing Reduced Order Model Predictive Control for Constrained Linear Systems, pp. 1159-1164

Hara, Naoyuki — Tokyo Metropolitan Univ.
Kojima, Akira — Tokyo Metropolitan Univ.

This paper considers a stabilizing reduced order model predictive control for constrained linear discrete-time systems. By employing a system decomposition on the input-output function space, a reduced order model predictive control law, which guarantees the closed-loop stability and feasibility, is obtained from a low dimensional on-line optimization problem. Numerical examples are provided to illustrate the proposed method.

15:20-15:40 MoB03.5

Practical Considerations for Override Compensator Synthesis and Implementation, pp. 1165-1170

March, Phil — Univ. of Leicester
Turner, Matthew C. — Univ. of Leicester

This paper discusses some of the practical considerations involved in the synthesis and implementation of override compensators for systems which have outputs constrained to lie below certain thresholds. The paper assesses three different override architectures: the first, a generic override control scheme from the literature; the second, a sub-class of the first which offers easier tuning and implementation at the expense of flexibility; and the third, a new modification of the generic scheme which is more flexible than the second, but of similar complexity. The various schemes are demonstrated and compared using a simulation case-study of a permanent-magnet-synchronous-motor speed control system.

15:40-16:00 MoB03.6

Geometric Analysis of a Class of Constrained Mechanical Control Systems in the Nonzero Velocity Setting, pp. 1171-1176

Nightingale, Jason	Univ. of Notre Dame
Hind, Richard	Univ. of Notre Dame
Goodwine, Bill	California Inst. of Tech.

We obtain an intrinsic vector-valued symmetric bilinear form that can be associated with an underactuated constrained mechanical control system. We determine properties of the form that serve as sufficient conditions for driving a constrained mechanical system underactuated by one control to an ë;-neighborhood of rest from an arbitrary initial configuration and velocity.We also determine properties of the form which serve as necessary conditions. These conditions are computable and coordinate invariant.

MoB04 308

Applications of Nonlinear Control I (Regular Session)

Chair: Back, Juhoon	Korea Univ.
Co-Chair: Moberg, Stig	ABB AB - Robotics

14:00-14:20 MoB04.1

Trajectory Stabilization of Wheeled System, pp. 1177-1182

Matiukhin, Vladimir	Russian Acad. of sciences

The control problem for wheeled systems similar to a mobile robot, a vehicle, a wheeled tractor, etc. is studied. These systems belong to the class of nonholonomic mechanical systems. Analysis in this paper is limited to kinematic models, and the dynamics of control drives is taken into account. Control that stabilizes the motion of a wheeled system along a given trajectory (planar smooth curve) is constructed. The stabilizability is substantiated in large with respect to basic variables of the system. The similar fact is confirmed when perturbations are taken into account.

14:20-14:40 MoB04.2

Variable Speed Control of Wind Turbines: A Robust Backstepping Approach, pp. 1183-1188

Sivrioglu, Selim	Gebze Inst. of Tech.
Ozbay, Ufuk	Gebze Inst. of Tech.
Zergeroglu, Erkan	Gebze Inst. of Tech.

Variable speed wind turbines maximize the energy capture by operating the turbine at the peak of the power coefficient, however parametric uncertainties and disturbances may limit the efficiency of a variable speed turbine. In this study, we present a robust backstepping approach for the variable speed control of wind turbines. Specifically, to overcome the undesirable effects of parametric uncertainties and disturbance effects a nonlinear robust controller have been proposed. The proposed method achieves globally uniformly ultimately bounded rotor speed tracking, despite the parametric uncertainty on both mechanical and electrical subsystems. Extensive simulation studies are presented to illustrate the feasibility and efficiency of the method proposed.

14:40-15:00 MoB04.3

Torque Multiplication and Singularity Avoidance in the Control of Electrostatic Torsional Micro-Mirrors, pp. 1189-1194

Zhu, Guchuan	Ec. Pol. de Montreal
Agudelo, Carlos Gustavo	École Pol.
Saydy, Lahcen	Ec. Pol. of Montreal
Packirisamy, Muthukumaran	Concordia Univ.

The present work addresses the control of micro-mirrors assisted by a constant bias voltage. It is shown that such a configuration will have an effect of torque multiplication and hence, it will reduce the dynamic range of actuation signal. A nonlinear controller using backstepping and barrier functions is developed, which can guarantee closed-loop stability in a restricted range covering a big portion of the physically allowable one, while eliminating the singularities due to uncontrollability and contact dynamics. In this study, the actuation voltage is taken as a state variable. This would further simplify the implementation of experimental systems. The development of the control algorithm has been demonstrated through a rectangular micro-mirror and the performance of the system is verified by numerical simulations. As a generic model is used in the design, the control algorithm developed can be applied to any device with the same structure regardless of the geometric shape.

15:00-15:20 MoB04.4

Operator Based Nonlinear Control Design for a Water Level Process System, pp. 1195-1199

Jiang, Changan	Okayama Univ.
Deng, Mingcong	Okayama Univ.
Inoue, Akira	Okayama Univ.

In this paper, a method of nonlinear control systems design for a water level process is proposed. This design method uses operator based robust right coprime factorization for the nonlinear process system, as a result, robust stability of the nonlinear process system is guaranteed. For the obtained robust stable process system, an operator based process tracking controller is also designed to realize the desired output tracking performance and to eliminate the disturbance of the process system input. A simulation result obtained to a water level process control system is given to show the effectiveness of the proposed method.

15:20-15:40 MoB04.5

Aircraft Automatic Maneouvering System Using Energy-Based Control Technique, pp. 1200-1205

Jones, Lim Jen Nee	Monash Univ. Sunway Campus Malaysia
Akmeliawati, Rini	International Islamic Univ.
Tan, Chee Pin	Monash Univ.

Automatic control systems are implemented in aircraft systems as it contributes to improve flight safety due to minimal routine pilot interaction. In classical aircraft control systems, overlaps in control systems often reduce the efficiency and effectiveness of the overall control of the aircraft. An integrated (robust) controller becomes a necessity especially where the stability and performance robustness are top priorities, process dynamics are known and variation ranges for uncertainties can be estimated. The success in implementing a nonlinear controller using the Nonlinear Energy Method (NEM) in the longitudinal dynamics of the aircraft has surfaced the need to design the lateral controllers and its integration to the entire aircraft control system. In this paper, a lateral controller that provides tracking of given roll and yaw commands is proposed. The controller is based on NEM. The proposed controller is applied to an aircraft model developed by Group of Aeronautical Research and Technology in Europe (GARTEUR) called the Research Civil Aircraft Model (RCAM). The robustness and disturbance rejection of the NEM controller is tested. The closed-loop responses of the aircraft in 'extreme' flight conditions and the presence of parameter variations indicate that the proposed controller can guarantee stability and performance robustness of the aircraft.

15:40-16:00 MoB04.6

A Benchmark Problem for Robust Control of a Multivariable Nonlinear Flexible Manipulator, pp. 1206-1211

Moberg, Stig	ABB AB - Robotics
Öhr, Jonas	Optimation AB
Gunnarsson, Svante	Linkoping Univ.

A benchmark problem for robust feedback control of a manipulator is presented. The system to be controlled is an uncertain nonlinear two link manipulator with elastic gear transmissions. The gear transmission is described by nonlinear friction and elasticity. The system is uncertain according to a parametric uncertainty description and due to uncertain disturbances affecting both the motors and the tool. The system should be controlled by a discrete-time controller that optimizes performance for given robustness requirements. The control problem concerns only disturbance rejection. The proposed model is validated by experiments on a real industrial manipulator.

MoB05 307

Fault-Tolerant Control I (Regular Session)

Chair: Sánchez-Peńa, Ricardo S.	Univ. Pol. de Catalunya
Co-Chair: Krokavec, Dusan	Tech. Univ. of Kosice, Faculty of Electrical

14:00-14:20 MoB05.1

Fault-Tolerant Switching Scheme with Multiple Sensor-Controller Pairs, pp. 1212-1217

Martinez-Molina, John Jairo	INP-Grenoble, Gipsa-Lab.
Seron, Maria	The Univ. of Newcastle
De Dona, Jose Adrian	The Univ. of Newcastle

This paper deals with the problem of achieving high performance and fault tolerance properties of a given plant by switching between a collection of different sensor-controller pairs. We assume that each sensor-controller pair has been previously designed to achieve an appropriate performance objective according to disturbances, sensor noises, available bandwidth and uncertainties. The proposed strategy selects, at each instant of time, the sensor-controller pair that minimises a suitable switching criterion. Stability of the switching system under normal (fault-free) operation conditions is established in the main result of this paper. In addition, a simulation example of active suspension control illustrates that the proposed switching system is able to maintain performance levels, and to preserve stability under the occurrence of severe faults in some of the sensors.

14:20-14:40 MoB05.2

Fault Accommodation for Discrete Event Systems Using Petri Nets with Application to Traffic Light Control, pp. 1218-1223

Yang, Hao — Nanjing Univ. of Aeronautics and Astronautics
Jiang, Bin — Nanjing Univ. of Aeronautics and Astronautics
Cocquempot, Vincent — Univ. des Sciences et Tech. de Lille

This paper discusses the fault tolerant control problem for discrete event systems modeled by Petri nets. The fault is represented by the unobservable transitions. Firstly, an observer-based fault diagnosis method is proposed to estimate the marking with unknown initial markings and meanwhile, to diagnose the faulty behavior. Then, an adaptive fault tolerant controller is designed to maintain the general mutual exclusion constraints (GMEC) property of the system. The proposed method is applied to the control of tra±c lights.

14:40-15:00 MoB05.3

Positive Invariant Sets for Fault Tolerant Multisensor Control Schemes, pp. 1224-1229

Olaru, Sorin — Supelec
De Dona, Jose Adrian — The Univ. of Newcastle
Seron, Maria — The Univ. of Newcastle

Positive invariance is a common analysis and control design tool for systems affected by constraints and disturbances. The present paper revisits the construction of e-approximations of minimal robust positive invariant sets proposing contractive procedures in the cases of switching between different sets of disturbances and the inclusion of a predefined region of the state space. The results are used in multisensor control schemes which have to deal with specific problems originated by the switching between different estimators and by the presence of faults. Within this framework, global stability of the switching strategies can be assured if the invariant sets topology allows the exclusive selection of estimates obtained from healthy sensors.

15:00-15:20 MoB05.4

Sensor Fault Tolerant Control of Induction Motors, pp. 1230-1235

Seron, Maria — The Univ. of Newcastle
Romero, Monica E. — Univ. Nacional de Rosario
De Dona, Jose Adrian — The Univ. of Newcastle

In this paper we propose a multiobserver switching control strategy for fault tolerant control of induction motors. The strategy combines three current sensors and associated observers that estimate the rotor flux. The estimates provided by the observers are compared at each sampling time by a switching mechanism which selects the sensors--observer pair with the smallest error between the estimated flux magnitude and a desired flux reference. The selected estimates are used by a field oriented controller to implement the control law. Pre-checkable conditions are derived that guarantee fault tolerance under an abrupt fault of a current sensor. Simulation results under realistic conditions illustrate the effectiveness of the scheme.

15:20-15:40 MoB05.5

Using the Unfalsified Control Concept to Achieve Fault Tolerance, pp. 1236-1242

Ingimundarson, Ari — Tech. Univ. of Catalonia
Sánchez-Peńa, Ricardo S. — Univ. Pol. de Catalunya

The paper investigates the use of the unfalsified control concept in the area of fault tolerant control. No fault diagnosis system is required but rather by a simultaneous on-line performance assessment of multiple controllers in a bank of controllers, the best one for the plant at each time can be selected. A controller does not need to form part of the feedback loop for its performance to be assessed. Strategies to construct the bank of controllers are discussed and a switching strategy for fault tolerant control is presented. No previous models of system or faults are necessary, only real-time input/output data streams. Finally the investigated methodology is put to the test by applying it to a non-linear model of the breathing system of a PEM fuel cell.

15:40-16:00 MoB05.6

Performance of Reconfiguration Structures Based on the Constrained Control, pp. 1243-1248

Krokavec, Dusan — Tech. Univ. of Kosice, Faculty of Electrical
Filasova, Anna — Tech. Univ. of Kosice

An approach is proposed for reconfigurable control structure design to obtain a system tolerant to state-variable sensor faults. The method is based on discrete-time constrained control design techniques for linear systems with state constraints, defined by linear equalities. Degradation in steady state performance is dealt with fixing that state variable which is associated with sensor fault to zero value. Since that control design can be viewed as a specific pole-assignment problem, reconfigured LQ control structures, as well as stabilizing reconfiguration structure are introduced.

MoB06 310A

Tools and Methods in Time-Delay System Theory and Control
(Invited Session)

Chair: Conte, Giuseppe — Univ. di Ancona
Co-Chair: Perdon, Anna Maria — Univ. Pol. delle Marche
Organizer: Conte, Giuseppe — Univ. di Ancona
Organizer: Perdon, Anna Maria — Univ. Pol. delle Marche

14:00-14:20 MoB06.1

Minimal Representations for Delay Systems (I), pp. 1249-1254

Yamamoto, Yutaka — Kyoto Univ.

There are many, nonequivalent notions of minimality in state space representations for delay systems.In this class, one can express the transfer function as a ratio of two exponential polynomials. One can then introduce various notions of coprimeness in such a representation. For example, if there is no common zero between the numerator and denominator, it corresponds to a spectrally minimal realization, i.e., all eigenspaces are reachable. Another fact is that if the numerator and denominator are approximately coprime in some sense, then it corresponds to approximate reachability. All these are nicely embraced in the class of pseudorational transfer functions introduced by the author.The central question here is to characterize the Bezout identity in this class. This is shown to correspond to a non-cancellation property in the extended complex plane, including infinity. This leads to a unified understanding of coprimeness conditions for commensurate and non-commensurable delay cases. Various examples are examined in the light of the general theorem obtained here.

14:20-14:40 MoB06.2

A Notion of Zero Dynamics for Linear, Time-Delay System (I), pp. 1255-1260

Conte, Giuseppe — Univ. Pol. delle Marche
Perdon, Anna Maria — Univ. Pol. delle Marche

The aim of this paper is to introduce a notion of zero dynamics for linear, time-delay systems. To this aim, we use the correspondence between time-delay systems and system with coefficients in a ring, so to exploit algebraic and geometric methods. By combining the algebraic notion of zero module and the geometric structure of the lattice of invariant submodules of the state module, we point out a natural way to define zero dynamics in particular situations. Then, we extend our approach, in order to encompass more general situations, and we provide a definition of zero dynamics which applies to a number of interesting cases, including that of time-delay systems with commensurable delays. Relations between this notion and fixed poles in closed loop control schemes, as well as with a concept of phase minimality, are discussed.

14:40-15:00 MoB06.3

Observers and State Reconstructions for Linear Neutral Time-Delay Systems (I), pp. 1261-1266

Perdon, Anna Maria — Univ. Pol. delle Marche
Anderlucci, Maria — Univ. Pol. delle Marche

The problem of state reconstruction is discussed for linear neutral systems with a finite number of commensurable point delays. Using as models systems with coefficients in a ring and following a geometric point of view, feasible and constructive procedures are proposed for the design of observers of increasing complexity. Conditions are given to characterize neutral systems with delays for which linear observers exist not depending on the derivatives of the state. Some examples illustrating the results are worked out in details.

15:00-15:20 MoB06.4

Delay-Scheduled State-Feedback Design for Time-Delay Systems with Time-Varying Delays (I), pp. 1267-1272

Briat, Corentin	INPG/ENSIEG
Sename, Olivier	INPG
Lafay, JeanFrancois	Ec. Centrale Nantes

This paper is concerned in the synthesis of delay-scheduled state-feedback stabilizing linear systems with time-varying delay when the delay can be approximatively known in real-time. First we introduce a new model transformation turning the time-delay system into an uncertain LPV system. Using this reformulation we elaborate delay-dependent stability test based on the so-called full block S-procedure and derive from it a delay-dependent stabilization lemma. Our results are then relaxed using a new relaxation lemma which is shown to have good properties and provide then LMI based theorems, well-known for their tractability. Our results tackle error measurement on the delay. We show the efficiency of the method through an example.

15:20-15:40 MoB06.5

Design of Fault-Tolerant Controllers for Guaranteed H2-Performance Over Digital Networks with Time-Varying Communication Delays (I), pp. 1273-1278

Yame, Joseph Julien	Univ. Henri Poincaré, Nancy 1
Sauter, Dominique D.J.	Univ. Henri Poincare, Nancy 1

This paper addresses the problem of fault tolerant control over communication networks which induce time-varying delays in bounded intervals. The problem is formulated in a discrete-time setting by modeling the controlled plant which may be subject to failures as an uncertain discrete-time process connected to a discrete-time controller via a digital communication network. A procedure is presented for the design of a bank of fault-tolerant controllers capable to stabilize and guarantee an mathcal{H}_{2}-performance bound for all faulty plant modes in the presence of network-induced time-varying delays.

15:40-16:00 MoB06.6

Transfer Matrix Approach to the Triangular Decoupling of General Neutral Multi-Delay Systems, pp. 1279-1286

Koumboulis, Fotis N.	Halkis Inst. of Tech.
Panagiotakis, George	HIT

The following major aspects of the problem of Input–Output Triangular Decoupling (TD) for general neutral multi–delay systems, via proportional realizable state feedback, are resolved for the first time: The necessary and sufficient conditions for the problem to have a realizable solution and the general analytical expressions of the proportional realizable TD controller matrices. The conditions and the solution of the controller matrices are computed using a finite step pure algebraic approach.

MoB07 310B

Linear Systems Analysis (Regular Session)

Chair: Willems, Jan C.	K.U. Leuven
Co-Chair: Malabre, Michel	UMR CNRS 6597

14:00-14:20 MoB07.1

A Period-Specific Realization of Linear Continuous-Time Systems, pp. 1287-1292

Hodaka, Ichijo	Univ. of Miyazaki
Jikuya, Ichiro	Nagoya Univ.

It is a well-known fact that a weighting pattern matrix is realizable as a linear periodic system if and only if the matrix is separable and periodic. This fact, however, can not cope with a reasonable question when a weighting pattern matrix can be realized as a linear periodic system with a specific period of time. This paper answers the question by constructing two types of period-specific realizations. Moreover, this paper describes in detail how the lowest dimension of period-specific realizations is identified.

14:20-14:40 MoB07.2

Singularly Perturbed Derivative Coupling-Filter, pp. 1293-1298

Mendez Delgadillo, Hugo	CINVESTAV - IPN
Bonilla, Moises E.	CINVESTAV-IPN
Malabre, Michel	UMR CNRS 6597
Pacheco Martínez, Jaime	CINVESTAV - IPN

In some control and observations problems, it may be convenient, at least from the analysis point of view, to use non proper systems. However, as far as their implementation is concerned, proper approximations have to be designed. In this paper, we show how exponential approximations can be rather easily designed. We consider the MIMO case and study the relative stability of the pproximation. As a by product, we show that the set of proper time-invariant linear systems is dense in the set of regular linear descriptor systems.

14:40-15:00 MoB07.3

A Factorization Approach for the L-Infinity-Gain of Discrete-Time Linear Systems, pp. 1299-1304

Picasso, Bruno	Univ. di Pisa and Pol. di Milano
Colaneri, Patrizio	Pol. di Milano

A method is presented for the computation of an upper bound for the L-infinity-gain of discrete-time BIBO-stable linear systems. The bound is proved to be tight for single-input positive systems. The approach is suitable to deal with the problem of the synthesis of a static output feedback ensuring that the L-infinity-gain of the closed loop dynamics is below a desired threshold: a sufficient criterion is provided which consists of the solution of a system of linear inequalities. Numerical examples are reported.

15:00-15:20 MoB07.4

Averaging and Stability of Time-Varying Discrete-Time Linear Systems, pp. 1305-1310

Vargas, Alessandro N.	UNICAMP
Do Val, Joao B.R.	UNICAMP - FEEC

Stability results for time-varying systems with output averaged using the norm are established. The discrete-time linear system is considered under a bound on time-average on the mean-value of the output norm. It is shown that under controllability, observability and a uniform bound on the matrix norm, the time-varying system is asymptotically and uniformly stable. If, in addition, the solution of the autonomous part of the system state is almost periodic, then under an additional limiting condition the system is uniformly asymptotically stable.

15:20-15:40 MoB07.5

On Rational Quadratic Differential Forms, pp. 1311-1318

Takaba, Kiyotsugu	Kyoto Univ.
Trentelman, Harry L.	Univ. of Groningen
Willems, Jan C.	K.U. Leuven

In linear system theory, we often encounter the situation of investigating some quadratic functionals which represent Lyapunov functions, energy storage, performance measures, e.t.c. Such a quadratic functional is called a quadratic differential form (QDF) in the context of the behavioral approach. In the past works, a QDF is usually defined in terms of a polynomial matrix. The contribution of this paper is to present a new and more general formulation of QDF's in terms of rational functions rather than polynomials. A QDF defined by rational functions is called a rational QDF. Unlike polynomial QDF's, a rational QDF defines a set of values of a quadratic functional. It turns out that several basic features of polynomial QDF's (nonnegativity, average nonnegativity, e.t.c.) can be generalized to the case of rational QDF's.

15:40-16:00 MoB07.6

Analysis and Improvements of a Systematic Componentwise Ultimate-Bound Computation Method, pp. 1319-1324

Haimovich, Hernan	Univ. Nacional de Rosario
Kofman, Ernesto	UNR
Seron, Maria	The Univ. of Newcastle

We perform in-depth analysis and provide improvements of a systematic componentwise ultimate-bound computation method recently introduced in the literature. This method was shown to have many advantages over traditional ultimate-bound computation methods based on the use of quadratic Lyapunov functions. The analysis performed enhances our understanding of the componentwise methodology, and simplifies the search for improvements. The improvements provided aim at reducing the conservatism of the componentwise ultimate-bound computation methods even further, hence leading to tighter bounds. These improvements do not alter the systematic nature of the method.

MoB08 310C

LMIs and Algebraic Methods in Control (Invited Session)

Chair: Ebihara, Yoshio — Kyoto Univ.
Co-Chair: Oishi, Yasuaki — Nanzan Univ.
Organizer: Ebihara, Yoshio — Kyoto Univ.
Organizer: Oishi, Yasuaki — Nanzan Univ.

14:00-14:20 MoB08.1

Robust Controller Synthesis for Disturbance Filter Uncertainty Described by Dynamic Integral Quadratic Constraints., pp. 1325-1330

Dietz, Sjoerd — Delft Univ. of Tech.
Scherer, Carsten W. — Delft Univ. of Tech.
Koroglu, Hakan — Delft Univ. of Tech.

Robust controller synthesis is considered for disturbances generated by an uncertain filter. The uncertainties are characterized by an integral quadratic constraint (IQC) with general frequency dependent multipliers. By exploiting the problem structure originating from the fact that the uncertainty enters the disturbance filter but not the plant, it is shown how to derive LMI-synthesis conditions for an a priori specified Ltwo-induced gain. For a specific sinusoidal disturbance rejection problem, it is shown that specifying a bound on the rate-of-variation of an uncertain parameter can improve performance if compared to earlier results based on static scalings.

14:20-14:40 MoB08.2

Sum-Of-Squares Approximations to Robust Semidefinite Programs with Functional Variables: A Region-Dividing Approach (I), pp. 1331-1336

Jennawasin, Tanagorn — The Univ. of Tokyo
Oishi, Yasuaki — Nanzan Univ.

In this paper, we consider robust semidefinite programs with functional variables. In the proposed approach, an approximate semidefinite program is constructed based on approximation with the sum-of-squares technique. Unlike the conventional use of the sum-of-squares technique, the quality of approximation is improved by dividing the parameter region into several subregions. The idea is generalized from that of Jennawasin and Oishi (in Proceedings of the 46th IEEE Conference on Decision and Control, New Orleans, USA, December 2007), where robust semidefinite programs without functional variables are considered. The present approach is asymptotically exact in the sense that the optimal value of the approximate problem converges to that of the original problem as the resolution of the division becomes finer. Our approach also gives an a priori upper bound on the discrepancy between the optimal values of the two problems in terms of the resolution of the division.

14:40-15:00 MoB08.3

Modeling and Solving Uncertain Optimization Problems in YALMIP (I), pp. 1337-1341

Löfberg, Johan — Linköping Univ.

A considerable amount of optimization problems arising in the control and systems theory field can be seen as special instances of robust optimization. Much of the modeling effort in these cases is spent on converting an uncertain problem to a robust counterpart without uncertainty. Since many of these conversions follow standard procedures, it is amenable to software support. This paper presents the robust optimization framework in the modeling language YALMIP, which carries out the uncertainty elimination automatically, and allows the user to concentrate on the high-level model instead.

15:00-15:20 MoB08.4

Sum of Roots Characterization for Parametric State Feedback H_infty Control (I), pp. 1342-1347

Kanno, Masaaki — Japan Science and Tech. Agency
Hara, Shinji — The Univ. of Tokyo

This paper is concerned with the solution of state feedback H_infty control for a single-input-single-output plant with parameters, and an algebraic approach that utilizes the so-called `sum of roots' is developed. A method is firstly devised that computes a polynomial which contains the optimal cost as one of its roots. Furthermore it is shown that an optimal/sub-optimal static feedback gain can be expressed in terms of plant parameters and the sum of roots. The proposed approach thus suggests that the sum of roots is useful for characterizing an achievable H_infty performance level as well as some H_2 performance limitations.

15:20-15:40 MoB08.5

Robust H2 Perfomance of Discrete-Time Periodic Systems: LMIs with Reduced Dimensions (I), pp. 1348-1353

Peaucelle, Dimitri — LAAS-CNRS
Ebihara, Yoshio — Kyoto Univ.
Arzelier, Denis — LAAS-CNRS

Recent papers in the field of LMI-based robust control have provided extensions of known results for linear time-invariant systems to the case of periodically time varying linear systems. These results, theoretically satisfactory because formulated in terms of optimization problems of polynomial complexity, may still have limited applications in practice because the number of variables and constraints is very large. The present paper proposes a new formulation of these results that allows to reduce the computational burden both by reducing the number of decision variables and the size of the constraints. Along with this numerical improvement, the paper produces a new modeling of periodic discrete-time systems in descriptor form that is believed promising for future research.

15:40-16:00 MoB08.6

LMI-Based Periodically Time-Varying Dynamical Controller Synthesis for Discrete-Time Uncertain Linear Systems (I), pp. 1354-1359

Ebihara, Yoshio — Kyoto Univ.
Peaucelle, Dimitri — LAAS-CNRS
Arzelier, Denis — LAAS-CNRS

In this paper, we propose a new LMI-based method for robust state-feedback controller synthesis of discrete-time linear periodic/time-invariant systems subject to polytopic uncertainties. In stark contrast with existing approaches that are confined to static controller synthesis, we explore dynamic controller synthesis and reveal a particular periodically time-varying dynamical controller structure that allows LMI-based synthesis. In particular, we prove rigorously that the proposed design method encompasses the well-known extended-LMI-based design methods as particular cases. Through numerical experiments, we demonstrate that the suggested design method is indeed effective to achieve less conservative results.

MoB09 311C

Errors in Variables Identification (Regular Session)

Chair: Aguero, Juan C — The Univ. of Newcastle
Co-Chair: Malti, Rachid — Univ. Bordeaux1

14:00-14:20 MoB09.1

Bias-Compensation Based Method for Errors-In-Variables Model Identification, pp. 1360-1365

Ikenoue, Masato — Ariake National Coll. of Tech.
Kanae, Shunshoku — Kyushu Univ.
Yang, Zi-Jiang — Kyushu Univ.
Wada, Kiyoshi — Kyushu Univ.

It is well known that least-squares (LS) method gives biased parameter estimates when the input and output measurements are corrupted by noise. One possible approach for solving this bias problem is the bias-compensation based method such as the bias-compensated least-squares (BCLS) method. In this paper, a new bias-compnesation based method is proposed for identification of noisy input-output system. The proposed method is based on compensation of asymptotic bias on the instrumental variables type (IV-type) estimates by making use of noise covariances estimates. In order to obtain the noise covariances estimates, an overdetermined system of equations is introduced, and the noise covariances estimation algorithm is derived by solving this overdetermined system of equations. From the combination of the parameter estimation algorithm and the noise covariances estimation algorithm, the proposed biascompensated instrumental variables type (BCIV-type) method can be established. The results of a simulated example indicate that the proposed algorithm provides good estimates.

14:20-14:40 MoB09.2

Recursive Identification of EIV ARMA Processes, pp. 1366-1371

Chen, Han Fu — AMSS, Chinese Acad. of Sciences

Easily computable recursive algorithms are proposed for estimating coefficients of A(z), C(z), and the covariance matrix R_w of w_k for the multivariate ARMA process A(z)y_k=C(z)w_k on the basis of the noise-corrupted observations eta_kdeq y_k+epsilon_k. It is shown that the estimates converge to the true ones under reasonable conditions. An illustrative example is provided, and the simulation results are shown to be consistent with the theoretical analysis.

14:40-15:00 MoB09.3

Accuracy Analysis of Time-Domain Maximum Likelihood Method and Sample Maximum Likelihood Method for Errors-In-Variables Identification, pp. 1372-1377

Hong, Mei — Uppsala Univ.
Soderstrom, Torsten — Uppsala Univ.
Schoukens, Johan — Vrije Univ. Brussel
Pintelon, Rik — Vrije Univ. Brussel

The time domain maximum likelihood (TML) method and the sample maximum Likelihood (SML) method are two approaches for identifying errors-in-variables models. Both methods may give the optimal estimation accuracy (achieve Cram'er-Rao lower bound) but in different senses. In the TML method, an important assumption is that the noise-free input signal is modeled as a stationary process with rational spectrum. For SML, the noise-free input needs to be periodic. It is interesting to know which of these assumptions contain more information to boost the estimation performance. In this paper, the estimation accuracy of the two methods is analyzed statistically. Numerical comparisons between the two estimates are also done under different signal-to-noise ratios (SNRs). The results suggest that TML and SML have similar estimation accuracy at moderate or high SNR.

15:00-15:20 MoB09.4

Identification of Errors-In-Variables Models Using the EM Algorithm, pp. 1378-1383

ALMutawa, Jaafar — King Fahd Univ. of Petroleum & Minerals

In this paper, we develop a new subspace system identification algorithm for the errors-in-variables (EIV) state space model via the EM algorithm. To initialize the EM algorithm an initial estimate is obtained by the classical errors-in-variables subspace system identification method: EIV-MOESP cite{MOESP} and EIV-N4SID cite{N4SID}. The EM algorithm is an algorithm to compute the maximum value for the likelihood function that is consists of two steps; namely the E- and M-steps. The E- and M-steps in the EM algorithm are calculated by computing the conditional expectation under the assumption that the input-output data is completely observed. Numerical examples show that the EM algorithm can monotonically improve the initial estimates obtained by subspace identification methods.

15:20-15:40 MoB09.5

Efficient Estimation of Errors-In-Variables Models, pp. 1384-1389

Vajk, Istvan — Budapest Univ. of Tech. and Ec.
Hetthessy, Jeno — Budapest Univ. of Tech. and Ec.

The paper addresses the discrete-time linear process identification problem assuming noisy input and output records available for the parameter estimation. The efficient algorithms are derived for the simultaneous estimation of the process and noise parameters. Implementation techniques based on matrix and polynomial decompositions are given in details resulting in estimation algorithms with reduced computation demand. The presented algorithms deliver the parameter estimation in an iterative way as a result of a generalized eigenvalue-eigenvector or a generalized singular value decomposition.

15:40-16:00 MoB09.6

Gradient-Based Approaches for Recursive Frisch Scheme Identification, pp. 1390-1395

Linden, Jens G. — Coventry Univ.
Vinsonneau, Benoit — Coventry Univ.
Burnham, Keith J. — Coventry Univ.

An algorithm for recursive Frisch scheme system identification of linear single-input single-output errors-in-variables systems is developed. For the update of the estimated model parameters, a recursive bias-compensating least squares algorithm, which is based on the well-known recursive least squares technique, is considered. The estimate of the output measurement noise variance is determined using a conjugate gradient method, which tracks the smallest eigenvalue of a slowly varying matrix. For the update of the input measurement noise estimate, a steepest gradient search is applied. It tracks the minimum of a model selection cost function, which is based on a set of high order Yule-Walker equations.

MoB10 311B

Prediction, Filtering and Smoothing II (Regular Session)

Chair: Novara, Carlo — Pol. di Torino
Co-Chair: Chen, Tongwen — Univ. of Alberta

14:00-14:20 MoB10.1

Switched IMM-EV Algorithms for State Estimation of Some Jump Markov Systems, pp. 1396-1401

Ho, Tan-Jan — Chung Yuan Christian Univ.

We consider state estimation for a class of jump Markov linear discrete-time systems. For this, we present an algorithm employing switches among two interacting multiple-model extended-Viterbi (IMM-EV) estimators. The models we adopt for describing the systems can be used in problems such as the tracking of targets capable of abrupt maneuvers and fault detection of systems subject to possible component failures. A maneuver detection scheme, and a method for detecting maneuver termination are integrated into the proposed algorithm. Both methods determine when switches between two IMM-EV algorithms have to be invoked. A numerical example illustrates that the proposed algorithm can be an improvement to several known algorithms.

14:20-14:40 MoB10.2

A New Parameter-Dependent Approach to Discrete-Time Robust H_{2} Filtering, pp. 1402-1407

Gao, Huijun — Harbin Inst. of Tech.
Meng, Xiangyu — Harbin Inst. of Tech.
Chen, Tongwen — Univ. of Alberta

This paper revisits the problem of robust H_{2} filtering for discrete-time systems with parameter uncertainties. Given a stable system with parameter uncertainties residing in a polytope with s vertices, the focus is on designing a robust filter such that the filtering error system is robustly asymptotically stable and has a guaranteed estimation error variance for the entire uncertainty domain. A new polynomial parameter-dependent idea is introduced to solve the robust H_{2} filtering problem, which is different from the quadratic framework that entails fixed matrices for the entire uncertainty domain, or the linearly parameter-dependent framework that uses linear convex combinations of s matrices. This idea is realized by carefully selecting the structure of the matrices involved in the products with system matrices. A linear matrix inequality (LMI) condition is obtained for the existence of admissible filters, and based on this, the filter design is cast into a convex optimization problem, which can be readily solved via standard numerical software. The merit of the proposed method lies in its less conservativeness than the existing robust filter design methods, as illustrated via a numerical example.

14:40-15:00 MoB10.3

High-Gain Observer-Based Parameter Identification with Application in a Gas Turbine Engine, pp. 1408-1413

Gao, Zhiwei — The Univ. of Manchester
Dai, Xuewu — Univ. of Manchester
Breikin, Tim — Univ. of manchester
Wang, Hong — the Univ. of Manchester

In this paper, a novel identification technique, that is high-gain observer-based identification approach, is proposed for systems with bounded process and measurement noises. For system parameters with abnormal changes, an adaptive change detection and parameter identification algorithm is next presented. The presented technique and algorithm is finally applied to the parameter identificationof thegas turbine engine by using the recorded input data from the engine test-bed. The identified parameters and the response curves are desired. The simulations have proved the effectiveness of the proposed procedure compared with the previous identification approach.

15:00-15:20 MoB10.4

Stability of Signal Reconstruction Filters Via Cardinal Exponential Splines, pp. 1414-1419

Nagahara, Masaaki — Kyoto Univ.
Yamamoto, Yutaka — Kyoto Univ.
Khargonekar, Pramod P. — Univ. of Florida

There is a new trend in digital signal processing. It is gradually recognized that while the processing is done in the digital domain, its performance must be measured in the analog domain.This framework was proposed by the present authors and co-workers, and also recently proposed by Unser and his co-workers. While our approach relies on modern sampled-data control theory which minimizes an analog H^∞ performance criterion, Unser independently proposed an oblique projection method. This paper examines their method, and shows that their method often leads to instability of designed filters. A comparison with the sampled-data method is made, along with some design examples, which shows the advantage of the sampled-data method.

15:20-15:40 MoB10.5

Multiple-Level Quantized Innovation Kalman Filter, pp. 1420-1425

You, Keyou	Nanyang Tech. Univ.
Xie, Lihua	Nanyang Tech. Univ.
Sun, Shuli	Heilongjiang Univ.
Xiao, Wendong	Inst. for Infocomm Res.

In this paper, we study a general multiple-level quantized innovation Kalman filter (MLQ-KF) for estimation of linear dynamic stochastic systems. First, given a multi-level quantization of innovation, we derive the corresponding MMSE filter in terms of the given quantization levels under the assumption that the innovation is approximately Gaussian. By optimizing the filter with respect to the quantization levels, we obtain an optimal quantization scheme and the corresponding optimal MLQ-KF. The optimal filter is given in terms of a simple Riccati difference equation as in the standard Kalman filter. For the case of 1-bit transmission, our proposed optimal filter gives a better performance than the sign-of-innovation filter (SOI-KF) Ribeiro et al. [2006]. The convergence of the MLQ-KF to the standard Kalman filter is established.

15:40-16:00 MoB10.6

A Level Measurement Method Based on Acoustic Resonance Using Unscented Kalman Filter, pp. 1426-1431

Deghat, Mohammad	Shiraz Univ.
Karimaghaee, Paknosh	Shiraz Univ.

An accurate and low-cost level measurement method based on acoustic resonance is presented. The method is useful in the cases that measurements are noisy which might be due to environment noise or due to low-cost instruments used in the measurement process. An iterative nonlinear filtering algorithm, called the “Unscented Kalman filter” (UKF) has been employed to obtain a good estimate of the noisy measurements. Simulation and experimental tests have been carried out indicating that the UKF greatly improves the accuracy of the measured level.

MoB11 311A

Nonlinear Systems II (Regular Session)

Chair: Xia, Xiaohua	Univ. of Pretoria
Co-Chair: Sun, Jing	Univ. of Michigan

14:00-14:20 MoB11.1

Counteracting the Effects of Adversarial Inputs on Asynchronous Sequential Machines, pp. 1432-1437

Yang, Jung Min	Catholic Univ. of Daegu
Hammer, Jacob	Univ. of Florida

The problem of counteracting the effects of adversarial inputs on the operation of an asynchronous sequential machine is considered. The objective is to build an automatic state-feedback controller that returns an asynchronous sequential machine to its original state, after the machine has undergone a state transition caused by an adversarial input. It is shown that the existence of such a controller depends on certain reachability and detectability properties of the affected machine.

14:20-14:40 MoB11.2

Flatness-Based Pre-Compensation of Laser Diodes, pp. 1438-1441

Abichou, Azgal	Tunisia Pol. School
El Asmi, Sadok	Univ. du 7 Novembre, SUPCOM
Rouchon, Pierre	ENSMP

A physical nonlinear dynamical model of a laser diode is considered. We propose a feed-forward control scheme based on differential flatness for the design of input-current modulations to compensate diode distortions. The goal is to transform without distortion a radio-frequency current modulation into a light modulation leaving the laser-diode and entering an optic fiber. We prove that standard physical dynamical models based on dynamical electron and photons balance are flat systems when the current is considered as control input, the flat output being the photon number (proportional to the light power). We prove that input-current is an affine map of the flat output, its logarithm and their time-derivatives up to order two. When the flat output is an almost harmonic signal with slowly varying amplitude and phase, these derivatives admit precise analytic approximations. It is then possible to design simple analogue electronic circuits to approximate the nonlinear computations required by our flatness-based approach. Simulations with the parameters of a commercial diode illustrate the practical interest of this pre-compensation scheme and its robustness versus modeling and analogue implementation errors.

14:40-15:00 MoB11.3

Partial Semi-Stability for a Class of Nonlinear Systems, pp. 1442-1447

Costa, Eduardo F.	Univ. de São Paulo
Astolfi, Alessandro	Imperial Col. London & Univ. of Rome Tor Vergata

This paper studies partial semi-stability for a class of non-linear systems. The system is sufficiently specialised to yield an algebraic test relying on the data A and Sigma, describing the dynamics of part of the state of the system and its initial condition. Comments on the applicability of the result to the study of stability properties of Kalman filters are included.

15:00-15:20 MoB11.4

State Estimation Based Model Predictive Control for LHD Vehicles, pp. 1448-1453

Nuńez, Felipe	Pontificia Univ. Catolica de Chile
Navarro, Sergio	Pontificia Univ. Catolica de Chile
Aguado, Alberto	Inst. of Cybernetics, Mathemtics and Physics.
Cipriano, Aldo	Pontificia Univ. Catolica de Chile

LHD (load-haul-dump) vehicles are used extensively in underground mining operations for ore transporting, primarily in tunnels where access is difficult or dangerous. To ensure underground efficient and safe LHD’s performance, a robust feedback control strategy is needed. A state estimation based MPC scheme was designed for control purposes, and evaluated by simulation. The state estimator was developed by testing four approaches, in order to select the optimal one: the extended Kalman filter, particle filter, moving horizon estimation and a genetic algorithm based moving horizon estimation. The simulation shows that non-linear MPC performs better than linear MPC for path tracking.

15:20-15:40 MoB11.5

Overcoming Singularity and Degeneracy in Neighboring Extremal Solutions of Discrete-Time Optimal Control Problem with Mixed Input-State Constraints, pp. 1454-1459

Ghaemi, Reza	Univ. of Michigan (Ann Arbor)
Sun, Jing	Univ. of Michigan
Kolmanovsky, Ilya V.	Ford Motor Co.

Neighboring Extremal Optimal approach is effective in solving optimal control problems through approximation. Under certain conditions, a matrix involved in the calculation of optimal control approximation can become singular, leading to a technical difficulty in the application of the approach. These situations may include the cases when a constraint depends only on the states but not the inputs, or the cases when the inequality constraints outnumber the inputs. In this paper, we propose a solution that can circumvent this technical difficulty. First, by back-propagating the state constraints, we show that input-independent constraints can be recast as the state-input constraints to avoid the matrix singularity. The back-propagation, however, might lead to another problem of ``degeneracy,'' where a back-propagated constraint is imposed on the initial state, so that no feasible neighboring extremal solution exists for the problem. In the latter case, a linear programming approach is proposed to deal with this degeneracy. A ship maneuvering control problem is used in the paper to illustrate the singularity and degeneracy issues, and to elucidate the mechanics of the proposed scheme.

15:40-16:00 MoB11.6

Stabilization for a Class of Nonlinear Systems: A Fuzzy Logic Approach, pp. 1460-1465

Di Gennaro, Stefano	Univ. di L'Aquila

Castillo-Toledo, Bernardino CINVESTAV-GDL, Mexico

In this paper, the problem of stabilization for the class of continuous time nonlinear systems which are exactly discretized is addressed. By using the Takagi-Sugeno model approach, a discrete controller capable of stabilizing the discrete TS model and the continuous model as well, is obtained. This scheme allows the use of a digital controller for stabilizing an analog plant.

MoB12 313
Iterative Learning Control I (Regular Session)

Chair: Rogers, Eric — Univ. of Southampton
Co-Chair: Karimi, Alireza — Ec. Pol. Federale de Lausanne

14:00-14:20 MoB12.1

Performance Assessment Measures of Batch Processes for Iterative Learning Control, pp. 1466-1471

Chen, Junghui — Chung-Yuan Christian Univ.
Kong, Cho-Kai — Chung-Yuan Christian Univ.

A new method is proposed for the assessment of the batch control system when the iterative learning control is applied. Unlike the continuous process, the performance assessment of the batch process requires particular attention to both disturbance changes and setpoint changes. Because of the intrinsically dynamic operations and the nonlinear behavior of batch processes, the conventional approach of the controller assessment cannot be directly applied. The bounds at each time point are derived and computed for the controlled output variance to create simple monitoring charts. They can help tracking the progress in each batch run to monitor the occurrence of the observable upsets. Simulation cases are used to demonstrate the advantages of the proposed strategies.

14:20-14:40 MoB12.2

Design and Stability Discussion of a Hybrid Intelligent Controller, pp. 1472-1477

Mohammadzaheri, Morteza — Univ. of Adelaide
Chen, Lei — Adelaide Univ.

In this paper, the pitch angle control of a laboratory model helicopter is discussed. The control has some specific features. As a main feature, it is observed that the steady state control command is completely dependent on the setpoint, so error-based controller design is not applicable to this case. Moreover, the system has a highly oscillating dynamics. In order to solve this control problem, two controllers are designed, an artificial neural network, whose input is the setpoint, is used to provide the steady state control command, and a fuzzy inference system ,whose input is the error of the system, is used to provide the transient control command. The total control command is the sum of the aforementioned two control commands. It is proved that both ANN and FIS are bounded-input bounded-output (BIBO) systems.

14:40-15:00 MoB12.3

Iterative Learning Control Based on Stochastic Approximation, pp. 1478-1483

Butcher, Mark Edward John — Ec. Pol. Federal de Lausanne
Karimi, Alireza — Ec. Pol. Federale de Lausanne
Longchamp, Roland — Ec. Pol. Federale De Lausanne

In this paper stochastic approximation theory is used to produce Iterative Learning Control (ILC) algorithms which are less sensitive to stochastic disturbances, a typical problem for the learning process of standard ILC algorithms. Two algorithms are developed, one to obtain zero mean controlled error and one to minimise the mean 2-norm of the controlled error. The former requires a certain knowledge of the system but in the presence of noise can give reasonably rapid convergence. The latter can either use a model or be model free by employing a second experiment.

15:00-15:20 MoB12.4

A Design Method of Robust Stabilizing Simple Multi-Period Repetitive Controllers, pp. 1484-1489

Yamada, Kou — Gunma Univ.
Hagiwara, Takaaki — Graduate School of Engineering, Gunma Univ.
Takenaga, Hiroshi — Graduate school of Engineering, Gunma Univ.
Kobayashi, Masahiko — Gunma Univ.

The multi-period repetitive control system is a type of servomechanism for the periodic reference input. Even if the plant does not include time-delay, the transfer function from the periodic reference input to the output and that from the disturbance to the output of the multi-period repetitive control system generally have an infinite number of poles. In order to specify the input-output characteristic and the disturbance attenuation characteristic easily, Yamada et al. propose the concept of simple multi-period repetitive control systems such that the controller works as a stabilizing multi-period repetitive controller and the transfer function from the periodic reference input to the output and that from the disturbance to the output have a finite number of poles. However, the method by Yamada et al. cannot apply for the plant with uncertainty. The purpose of this paper is to propose the concept of robust stabilizing simple multi-period repetitive controllers for the plant with uncertainty and to clarify the parametrization of all robust stabilizing simple multi-period repetitive controllers.

15:20-15:40 MoB12.5

Perfect Tracking of Repetitive Signals for a Class of Nonlinear Systems, pp. 1490-1495

Yang, Zaiyue — Univ. of Hong Kong
Chan, Che Wai — Univ. of Hong Kong

Perfect tracking of the output of a class of nonlinear systems that has a unique response for a given input and is subject to repetitive reference input is considered in this paper. A conditional learning scheme guaranteeing sufficient knowledge can be learned iteratively to improve the input to achieve perfect tracking is proposed. The sufficient condition for monotonic convergence of the input sequence and the choice of the learning gains are given. The tracking performance of the proposed scheme is illustrated by a simulated example.

15:40-16:00 MoB12.6

Strong Practical Stability and Stabilization of Uncertain Discrete Linear Repetitive Processes, pp. 1496-1501

Dabkowski, Pawel — Nikolaus Copernicus Univ. in Torun
Galkowski, Krzysztof — Univ. of Zielona Gora
Rogers, Eric — Univ. of Southampton
Kummert, Anton — Univ. of Wuppertal

Repetitive processes are a distinct class of 2D systems of both theoretical and practical interest. The stability theory for these processes currently consists of two distinct concepts termed asymptotic stability and stability along the pass respectively where the former is a necessary condition for the latter. Recently applications have arisen where asymptotic stability is too weak and stability along the pass is too strong for meaningful progress to be made. Previously reported work has defined the concept of strong practical stability for such cases and produced Linear Matrix Inequality (LMI) based necessary and sufficient conditions for it to hold. These can then be used as a basis for the design of a stabilizing control law. In this paper the (more practically relevant) case when there is uncertainty associated with the process description which is assumed to be of the norm bounded form is considered.

MoB13 314
Distributed Estimation and Consensus I (Regular Session)

Chair: Mareels, Iven — The Univ. of Melbourne
Co-Chair: Keviczky, Tamas — Delft Univ. of Tech.

14:00-14:20 MoB13.1

Algebraic Criteria for Consensus Problem of Discrete-Time Networked Systems, pp. 1502-1509

Li, Zonggang — Beihang Univ.
Jia, Yingmin — Beihang Univ.
Du, Junping — Beijing Univ. of Posts and Telecommunications
Yu, Fashan — Henan Pol. Univ.

This paper is mainly devoted to the algebraic criteria for consensus problems of discrete-time networked systems with the fixed and switching topology. A special eigenvector w of the Laplacian matrix is first correlated with the connectivity of a digraph, and then the relations between a class of Laplacian-type matrix and the stochastic matrix are established. Based on these tools, some necessary and/or sufficient algebraic conditions are proposed, which can directly determine whether the consensus problem can be solved or not. Furthermore, it is proved that only the agents corresponding to the positive elements of w contribute to the group decision value and decide the collective behavior of the system. Particularly for the fixed topology case, it is shown that not only the role of each agent is exactly proportional to the value of the corresponding element of w but also the group decision value can be calculated by such a vector and the initial states of all agents.

14:20-14:40 MoB13.2

Robustness of Distributed Multi-Agent Consensus, pp. 1510-1515

Wang, Jinzhi — Peking Univ.
Mareels, Iven — The Univ. of Melbourne
Tan, Ying — The Univ. of Melbourne

Distributed consensus schemes in the presence of measurement errors are analyzed for both first-order and second-order dynamic agents. The connection between consensus error of coordination variables and the measurement errors is derived. Analytic estimates of consensus error are given. A design problem based on minimizing the ``error gain'' is thus identified. Several examples illustrate our results.

14:40-15:00 MoB13.3

A Study on Distributed Model Predictive Consensus, pp. 1516-1521

Keviczky, Tamas — Delft Univ. of Tech.
Johansson, Karl Henrik — Royal Inst. of Tech.

We investigate convergence properties of a proposed distributed model predictive control (DMPC) scheme, where agents negotiate to compute an optimal consensus point using an incremental subgradient method based on primal decomposition as described in Johansson et al. [2006, 2007]. The objective of the distributed control strategy is to agree upon and achieve an optimal common output value for a group of agents in the presence of constraints on the agent dynamics using local predictive controllers. Stability analysis using a receding horizon implementation of the distributed optimal consensus scheme is performed. Conditions are given under which convergence can be obtained even if the negotiations do not reach full consensus.

15:00-15:20 MoB13.4

Nonlinear Multi-Agent System Consensus with Time-Varying Delays, pp. 1522-1527

Muenz, Ulrich — Univ. of Stuttgart
Papachristodoulou, Antonis — Univ. of Oxford
Allgower, Frank — Univ. of Stuttgart

Most consensus protocols for Multi-Agent Systems (MAS) presented in the past do not consider communication constraints such as delays in the exchange of information between the agents. In this paper, we provide conditions for a nonlinear, locally passive MAS with time-varying communication delays to reach a consensus, using a recently presented method based on an invariance principle for Lyapunov-Razumikhin functions. We consider both the cases of fixed and switching topologies. In the case of a fixed topology, the underlying directed graph has to contain a spanning tree. In the case of a switching topology, only the union graph of all graphs that persist over time is required to contain a spanning tree.

15:20-15:40 MoB13.5

Leader-Following Consensus Control for Multi-Agent Systems under Measurement Noises, pp. 1528-1533

Ma, Cui-Qin — Chinese Acad. of Sciences
Li, Tao — Chinese Acad. of Sciences
Zhang, Ji-Feng — Chinese Acad. of Sciences

This paper is concerned with leader-following consensus control for multi-agent systems under measurement noises. Time-varying consensus gains are introduced into the network protocol designed. By using the tools of stochastic analysis and algebraic graph theory, a sufficient condition is obtained for the protocol to ensure strong mean square consensus under the fixed topologies. This condition is shown to be necessary and sufficient in the noise-free case. In addition, by using a common Lyapunov function, the result is extended to the switching topology case.

15:40-16:00 MoB13.6

Switching Control of a Modified Leader-Follower Team of Agents under the Leader and Network Topological Changes, pp. 1534-1540

semsar Kazerooni, Elham — Concordia Univ.
Khorasani, Khashayar — Concordia Univ.

In this paper the existence of a common Lyapunov function for stability is guaranteed in a switching network of agents. The objective of the team is to achieve consensus in a modified leader-follower team while the team structure is changing during the mission. The stability of the team dynamics is guaranteed for networks with both balanced or unbalanced describing graphs with directional communication links. Although the original design strategy is based on an optimal control approach, for determining a common Lyapunov function the optimal gains have to be reselected. However, by introducing a criterion for control gains selection, a desirable performance can still be achieved. In this paper, we concentrate on one of the many possible criteria, namely performance-control effort criterion in details. Simulation results are presented to illustrate the performance and capabilities of the team in presence of a switching structure and switching leader scenarios.

MoB14 318

Control and Synchronization of Networks (Regular Session)

Chair: Hill, David J. — The Australian National Univ.
Co-Chair: Wieland, Peter — Univ. of Stuttgart

14:00-14:20 MoB14.1

On Consensus in Multi-Agent Systems with Linear High-Order Agents, pp. 1541-1546

Wieland, Peter — Univ. of Stuttgart
Kim, Jung-Su — Univ. of Stuttgart
Scheu, Holger — Univ. of Stuttgart
Allgower, Frank — Univ. of Stuttgart

Consensus of a group of agents in a multi-agent system is considered. All agents are modeled by identical linear nth order dynamical systems and the interconnection topology between the agents is modeled as a directed weighted graph. We provide answers to the questions whether the group converges to consensus and what consensus value it eventually reaches. Furthermore, we give a necessary and sufficient condition for convergence to consensus in the double integrator case and propose an LMI-based design for group consensus in the general case. An example is used to illustrate the results.

14:20-14:40 MoB14.2

Master Stability Equations of Complex Dynamical Networks with General Topology, pp. 1547-1552

Sun, Hongfei — Xiamen Univ.
Hill, David J. — The Australian National Univ.

The master stability equations for a complex dynamical network with general topology are obtained. Compared to prior work, we remove almost all the restrictions on the graph of the network. The coupling configuration matrix is not necessarily diagonalizable, the coupling coefficients are not necessarily nonnegative, and the graph of the network can be directed. These new master stability equations as for those in the previous studies are still very effective in analyzing the stability of complex dynamical networks in terms of synchronization to a manifold. We present some new observations on stability. A new concept “heavily connected”, which can be regarded as the generalization of both “connected” for an undirected graph and “strong connected” for a directed graph, is proposed. The proofs of the two main theorems are very short but can substitute many of those in the literature.

14:40-15:00 MoB14.3

Transition to Complex Behavior in Networks of Coupled Dynamical Systems, pp. 1553-1558

Barajas-Ramirez, Juan Gonzalo — IPICYT Res. Center
Femat, Ricardo — IPICYT

The emergence of complex behavior is studied in a network of coupled dynamical systems whose trajectories converge to a stable equilibrium point. The effects of network topology on the stability of its synchronized behavior is measured in terms of transverse Lyapunov exponents. By choosing a suitable coupling configuration, the transverse Lyapunov exponents are made positive, which may lead to the emergence of complex behavior. Moreover, the effects of the coupling configuration can lead to unbounded trajectories. The relationship between the transverse Lyapunov exponents and the eigenvalues of the connectivity matrix is used to establish upper and lower limit values for the transition to complex behavior. The transition criteria are expressed in terms of coupling strength and the number of nodes in the network. There are two main contributions on this manuscript: (1) the analytical derivation of the relationship between the local Lyapunov exponents and those of the entire network as the number of nodes increases, and (2) to show the existence of an interval of coupling strength values for the transition into complex behavior in networks with homogeneous connectivity, which becomes smaller as the number of nodes in the network growths. Additionally, we also show that in networks with heterogeneous connectivity, the trajectories transit directly from stable equilibrium to unbounded behavior. These results are illustrated with numerical simulations.

15:00-15:20 MoB14.4

Synchronization of a Complex Network with Switched Coupling, pp. 1559-1564

Kim, Sehjeong — Australian National Univ.
Hill, David J. — The Australian National Univ.

Synchronization of a complex network with switched coupling is considered. In particular, we establish a simple method to obtain a proper coupling strength for the network. Via switched system theory, with this coupling strength, we achieve synchronization of the network without requiring synchronizability of all possible configurations.

First, we convert the network into a switched system with the reduced number of subsystems which are static complex networks whose configurations are non isomorphic via partitioning all possible configurations generated from the switched coupling. Then, we obtain a finite number of coupling strength candidates from the subsystems. By applying the average dwell time approach, synchronization of the network is indeed achieved with the coupling strength chosen among the candidates.

15:20-15:40 MoB14.5

Synchronization in a Network of Chaotic Solid-State Nd: YAG Lasers, pp. 1565-1570

Posadas-Castillo, Cornelio — Nuevo León Autonomous Univ. (UANL)
Cruz-Hernandez, Cesar — CICESE
Lopez-Gutierrez, Rosa Martha — Baja California Autonomous Univ.

In this work, compex dynamical networks of chaotic solid state Nd:YAG lasers (used as nodes) are arranged in coupled star arrays and synchronized. We consider two cases of interest: i) synchronization without master Nd:YAG laser (where the collective behavior is a new chaotic state) and ii) with master Nd:YAG laser (where the collective behavior is imposed by the dynamics of the master node to multiple slave nodes). Synchronization in complex networks is achieved by appealing to complex systems theory. Synchronization of chaotic Nd:YAG lasers in the complex network is shown in the amplitude of the electronic field of each laser.

15:40-16:00 MoB14.6

Stabilizing Interconnection Characterization for Multi-Agent Systems with Dissipative Properties, pp. 1571-1577

Hirche, Sandra — Tech. Univ. Muenchen
Hara, Shinji — The Univ. of Tokyo

This paper addresses the problem of stabilization and output-synchronization for a network of interconnected nonlinear agents, where each agent is assumed to be dissipative with respect to a specified quadratic supply rate which may differ among the agents. Main results concern the characterization and design of the information exchange structure for stabilization. Applying a linear protocol here, the associated interconnection matrix is characterized based on LMI's, as well as on spectral properties. Additionally a synthesis based on LMI's under structural constraints is proposed. The results are validated in simulations.

MoB15 317

Mechatronics in Agriculture (Regular Session)

Chair: Blanke, Mogens — Tech. Univ. of Denmark
Co-Chair: Visala, Arto — Helsinki Univ. of Tech.

14:00-14:20 MoB15.1

XML Based Graphical User Interface Editor and Runtime Parser for ISO 11783 Machine Automation Systems, pp. 1578-1583

Ohman, Matti — Helsinki Univ. of Tech.
Kalmari, Jouko — Helsinki Univ. of Tech.
Visala, Arto — Helsinki Univ. of Tech.

Graphical user interface design is a very visual process which requires graphical tools. Modern integrated development environments have text editors for writing code and graphical user interface editors for designing the user interface. In ISO 11783 systems this distinction between the program logic and the user interface elements is even more pronounced as the program is executed by the electronic control unit on the agricultural implement while the user interface is being loaded to the virtual terminal in the tractor cabin.

The ISO 11783 standard defines a binary format for loading user interfaces to the virtual terminal. However, using XML format for manipulating and storing user interfaces has many advantages. XML files can be validated and parsed by standard tools and libraries. They are human readable which makes debugging relatively easy. XML files can also be extended to contain new information without breaking existing implementations. Most importantly, describing user interfaces as structured documents allows efficient reuse of composite user interface objects such as entire displays.

14:20-14:40 MoB15.2

Estimating Hay Bale Position with Stereo Vision Technique Using an Omnidirectional Camera, pp. 1584-1589

Farrokhi Teimourlou, Rahman — Hokkaido Univ.
Noguchi, Noboru — Hokkaido Univ.

In path planning of autonomous agriculture vehicles, detecting and identifying obstacles, and taking appropriate collision avoidance measures are critical for safe operation. The goal of this research was to obtain the hay bale distance and position to be used in real-time obstacle avoidance detection for autonomous robot tractors using stereo vision system. The vision system was an omnidirectional camera that have a wide field view and useful for specific applications such as meadow, open field, etc. The estimated hay bales distance from the camera showed that the calibration parameters should be further improved to enable autonomous navigation of a robot tractor in the meadow.

14:40-15:00 MoB15.3

Natural Environment Modeling and Fault-Diagnosis for Automated Agricultural Vehicle., pp. 1590-1595

Blas, Morten Rufus — Tech. Univ. of Denmark
Blanke, Mogens — Tech. Univ. of Denmark

This paper presents initial results for an automatic navigation system for agricultural vehicles. The system uses stereo-vision, inertial sensors and GPS. Special emphasis has been placed on modeling the natural environment in conjunction with a fault-tolerant navigation system. The results are exemplified by an agricultural vehicle following cut grass (swath). It is also demonstrated how faults in the system can be detected and diagnosed using state of the art techniques from fault-tolerant literature. Results in performing fault-diagnosis and fault accomodation are presented using real data.

15:00-15:20 MoB15.4

Calibration Method for 2-Dimensional Laser Scanner Attached on a Robot Vehicle, pp. 1596-1601

Barawid, Oscar Jr. — Hokkaido Univ.
Noguchi, Noboru — Hokkaido Univ.
Ishii, Kazunobu — Hokkaido Univ.

The objective of this study was to develop a calibration method to get the exact position of the 2-dimensional laser scanner mounted on the front of an automated vehicle from a reference coordinate system before the automatic navigation in an orchard application. The research was limited only in calibrating a 2-dimensional laser scanner that gathers distance and angle data of the objects in front of it. The methods used in this research were Hough transform, Euler rotation theorem and LSM (least squares method). The calibration results identified the exact attachment position of the laser scanner with respect to the vehicle coordinates. Finally, field test runs for autonomous guidance with developed calibration was conducted to confirm the travel accuracy improvement. The accuracy of both lateral and heading error for calibrated sensor was higher than run of subjected calibration.

15:20-15:40 MoB15.5

Development of the Biogas Tractor with Two Biogas Feeding Algorithms, pp. 1602-1607

Jaber, Nizar — Hokkaido Univ.
Tsukamoto, Takayuki — Hokkaido Univ.
Noguchi, Noboru — Hokkaido Univ.

The research on biogas tractor was started as a possible solution to reduce tractor's fuel consumption and increase farmer's benefit out of a biogas plant. The tractor was equipped with a fontal gas unit containing 4 cylinders of purified biogas (more than 95% methane) with a volume of 26.5 L each at 19.6 MPa. A pressure regulating system was used to insure constant pressure potential across the biogas injectors. Based on previous study regarding biogas effects on the diesel engine, two possible algorithms were developed and tested. In the field tests, the first one was successful at replacing the high amounts of fuel (about 80%) while the other was able to run the engine at its best efficiency point.

15:40-16:00 MoB15.6

Analysis of Grain Mass Flow Experiments in a Mixed-Flow Dryer, pp. 1608-1612

Gottschalk, Klaus — Leibniz-Inst. für Agrartechnik Potsdam-Bornim e.V. (ATB)
Mellmann, Jochen — Leibniz-Inst. für Agrartechnik Potsdam-Bornim e.V. (ATB)

In Central Europe approximately 30% of the grain must be dried after harvest. The most popular continuous crop dryers are mixed-flow dryers. Although this type of dryer is widely used it is still necessary to optimize many segment processes during the drying. For example there are big differences in the vertical grain particle velocity causing differences in the residence time. The aim of the work was to carry out experiments for the grain mass flow measurements in a semi technical dryer. Based on the results a mathematical and 3D computer model for the grain mass flow will be developed in the future enabling improvements in the prediction of the drying process which does not form part of present study.

MoB16 316

Economic and Management Systems II (Regular Session)

Chair: Wang, Dingwei — Northeastern Univ.
Co-Chair: Barmish, B. Ross — Univ. of Wisconsin

14:00-14:40 MoB16.1

Cognitive Approach in Simulation and Control, pp. 1613-1620

Avdeeva, Zinaida — Inst. of Control Sciences of the Russian Acad.
Kovriga, Svetlana — Inst. of Control Sciences of the Russian Acad. of Sciences

Paper presents brief review of cognitive approach in simulation and control. A class of control problems that are advisable to be solved via cognitive simulation is defined. The basic definitions are made. The method for forming strategy of ill-structured problem solution on the base of cognitive models as applies to socio-economic system is presented. Some trends of further development of cognitive approach are denoted.

14:40-15:00 MoB16.2

On Trading of Equities: A Robust Control Paradigm, pp. 1621-1626

Barmish, B. Ross — Univ. of Wisconsin

The objective of this paper is describe a new paradigm for the trading of equities. In our formulation, the control corresponds to a feedback law which modulates the amount invested I(t) in stock over time. The controller also includes a saturation limit Imax corresponding to a limit on the value at risk. The admissible stock price evolution p(t) over time is modelled as a family P of uncertain inputs against which we seek robust returns. Motivated by the fact that back-testing of candidate trading strategies involves significant cost and effort associated with computational simulation over sufficiently diverse markets, our paradigm involves the notion of synthetic prices and some idealizations involving the volatility of prices and trading liquidity. Our point of view is that a robust performance certification in this somewhat idealized market setting serves as a filter to determine if a trading strategy is worthy of the considerable time and expense associated with full-scale back-testing. The paper also includes a description of a so-called saturation reset controller. This controller is used to illustrate how the model works in practice and the attainment of robustness objectives over various sub-classes of P.

15:00-15:20 MoB16.3

A Mean-Variance Model for Optimal Portfolio Selection with Transaction Costs, pp. 1627-1632

Peng, Hui — Central South Univ.

On the basis of Markowitz mean-variance framework, a new optimal portfolio selection approach is presented. The portfolio selection model proposed in the approach includes the expected return, the risk, and especially a quadratic type transaction cost of a portfolio. Using this model may yield an optimal portfolio solution that maximizes return, and minimizes risk, as well as also minimizes transaction costs by softening the transaction strength and smoothing the volume of the transacted securities in trading process. The optimization problem appeared in this approach is convex and can be solved by the quadratic programming (QP) routine. A case study demonstrates the effectiveness and the significant performance improvements of the optimal portfolio selection strategy proposed.

15:20-15:40 MoB16.4

Team Building under Pareto Uncertainty, pp. 1633-1638

Novikov, Dmitry — Inst. of Control Sciences of Russian Acad. ofSciences

Game-theoretical models of team-building and team incentive problems are described. Solutions of these problems are obtained for the case of probabilistic uncertainty of the team members abilities. Conditions of team «vitality» are formulated in terms of the distribution and the reservation utility properties.

15:40-16:00 MoB16.5

Modelling and Analysis of Bargaining Process for E-Procurement of Large Enterprise Group, pp. 1639-1644

Wang, Dingwei — Northeastern Univ.
Kaku, Ikou — Akita Prefectural Univ.

To solve the bargaining problems of centralized procurement in the environment of e-commerce, we propose a visible tool named as Bargaining Process Chart to support bargaining process. By mapping any bargaining process into a curve from the point with coordinates (0,1) to the halving line of the first quadrant in Cartesian coordinates, Bargaining Process Chart makes the current and historical bargaining processes become visible. Thus, the negotiators can obtain efficient support from the useful information in their price bargaining. The bargaining process chart had been applied to the e-procurement centre of a big enterprise group in China. The application results are satisfactory.

MoB17 320A

Hot Rolling (Highlight Session)

Chair: Park, Cheol Jae — POSCO
Co-Chair: Choi, IlSeop — POSCO

14:00-14:20 MoB17.1

Model–based Control of Front–end Bending in Hot Rolling Processes, pp. 1645-1650

Kiefer, Thomas — Vienna Univ. of Tech.
Kugi, Andreas — Vienna Univ. of Tech.

This contribution deals with the modeling and control of flatness defects in form of so–called ski–ends which occur during the hot rolling process of heavy plates. These ski–ends are caused by asymmetrical rolling conditions, e.g., different work roll circumferential speeds or vertical temperature gradients. In a first step, a physics–based model for asymmetrical rolling is derived based on the upper bound method for ideal rigid–plastic materials and is validated by means of numerical and measurement data. It turns out that the drive train proves to be the suitable actuator for suppressing the ski–ends. Therefore, an improved underlying multi–input multi–output control concept for the two main drives is presented. Finally, an overall pass–to–pass model–based control concept for the reduction of ski–ends is developed.

14:20-14:40 MoB17.2

Start-Up Control of a Hot Strip Mill Tension/Looper System: An Approach Based on Model Predictive Control (I), pp. 1651-1656

Kojima, Akira — Tokyo Metropolitan Univ.
Morooka, Nobuyuki — JFE Steel Corp.

For the start-up control of tension and looper system, an off-line design method of the control law is considered based on model predictive control approach. By employing a multi-parametric programming for the posed problem, a piecewise affine state feedback control law, which inherits the advantage of the model predictive control, is constructively given. The feature of resulting control system is illustrated with numerical examples.

14:40-15:00 MoB17.3

Tension Control with ARHC Scheme for Hot Strip Finishing Mills (I), pp. 1657-1658

Park, Cheol Jae — POSCO
Hwang, I Cheol — Dong-Eui Univ.

This paper presents a design procedure of the ARH(Adaptive

Receding Horizon Control) of the looper-tension controller in hot strip Žnishing mill. The controller is applied to satisfy the constraints of the control input and attenuate the disturbance of the actuator. The system matrices of the looper model are periodically updated during online simulation. Moreover the closed loop stability of the controller is analyzed.

15:00-15:20 MoB17.4

Nonlinear Looper-Tension Control for Hot Strip Finishing Mill Using Feedback Linearization. (I), pp. 1659-1660

Hwang, I Cheol — Dong-Eui Univ.
Park, Cheol Jae — POSCO

This paper studies on the design of a nonlinear controller for the looper-tension system in hot strip finishing mills using a static state feedback linearization and an ILQ(Inverse Linear Quadratic) Optimal Control. Nonlinear dynamic equations of the looper-tension system are analytically linearized by a static feedback linearization algorithm with a compensator. A nonlinear controller is designed from the feedback linear model, which is composed of an ILQ controller and an input transformer. It is shown from a computer simulation that the nonlinear controller has good performances throughout the full strip part including top, middle and end parts of the strip.

15:20-15:40 MoB17.5

An MPC Strategy for Hot Rolling Mills and Applications to Strip Threading Control Problems. (I), pp. 1661-1662

Choi, IlSeop — POSCO
Rossiter, J. Anthony — Univ. of Sheffield
Chung, Jea Sook — POSCO
Fleming, P.J. — Univ. of Sheffield

Strip threadability is an ability to keep a strip flowing smoothly between interstands and run-out tables without severe longitudinal and lateral movements. The occurrence of a longitudinal movement is mainly related to looper–tension control performance, while a lateral movement is affected by steering control actions. Unstable threading may induce folding and pinching of a strip, thus resulting in damage to the strips and rolls and, in the worst case, an emergency shutdown. This paper investigates the potential of an MPC algorithm for the strip threading control problem and evaluates its efficacy through looper–tension and strip steering control case studies.

MoB18 320B

Recent Development of Intelligent Robots I: Navigation

(Highlight Session)

Chair: Song, Jae-Bok — Korea Univ.
Co-Chair: Chung, Woojin — Korea Univ.

14:00-14:20 MoB18.1

Upward Monocular Camera Based SLAM Using Corner and Door Features (I), pp. 1663-1668

Hwang, Seo-Yeon — Korea Univ.
Song, Jae-Bok — Korea Univ.

Small-size robots usually employ cheap sensors for navigation instead of expensive laser scanners or stereo cameras. This paper deals with the SLAM process using a monocular camera which heads upward to see the ceiling and the upper portion of a wall. This upward camera has some advantages of being free of dynamic obstacles, the fixed distance to the ceiling and so on. Most past research based on an upward camera used corner features for localization, which are not always extracted in an indoor environment. In this research, however, door features are added to overcome this difficulty involved in SLAM using the corner features only. A door helps not only to estimate the pose of a robot, but also to divide the environment into several meaningful areas. A particle filter is adopted to estimate the door position to check whether the specific door is suitable for the SLAM process before registering it in the EKF algorithm. Experimental results show that the proposed scheme works successfully in various indoor environments.

14:20-14:40 MoB18.2

Use of Range Sensor Information for Improving Positioning Accuracy (I), pp. 1669-1674

Cho, Seong Ho — Hongik Univ.
Lee, Sooyong — Hongik Univ.
Yu, Wonpil — ETRI

Range sensors are commonly used for mobile robots in order to avoid collision with obstacles and build an environmental map. Unless the robot uses an external localization device, the dead-reckoning alone incurs the accumulated position errors. This paper presents an algorithm for the position error correction. Edges and nodes are identified from the range sensor information; using the identified feature points the dead-reckoning error becomes smaller.More accurate map is built while the positional error is being reduced.The proposed algorithm is implemented on a map building device and shows the effectiveness of the proposed algorithm.

14:40-15:00 MoB18.3

High Accurate Two-Dimensional Geo-Location System for Social Safety Robot (I), pp. 1675-1678

Kim, Sujin — Information and Communications Univ.
Kim, Jaehwan — Electronics and Telecommunications Res. Inst. (ETRI)
Kang, Joonhyuk — Information and Communications Univ.
Kim, Gon-Woo — Korea Inst. of Industrial Tech. (KITECH)
Nam, Kyung-Tae — Kitech(Korea Inst. of Industrial Tech.
Lee, Sang-Moo — Korea Inst. of Industrial Tech. (KITECH)
Shon, Woong-Hee — Korea Inst. of Industrial Tech. (KITECH)

In this paper, we propose an efficient two-dimensional geo-location system for social safety robot, where its location is obtained by direction of arrival (DOA) and time of arrival (TOA) of the radio signal. The proposed system requires two reference signals while the conventional systems generally deploy more than three reference signals. For estimating DOA and DOA information together, we employ a multiple signal classification (MUSIC) algorithm. The simulation results show that the proposed geo-location system achieves accuracy within 3 meters error in 2 kilo-meters coverage which is constraint for social safety robot.

15:00-15:20 MoB18.4

Multi-Agent Coordinated Motion Planning for Monitoring and Controlling the Observed Space in a Security Zone (I), pp. 1679-1684

Kim, Jimin — Seoul National Univ.
Choi, Jeong Sik — Seoul National Univ.
Lee, Beom Hee — Seoul National Univ.

Monitoring and control of observed space in a security zone equipped with multi cameras and security robots are essential for efficient invader detection. For controlling the observed space, a coordinated motion planning technique is essential when a centralized motion planning solution is realized by a single supervisory system. This technique, however, is known to be very difficult to realize because concurrent multi-agent planning involves high computational complexity. We propose a new method for monitoring and controlling the observed space for a multi-agent security system with applicable computational burden. To identify time-varying observed space, two new tools, the extended overlap map (EOM) and the time-global surveillance coverage ratio graph (TGSG), are developed. Using these tools, we can properly monitor the time-varying observed space. In addition, to overcome the high complexity in the centralized motion planning, the priority is assigned to multi-agents. Finally, the observed space is monitored and controlled by planning multi-agents motions interactively using the EOM and the TGSG. The proposed method is then applied to conventional multi-agent security systems.

15:20-15:40 MoB18.5

Safe and High Speed Navigation of a Patrol Robot in Occluded Dynamic Obstacles (I), pp. 1685-1690

Choi, Min-Ki — Korea Univ.
Chung, Woojin — Korea Univ.

It is difficult to detect all dynamic obstacles around a robot due to the limitation of field of view. Visibility information is necessary in order to avoid collisions. In previous research, we proposed a path planning and speed control scheme that could be applied to a robot to avoid occluded dynamic obstacles. In this paper experimental verifications of the proposed scheme for various environments are presented. The path planning scheme is improved by considering the robot’s moving direction. Experimental results show that the proposed high speed navigation of a patrol robot can be achieved together with safety.

15:40-16:00 MoB18.6

An Intelligent Navigation Method for Service Robots in the Smart Environment (I), pp. 1691-1696

Park, Jae-Han KITECH
Baeg, Seung-Ho KITECH
Ryu, Ho-Sun LG Electronics
Baeg, Moon-Hong KITECH

Autonomous navigation is one of primitive functionalities which service robots should have; nevertheless, the navigation problem for a service robot still has many difficulties because the real environment where service robots should works is so complex and dynamical. This paper proposes a framework of intelligent navigation for service robots based on a semantic map of the smart environment. In the smart environment, the robot can receive his position information from location sensors by sensor networks, and it can eliminate the accumulated localization errors. So the robot can accomplish confidential localization in the dynamic and complex environment. With the topological information in the semantic map, path planning problem can be simple even in the wide and complex spaces, and topological path from semantic map can be divided into several sub goals. Robust navigation can be accomplished by moving towards these sub goals with reactive navigation algorithm which has robust characteristics in the dynamic environments. Our approaches have ascertained the good performance on the localization and the navigation, and the feasibility of these methods could be confirmed with the result of experiments in the real environment.

MoB19 320C

Robotic Mechanism II (Regular Session)

Chair: Iwasaki, Tetsuya Univ. of Virginia
Co-Chair: Zhu, Wen-Hong Canadian Space Agency

14:00-14:20 MoB19.1

Virtual Decomposition Control of a Planar Flexible-Link Robot, pp. 1697-1702

Zhu, Wen-Hong Canadian Space Agency
Lange, Christian Canadian Space Agency
Callot, Mathilde Canadian Space Agency

Use of flexible link robots is motivated by applications featuring lightweight or long arms. However, the control problem faces strong technical challenges resulting from the complex dynamics. In this paper, the virtual decomposition control (VDC) approach is applied for the first time to address the technical challenges of this thorny problem mainly resulting from the dynamic coupling effects among flexible links. In view of the VDC approach, the control problem of a multiple-flexible-link robot is no more complex than the control problem of individual flexible links subject to kinematics constraints. A planar beam governed by Euler-Bernoulli equation is studied as an example for simplicity. A possible extension to robots with multiple flexible links is theoretically possible by creating appropriate virtual power flows at the two ends of each beam. The validity of the theoretical results is verified by simulations with respect to two typical space systems in planar motion.

14:20-14:40 MoB19.2

Optimal Protraction of a Three-Joint Robot Leg, pp. 1703-1710

Erden, Mustafa Suphi Delft Univ. of Tech.
Leblebicioglu, Kemal Middle Esat Tech. Univ.

In this paper protraction movement, namely stepping ahead, of a three joint robot leg is optimized for energy efficiency for any given pair of initial-final tip point positions. For the optimization a modified version of gradient descent based optimal control algorithm with Hamiltonian formulation is used. The objective function is modified in steps to jump over the infeasible and inefficient local optimums. The results of 79 optimizations are used to construct a radial basis function neural network (RBFNN) in order to interpolate between the optimized trajectories. The results are presented and discussed in the paper.

14:40-15:00 MoB19.3

Vibration Suppression and Balance Control for Biped Humanoid Walking, pp. 1711-1716

Chang, Young-Hwan Korea Inst. of Science and Tech. (KIST)
Oh, Yonghwan Korea Inst. of Science & Tech. Korea
Kim, Doik Korea Inst. of Science and Tech. (KIST)
Hong, Seokmin UST, KIST

In this paper, we present vibration suppression and balance control algorithm for biped humanoid robots in the motion embedded CoM Jacobian. The vibration control is employed during a single supporting phase, which can suppress vibration induced by structure flexibility. Because the previously proposed walking control method in the whole body coordination (WBC) framework is based on the rigid body motion, flexible mode vibration control which suppresses the residual vibration can make the humanoid motion into rigid body motion. Also, balance control algorithm which controls body attitude is applied to the WBC framework. By dynamic walking experiments using a humanoid robot MAHRU-R, we verify the validity of the proposed control methods.

15:00-15:20 MoB19.4

Dynamic Control Algorithm for Biped Walking Based on Policy Gradient Fuzzy Reinforcement Learning, pp. 1717-1722

Katic, Dusko Mihailo Pupin Inst.
Rodic, Aleksandar Mihailo Pupin Inst.

This paper presents a novel dynamic control approach to acquire biped walking of humanoid robots focussed on policy gradient reinforcement learning with fuzzy evaluative feedback . The proposed structure of controller involves two feedback loops: conventional computed torque controller including impact-force controller and reinforcement learning computed torque controller. Reinforcement learning part includes fuzzy information about Zero-Moment Point errors. To demonstrate the effectiveness of our method, we apply it in simulation to the learning of a biped walking.

15:20-15:40 MoB19.5

On the Optimal Harmonic Gait for Locomotion of Mechanical Rectifier Systems, pp. 1723-1728

Blair, Justin UVA
Iwasaki, Tetsuya Univ. of Virginia

This paper formally defines a class of multibody rectifier systems that captures the essential aspects of animal locomotion, and formulate an optimal locomotion problem to find a set of harmonic inputs that minimizes a quadratic objective function subject to an equality constraint on the average velocity. Our main result shows that the global optimum is given in terms of a generalized eigenvalue of a pair of Hermitian matrices, with a minimizer characterized by the associated eigenvector. Thus, an optimal harmonic gait can be computed efficiently even for hyper-redundant rectifiers with a large number of variables. We provide case studies for two specific rectifiers; (i) a chain of multiple links mimicking snakes, leeches, and other slender animals, and (ii) a disk-mass system that captures the rectifying dynamics in the simplest way. For each case, we examine optimal gaits for three types of objective functions, consisting of input power, input torque, and shape derivative. We compare the multilink results against natural motions observed in leeches, and discuss what optimality criteria appear to be used in nature. Analytical results are obtained for the disk-mass system, providing insights into determinants of optimal gaits.

15:40-16:00 MoB19.6

Biped Gait Generation Via Iterative Learning Control Including Discrete State Transitions, pp. 1729-1734

Satoh, Satoshi Nagoya Univ.
Fujimoto, Kenji Nagoya Univ.
Hyon, Sang-Ho JST-ICORP/ATR

This paper is concerned with a gait generation for legged robots via iterative learning control (ILC) including discrete state transitions. This method allows one to obtain solutions of a class of optimal control problems without using precise knowledge of the plant model by iteration of laboratory experiments. Generally in walking motion, there are discrete state transitions caused by landing. The proposed framework can also deal with such state transitions without using the parameters of the transition model by combining ILC method and the leastsquares. It is applied to the compass gait biped to generate optimal gait on the level ground. Furthermore, some numerical examples demonstrate the effectiveness of the proposed method.

MoB20 321C

Flying Robot II (Regular Session)

Chair: Ollero, Anibal Ollero — Escuela Superior de Ingenieros - Univ. de Sevilla
Co-Chair: Tayebi, Abdelhamid — Lakehead Univ.

14:00-14:20 MoB20.1

A Two Step Velocity Planning Method for Real-Time Collision Avoidance of Multiple Aerial Robots in Dynamic Environments, pp. 1735-1740

Rebollo, J.J. — Univ. of Seville
Maza, Ivan — Univ. of Seville
Ollero, Anibal Ollero — Escuela Superior de Ingenieros - Univ. de Sevilla

This paper presents a collision avoidance method to improve the safety conditions in scenarios with multiple UAVs sharing the same aerial space with other aircrafts or mobile obstacles. The method modifies the velocity profile of the UAVs under control maintaining the paths initially planned. It is based on the combination of both a Search Tree algorithm which finds a solution if it exists, and the minimization of a cost function which tries to find the nearest solution to the initially planned trajectories for the UAVs. The Search Tree algorithm provides an initial valid order of pass for the vehicles involved in a given conflict and allows to formulate the minimization problem as a LP problem that can be efficiently solved. A model for the UAVs has been considered in the paper and several simulations are presented with promising results.

14:20-14:40 MoB20.2

Asymptotic Stability of Hierarchical Inner-Outer Loop-Based Flight Controllers, pp. 1741-1746

Kendoul, Farid — Univ. of Tech. of Compičgne
Fantoni, Isabelle — Univ. de Tech. de Compiegne
Lozano, Rogelio — Univ. de Tech. de Compiegne

In this paper, we present a hierarchical controller for autonomous aerial vehicles control and navigation. For autonomous rotorcraft flight, it is common to separate the flight control problem into an inner loop that controls attitude and an outer loop that controls the translational trajectory of the rotorcraft. The resulted nonlinear controller is thus, easy to implement and to tune. Furthermore, satisfactory results have been reported in the literature and various navigational tasks have been achieved using this hierarchical control technique. However, this control scheme suffers from the lack of the stability proof and analysis for the closed-loop system. Here, we propose a 3D flight controller which is based on the inner- and outer-loop control scheme, and we prove the asymptotic stability property for the connected closed-loop system.

14:40-15:00 MoB20.3

Global Discrete Time Stabilization of the PVTOL Aircraft Based on Fast Predictive Control, pp. 1747-1752

Chemori, Ahmed — UM2
Marchand, Nicolas — GIPSA-Lab. CNRS

This paper deals with stabilization control of a non-minimum phase under-actuated Planar Vertical Take-Off and Landing (PVTOL) aircraft. The proposed control approach, inspired from that proposed in Poulin et al. [2007], is based on a discrete time model of the PVTOL and receding horizon technique to take into account constraints on the control inputs (positivity and boundedness). State constraints can also be handled. The computational cost is reduced by decoupling the optimization problem into two QP problems of reduced dimensions. The minimized cost functions proposed here extends the previous work by allowing state and control weight. The proposed control approach is illustrated through simulation case studies including stabilization and robustness towards parameters uncertainties.

15:00-15:20 MoB20.4

Discrete-Time Dynamic Feedback Linearization of a VTOL Using Observed States, pp. 1753-1759

Rejón, Victor — CINVESTAV
Aranda-Bricaire, Eduardo — CINVESTAV

This paper addresses the trajectory tracking problem for a remotely controlled quad-rotor vertical take off and landing aircraft (VTOL), under the restriction that only the inertial coordinates are available for measurement. The problem is solved in two steps: First, a discrete-time local exponential observer is designed which allows estimating the roll and pitching angles as well as all the velocities of the VTOL. Second, a discrete-time dynamic linearizing controller is proposed and the VTOL actual states variables are replaced by their corresponding estimates. It is shown that a kind of separation principle holds, in the sense that exponential convergence to the prescribed trajectory is preserved. Real-time experiments show that the proposed observer-controller scheme exhibits good performance.

15:20-15:40 MoB20.5

A Simple Time-Varying Observer for Speed Estimation of UAV, pp. 1760-1765

Boutayeb, Mohamed — Nancy Univ.
Richard, Edouard — nancy Univ.
Rafaralahy, Hugues — Univ. Henri Poincaré, Nancy I
Souley Ali, Harouna — Univ. Henri Poincaré
Zaloylo, Guy — Nancy Univ.

This note deals with the speed estimation of Unmanned Aerial Vehicle (UAV) using linear acceleration measurements. The estimator is a useful time-varying reduced-order Luemberger like observer such that the observation error is reduced to a time varying linear differential equation. Asymptotic stability of the estimation error is proved using the Lyapunov approach and the Barbalat lemma. Moreover, we generalize the proposed approach to systems with partial accelerations measurements. Conditions for the existence of the observer, which are less restrictive than those given in the literature, are given. A numerical simulation on a Quad-rotor UAV is performed to illustrate the effectiveness of the approach.

15:40-16:00 MoB20.6

Decentralized Attitude Alignment Control of Spacecraft within a Formation without Angular Velocity Measurements, pp. 1766-1771

Abdessameud, Abdelkader — Univ. of Western Ontario
Tayebi, Abdelhamid — Lakehead Univ.

In this paper, we consider the coordinated attitude control problem without velocity measurements. Based on the recently introduced unit quaternion output feedback for the attitude tracking of a rigid body, we present a class of decentralized coordinated control laws to solve the alignment problem for a group of spacecraft within a formation without velocity measurements. The approach consists of introducing an auxiliary system for each spacecraft and for each pair of spacecraft with a communication link. The vector parts of the unit quaternion, representing the discrepancies between the output of these auxiliary systems and the attitude tracking error as well as the relative attitude errors between spacecraft, are used in the control law instead of the angular velocity and the relative angular velocity vectors. The spacecraft attitudes are guaranteed to converge to a desired attitude (possibly time-varying), while keeping the flight formation during the transient. Simulation results of a scenario of four spacecraft are provided to show the effectiveness of the proposed control scheme.

MoB21 321B

Servo Control for Storage Systems and Precision Devices II

(Invited Session)

Chair: Yamaguchi, Takashi — Hitachi Global Storage Tech.
Co-Chair: Horowitz, Roberto — Univ. of California at Berkeley
Organizer: Yamaguchi, Takashi — Hitachi Global Storage Tech.

14:00-14:20 MoB21.1

Friction Compensation in Servo Systems Using a Local Control Design Approach (I), pp. 1772-1777

Mostefai, Lotfi — The Univ. of Tokyo, Inst. of Industrial science
Danai, Mouloud — Univ. of Sheffield
Hori, Yoichi — Univ. of Tokyo

Nonlinearities degrade considerably performances in motion control systems. Nonlinear friction is a major source of many serious problems such as wear, tracking errors and limit cycles. There has been an extensive research activity dealing with the design of compensating techniques. The approaches cited in the litterature can be divided into: free model compensation or model based compensation strategy. In the present work, a dynamic fuzzy modeling approach of a servo system with friction is developed. The main idea is to take advantage of the linear form of the resulting dynamics to design: 1- a friction observer used as a compensating term of friction effects, 2- a stable tracking controller that allows the system to achieve a trajectory involving slow motions and velocity reversal. The proposed control method is relatively simple to design and efficient for the compensation of friction induced errors. The experimental tests on a robot joint control have demonstrated

precise motion control and smoother velocity reversal in the presence of significant level of friction.

14:20-14:40 MoB21.2

Discrete-Time Exact and Approximate Dynamic Inversion for Settle Performance (I), pp. 1778-1784

Rigney, Brian	Univ. of Colorado at Boulder
Pao, Lucy Y.	Univ. of Colorado at Boulder
Lawrence, Dale A.	Univ. of Colorado

Single-track hard disk drive (HDD) seek performance is measured by settle time, t_s, defined as the time from the arrival of a seek command until the measured position reaches and stays within an acceptable distance from the target track. In this paper, we show the effective use of feedforward dynamic inversion, coupled with an aggressive desired trajectory y_d, to achieve high performance settle times. It is well known that the exact tracking solution for nonminimum phase (NMP) systems requires noncausal preactuation to maintain bounded internal signals. In the specific HDD operating modes of interest, anticipation of a seek command is unrealistic, and thus preactuation adds to the overall computation of settle time. Unlike many dynamic inversion tracking applications, this negative effect of preactuation leads to interesting trade-offs between preactuation delay, tracking accuracy, and achievable settle performance. We show that, surprisingly, very little preactuation is desirable when truncating the exact tracking solution and applying it to our NMP HDD model. For comparison, we also review the stable Taylor series approximate inverse, and show that a zero-order series' settle performance is comparable to truncated exact inversion while being easier to compute and implement. We experimentally validate this conclusion on a Servo Track Writer (STW).

14:40-15:00 MoB21.3

An Operator Based Modeling and Compensation of VCM Actuator Pivot Friction in a 1.8-Inch HDD (I), pp. 1785-1790

Du, Chunling	Data Storage Inst.
Xie, Lihua	Nanyang Tech. Univ.
Zhang, Jingliang	Data Storage Inst.

The pivot friction of voice-coil-motor (VCM) actuator is measured for a 1.8-inch small disk drive with disk rotating and slider flying. The measurement is carried out under the conditions that the actuator is controlled and the head movement amplitude is growing by changing the references. The hysteresis of friction versus head position is then obtained. An operator based modeling approach is adopted for the hysteresis, and an optimal model is obtained by minimizing the energy gain between the head position and the modeling error. It is also found that the frequency response of the actuator model with the inclusion of the hyteresis model matches well with the measured frequency response of the actuator. A friction compensation method based on the nonlinear hysteresis model is then proposed. The simulation and implementation results demonstrate a significant improvement in disturbance rejection in low frequency range.

15:00-15:20 MoB21.4

Design Approach for Hard Disk Drive Settle Performance Optimization (I), pp. 1791-1796

Stoev, Julian	Samsung Electronics
Lee, Ho Seong	Samsung Electronics

A design approach is presented for constrained optimization of feed-forward signal using closed loop impulse response. The approach is flexible and is possible to integrate easily with the existing controller structure. It is demonstrated that the approach does not need high order and precise description of the closed loop system.

15:20-15:40 MoB21.5

A Hybrid Modeling Method for Precise Positioning Systems (I), pp. 1797-1802

Hirata, Mitsuo	Utsunomiya Univ.
Noguchi, Sakae	Utsunomiya Univ.
Adachi, Shuichi	Keio Univ.

In this paper, a system identification method for hybrid systems switched by the magnitude of velocity is proposed. First, it is shown that the regression vector space of a mechanical system switched by the magnitude of velocity cannot be separated by a hyperplane. Then a method based on support vector machines with a polynomial kernel is proposed. The effectiveness of the proposed method is shown by simulations.

15:40-16:00 MoB21.6

Design of Seeking Control Based on Two-Degree-Of-Freedom Controller Using Frequency Shaped Final-State Control (I), pp. 1803-1808

Kang, Hyun Jae	Hanyang Univ.
Lee, Choong Woo	Hanyang Univ.
Chung, Chung Choo	Hanyang Univ.
Lee, Ho Seong	Samsung Electronics

In this paper, we introduce a new seeking control method based on the frequency shaped final-state control (FFSC). The seeking control method is a two-degree-of-freedom control, which is the plant-based feedforward control. The feedforward control input is designed through zero-order-hold using FFSC which imposes the constraints on control input magnitude and its frequency components to minimize residual vibrations. The reference generation is made through a feedforward path controller which is in the form of the zero-phase error tracking controller (ZPETC) of the nominal plant. The reference prefilter is designed to compensate the delay in the control system via the ZPETC. Mode switching control (MSC) is employed to enhance tracking performance after settling. An add-on type disturbance observer that is in the form of finite impulse response is used with the feedback controller. From the simulation results, the proposed method shows the improvement to the settling and disturbance rejection.

MoB22 321A

Control Methods for Mechatronic Systems (Regular Session)

Chair: Jezernik, Karel	Univ. of Maribor
Co-Chair: Nguyen, Tu Duc	Norwegian Univ. of Science and Tech.

14:00-14:20 MoB22.1

The Control and Identification Algorithm for Devices with Differential Inductive Sensors, pp. 1809-1814

Kochetkov, Sergey	Togliatti State Univ.
Shavrin, Pavel	Togliatti State Univ.
Kiselyov, Sergey	Togliatti State Univ.

The design algorithms of closed loop control system for surface profile measurement device are proposed. Control inputs are used to construct closed loop system, which oriented on identification of desired parameter that is estimated by high gain observer then. As a result, the designed nonlinear system has high selective properties with respect to registered value. The dynamic compensator approach is used to reduce the estimation error.

14:20-14:40 MoB22.2

Vss Speed Sensorless Control of PMSM, pp. 1815-1820

Jezernik, Karel	Univ. of Maribor

The speed sensorless control of nonsalient PMSM that uses estimated rotor flux instead of the transformation angle is designed. This paper introduces a new sequential switching control strategy for a current control of a three phase inverter. The key idea is to integrate the benefits of the variable structure system control design and the event-driven sequential control structures to raise the system performance and control efficiency. The design is applied to the control of three phase permanent magnet synchronous machine. The operation at low speed is improved by reducing the disturbance impact. The estimation angle error at zero speed is limited by injecting the DC current that compensates the unknown load torque and enables operation at zero speed. The VSS speed sensorless control of PMSM is implemented on a DSP/FPGA system, and verified experimentally.

14:40-15:00 MoB22.3

Frequency Locking of an Optical Cavity Using LQG Integral Control, pp. 1821-1826

Sayed Hassen, Sayed Zahiruddeen	Univ. of New South Wales
Huntington, Elanor	Univ. of New South Wales
James, Matthew R.	Australian National Univ.
Petersen, Ian Richard	Univ. of New South Wales - ADFA

This paper considers the application of LQG integral control theory to a problem of cavity locking in quantum optics. The cavity locking problem involves controlling the error between the laser frequency and the cavity frequency. A model for the cavity system, which comprises of a piezo-electric actuator and an optical cavity is determined in the frequency domain using a subspace identification method. An LQG controller which includes integral action is synthesized to stabilize the frequency of the cavity at the laser frequency and to reject low frequency noise inherent in laser systems. The controller is discretized and is successfully tested in thelaboratory after being implemented on a dSpace DSP board.

15:00-15:20 MoB22.4

Nonlinear Passivity Based Control Law with Application to Electropneumatic System, pp. 1827-1832

Turki, Karima	INSA de Lyon
Smaoui, Mohamed	INSA de Lyon
Thomasset, Daniel	INSA de Lyon
Mnif, Faical	Sultan Qaboos Univ.
Derbel, Nabil	Professor

This paper presents a synthesis of a nonlinear controller to an electropneumatic system. Nonlinear passivity based control law is applied to the system under consideration. First, the nonlinear model of the electropneumatic system is presented. It is transformed to be a nonlinear affine model and a coordinate transformation is then making possible the implantation of the nonlinear controller. A nonlinear control law is developed to track desired position. Experimental results are also presented and discussed.

15:20-15:40 MoB22.5

Tracking Control for Port-Hamiltonian Systems Using Feedforward and Feedback Control and a State Observer, pp. 1833-1838

Stadlmayr, Richard	Linz Center of Mechatronics GmbH
Schlacher, Kurt	Johannes Kepler Univ. of Linz

This contribution is about the combination of a feedforward and a feedback controller and a reduced state observer in order to stabilize the trajectories of a nonlinear plant. Port-Hamiltonian systems provide some special mathematical properties and have turned out beneficial for the stability analysis of nonlinear control systems. The combination of a feedforward and feedback controller allows us to achieve good tracking and the rejection of disturbances and parameter variations. In addition the extension of the nonlinear control scheme with a state observer allows a reduction of the number of measured quantities. This approach will be shown for the example Ball on the Wheel.

15:40-16:00 MoB22.6

Boundary Stabilization of Marine Structure, pp. 1839-1844

Nguyen, Tu Duc	Norwegian Univ. of Science and Tech.

This note addresses the stabilization problem of a marine structure (i.e. cable/riser), connected to a surface vessel at one end and to a thruster unit at the other. Here, only lateral motion is considered. Based on boundary measurements, stabilizing control laws are designed. The controllers consist only on feedback from boundary measurements. The costs are thus minimized and the spillover instabilities are avoided. Simulation results are included.

MoB23 323

Large Scale and Complex Systems: Applications II (Regular Session)

Chair: Díez, José Luis	Univ. Pol. de Valencia
Co-Chair: Filip, Florin Gheorghe	Romanian Acad.

14:00-14:20 MoB23.1

Knowledge Based Approach to Project Prototyping, pp. 1845-1850

Tomczuk-Pirog, Izabela	Aalborg Univ.
Nielsen, Peter	Aalborg Univ.
MuszyD;ski, Wojciech	WrocB;aw Univ. of Tech.
Banaszak, Zbigniew	Tech. Univ. of Koszalin

Decision making supported by task-oriented software tools plays a pivotal role in modern enterprises, because commercially available ERP systems are unable to respond in an interactive on-line/real-time mode. It opens up for a new generation of decision support system (DSS) that enable a fast prototyping of production flows in multi-project environment as well as integrating approaches to project execution evaluation. In that context our goal is to provide a knowledge base approach allowing one to be independent of context or representation data as well as allowing for the design of an interactive and task-oriented DSS. The assumed knowledge base mode of specifying a production system leads to solving a logic-algebraic method (LAM) decision problem. The results obtained are implemented in a software package supporting project management in SMEs. Illustrative example of the ILOG-based software application is provided.

14:20-14:40 MoB23.2

Operating-State-Based Intelligent Control of Combustion Process of Coke Oven, pp. 1851-1856

Lei, Qi	Central South Univ.
Wu, Min	Central South Univ.
Cao, Weihua	Central South Univ.
She, Jin-Hua	Tokyo Univ. of Tech.

This paper describes a hierarchical intelligent integrated control method for controlling the combustion process in a coke oven. A key feature is the determination of the operating state of the oven from an analysis of the characteristics of the process. The system contains three layers: a decision layer, a temperature optimization and control layer, and a process control layer. An information fusion method is used in the decision layer to determine the operating state of the combustion process. The control strategy uses an outer and an inner loop. The outer loop uses fuzzy controllers to adjust the temperature, and to generate proper settings for the gas flow rate and air suction power for the inner loop. The parameters of the outer loop controllers are tuned by a multiple-objective optimization method with an adaptive genetic algorithm. The inner loop controllers keep the temperature of the coke oven in the proper range. A switching control strategy is used to select a suitable controller for the current operating state.

14:40-15:00 MoB23.3

Applying Dynamic Data Mining on Multi-Agent Systems, pp. 1857-1862

Benítez Sánchez, Ignacio	Pol. Univ. of Valencia
Díez, José Luis	Univ. Pol. de Valencia
Albertos, Pedro	Univ. Pol. de Valencia

A new perspective on analysis of large-scale Multi-Agent Dynamic Systems is presented. The aim is to capture the global trends at a glance, by the use of dynamic data mining techniques, which group agents according to similar characteristics or behavior, measuring and recording how the different trends evolve through time. This methodology is presented and an example with a simulated dynamic Multi-Agent System is included.

15:00-15:20 MoB23.4

Production Process Efficiency Analysis: An Approach Based on Colored Petri Nets, pp. 1863-1868

Bastos Jr, Nilson	Pontifical Catholic Univ. of Parana
Santos, Eduardo Alves Portela	Pontifical Catholic Univ. of Parana
Rocha Loures, Eduardo	Pontifical Catholic Univ. of Paraná
Busetti, Marco Antonio	Pontifical Catholic Univ. of Parana

The purpose of this paper is to analyze the overall equipment efficiency (OEE) of the machines in the production process, with the objective of measure the quality and efficiency of the process and the used resources (machines). For this analysis the present work shows the Colored Petri Nets for the modeling the flow data in Factory Information System (FIS). The obtained net represents the necessary information flow for data acquisition from machines. This data will be processed to calculate the performance indexes. Using a colored net is shown how to obtain the necessary code for the FIS implementation. The simulation of the proposed model is also presented in this paper.

15:20-15:40 MoB23.5

Control of a Production-Inventory System Using a PID Controller and Demand Prediction, pp. 1869-1874

Tosetti, Santiago	Univ. Nacional de San Juan
Patino, H. Daniel	Univ. Nacional de San Juan
Capraro, Flavio	Univ. Nacional de San Juan (UNSJ)
Gambier, Adrian	Univ. of Heidelberg

Abstract: A common and important problem in business is the determination of inventory policies for a production system within a changing business environment and market demand. In this paper, an automatic pipeline feedback order-based production control system (APIOBPCS), considering a demand with cyclic and stochastic components, is proposed. The dynamics and delays of the production process are modeled as a pure delay. The control system structure consists of a PID (Proportional, Integrative and

Derivative) controller with an Extended Kalman Filter-based demand prediction. The main objective of the this dynamic controller is to stabilize and regulate the inventory levels in function of a desired set-point level. The Extended Kalman Filter (EKF) estimates the parameters of a Volterra time-series model to forecast future values of the demand. A control error analysis is also performed for the proposed inventory control system, in order to obtain bounds for the control errors and to probe its stability. This methodology is useful to make an appropriate decision about the desired inventory level for a given demand prediction error. The inventory control system is evaluated by simulations showing a good performance.

15:40-16:00 MoB23.6

Advances in the Control of Sheet Metal Forming, pp. 1875-1883

Lim, Yongseob — Univ. of Michigan
Venugopal, Ravinder — Intellicass Inc.
Ulsoy, A. Galip — Univ. of Michigan

This paper presents a review of research on control of the sheet metal stamping process, and its effect on the quality of stamped parts. Section 1 of the paper introduces key quality considerations in the sheet metal stamping process, including new challenges for industrial needs. Section 2 presents the evolution of control strategies for the forming process. Section 3 describes the different types of active blank holder force systems from previous research. Finally, Section 4 reviews in-process sensor technologies to monitor the process variables used in machine or process controllers for the sheet metal stamping process.

MoB24 324

Fault Detection and Accommodation for Nonlinear Systems
(Invited Session)

Chair: Jiang, Bin — Nanjing Univ. of Aeronautics and Astronautics
Co-Chair: Cocquempot, Vincent — LAGIS - LILLE 1 Univ.
Organizer: Jiang, Bin — Nanjing Univ. of Aeronautics and Astronautics
Organizer: Cocquempot, Vincent — Univ. des Sciences et Tech. de Lille

14:00-14:20 MoB24.1

Algebraic Approach to the Problem of Fault Accommoation in Nonlinear Systems (I), pp. 1884-1889

Shumsky, Alexey — Inst. for Marine Tech. Problems

The problem of fault accommodation is considered for a class of nonlinear systems whose purpose is tracking the prescribed trajectory. In the framework of solving above problem, two main tasks are investigated involving algebraic tools (algebra of functions). The first task is nonlinear model reduction followed by adaptive observer design for fault estimation. The second one is asymptotic model matching to accommodate the faults.

14:20-14:40 MoB24.2

Design of Sensor Fault Diagnosis Method for Non Linear Systems Described by Linear Polynomial Matrices Formulation: Application to a Winding Machine (I), pp. 1890-1895

Theilliol, Didier — Univ. Henri Poincare, Nancy 1
Ponsart, Jean-Christophe — Univ. Henri Poincare, Nancy I
Rodrigues, Mickael — Univ. OF LYON 1; LAGEP UMR CNRS 5007
Aberkane, Samir — UHP, NANCY 1
Yame, Joseph Julien — Univ. Henri Poincaré, Nancy 1

In this paper, a sensor model-based fault diagnosis method for a particular class of nonlinear systems is developed. A polynomial matrices representation is considered for modeling the dynamic behavior of a class of nonlinear systems. According to nonlinear representation via a polytopic transformation, the nonlinear faulty system can be considered as a nonlinear system with the presence of additive unknown inputs. Under fault isolation conditions, the main contribution of the paper relies on the use of an accurate observer that performs fault detection and isolation over the whole operating range of the nonlinear system. The effectiveness and performance of the proposed method are illustrated via real tests on a winding machine subject to sensor faults.

14:40-15:00 MoB24.3

Fault Estimation for Single Output Nonlinear Systems Using an Adaptive Sliding Mode Observer (I), pp. 1896-1901

Yan, Xing-Gang — Univ. of Leicester
Edwards, Christopher — Univ. of Leicester

In this paper, a class of single output nonlinear systems with an uncertain parameter is considered. A diffeomorphism is first introduced to simplify the system structure, then, by employing an adaptive approach to identify the unknown parameter, a sliding mode observer is developed to estimate the system state variables. Based on the observer, a fault estimation scheme is proposed based on the minimization of a weighted L_2 norm of the fault estimation error. A simulation example is given to demonstrate the proposed scheme.

15:00-15:20 MoB24.4

Observer-Based Fault Estimation for Networked Control Systems with Transfer Delays (I), pp. 1902-1907

Mao, Ze hui — Nanjing Univ. of Aeronautics and Astronautics
Jiang, Bin — Nanjing Univ. of Aeronautics and Astronautics
Cocquempot, Vincent — Univ. des Sciences et Tech. de Lille
Shi, Peng — Faculty of Advanced Tech.

In this paper, diagnosis of actuator/component faults for networked control systems (NCSs) with transfer delays is investigated. First, the linear NCSs with transfer delays are modelled by T-S discrete-time systems with input delays. Next, under certain conditions, a stable adaptive observer for fault diagnosis is designed. An extension to a class of nonlinear systems is then made. Finally, a motor example is given to illustrate the e±ciency of the proposed method.

15:20-15:40 MoB24.5

Fault Detection and Isolation Applied to a Ship Propulsion Benchmark (I), pp. 1908-1913

Zhang, Youmin — Concordia Univ.
Wu, Neng Eva — Binghamton Univ.
Jiang, Bin — Nanjing Univ. of Aeronautics and Astronautics

This paper describes a fault detection and isolation (FDI) scheme performed on the benchmark problem of a ship propulsion system. The model used for the ship propulsion system is nonlinear, for which two types of additive sensor faults, an additive incipient fault, and a multiplicative parametric fault are simulated. The estimation of the fault severity is accomplished by using an adaptive two-stage extended Kalman filter. A set of statistical detection variables is formed from the residuals of the bias and measurement estimates of the filter. These variables are then used in a threshold based hypothesis test to declare the occurrence of a fault and through a binary logic filter to identify the fault type. The simulation results showed that the developed fault detection and isolation scheme fulfilled some of the benchmark requirements reasonably well in the face of some prescribed perturbations in the model and disturbances of external signals.

15:40-16:00 MoB24.6

Fault Detection, Isolation and Accommodation Using the Generalized Parity Vector Technique, pp. 1914-1921

Taylor, James H. — Univ. of New Brunswick
Omana, Maira — Univ. of New Brunswick

This paper extends the generalized parity vector (GPV) approach for fault detection and isolation presented in Omana and Taylor [2], [3], [4], to achieve sensor accommodation.

In this study, this fault detection, isolation and accommodation technique is applied to a two-phase separator followed by a three-phase gravity separator model used in oil production facilities. This model simulates a large scale process, which allows the technique to be tested on a high dimensional space with more complex system dynamics. The fault management strategy is significantly improved by implementing a fault-size estimation and classification technique using the GPV magnitude signature. This fault characterization is refined by incorporating a recursive fault size recalculation algorithm based on the sensor accommodation error. Two different methods for sensor accommodation and fault size recalculation are proposed to take into account the software and hardware configuration in the plant.

MoB25 328

New Theoretical Results and Numerical Methods in

Optimization Based Control (Invited Session)

Chair: Findeisen, Rolf — Univ. of Stuttgart
Co-Chair: Engell, Sebastian — Univ. of Dortmund
Organizer: Findeisen, Rolf — Univ. of Stuttgart
Organizer: Engell, Sebastian — Univ. of Dortmund

14:00-14:20 MoB25.1

NCO Tracking for Singular Control Problems Using Neighboring Extremals (I), pp. 1922-1927

Gros, Sebastien — Doctoral Student
Chachuat, Benoit — Ec. Pol. Federale de Lausanne (EPFL)
Bonvin, Dominique — EPFL

A powerful approach for dynamic optimization in the presence of uncertainty is to incorporate measurements into the optimization framework so as to track the necessary conditions of optimality (NCO), the so-called NCO-tracking approach. For nonsingular control problems, this can be done by tracking active constraints along boundary arcs, and using neighboring-extremal (NE) control along interior arcs to force the first-order variation of the NCO to zero. In this paper, an extension of NE control to singular control problems is proposed. The idea is to design NE controllers from successive time differentiations of the first-order variation of the NCO. Based on these results, a NCO-tracking controller that is easily tractable from a real-time optimization perspective is proposed, whose application guarantees that the first-order variation of the NCO converges to zero exponentially. The performance of this NCO-tracking controller is illustrated via the case study of a steered car, a 5th-order two-input dynamical system.

14:20-14:40 MoB25.2

An Efficient Strategy for Real-Time Dynamic Optimization Based on Parametric Sensitivities (I), pp. 1928-1933

Würth, Lynn — RWTH Aachen
Hannemann, Ralf — RWTH Aachen Univ.
Marquardt, Wolfgang — RWTH Aachen Univ.

The optimal operation of chemical processes is challenged by frequent transitions and by the influence of process or model uncertainties. Under uncertainties, it is necessary to quickly update the optimal trajectories in order to avoid the violation of constraints and the deterioration of the economic performance of the process. Although an economically optimal operation can be ensured by online dynamic optimization, the high computational load of dynamic optimization associated with nonlinear and complex models is often prohibitive in real-time applications. To reduce the computational time required for online computation of the optimal trajectories in the neighborhood of the optimal solution under uncertainty, different strategies have been explored recently. If the operation is affected by small perturbations, efficient techniques for updating the nominal trajectories based on parametric sensitivities are applied, which do not require the solution of the rigorous optimization problem. However for larger perturbations, the linear updates obtained by the neighboring extremal solutions are not sufficiently accurate, and the solution of the nonlinear optimization problem requires further iterations with updated sensitivities to give a feasible and optimal solution. In this work, the sensitivity-based approach of Kadam (2004) is extended with a fast computational method for second-order derivatives based on composite adjoints. The application of the method to a simulated semi-batch reactor demonstrates that fast and optimal trajectory updates can be obtained.

14:40-15:00 MoB25.3

An Adjoint-Based Numerical Method for Fast Nonlinear Model Predictive Control (I), pp. 1934-1939

Wirsching, Leonard — Univ. of Heidelberg
Albersmeyer, Jan — Uni Heidelberg
Kühl, Peter — Univ. of Heidelberg
Diehl, Moritz — Univ. of Heidelberg
Bock, Georg — Univ. of Heidelberg

The application of optimization-based control methods such as nonlinear model predictive control (NMPC) to real-world process models is still a major computational challenge. In this paper, we present a new numerical optimization scheme suited for NMPC. The SQP-type approach uses an inexact constraint Jacobian in its iterations and is based on adjoint derivatives, that can be computed very efficiently. In comparison to a similar real-time algorithm based on directional sensitivities and an exact constraint Jacobian, the computational complexity is significantly reduced. Both algorithms are applied to the model of a thermally coupled distillation column for disturbance rejection. The results provide a proof-of- principle for the proposed adjoint-based optimization approach.

15:00-15:20 MoB25.4

A Hidden Markov Disturbance Model for Offset-Free Linear Model Predictive Control (I), pp. 1940-1945

Wong, Wee Chin — Georgia Inst. of Tech.
Lee, Jay — Georgia Tech.

Model predictive controllers are often designed with integral action to impart robustness. For this, disturbance models are usually employed. It is customary to append integrated white-noises to either the input or output channels. However, neither by themselves may be adequate representations in the presence of switching disturbance patterns that are typically witnessed in process industries. In order to handle such scenarios, we first propose a differenced state-space formulation that can incorporate both input and output disturbances while retaining detectability. Then, we couple it with Hidden Markov Model (HMM) to express the switching characteristics of the disturbances. This bypasses the need to add artificial noises into state variables to consider both the input and output disturbances, as previously suggested. Simulation examples are provided to highlight closed-loop performance improvement as a result of the proposed formulation.

15:20-15:40 MoB25.5

Adaptive Model Predictive Control for Constrained Nonlinear Systems (I), pp. 1946-1951

Guay, Martin — Queen's Univ.
Adetola, Veronica — Queen's Univ.

A true adaptive nonlinear model predictive control (MPC) algorithm must address the issue of robustness to model uncertainty while the estimator is evolving. Unfortunately, this may not be achieved without introducing extra degree of conservativeness and/or computational complexity in the controller calculations. To attenuate this problem, we employ a finite time identifier and propose an adaptive predictive control structure that reduces to a nominal MPC problem when exact parameter estimates are obtained. The adaptive MPC is formulated in such a way that useful excitation is automatically injected into the closed loop system to decrease the identification period.

15:40-16:00 MoB25.6

Avoidance of Poorly Observable Trajectories: A Predictive Control Perspective (I), pp. 1952-1957

Böhm, Christoph — Univ. of Stuttgart
Findeisen, Rolf — Otto-von-Guericke-Univ. Magdeburg
Allgower, Frank — Univ. of Stuttgart

Nonlinear systems can be poorly or non-observable along specific state and output trajectories or in certain regions of the state space. Operating the system along such trajectories or in such regions can lead to poor state estimates being provided by an observer. Such trajectories should be avoided if used for state-feedback control or monitoring purposes. In this paper, we outline two possible approaches to avoid weakly observable trajectories in the frame of nonlinear predictive control. The first approach is based on the use of a term in the cost functional that penalizes weakly observable trajectories and thus leads to avoidance of weakly or non-observable regions of operation. In the second approach, the observer error dynamics are directly considered in the prediction. Large state estimation errors lead to a large penalization in the cost functional and are thus avoided. The approaches are exemplified by considering an example system.

MoB26 327

Furnace Control (Regular Session)

Chair: Chai, Tianyou — Northeastern Univ.
Co-Chair: Salas-Cabrera, Ruben — Inst. Tecnologico de Cd. Madero

14:00-14:20 MoB26.1

Outlier Detection for 2D Temperature Data, pp. 1958-1963

Leiviska, Kauko — Univ. of Oulu/
Ruuska, Jari — Univ. of Oulu

This paper reports the study of using 2D temperature data for analysing the operation of the cooling process in the steel strip mill.

Scanning pyrometers are producing data profiles of the strip in longitudinal and transversal directions. Instrument malfunctions, dust and dirt particles on the strip surface and other disturbances make the use of the measurements difficult. This makes the data pre-processing, and especially the outlier detection, of utmost importance for a reliable process and fault analysis.

14:20-14:40 MoB26.2

Control and Optimization for Steel Plant Preheating Installations, pp. 1964-1969

Popescu, Dumitru — Pol. Univ. of Bucharest
Dimon, Catalin — Univ. Pol. of Bucharest
Petrescu, Catalin — Pol. Univ. of Bucharest

The paper presents the results of the research performed by the authors on control systems and optimization for the operating process of the heating installations from the blast furnace at a steel plant. This system was developed on two relevant levels interconnected in a hierarchical control structure. The acquisition and control level using specialized microcontrollers was implemented. The supervisory level for the optimization of the combustion process was implemented on an operator console. The solution of the optimization problem represents the optimal decision, translated in real-time procedure to the acquisition and control level.

14:40-15:00 MoB26.3

Temperature Control of a Tube Furnace: An Experimental Approach, pp. 1970-1975

Salas-Cabrera, Ruben — Inst. Tecnologico de Cd. Madero
Joers Delgado, Carlos Alberto — Inst. Tecnologico de Ciudad Madero
Medellin-Marsuez, Reyna — Inst. Tecnologico de Cd. Madero

This work deals with the experimental temperature control of a tube furnace that is used for determining physical and chemical properties of different compounds. Several experimental tests are performed to identify the dynamic model, then pole placement technique and integral control by state augmentation are employed to design the control law. In other words discrete time control theory is utilized to implement this temperature microprocessor-based controller. Analog, digital and power electronics are the fundamental components of the custom-made instrumentation.

15:00-15:20 MoB26.4

Intelligent Integrated Model for Predicting Burn-Through Point Based on Gas Temperature Distribution, pp. 1976-1981

Xu, Chen-Hua — Central South Univ.
Wu, Min — Central South Univ.
She, Jin-Hua — Tokyo Univ. of Tech.
Ding, Lei — Central South Univ.
Yokoyama, Ryuichi — Waseda Univ.

This paper presents an integrated model for predicting the burn-through point (BTP) of the lead-zinc sintering process from the gas temperature distribution (GTD). This process features strong nonlinearity, a large time delay, and time-varying parameters. First, the characteristics of the GTD in the sintering machine are obtained from experiments, and a surface temperature model for the material is established. Based on that model, the current BTP is obtained by a soft-sensing technique. Then, a time-sequence-based model for predicting the BTP is built using grey theory. Since the BTP is affected by variations in the process parameters, a technological-parameter-based prediction model of the BTP is set up using a neural network. Finally, an integrated model for predicting the BTP is implemented using a fuzzy classier to integrate the time-sequence-based and technological-parameter-based models. The results of actual runs demonstrate the validity of the method.

15:20-15:40 MoB26.5

Optimizing Control of Hot Blast Stoves in Staggered Parallel Operation, pp. 1982-1987

Sahin, Akin — ETH Zurich
Morari, Manfred — Swiss Federal Inst. of Tech.

An optimizing control scheme is designed for the minimization of the energy consumption in the hot blast stoves. By an appropriate selection of the control structure, the problem of energy minimization at steady-state in the presence of constraints is formulated as a constrained optimal control problem. A model predictive control (MPC) scheme is designed based on a simple linear control model, which is obtained from step response experiments on a detailed dynamical model of the process. The control model is augmented with an integrating disturbance model to compensate the steady-state offset. The performance of the MPC scheme is tested on the detailed dynamical model.

15:40-16:00 MoB26.6

Hybrid Intelligent Control for Optimal Operation of Shaft Furnace Process, pp. 1988-1995

Chai, Tianyou — Northeastern Univ.
Ding, Jinliang — Northeastern Univ.
Wu, Fenghua — Northeastern Univ.

The extensively used shaft furnace in the ore concentration industry is an important facility that turns the weak-magnetic low-grade hematite ore into strong-magnetic one. During the operation of the shaft furnace roasting process, the optimal control objective is to control the technique indices, namely the magnetic tube recovery ratio (MTRR) that represents the quality, the efficiency, and the consumption of the product processing, into its targeted ranges. However, due to the complex dynamics between the MTRR and the control loops, such a control objective is by far difficult to achieve by the existing control methods, thus only manual control is adopted. In this paper, a hybrid intelligent control method for the optimal process operation is proposed with the purpose of controlling the technique indices into the desired range by on-line adjusting the set-points of the control loops. The proposed method was applied to the roasting process undertaken by 22 shaft furnaces in the ore concentration plant of Jiuquan Steel & Iron Ltd in China. The application results show that the MTRR is controlled to the targeted range with 2% increase; the faulty working-conditions are eliminated, which boosts the equipment operation ratio by 2.98%, resulting in a raise of 0.57% in the concentrated grade and 2.01% in the metal recovery ratio.

MoB27 326

Precision Systems and Friction Modeling/Control (Regular Session)

Chair: Alvarez-Icaza, Luis — Univ. Nacional Autónoma de México
Co-Chair: Babuska, Robert — Delft Univ. of Tech.

14:00-14:20 MoB27.1

Robust H Infinity Control of Hysteresis in a Piezoelectric Stack Actuator, pp. 1996-2001

Chuang, Ning — Australian Defence Force Acad.
Petersen, Ian Richard — Univ. of New South Wales - ADFA

This paper describes a method for controlling a piezoelectric stack actuator with hysteresis nonlinearity. The actuator used is a high-performance monolithic multilayer piezo actuator. The proposed control method involves a circuit, which was built with a capacitor in series with the piezo actuator to provide a measured output voltage which is proportional to the charge on the piezo actuator.The controller is designed based on a model of the hysteresis nonlinearity constructed using experimental data. The paper considers a robust H infinity tracking controller to control the piezoelectric actuator. The controller is designed using an uncertain system model. Simulation results show that the controller can significantly reduce the effect of the hysteresis nonlinearity.

14:20-14:40 MoB27.2

A Practical Loop Shaping Design Procedure with Classical Control Criteria and Its Application to Hard Disk Drives, pp. 2002-2007

Ohno, Keitaro — The Univ. of Tokyo
Hara, Shinji — The Univ. of Tokyo
Yamahira, Naoshi — The Univ. of Tokyo
Kawabe, Takayuki — Fujitsu Lab. Ltd.
Maruyama, Tsugito — Fujitsu Lab. Ltd.

This paper is concerned with integration of classical control criteria into the H-infinity robust control design with the use of the H-infinity Loop Shaping Design Procedure (LSDP) by McFarlane and Glover. Classical control criteria such as gain crossover frequency and phase margin still play important roles to designing and evaluating feedback control systems in practical applications including Hard Disk Drives (HDDs) where empirical knowledge has great importance. The systematic use of the robust control design has been tried in industry. However, it has yet to be fully adopted simply because of the familiarity with the classical control criteria. In this paper, we will propose a way to design digital robust control systems with the use of the LSDP in which we can specify the classical control criteria. Application to HDDs will be demonstrated with a set of simulations to validate the proposed method.

14:40-15:00 MoB27.3

Wind Turbine Modeling by Friction Effects, pp. 2008-2013

Villanueva, Juvenal — Univ. Nacional Autónoma de México
Alvarez-Icaza, Luis — Univ. Nacional Autónoma de México

The mechanical power in a wind turbine is modeled from a friction phenomenon perspective. Two models for the available power are derived based on a relative speed between the wind speed and turbine blades. The models are compared with a heuristic reference model showing good performance.

15:00-15:20 MoB27.4

Friction Identification and Compensation on Nanometer Scale, pp. 2014-2019

Amthor, Arvid — TU Ilmenau
Ament, Christoph — Tech. Univ. Ilmenau
Li, Pu — Tech. Univ. of Ilmenau

This work concerns the modeling and experimental verification of the highly nonlinear friction behavior in positioning on nanometer scale. The main target of this work is to adjust and identify a simple dynamic friction model which allows a model-based estimation of the friction force in combination with the system inertia against displacement. Experiments in the pre-sliding and sliding friction regimes are conducted on an experimental setup. A hybrid two-stage parameter estimation algorithm is used to fit the model parameters based on the experimental data. Finally, the identified friction model is utilized as a model-based feedforward controller combined with a classical feedback controller to compensate the nonlinear friction force and reduce tracking errors.

15:20-15:40 MoB27.5

Adaptive Friction Compensation: Application to a Robotic Manipulator, pp. 2020-2024

Susanto, Witono — TU Delft
Babuska, Robert — Delft Univ. of Tech.
Liefhebber, Freek — TNO Science and Industry
van der Weiden, Ton — TU Delft

This paper presents a feed-forward model-based friction compensation technique using the LuGre friction model. An off-line method is given to estimate the model's parameters based on simple ramp-response experiments. In addition, an on-line parameter adaptation procedure for the two most important model parameters is provided. Experimental results obtained with a robotic manipulator are presented to illustrate the merits of the friction compensation technique.

15:40-16:00 MoB27.6

Stability of a Class of Relay Feedback Systems Arising in Controlled Mechanical Systems with Ideal Coulomb Friction, pp. 2025-2030

Jeon, Soo — Univ. of California at Berkeley
Tomizuka, Masayoshi — Univ. of California, Berkeley

Coulomb friction is inevitable in every mechanical system with contact motion. When the mechanical system with Coulomb friction is under feedback control, it can destabilize the system by generating limit cycles. Controlled mechanical systems with ideal Coulomb friction can be viewed as a particular class of relay feedback systems characterized by the zero DC gain property and the positivity of the first Markov parameter. This paper elaborates recent results on sufficient conditions to guarantee the global pointwise stability of such systems. The scope of analysis has been kept broad so that the results apply to systems with multiple inertia elements and multiple Coulomb friction sources. To employ the recent advances in the absolute stability theory, the limiting arguments are adopted to approximate the relay elements to continuous functions. As a result, a new sufficient condition on the global pointwise stability of the systems with multiple Coulomb friction sources is derived by extending the existing result with a single Coulomb friction source when the stiction level is larger than the Coulomb friction level. Also, it has been shown that the describing function criterion is indeed an exact condition when the order of the closed-loop system is 3. Simulation results are presented with a flexible joint mechanism to illustrate the main points.

MoB28 330A

Engine Modeling, Diagnostics and Control (Invited Session)

Chair: Rizzo, Gianfranco — Univ. of Salerno
Co-Chair: Isermann, Rolf — Univ. of Tech. Darmstadt
Organizer: Rizzo, Gianfranco — Univ. of Salerno

14:00-14:20 MoB28.1

Model-Based Fault Detection and Diagnosis with Special Input Excitation Applied to a Modern Diesel Engine (I), pp. 2031-2036

Clever, Sebastian — Tech. Univ. Darmstadt
Isermann, Rolf — Univ. of Tech. Darmstadt

Due to the rising complexity of many technical processes modern diagnosis systems have to supervise a multitude of hydraulic, mechanical, electromechanical and mechatronic components. Therefore model-based methods of fault-detection and diagnosis have been developed. These methods use mathematical process models to relate data of several measurable variables. Thus the diagnosis quality depends on the available sensor data. In order to obtain additional information with the given sensor configuration special input excitation signals can be used. This paper will describe a method to locate faults in multivariable systems using such input excitation and its application to the intake air system of a modern common rail Diesel engine. The presented method uses the knowledge of fault effects on the measured output, when the inputs are successively excited quasi-stationary, to determine the location of the fault. It has been applied successfully to differentiate air mass sensor faults from other process faults.

14:20-14:40 MoB28.2

A Modeling Approach for Engine Dynamics Based on Electrical Analogy (I), pp. 2037-2042

Palma, Antonio — Elasis SPA
Palladino, Angelo — Univ. degli Studi del Sannio
Fiengo, Giovanni — Univ. degli Studi del Sannio
De Cristofaro, Ferdinando — Elasis
Garofalo, Fabio — Elasis S.C.p.A.
Glielmo, Luigi — Univ. of Sannio

In this paper, a multi-cylinder, internal combustion engine model is presented. The paper is focused on a new modular, physically based and lumped parameter (zero dimensional) approach, leading to a complete and coherent model structure. The model is conceived to be used with general purpose simulation software, as MATLAB/Simulink. The mean value outputs of the model (pressure, temperature, mass flow, torque) are compared with experimental data, collected by a Fiat 1.8 liter engine, in order to perform a standard identification and validation procedure.

14:40-15:00 MoB28.3

Observer Design and Model Augmentation for Bias Compensation Applied to an Engine (I), pp. 2043-2048

Höckerdal, Erik — Linköping Univ.
Frisk, Erik — Linkoping Univ.
Eriksson, Lars — Linköping Univ.

A systematic design method for reducing bias in observers is developed. The method utilizes an observable default model of the system together with measurement data from the real system and estimates a model augmentation. The augmented model is then used to design an observer which reduces the estimation bias compared to a default observer. A key result is the theoretical analysis that characterizes the possible augmentations is also conducted. The method is applied to a truck engine where the resulting augmented observer reduces the estimation bias with 50 % in an ETC.

15:00-15:20 MoB28.4

Closed-Loop Individual Cylinder Air-Fuel Ratio Control Via UEGO Signal Spectral Analysis (I), pp. 2049-2056

Cavina, Nicolo — Univ. of Bologna
Moro, Davide — Univ. of Bologna
Corti, Enrico — Univ. of Bologna

The paper presents the development and real time application of an original closed-loop individual cylinder AFR control system, based on a spectral analysis of the lambda sensor signal measured at the confluence of the various exhaust runners. The observation that any type of AFR disparity between the various cylinders is reflected in a specific harmonic content of the AFR signal spectrum, represents the starting point of the project. The proposed approach has been designed in order to be compatible with on-board application. The AFR individual cylinder closed-loop controller has been tested in real time, by implementing it in a virtual Electronic Control Unit, using rapid control prototyping techniques. The results observed on a 4 cylinder Spark Ignition 1.2 liter engine are encouraging, since in the investigated engine operating conditions the controller is able to guarantee AFR inequality below 0.01 lambda. The paper shows how the proposed controller can be applied to other engine configurations (6, 8, or 12 cylinder engines), if a lambda sensor is available per each engine bank.

15:20-15:40 MoB28.5

Robust Nonlinear EGR and VGT Control with Integral Action for Diesel Engines (I), pp. 2057-2062

Wahlström, Johan — Linköping Univ.
Eriksson, Lars — Linköping Univ.

A robust non-linear multivariable control design with integral action is proposed and investigated for control of EGR valve and VGT position in heavy duty diesel engines. The main control goal is to regulate oxygen/fuel ratio and intake manifold EGR-fraction. These are chosen as main performance variables since they are strongly coupled to the emissions. A recently developed non-linear control design based on feedback linearization is extended with integral action. The nonlinear controller gives an inner loop with good stability and robustness properties. It is shown that integral action is necessary to handle model errors so that the controller can track the performance variables specified in the outer loop. In particular the control design method utilizes a control Lyapunov function and inverse optimal control, which results in a control law with robustness properties interpretable as gain and phase margins. Furthermore, comparisons by simulation also show that the proposed control design successfully handles non-linear effects.

15:40-16:00 MoB28.6

Time to Surge Concept and Surge Control for Acceleration Performance (I), pp. 2063-2068

Leufven, Oskar — Linköping Univ.
Eriksson, Lars — Linköping Univ.

Surge is a dangerous instability that can occur in compressors. It is avoided using a valve that reduces the compressor pressure. The control of this valve is important for the compressor safety but it also has a direct influence on the acceleration performance. Compressor surge control is investigated by first studying the surge phenomenon in detail. Experimental data from a dynamic compressor flow test bench and surge cycles measured on an engine is used to tune and validate a model capable of describing surge. A concept time to surge is introduced and a sensitivity analysis is performed to isolate the important characteristics that influence surge transients in an engine. It is pointed out that the controller clearly benefits from a feed-forward term due to the small time frames associated with the transition to surge. In the next step this knowledge is used in the design of a novel surge controller. This surge controller is then compared to two other controllers and it is shown that it avoids surge and improves the acceleration performance by delivering both higher engine torque and turbo shaft speed after a gear change.

MoB29 330B

New Trends in Chassis Control and Supervision (Invited Session)

Chair: Gissinger, Gerard — Univ. of Mulhouse
Co-Chair: Yi, Kyongsu — Seoul National Univ.
Organizer: Gissinger, Gerard — Univ. of Mulhouse

14:00-14:20 MoB29.1

Navigation and Speed Signs Recognition Fusion for Enhanced Vehicle Location (I), pp. 2069-2074

Lauffenburger, Jean-Philippe — Univ. of Haute-Alsace
Bradai, Benazouz — Valeo
Basset, Michel — Univ. de Haute-Alsace
Nashashibi, Fawzi — Ec. des Mines de Paris

This paper presents an approach that provides extended vehicle location information based on multi sensor data fusion. Firstly, the vehicle location, a recommended speed level referred to this location and a confidence level attached to this speed evaluation are determined thanks to the digital road map of a navigation system. At the same time, a speed sign recognition device based on image processing determines the legal speed limit and an associated confidence level of the detection. Because of the uncertainties and imprecision of both sensors, fusion using Belief Theory is performed between the data provided by each sources. By merging several criteria from the digital map with the traffic sign detection results, this approach allows on the one hand a reliable determination of the driving conditions and on the other hand the evaluation of the confidence level of the decision. Real experiment results from a driving situation in which both sources are in conflict illustrate the effectiveness of the approach.

14:20-14:40 MoB29.2

Attitude and Handling Improvements through Gain-Scheduled Suspensions and Brakes Control (I), pp. 2075-2080

Poussot, Charles — INPG/ENSIEG
Sename, Olivier — INPG
Dugard, Luc — CNRS-INPG-UJF
Gaspar, Peter — Computer & Automation Inst. of HAS
Szabo, Zoltan — Hungarian Acad. of Sciences
Bokor, Jozsef — Hungarian Acad. of Sciences

In this paper, the problem of comfort and handling improvements of a ground vehicle is treated through the control of the suspension and braking systems. Two gain-scheduled controllers are synthesized (in the Hinf framework) to achieve, in the frequency domain, comfort and yaw performances according to the driving situation, observed by the mean of a monitor. The proposed strategy tackles the nonlinear tire braking force in an original way and meets the situation dependent objectives of the vehicle in a unified synthesis. Simulation tests on a complex nonlinear full vehicle model shows improvements of the proposed approach.

14:40-15:00 MoB29.3

Optimization of Global Chassis Control Variables (I), pp. 2081-2086

Kasac, Josip — Faculty of Mechanical Engineering and Naval Architecture
Deur, Josko — Univ. of Zagreb
Novakovic, Branko — Faculty of Mechanical Engineering and Naval Architecture
Assadian, Francis — Jaguar Cars Ltd
Hancock, Matthew — Jaguar Cars Ltd

The paper presents a global chassis control (GCC) optimization approach using a gradient-based optimal control algorithm. The goal is to find optimal actions of various actuators such as active steering and active differential, which ensure satisfying the optimization criterion (e.g. trajectory following error minimization) subject to different equality and inequality constraints on state and control variables. The optimization algorithm is based on an exact gradient method, where the const function gradient is calculated by using a backpropagation-through-time-like algorithm. The proposed GCC optimization approach is illustrated on an example of double lane change maneuver using rear active steering and/or rear active differential actuators.

15:00-15:20 MoB29.4

An Integrated Vehicle Control with Actuator Reconfiguration (I), pp. 2087-2092

Gaspar, Peter — Computer & Automation Inst. of HAS
Szabo, Zoltan — Hungarian Acad. of Sciences
Bokor, Jozsef — Hungarian Acad. of Sciences

The aim of this paper is to present an algorithm that, by an actuator reconfiguration, performs tracking and rollover prevention at the same time. Using an active steering control a path following task can be realized. However during operational time maneuvers might occur when overturning moments are generated. By the brake mechanism rollover prevention can be ensured but the real path will significantly deviate from the desired one and this effect on the yaw motion has to be compensated using active steering. The integrated control of the steering and braking actuators that realizes the balance between the tracking task and rollover prevention is designed based on a Linear Parameter Varying (LPV) model. The conflict between these performance demands can be avoided by a suitable reconfiguration of the active suspension system by generating roll moments to reduce the rollover risk without affecting the yaw dynamics. Thus the critical level when braking must be applied to prevent rollover situation is increased by an active suspension mechanism.

15:20-15:40 MoB29.5

Design and Tests of a Controller for Autonomous Vehicle Path Tracking Using GPS/INS Sensors, pp. 2093-2098

Kang, Juyong — Seoul National Univ.

Hindiyeh, Rami Y.	Stanford Univ.
Moon, Seung-Wuk	Seoul National Univ.
Yi, Kyongsu	Seoul National Univ.
Gerdes, J. Christian	Stanford Univ.

This paper describes a steering controller integrated with speed controller for autonomous path tracking using GPS and INS sensors. The steering controller for path tracking is developed based on the finite preview optimal control method. The steering control input is computed using the road information within preview distance. The speed controller determines the speed command necessary to maintain a lateral acceleration limit and improve vehicle safety. The vehicle model for simulation study is validated using vehicle test data. Finally, the controller is implemented on a by-wire vehicle, P1, to validate the performance of the steering controller integrated with the speed controller.

15:40-16:00 MoB29.6

Anti-Lock Braking System Using Predictive Control and On-Line Tire/Road Characteristics Estimation, pp. 2099-2104

Jacquet, Arnaud	Messier-Bugatti
Chamaillard, Y.	LME
Basset, Michel	Univ. de Haute-Alsace
Gissinger, Gerard	Univ. of Mulhouse
Franck, David	Messier-Bugatti
Garcia, Jean-Pierre	messier bugatti

A model predictive controller for optimal braking of a road vehicle is proposed. Taking into account the additional information provided by a torque sensor located in the wheel, there is no need to use any longitudinal model of the vehicle. Instead, we detail a way to identify a tire/road characteristic. This on-line reconstruction is based on an estimation of the longitudinal wheel slip and an estimation of the adhesion torque. The design approach, focused on the angular dynamics of the wheel, allows the use of the controller in vehicles for which assumptions on the longitudinal dynamics are not possible. Therefore, this controller is very indicated for aircraft applications.

MoB30 330C

Formation Flight (Invited Session)

Chair: de Lafontaine, Jean	Univ. de Sherbrooke / NGC Aerospace Ltd
Co-Chair: Lovera, Marco	Pol. di Milano
Organizer: de Lafontaine, Jean	Univ. de Sherbrooke / NGC Aerospace Ltd
Organizer: Kron, Aymeric	Univ. of Sherbrooke

14:00-14:20 MoB30.1

An LTP/LPV Approach to Orbit Control of Spacecraft on Elliptical Orbits (I), pp. 2105-2110

Vigano', Luca	Pol. di Milano
Lovera, Marco	Pol. di Milano
Drai, Rémi	ESA-ESTEC

The problem of orbit control for spacecraft on elliptical orbits is analysed and an approach to the design of optimal constant gain controllers for the periodic dynamics of relative motion is proposed. In particular, it is shown how the proposed approach can guarantee closed loop stability and optimal performance both in the case of circular and elliptical orbits.

14:20-14:40 MoB30.2

Relative State Estimation of Satellite Formation Flying Using Kalman Filter (I), pp. 2111-2116

Lee, Young Gu	Korea Advanced Inst. of Science and Tech.
Bang, Hyochoong	KAIST

In this paper, an approach is proposed for relative state estimation for satellites in formation flying. To estimate the relative states of two satellites, the Kalman Filter algorithms (EKF, UKF) are adopted with the relative range and range rate between two satellites and attitude of a satellite as measurement variables. In case that the initial state and measurements errors are moderate, both EKF and UKF perform well. As those errors increase, however, the EKF degrades unlike the UKF. Numerical simulations are performed under two circumstances. The first one presented both chief and deputy satellites are orbiting a circular reference orbit around a perfectly spherical Earth model with no disturbing acceleration, in which the elementary relative orbital dynamics are taken into account. In reality however, the Earth is not a perfect sphere, but rather an oblate spheroid. Both satellites are under the effect of J2 geopotential disturbance, which causes the relative distance between two satellites to increase gradually. The near-Earth orbit decays as a result of atmospheric drag. In order to remove the modeling error, the second scenario incorporates the effect of J2 geopotential disturbing force, atmospheric drag, and the eccentricity.

14:40-15:00 MoB30.3

Robust Multi-Objective Control for the Station Keeping of the Interferometric Cartwheel (I), pp. 2117-2122

Arzelier, Denis	LAAS-CNRS
Theron, Alain	Univ. de Toulouse
Peaucelle, Dimitri	LAAS-CNRS
Fourcade, Jean	CNES

Groups of satellites flying in formation require maintaining the specific relative geometry of the formation with high precision. This requirement implies to consider the problem of relative station keeping in a renewed framework. In this framework, issues related to the derivation of reliable relative models as well as to the peculiarity of the synthesis problems must be jointly considered. This paper presents some preliminary results of a robust multi-objective control approach applied to the station keeping of a low Earth observation system, i.e. the interferometric cartwheel, patented by CNES. This wheel is made up of three receiving spacecrafts, which follow an emitting Earth observation radar satellite. The particular geometry of this formation of satellites leads to the derivation of a simplified uncertain state-space model. Atmospheric drag perturbations are included in the linearized equations of the relative motion and the atmospheric density part of the definition of the atmospheric drag force is considered to be uncertain due to its dependence upon the solar activity. In the first part of the paper, an uncertain polytopic state-space model is derived. The second part describes the station keeping strategy of the formation. The station keeping strategy is performed using pure passive actuators. Due to the high stability of the relative eccentricity of the formation, only the relative semi major axis has to be controlled. Differential drag due to a differential orientation of the solar panel is used here to control relative altitude. A robust multi-objective control strategy via state-feedback is developed and tested as autonomous orbit controller. These results are analyzed via highly non linear simulations performed on a platform of CNES.

15:00-15:20 MoB30.4

Distributed Estimation for Spacecraft Formations Over Time-Varying Sensing Topologies (I), pp. 2123-2130

Acikmese, Behcet	Jet Propulsion Lab.
Scharf, Daniel	Jet Propulsion Lab.
Carson, John M.	California Inst. of Tech. Jet Propulsion Lab.
Hadaegh, Fred Y.	California Inst. of Tech.

In this paper we present the analysis and design of distributed estimators for formation flying spacecraft with time-varying sensing topologies. We first develop a discrete-time, switched linear model of the formation translational dynamics in which the measurement vector is characterized in terms of the edge matrix of a graph associated with the sensing topology. Then a switched, linear estimator is developed, called a lambda-estimator, for a general class of discrete-time, switched linear systems. This estimator is replicated on each spacecraft to estimate the entire relative translational state of a formation, and estimator gain switching occurs as a function of the instantaneous sensing topology. These estimators guarantee that the mean of the estimation error decays to the origin with a prescribed decay rate and that the error covariance decays to an ultimate bound, also with a prescribed decay rate. In addition, linear matrix inequality-based design procedures are developed for lambda-estimators. It is proven that a stable formation lambda-estimator exists if all of the possible sensing topologies describe connected graphs. This observation leads to the design of opportunistic lambda-estimators for formations switching among connected sensing topologies in which more sensing links are available than considered in estimator design.

15:20-15:40 MoB30.5

Formation Flying Guidance Navigation and Control Design for Science Missions (I), pp. 2131-2136

Villien, Anthony	ASTRIUM SAS
Morand, Julien	ASTRIUM SAS
Borde, Jacques	ASTRIUM SAS

Cavel, Cyril ASTRIUM SAS

This paper presents the recent activities performed by Astrium to design Guidance Navigation Control systems for European Formation Flying missions: PROBA 3, SIMBOL-X, Darwin and Pégase. These missions cover a wide range of formation flying needs from medium accuracy mission (astronomy) up to high accuracy (interferometry). For each class of mission the paper gives an overview of the major system requirements, the trade-off for the GNC architecture definition, the proposed GNC design and the assessment of the performances.

15:40-16:00 MoB30.6

Output Attitude Tracking of a Formation of Spacecraft, pp. 2137-2143

Grřtli, Esten Ingar Norwegian Univ. of Science and Tech.

Gravdahl, Jan Tommy Norwegian Univ. of Science & Tech.

In this paper we will consider the control of spacecraft in a leader-follower formation using attitude measurements only. To analyze the formation under non vanishing disturbances, we make use of the concept of uniform practical exponential stability. To ease the Lyapunov analysis a new theorem is provided, giving sufficient conditions for systems presenting a cascaded structure to satisfy this definition. Finally, output control is applied to both the leader and follower spacecraft and the stability of the overall system is analyzed by applying this new result.

MoBCC 401

Milestone Report by IFAC Coordinating Committee on Design Methods (CC2) (Milestone Session)

Chair: Bars, Ruth Budapest Univ. of Tech. and Ec.

14:00-16:00 MoBCC.1

Trends in Theory of Control System Design - Status Report by the IFAC Coordinating Committee on Design Methods, pp. 2144-2155

Bars, Ruth Budapest Univ. of Tech. and Ec.

Colaneri, Patrizio Pol. di Milano

Dugard, Luc CNRS-INPG-UJF

Allgower, Frank Univ. of Stuttgart

Kleimenov, Anatolii Inst. of Mathematics and Mechanics of Ural Branch of the Rus

Scherer, Carsten W. Delft Univ. of Tech.

Control theory deals with disciplines and methods leading to an automatic decision process in order to improve the performance of a control system. The evolution of control engineering is closely related to the evolution of the technology of sensors and actuators, and to the theoretical controller design methods and numerical techniques to be applied in real time computing. New control disciplines, new development in the technologies will fertilize quite new control application fields. Theory on control design methods traditionally focuses on domains reflected in the TC structure of CC2 (Control design, linear control systems, nonlinear control systems, optimal control, robust control). The status report gives an overview of the current key problems in control theory and design, evaluates the recent major accomplishments and forecasts some new areas. It points out some control fields, which could be challenges for future research.

MoC01 Atlantic Hall

Mechatronics & Computers (Poster Session)

Chair: Wang, Wei Dalian Univ. of Tech.

Co-Chair: Boverie, Serge Continental Automotive France

16:30-18:30 MoC01.1

LQ Control Problem Based on Numerical Computation with Guaranteed Accuracy, pp. 2156-2161

Yano, Kentaro Kyushu Inst. of Tech.

Koga, Masanobu Kyushu Inst. of Tech.

This paper presents LQ control problem based on numerical computation with guaranteed accuracy. By using the proposed methods, it is possible to guarantee numerical quality about design of control system. This paper also proposes a problem which finds the numerical optimal controller from a set of solutions solved by verified LQ control problem.

16:30-18:30 MoC01.2

Design of Intelligent Information Support Systems for Human-Operators of Complex Plants, pp. 2162-2167

Jharko, Elena V.A. Trapeznikov Inst. of Control Sciences

Complex equipment of an industrial plant subject to control, large body of information flows, complexity of control problems, lack of time available to make a decision, etc. are the reasons which lead to a number of cases to contradiction of human-operator control capabilities and actual control problem requirements. Within such a problem, a natural way out is to design an intelligent information support system (IISS) which would be able to assist the human-operator to implement the complex industrial plant control functions. These functions are to involve operative mode control of automatic systems, monitoring the systems performance, and prediction of the plant status, both within normal and abnormal situations. Involving such an IISS into control process enables one to decrease the human-operator load, to increase the human-operator performance, and to increase the plant performance reliability.

16:30-18:30 MoC01.3

Model Parameter Estimation by Tracking Simulator for the Innovation of Plant Operation, pp. 2168-2173

Nakaya, Makoto Yokogawa Electric Corp.

Seki, Tatenobu Yokogawa Electric Corp.

Kawaguchi, Kyojiro Yokogawa Electric Corp.

Onoe, Yasushi Yokogawa Electric Corp.

Ohtani, Tetsuya Yokogawa Electric Corp.

This paper proposes a new application of the tracking simulator relevant to future plant operation. The tracking simulation technique will enable matching of physical and virtual worlds. The simulator receives sensor data from the plant and the model parameters in the simulator are constantly adjusted to match the actual plant behavior. Model parameter estimation is one application of the tracking simulator. Here, the tracking simulator showed good simulation accuracy with model parameters to estimate the functions of its related variables. A fuel cell simulator was used for model parameter estimation in this study.

16:30-18:30 MoC01.4

Design on Odd-Even Steps Third Order Approach Interpolation Algorithm for Logarithmic Curve, pp. 2174-2179

Jiang, Xinhua Central South Univ.

Chen, Xingwu Fujian Univ. of Tech.

Logarithmic curve interpolation is essential for precise machining conical cutters with constant rake and spiral angle in CNC machine. In this paper, a novel odd-even steps third order approach algorithm is presented to realize the logarithmic interpolation. In each interpolating cycle there are odd and even steps divided. At the odd step, the interpolating point moves in tangent direction for an instruction interpolation length. The even step is in succession to interpolate same length through the coordinate increments computed by using the Taylor Mean-value Theorem in third order approach algorithm for the interpolation point approaching the ideal curve closely. The third order approach interpolating formulae for calculating coordinate increments are deduced in the results with simplified arithmetic operations that can be quickly computed for real time application. Test results indicate the third order approach algorithm is featured with high accuracy, suitable to be executed by the 32-bit micro-processor in ARM9 embedded CNC system for multi-axis servo control to accurate grind the conical teeth.

16:30-18:30 MoC01.5

Hybrid System Approach to On-Line Testing of Mixed Signal VLSI Circuits: A Case Study of DC-DC Buck Converters, pp. 2180-2187

Biswas, Santosh IIT Kharagpur INDIA

Samanta, Susovan IIT Kharagpur

Mukhopadhyay, Siddhartha IIT KGP

Patra, Amit IIT Kharagpur

Sarkar, Dipankar IIT,Kharagpur

This work is concerned with the development of a method for the design of Mixed Signal VLSI circuits with on line testing capability. A novel theory of Fault Detection and Diagnosis of Hybrid Systems has been applied for the on-line detection of catastrophic stuck-at faults in mixed VLSI circuits. Based on this an FPGA based system has been developed to design a DC-DC buck converter with on-line testing capability. To the best of our knowledge the proposed methodology is one of the first attempts to provide a solution for

On-Line Testing of mixed signal VLSI circuits using a formal theory, which is applicable to a very large class of low frequency analog circuits.

16:30-18:30 MoC01.6

A Fuel-Cell-Battery Hybrid Platform for Portable Embedded Systems, pp. 2188-2193

Lee, Kyungsoo SEOUL NATIONAL Univ.
Cho, Youngjin seoul national Univ.
Park, Jaehyun SEoul national Univ.
Kim, Younghyun Seoul National Univ.
Kim, Jihun seoul national Univ.
Chang, Naehyuck Seoul national Univ.

A portable proton exchange membrane (PEM) fuel cell operates at room temperature, has an energy density which is 4 to 6 times larger than that of a Li-ion battery, and thus is a promising next generation power source for power-hungry portable devices. However, in spite of the high energy density, fuel cells have limited power capacity and cannot respond to sudden changes in the load. Thus, a system powered solely by the fuel cell should be over-designed and not economical. Thus, fuel cells are commonly used with a battery to utilize both the high energy density of the fuel cell and the high power capacity of the battery.

Since power consumption of embedded systems dynamically changes over time, the control of a fuel cell and the charge management in the battery is sophisticated. Ultimate fuel-optimal configuration is achievable only when the control of the fuel cell, charge management of the battery, and the power management of the embedded system are jointly optimized. Since this is certainly a new problem, we first need an evaluation platform for the measurement and characterization. Nevertheless, there has been no existing platform to tackle such a problem.

In this paper, we demonstrate the design and implementation of a 20W average, 80W peak power fuel cell and dual Li-ion battery hybrid power source platform. This platform is designed to characterize the performance of hybrid power source, and also to explore new energy management strategies for embedded systems powered by a hybrid source. We devise a new hybrid power supply scheme named DTC (Dynamic duTy cycle Control) so that we may fully control the proportion of the fuel cell current and the battery current.

16:30-18:30 MoC01.7

Home Network Infrastructure Based on Corba Event Channel, pp. 2194-2199

Binugroho, Eko Henfri Pusan National Univ.
Seo, Young Bong Pusan National Univ.
Choi, Jae Weon Pusan National Univ.

This paper proposes a home network infrastructure based on CORBA as a middleware with client-server configuration. Communication inside the network is designed as an event-oriented communication, by using event channel that defined in OMG event service. By modifying CORBA event channel, several functions are developed for enabling the connection, communication, remote control, remote monitoring, and device management of home appliances. CORBA event channel enables decoupling interface between objects, so asynchronous communication between multiple clients can be developed easily. The proposed design has been tested using CORBA based computer test-bed that equipped with PLC Ethernet and WI-Fi communication. Several functions and services that provided in the design have been tested in order to examine test-bed's performance. Simulation of connection from small number of clients until large number of clients has been made, to measure overall network performance. A linear relation between number of clients and the latency of command delivered by server can be seen from the experiment results within test-bed environment.

16:30-18:30 MoC01.8

A Soar-Based Planning Agent for Gas-Turbine Engine Control and Health Management, pp. 2200-2205

Gunetti, Paolo Univ. of Sheffield
Thompson, Haydn Univ. of Sheffield

Intelligent Agent technologies constitute an important stream of research in the Artificial Intelligence community. Their characteristics make them suitable for a variety of applications. In this paper, we investigate the use of Intelligent Agent technology in the field of Gas-Turbine Engine Control and Health Management. We present and test a Planning agent, developed to choose and apply appropriate investigative and reversionary action plans, which are useful to correctly assess and mitigate faults. The agent is based on Soar technology and tests are performed using a previously developed Intelligent Agent architecture. The Planning agent uses a simple FMECA database and results show it is capable of choosing the correct action plans when presented with different failure cases.

16:30-18:30 MoC01.9

Fuzzy Logic Application to Drying Kinetics Modelling, pp. 2206-2211

Vaquiro, Henry A. Univ. of Tolima
Bon, Jose Pol. Univ. of Valencia
Díez, José Luis Univ. Pol. de Valencia

A Fick's model that includes a Takagi-Sugeno fuzzy model to estimate the effective diffusivity was analyzed. The modelling of drying kinetics on mango trough this diffusional-fuzzy model was compared with the theoretical Fick's model and the empirical Peleg and Weibull models. The identification and validation was performed from experimental drying curves of ripe mango slices (Mangifera indica L. cv. Tommy Atkins) at constant air velocity (4 m/s) and different drying temperatures (40, 50, 60 and 70 şC). The fuzzy sets for the antecedent of Takagi-Sugeno system were identified by the Gustafson-Kessel clustering algorithm and approximated by membership functions of piecewise exponential form. On identification and validation, the diffusional-fuzzy model showed best results than the Fick's model, whereas it showed little difference with the Weibull and Peleg models. The diffusional-fuzzy model keeps the interpretability of Fick's model, improves the process simulation and avoids phenomenon and property considerations which require additional experimental and modelling work.

16:30-18:30 MoC01.10

Reinforcement Learning for Elevator Control, pp. 2212-2217

Yuan, Xu ASML Netherlands B.V.
Busoniu, Lucian Delft Univ. of Tech.
Babuska, Robert Delft Univ. of Tech.

Reinforcement learning (RL) comprises an array of techniques that learn a control policy so as to maximize a reward signal. When applied to the control of elevator systems, RL has the potential of finding better control policies than classical heuristic, suboptimal policies. On the other hand, elevator systems offer an interesting benchmark application for the study of RL. In this paper, RL is applied to a single-elevator system. The mathematical model of the elevator system is described in detail, making the system easy to re-implement and re-use. An experimental comparison is made between the performance of the Q-value iteration and Q-learning RL algorithms, when applied to the elevator system.

16:30-18:30 MoC01.11

A Novel Multi-Source Classification Approach Based on Evidence Combination, pp. 2218-2223

Han, Deqiang Xi'an Jiaotong Univ.
Han, Chongzhao Xi'an Jiaotong Univ.
Yang, Yi Xi'an Jiaotong Univ.

In this paper, a novel classifiers combination approach based on evidence theory is proposed. In classifiers combination, the diversity among member classifiers is known to be a necessary condition for improving classification performance. In our implementation of classifiers combination, we generate the diversity by utilizing different feature spaces to implement member classifiers. And by using different types of classifiers selectively and dynamically according to their expert environments, the diversity can be further enlarged. Thus better combined classification performance can be achieved. In the experiments, the approach proposed shows its efficacy and rationality.

16:30-18:30 MoC01.12

Neural Network-Based Intelligent Compaction Analyzer for Estimating Compaction Quality of Hot Asphalt Mixes, pp. 2224-2229

Commuri, Sesh Univ. of Oklahoma
Mai, Anh Univ. of Oklahoma
Zaman, Musharraf Univ. of Oklahoma

The development and validation of a tool that can estimate the level of compaction of a Hot Mix Asphalt (HMA) pavement during its construction is addressed in this paper. Densification of asphalt pavements during their construction is usually accomplished

through the use of vibratory compactors. During compaction, the compactor and the asphalt mat form a coupled system whose dynamics are influenced by the changing stiffness of the mat. In this paper, it is shown that the measured vibrations of the compactor along with the process parameters such as lift thickness, mix type, mix temperature, and compaction pressure can be used to predict the density of the asphalt mat.

Contrary to existing techniques in the literature where a model is developed to fit the experimental data and to predict the density of the mat, a novel neural network based approach is adopted that is model-free and uses pattern-recognition techniques to estimate the density. During compaction of a HMA mat, the neural network then classifies the observed vibrations as those corresponding to a known level of compaction. The results also show that the analyzer can estimate the density continuously, and in realtime with accuracy levels adequate for quality control in the field. Using this tool, for the first time, the overall quality of construction of a HMA pavement can be verified thereby creating the potential to improve the quality of the roads.

16:30-18:30 MoC01.13

ANN for Interpolating Instability Trends in WEDM, pp. 2230-2235

Portillo Perez, Eva — Univ. of the Basque Country
Marcos, Marga — Univ. del País Vasco
Cabanes, Itziar — Univ. of the Basque Country
Zubizarreta, Asier — Univ. of the Basque Country
Sánchez, José Antonio — Univ. of the Basque Country

In Wire Electrical Discharge Machining (WEDM) the breakage of the cutting tool (the wire) reduces the process performance and the required accuracy. Previous works of authors showed that the behavior of the basic signals of the process (current and voltage) can be employed to detect degraded situations that can lead to wire breakage. In particular, different types of degraded behaviors in two commonly used workpiece thicknesses (50 and 100 mm) were identified. In order to achieve this objective, a set of virtual sensors were defined and constructed from the basic signals of the process. Although the types of degraded behaviors were common for the studied workpiece thicknesses, the thresholds achieved by the virtual measurements depended on these. At the sight of this conclusion, the main goal of this work is to detect the process degradation in different workpiece thicknesses using one unique empirical model. Since Artificial Neural Networks are appropriated for processes of stochastic and nonlinear nature, its use is investigated here in order to interpolate the instability trends for different workpiece thicknesses. Firstly, a comparative study performed to select the most appropriated configuration of the neural network is summarized. Secondly, the strategy applied to detect degraded situations in different workpiece thicknesses is presented. The results of this work show a satisfactory performance of the presented approach.

16:30-18:30 MoC01.14

Radio-Frequency Transducers and Algorithms for Determining the Volumetric Content of the Components of Emulsion and Stratified Flows, pp. 2236-2241

Lunkin, Boris V. — Inst. of Control Sciences, Russian Acad. of Sciences

Radio-frequency transducers for obtaining primary information about parameters of the flows of mixes in pipelines are proposed. Sensors of transducers are resonators of a special construction, which do not create interference with the flow. The dependences of resonance frequency and amplitude of oscillations of resonators on the volumetric content of components of two- and three-component emulsions and stratified flows are obtained. On the basis of these dependences, algorithms for specific applications, such as measuring the mixes of gas-liquid flows, in particular "gas - oil - water", are developed.

16:30-18:30 MoC01.15

Motion Planning and Trajectory Tracking of Underactuated Three-Link Robots, pp. 2242-2247

Liu, Qingbo — Beijing Univ. of Tech.
Yu, Yueqing — Beijing Univ. of Tech.
Xu, Zihong — Jiang Su Univ.
Su, Liying — Beijing Univ. of Tech.
Liu, Shanzeng — Beijing Univ. of Tech.

A new method for motion planning and trajectory tracking of underactuated three-link planar robots with a passive rotational third joint is proposed. One fundamental feather is to use the switching of partly stable controllers (PACs) in order to fulfill the control objective. The dynamic model of this kind of underactuated robot system is built based on Lagrange method. Different objective functions are given for motion planning and trajectory tracking. The genetic algorithm (GA) is utilized to get the optimum control actions for a given time-frame with the available set of elemental controllers. Penalty method is utilized when there are constraints and then the constrained optimizations change to be unconstrained ones. Because the proposed method does not make any hypothesis about the degree of freedom so it can be used without modification for arms with a large number of degree of freedom. At last numerical simulations are carried out to illuminate the validity of the proposed method.

16:30-18:30 MoC01.16

Monitoring Phase Transition in Polymer Using a Quartz Crystal Resonator, pp. 2248-2251

Kim, Young Han — Dong-A Univ.
Kim, Byoung Chul — Dong-A Univ.

A monitoring device for the phase transition of polymer material with temperature variation is developed utilizing a quartz crystal resonator, and its performance has been evaluated by implementing in the melting and crystallization of polyethylene. The observation is compared with the result of DSC thermo-analysis. The experimental outcome indicates that the resonant frequency variation shows not only the temperature of melting and crystallization, but the phase transition temperature of monoclinic to hexagonal phase.

16:30-18:30 MoC01.17

On the Implementation of a Wavelet-Based Iterative Learning Controller Using CPLD/FPGA, pp. 2252-2257

Chen, Jian-Shiang — National Tsing Hua Univ.
Tzeng, Kune-Shiang — National United Univ.

The realization of a wavelet-based iterative learning controller (WILC) is presented in this paper. To meet the requirements of simplified hardware, fast rapid prototyping and fast up-date cycle, a wavelet-based iterative learning control system is implemented on a single FPGA (Field Programmable Gate Array) . There are three modules in this FPGA-based system, they are a feedback module, a discrete wavelet transform (DWT) module and an inverse discrete wavelet transform (IDWT) module. An external static random access memory (SRAM) is also employed to store the learning control signal processed by wavelet transform before updating the feedback control signal. To verify its effectiveness, a belt-driven ink-jet printer is adopted as the control target and a much improved speed-tracking performance is observed from the experimental verification. With the help of the learning process, the ink-jet printer needs no calibration during continuous operation and the velocity of the printer-head can be steadily running at 24 inch/sec.

16:30-18:30 MoC01.18

Modeling and Precison Control of Permanent Magnet Linear Motors, pp. 2258-2263

Zhang, Dailin — The Chinese Univ. of Hong Kong

Permanent magnetic linear motors(PMLMs) are easier to accelerate and achieve higher precision than rotary motors. Hence, they have a broad range of applications in the manufacturing industry and other motion control fields. Owing to the structural variation, however, the models of permanent magnet linear motors and rotary motors are different. As a result, their motion control systems shall also be different. In order to efficiently control a PMLM, the control system model of the PMLM is built in the paper. Unlike rotary motors, PMLMs are more sensitive to various force disturbances due to the absence of gears. Based on the simplified system model, feed forward compensation method using an intelligent I/O module is proposed to compensate the disturbances. The simulation results show that the disturbances are suppressed with the intelligent I/O module

16:30-18:30 MoC01.19

On the Importance of Tailorable Processes in the Development of Embedded Industrial Automation Systems, pp. 2264-2269

Nenninger, Philipp — ABB
Streitferdt, Detlef — ABB

Due to increasing complexity in embedded networked devices for industrial automation, conventional development processes put growing strain on the developers of these systems. For future generations of devices, it is therefore necessary to adapt the

development process in order to be able to deliver the reliability required for these devices. In this paper, testing of embedded systems is taken as an example of how the increase in complexity drives the need for new approaches and how model-based testing can be employed to offset these effects.

16:30-18:30 MoC01.20

Feedforward Design for a Mechanical System with Marginally Stable Inverse, pp. 2270-2275

Naucler, Peter — Uppsala Univ.
Soderstrom, Torsten — Uppsala Univ.

This paper considers feedforward control of a system which is described by transfer functions with marginally stable inverses. We present three different feedforward control strategies. Two of them relies on an `ideal' design which is derived in the noise-free case, whereas the third is based on Wiener filtering theory.

The control strategies are compared and evaluated for different signal models and inthe presence of measurement noise. We show that the performance can be substantially improved by using the (optimal) Wiener feedforward controller.

16:30-18:30 MoC01.21

Robust Trajectory Control of Robot Manipulators Using Time Delay Control with Adaptive Compensator, pp. 2276-2281

Han, Dong Ki — Korea Advanced Inst. of Science and Tech. (KAIST)
Chang, Pyung Hun — Korea Adv. Inst. of Sci. & Tech.
Jin, Maolin — Korea Advanced Inst. of Science and Tech.

An enhanced controller to improve the robustness of Time Delay Control (TDC) for a robot manipulator in the presence of hard nonlinearities is proposed. The problem of TDC is first analyzed with TDC as a trajectory control for a robot manipulator in the presence of hard nonlinearity. The method of steepest descent, which is a type of adaptive control scheme, is used to solve this problem in order to develop an enhanced controller. The proposed controller is called TDC with Adaptive Compensator (TDCAC). The adaptive compensator of TDCAC serves as a type of high pass filter for the effect of hard nonlinearities and is very intuitional for choosing the adaptive gain of the adaptive compensator. The robustness of TDCAC is verified by experiment.

16:30-18:30 MoC01.22

Adaptive Sliding-Mode Control for a Precision Positioner with Hybrid Mechanism, pp. 2282-2287

Huang, Sheng-Chih — National Taiwan Univ.
Hung, Shao-Kang — National Taiwan Univ.
Chen, Mei-Yung — National Taiwan Normal Univ.
Lin, Chih-Hsien — National Taiwan Univ.
Fu, Li-Chen — National Taiwan Univ.

This paper proposes a novel six-degree-of-freedom (DOF) electromagnetic precision positioner made of a hybrid mechanism utilizing both magnetic driving force and fluid upper lifting power, in which the new structure, the electromagnetic actuator, and the effective controller are developed. The concept of the mechanism design not only involves the magnetic driving mechanism but also the fluid buoyancy and damping properties, of which the latter help counter-balance weight of the platen so as to achieve very low steady-state power consumption. The four goals of novel system design include: (1) to have large moving range (in mm level), (2) to achieve precision positioning, (3) to design compact but low-cost mechanism, and (4) to achieve low power consumption. The experimental results show that traveling range is 3mm×3mm×4mm, and the tracking error in each axis is kept within 10 , which is up to the limitation of our optical sensors.

16:30-18:30 MoC01.23

Stress-Dependent Hysteresis Modeling and Tracking Control of Giant Magnetostrictive Actuator for Periodic Reference Input, pp. 2288-2293

Zhang, Zhen — Beijing Univ. of Aero & Astro, Beijing
Mao, Jianqin — Beijing Univ. of Aeronautics and Astronautics
Chen, Wenli — Beijing Univ. of Aero & Astro

The tracking control accuracy of giant magnetostrictive actuator (GMA) is limited due to its inherent hysteresis nonlinearity. Hysteresis characteristic of GMA is stress-dependent. This paper proposes a stress-dependent Prandtl-Ishlinskii (SDPI) hysteresis model for GMA by extending the modified Prandtl-Ishlinskii (MPI) model to account for the hysteresis of GMA at varying compressive stress. It is shown experimentally that the weights of play operators is non-sensitive to the compressive stress applied in longitudinal direction of GMA and the relationships between weights of deadzone operators and compressive stress could be modeled by quadratic functions. Then the inverse of SDPI model is established and implemented in open-loop feedforward controller for real-time tracking control for periodic reference input. Comparisons are made between feedforward controller with stress-dependent hysteresis model and stress-independent model. Experimental results show that tracking performance is noticeably improved by using SDPI model.

16:30-18:30 MoC01.24

Macroscopic Drive Chain Efficiency Modeling Using State Machines, pp. 2294-2299

Al Assad, Omar — GE healthcare/ SUPELEC
Godoy, Emmanuel — Supelec
Croulard, Vincent — GEMS

In this paper, we propose a new approach to model irreversibility in robotic drive chains. Actually, some types of gears such as worm gears have an efficiency which varies according to the power flow direction. The irreversibility appears when the efficiency tends to zero in one direction only, usually, from the load to the motor. The proposed methodology consists of using a state machine to describe the functional state of drive chain. For each state, an efficiency coefficient that characterizes the power loss is defined. This technique gives conclusive results during experimental validation and allows reproducing a reliable robot simulator. This simulator is set up for the purpose of position control of a medical positioning robot.

16:30-18:30 MoC01.25

Multi-Scale Distributed Port-Hamiltonian Representation of Ionic Polymer-Metal Composite, pp. 2300-2305

Nishida, Gou — RIKEN
Takagi, Kentaro — Nagoya Univ.
Maschke, Bernhard — Univ. Claude Bernard of Lyon
Luo, Zhiwei — Bio-mimetic Control Res. Ctr.

This paper shows that one of soft actuators, Ionic Polymer-Metal Composite (IPMC) can be modeled in terms of distributed port-Hamiltonian systems with multi-scale. The physical structure of IPMC consists of three parts. The first part is an electric double layer at the interface between the polymer and the metal electrodes. The frequency response of the polymer-metal interface shows a fractal degree of gain slope. Then we adopt a black-box circuit model to this part and give considerations for distributed impedance parameters. The second part is an electrostress diffusion coupling model with bending and relaxation dynamics. This part is represented by an electro-osmosis, which is a water transport by an electric field, and a streaming potential, which is an electric field created by a water transport. We discuss the relationship of stress and bending moment induced by swelling. The third part is a mechanical system modeled as a flexible beam with large deformations. The representation has the capability extracting the control structure based on passivity from distributed parameter systems possessing a complex behavior.

16:30-18:30 MoC01.26

Identification and Control of a Hydraulic Forestry Crane, pp. 2306-2311

Miranda La Hera, Pedro Xavier — UmeÍ Univ.
Mettin, Uwe — UmeÍ Univ.
Manchester, Ian — UmeÍ Univ.
Shiriaev, Anton — Umea Univ.

This article presents the identification and control of an electro-hydraulic crane. The crane is of the type used on forestry vehicles known as forwarders, which travel off-road collecting logs cut by the harvesters. The dynamics identified include significant frictional forces, dead zones, and structural and hydraulic vibrations. The control algorithm proposed, comprised of a linear controller and a compensator for nonlinearities, is able to accurately track a reference trajectory for the end effector, despite uncertainties in the arm mechanics and hydraulic system dynamics. A further control design is presented which uses an inner loop to compensate for vibrations in the hydraulic system, and its performance is experimentally verified.

16:30-18:30 MoC01.27

On Modeling and Parameter Estimation of Brushless DC Servoactuators for Position Control Tasks, pp. 2312-2317

Campa, Ricardo — Inst. Tecnologico de la Laguna
Torres, Elio — Inst. Tecnologico de la Laguna
Salas, Francisco — Inst. Tecnologico de la Laguna
Santibanez, Victor — Inst. Tecnologico De La Laguna

Brushless DC (BLDC) servomotors have become a popular choice when implementing high–precision position controllers for mechatronic systems. A motor of this kind requires a drive that can be configured in different operation modes, according to the internal controllers it utilizes. This paper first describes the main features and the complete electromechanical model of a BLDC motor/drive system, including some procedures for the identification of its parameters. Three common schemes for implementing position control using this kind of actuators are also presented, and the equivalence among them is employed to determine the drive's internal control gains. Finally, experimental results in a typical BLDC servoactuator allow us to show the significance of the estimated parameters in real position control tasks.

16:30-18:30 MoC01.28

High-Fidelity Tracking Control of Electric Shaking Tables, pp. 2318-2323

Sawada, Yuichi — Kyoto Inst. of Tech.
Ohgawara, Naoto — Kyoto Inst. of Tech.

This paper proposes a design method of tracking control for electric shaking tables via the stochastic optimal control theory with preview action based on a third-order model with respect to the jerk, acceleration, velocity and displacement of the table. The reaction force caused by the dynamic motion of a test structure subjected to seismic disturbances can be regarded as a random disturbance for the shaking table. The mission of our tracking controller is accurately to reproduce the earthquake ground motions using the derived third-order model and the preview information of the displacement of the ground motions. An augmented discrete-time stochastic system of an incremental state and an incremental tracking error corresponding to the shaking table is constructed. This system is subject to the sum of the reaction force of the test structure and its derivative which is modeled by a white Gaussian noise. Combining this system with a command generator for making the preview information, a stochastic optimal tracking control based on the noisy observation data is constructed for the resultant system.

16:30-18:30 MoC01.29

Backstepping Technique for Tracking Control of an Underactuated Surface Vessel with Unmeasured Thruster Dynamic, pp. 2324-2329

Ghommam, Jawhar — MECA
Mnif, Faical — Sultan Qaboos Univ.
El-Metwally, K.A — Cairo Univ.

We consider in this paper the tracking control problem of an underactuated surface vessel moving on the horizontal plane. A reference feasible trajectory for the position and orientation of the surface vessel is planned so that it is consistent with vehicle dynamics. Using these reference values the dynamics of the vehicle is transformed to the error cascade structure. The proposed controller is designed using Lyapunovs direct method and the popular backstepping techniques are utilized to stabilize the above system and force the tracking error to globally exponentially stabilized to the origin. Extension to unmeasured thruster dynamics is also considered. Simulation results that validate the proposed tracking methodology are presented and discussed.

16:30-18:30 MoC01.30

Reducing Effect of Outliers in Landmark-Based Spatial Localization Using MLESAC, pp. 2330-2335

Choi, Sunglok — Electronics and Telecommunications Res. Inst.
Kim, Jong-Hwan — Korea Advanced Inst. of Science and Tech.

In the landmark-based localization problem, movement and ambiguity of landmarks and imperfect identification process make measurements of the landmarks completely different from its true value. The incorrect measured data have degraded existing localization methods in the practical applications. This paper proposes a framework to improve accuracy of the existing landmark-based localization methods regardless of such incorrect measured data. The framework is based on Maximum Likelihood Estimation Sample Consensus (MLESAC). It samples a set of measured data randomly to estimate position and orientation, and the estimated pose is evaluated through likelihood of whole measured data with respect to the result. Iterations of sampling, estimation, and evaluation are performed to find the best result to maximize the likelihood. Simulation results demonstrate that the proposed framework improved the the existing localization methods. Analysis using a concept of loss functions also explains that the framework is superior compared to previous researches such as Random Sample Consensus (RANSAC).

16:30-18:30 MoC01.31

A Virtual Range Finder Based on Monocular Vision System in Simultaneous Localization and Mapping, pp. 2336-2341

Zhang, Xinzheng — The Hong Kong Pol. Univ.
Rad, A. B. — Simon Fraser Univ.
Wong, Y. K. — Hong Kong Pol. Univ.

This paper presents a virtual range finder model with the monocular vision system for simultaneous localization and mapping (SLAM). It relaxes the constraint often cited in the literature that the motion of the optical axis has to be parallel, and reduces the errors for range extraction by a single camera. This model could also provide a supplementary range measurement for landmark initialization in bearing-only SLAM. As the sensor data transformation from pixel to metric value is a nonlinear process, the uncertainty for observation model adopted in Extended Kalman Filter (EKF) SLAM framework can not be in the Gaussian form, which probably makes difficult for data association and SLAM. Concerning this problem, we present a new data association technique based on the homography transformation by a sequence of images and integrate it into the update process of the EKF to assist the innovation computation. The experimental results on real data validated the performance of the virtual range finder model and the new data association approach.

16:30-18:30 MoC01.32

Plan Planning of Mobile Robot in Irregular Environment Using Immune Evolutionary Algorithm, pp. 2342-2346

Cai, Zixing — Central South Univ.
Yu, Lingli — Central South Univ.
Xiao, Chang — Central South Univ.
Liu, Lijue — Central South Univ.

Abstract: The traditional evolution algorithm usually traps into local optimization easily. Aiming to the drawback of evolution algorithm, we propose a novel mobile robot path planning approach of immune evolutionary algorithm in irregular environment. The advantages of this method lie in two aspects. The diversity of antibodies can be maintained. Meanwhile immunity operation and optimizing operator can be used to improve the global search ability. The results of simulation experiment show that immune evolution algorithm is feasible and efficient, because it enhances the performance and quality of mobile robot path planning.

16:30-18:30 MoC01.33

Model Algorithm Tracking Control of Wheeled Mobile Robots, pp. 2347-2352

Zhang, Yuanliang — Chonbuk National Univ.
Chong, Kil To — Chon Buk National Univ.

This paper proposed a model algorithm control (MAC) method for trajectory tracking control of the differentially steered wheeled mobile robots (WMRs) subject to nonholonomic constraint. The dynamic model of the wheeled mobile robot is presented and used as the model to be controlled. The performance of the proposed control algorithm is verified via computer simulations in which the WMR is controlled to track two different reference paths. It is shown that the control strategy is feasible.

16:30-18:30 MoC01.34

Speeded-Up Algorithm for Human/Vehicle Classification Using Hilbert Scanning Distance, pp. 2353-2358

Baek, Young Min — Seoul National Univ.
Choi, Jeong Hwan — Seoul National Univ.
Choi, Jin Young — Seoul National Univ.

In this paper, we propose speeded-up algorithm for human/vehicle classification in real-time surveillance system. We have approached this problem using silhouette-based template matching. The silhouette of the object is extracted, and then it is compared with representative template models. Template models are previously

stored in the database. Our algorithm is similar to previous pixel-based template matching scheme like Hausdorff Distance, but we use 1D image array rather than 2D regions inspired by Hilbert Curve. Transformation of images could reduce computational burden to compute similarity between the detected image and the template images. Experimental results show robustness and real-time performance in human/vehicle classification.

16:30-18:30 MoC01.35

Color-Based Visual Servoing of a Mobile Manipulator with Stereo Vision, pp. 2359-2364

Lee, Hyun-Jeong — Pusan National Univ.
Lee, Min Cheol — Pusan National Univ.

In this study, stereo vision system is applied to visual servoing of a mobile manipulator. The robot can recognize a target and compute the 3D position of the target by using a stereo vision system. A stereo vision system enables the robot to find the position of a target without additional information while a monocular vision system needs properties such as geometric shape of a target. Many algorithms have been studied and developed for object recognition. However, most of these approaches have a disadvantage of the complexity of computations and they are inadequate for real-time visual servoing. The other hand color information is useful for simple recognition in real-time visual servoing. In this paper, we refer to object recognition using colors, stereo matching method, recovery of 3D space, and the visual servoing.

16:30-18:30 MoC01.36

Delayed Inverse Depth Monocular SLAM, pp. 2365-2370

Munguia, Rodrigo — Tech. Univ. of Catalonia, UPC
Grau, Antoni — Tech. Univ. of Catalonia, UPC

The 6-DOF monocular camera case possibly represents the harder variant in the context of simultaneous localization and mapping problem. In the last years, several advances have been appeared in this area; however the application of these techniques to real world applications it's difficult so far. Recently, the unified inverse depth parametrization has shown to be a good option this challenging problem, in a scheme of EKF for the estimation of the stochastic map and camera pose. In this paper a new delayed initialization scheme is proposed for adding new features to the stochastic map. The results show that delayed initialization can improve some aspects without losing the performance and unified aspect of the original method, when initial reference points are used in order to fix a metric scale in the map.

16:30-18:30 MoC01.37

Robust Salient Moving Object Detection with Light-Computational Load, pp. 2371-2376

Choi, Jeong Hwan — Seoul National Univ.
Baek, Young Min — Seoul National Univ.
Choi, Jin Young — Seoul National Univ.

In this paper, we propose a method which detects salient moving objects with light-computational load. Though Gaussian Mixture Model is widely used for object detection, it is computationally heavy. On the other hand, basic methods like temporal difference are simple and fast but they have constraints as hole or ghost problems. We have combined these algorithms to overcome each one's weakness. We use background modeling and subtraction method which are similar to adaptive threshold with foreground map. Foreground map is generated by Modified Temporal Difference to speed up the process. Using adaptive threshold, we have improved the performance, when there is slightly moving background like branches in the wind. So we can eliminate meaningless objects with light-computational load. Experimental results show efficiency and robustness of our algorithm in several outdoor scenes.

16:30-18:30 MoC01.38

Automatic Segmentation for Emotional Feature Extraction from Spoken Sentence, pp. 2377-2381

Hyun, Kyung Hak — KAIST
Kim, Eun Ho — KAIST
Kwak, Yoon Keun — KAIST

Perception of speaker's emotion is one of interesting issues in human-robot interaction. Especially, friendly and instinctive interface between robots and humans is required for making service robots useful to inexpert interacting with robots. Among several mode in communications, speech is easiest method for human because speech is fundamental communication tool in human-human interaction. However, continuous speech is difficult to extract some features because speech is time-variant signal. In other words, segmentation is necessary to analyze speech signal easier. Researcher who were interested in phonetic information usually used 20~40ms windowing because they should extract features in short duration which gives an assumption about time-invariant in a frame. On other hand, emotions in speech are hard to be revealed in short duration because emotion does not change rapidly as phonetic feature does. Therefore, automatic segmentation for emotion feature extraction is proposed in this paper. Automatic segmentation is used for estimating boundaries between phonemes based on "spectral variation function method" and grouping phonemes based on "average energies per frames". In simulation result, it showed that automatic segmentation is useful for emotional feature extraction from spoken sentence.

16:30-18:30 MoC01.39

Adaptive Neural Network Tracking Control for Manipulators with Uncertainties, pp. 2382-2387

Cheng, Long — Inst. of Automation, Chinese Acad. of Sciences
Hou, Zeng-Guang — Chinese Acad. of Science
Tan, Min — Inst. of Automation, Chinese Acad. of Sciences
Wang, Hong-Ming — Inst. of Automation, Chinese Acad. of Sciences

An adaptive neural network controller is proposed to deal with the end-effector tracking problem of manipulators with uncertainties. By employing the adaptive Jacobian scheme, neural networks, and backstepping technique, the torque controller can be obtained which is demonstrated to be stable by the Lyapunov approach. The updating laws for designed controller parameters are derived by the projection method, and the tracking error can be reduced as small as possible. The favorable features of the proposed controller lie in that: (1) the uncertainty in manipulator kinematics is taken into account; (2) the ``linearity-in-parameters'' assumption for the uncertain terms in dynamics of manipulators is no longer necessary; (3) effects of external disturbances are considered in the controller design. Finally, the satisfactory performance of the proposed approach is illustrated by simulation results on a PUMA 560 robot.

16:30-18:30 MoC01.40

Direct Method of Manipulator Endpoint Control Synthesis, pp. 2388-2393

Krasnova, Svetlana — ICS
Utkin, Victor — ICS
Utkin, Anton — ICS

Manipulator endpoint location autonomous control procedures are suggested. A method of uplimited control hierarchy has been designed, which allows to provide a desired tracking precision under conditions of uncertainty of the control object operator and the effect of external uncontrolled disturbances. Sliding mode state observers synthesis procedures have been designed, which allow, in a theoretically limited time period, to obtain information on immeasurable variables of the state vector and available uncertainty. The results of the designed algorithms modeling are presented.

16:30-18:30 MoC01.41

Humanoid Gait Synthesis Using Trajectory Plot and Relative-ZMP (R-ZMP) Concept, pp. 2394-2399

Er, Meng Joo — NTU
Weng, Soon Khor — Nanyang Tech. Univ.
Tang, Zhe — Nanyang Tech. Univ.

The human body exploits the redundancy of the degree of freedom (DOF) to execute various motions and maintain the body stability. In Humanoid Robots (HRs), the Zero Moment Point (ZMP) and Center of Gravity (COG) are commonly used to evaluate stability. One of the basic motions of a HR is walking. There are two types of walking scheme, namely the Static and Dynamic Gait. The Static Gait uses the COG as the stability criterion. Static Gait usually yields a very slow walking gait. Hence, static walk is now not very common in HRs. On the contrary, Dynamic Gait employs the ZMP as the criterion of stability. Robots like ASIMO and QRIO use Dynamic Gait scheme to achieve impressive walking speed and stability. In this paper, a new trajectory design algorithm by using the trajectory plot and posture plot is proposed. This method is based on the new Relative-ZMP (R-ZMP) concept. The resulting walking gaits were then tested on a humanoid with 18 DOF, LUCY. It is evident that it is able to walk much faster in comparison with other humanoid robots which participated in the Humanoid Robocup Competition 2006

16:30-18:30 MoC01.42

Development of a Foot Mechanism for Landing Experiment, pp. 2400-2405

Cheon, Seyoung — 1.Yonsei Univ. Republic of Korea 2.The Centerfor Co
Oh, Yonghwan — Korea Inst. of Science & Tech. Korea
Chang, Young-Hwan — Korea Inst. of Science and Tech. (KIST)
Park, Youngpil — Yonsei Univ. 134 Sinchon-dong, Seodaemun-gu, Seoul 120-749,

For the stable landing of a humanoid walking, a humanoid foot needs to reduce an impact from the ground reaction force and does not cause ZMP variation when its foot is landing. To satisfy the above condition, this paper introduces the newly designed foot mechanism has an additional shock absorbing material and guided equipment which constrains translational direction. The ability of the proposed foot mechanism is shown as the experiment which is performed in landing leg platform. The landing leg platform provides the same landing effect and a variety of condition that a humanoid robot may be faced with various environments when the humanoid foot is landing. The two kinds of experiments are performed. One verifies the capability of additional shock absorbing material and the other shows the effect of the guided equipment.

16:30-18:30 MoC01.43

Data Fusion and Efficient Algorithm for Moving Target Tracking, pp. 2406-2411

Liu, Guocheng — Coll. of Power and Mechanical Engineering, WuhanUniversity
Wang, Yongji — Hauzhong Univ. of Science And Tech.

The principle of target tracking and data fusion techniques are discussed. To resolve high uncertainty that exists in sensors of mobile robots, one multi-sensor data fusion algorithm is presented. The algorithm is based on particle filter techniques, fuses the information coming from multiple sensors and merges different state space models. So it can be used to eliminate system and measurement noise and estimate value of position and headings of mobile robot. On simulation experiments, we compare different cases such as single sensors and multi-sensor data fusion, the results demonstrate the feasibility and effectiveness of this algorithm and exhibits good tracking performance.

16:30-18:30 MoC01.44

Explanation-Based Manipulator Learning: Acquisition of Assembling Technique through Observation, pp. 2412-2417

Wang, Lei — Kyoto Univ.
Tian, Yajie — Kyoto Univ.
Sawaragi, Tetsuo — Kyoto Univ.

This paper describes a robot manipulator system currently under development which learns assembling technique from observation of skilled worker’s demonstrations. The system is an application of EBL (Explanation-Based Learning) to the robot manufacturing domain. The system improves the operating capability of the robot manipulator through observing, analyzing the skilled worker’s assembling operation, and learning the assembling technique, that is, the tacit knowledge of skilled workers which makes them complete the assembling task more efficiently. The learning process is a knowledge-based deduction approach, requiring sufficient background knowledge, to understand the observed sequence.

16:30-18:30 MoC01.45

Timed Petri Nets Model on Bell-Type Batch Annealing Process and Its Simulation Using SystemC Platform, pp. 2418-2423

Zhang, Xiaoping — Dalian Univ. of Tech.
Liu, Quanli — Dalian Univ. of Tech.
Wang, Wei — Dalian Univ. of Tech.
Zhao, Jun — Dalian Univ. of Tech.
Wang, Zhigang — Dalian Univ. of Tech.

Based on the analysis of the technical flow of bell-type batch annealing in cold rolling plant, a Timed Petri net model for describing batch annealing process is established in this paper. In order to solve the concurrence and time sequence of annealing process in the course of simulation, the mapping rules between Petri nets and SystemC platform are constructed by using the SystemC simulation platform which is widely employed in the design of large-scale integrated circuit. Accordingly, the simulation model of bell-type batch annealing process is implemented. The simulation result shows the proposed model and simulating method is better than the traditional object oriented discrete event simulation on the simulating speed and the scheduling result.

16:30-18:30 MoC01.46

Human-Robot Cooperation in Precise Positioning of a Flat Object, pp. 2424-2429

Wojtara, Tytus — Bio-Mimetic Control Res. Center
Uchihara, Masafumi — Toyota Motor Corp.
Murayama, Hideyuki — Toyota Motor Corp.
Shimoda, Shingo — Riken
Sakai, Satoshi — Nagoya Inst. of Tech.
Fujimoto, Hideo — Nagoya Inst. of Tech.
Kimura, Hidenori — The Inst. of Physical and Chemical Res. (RIKEN)

This paper deals with fundamental issues of human-robot cooperation in precise positioning of a flat object on a target. Based on the analysis of human-human interaction, two cooperation schemes were defined. An algorithm derived from one of these schemes is presented. A general mathematical framework for cooperation was developed to express cooperation algorithms. The evaluation of the algorithm on our in-house made robot prototype using a number of subjects verified our ideas. The main problem was the regulation of the robot human interaction. Since the robot has no range sensors, it has to rely on the force and displacement information resulting from the interaction with human. The way the robot interprets these signal is crucial for smooth interaction. To be able to realize a concrete task a simplification was made, i.e. robot and human do not directly hold the object but a frame to which the object and various sensors are attached. Based on our research results, we succeeded in installing a commercial platform.

16:30-18:30 MoC01.47

Tele-Operation between Human and Robot Arm Using Wearable Electronic Device, pp. 2430-2435

Song, HeeBae — KIST
Kim, Doik — Korea Inst. of Science and Tech. (KIST)
Park, Mignon — Yonsei Univ.
Park, JoonByung — KIST

In this paper, a wearable-type motion capturing system is designed and implemented. The device consists of flex sensors, photo detector and luminous element, AVR microcontroller and Bluetooth modules. It can transmit the motion capture data to host computer and then the computer calculates desired degrees for operating the slave robot. As a counterpart of the wearable system, it could be easily wearable, portable and is built to send the human motion data wirelessly. And it has no limitation to detect the human motion because the device capture human's motion directly unlikely motion capture camera using markers which isn't able to detect to their the locations frequently. The proposed system through the wearable device to control the robot arms can show feasible application of wireless man-machine interface and can be applicable various types.

16:30-18:30 MoC01.48

Ubiquitous Display for Human Centered Interface -Fixed Shape Projection and Parameter Optimization, pp. 2436-2441

Miyashita, Satoshi — Ritsumeikan Univ.
Lee, Joo-Ho — Ritsumeikan Univ.

Projection based information display system was proposed and its problems were considered in previous papers. In usual cases, a man should approach information sources which are located around our living environment. E.g. bulletin boards, artificial signs, local maps, etc. However, the proposed system is able to afford human with relevant information by projecting it on where the human is facing so that the man does not need to move for seeking information. The proposed system is based on Intelligent Space and a projector mounted mobile robot which is called ubiquitous display. In this paper, a fixed shape projection method and an optimal parameter selection method are proposed and their results are shown.

16:30-18:30 MoC01.49

Impedance Compensation of Flexible Joint Actuator for Ideal Force Mode Control, pp. 2442-2447

Kong, Kyoungchul — Univ. of California, Berkeley
Bae, Joonbum — Univ. of California at Berkeley
Tomizuka, Masayoshi — Univ. of California, Berkeley

To realize an ideal force control of robots interacting with humans, a very precise actuation system with zero impedance is desired. A flexible joint actuator may serve for this purpose. This paper presents the design of control algorithms to compensate for the impedance in the flexible joint actuator. To generate the torque as desired, a spring is installed between a motor and a human joint, and the motor is controlled to produce the proper spring deflection. When the desired torque is zero, the motor must follow human joint motion, which requires that the friction and inertia of the motor are compensated. Mechanical properties of a human body are not fixed, while they represent the load to the flexible joint actuator. The disturbance observer method is applied to make the flexible joint actuator precisely generate the desired torque under such time-varying conditions. Based on the nominal model preserved by the disturbance observer, feedback and feedforward controllers are optimally designed for the desired performance: i.e. the flexible joint actuator 1) exhibits very low impedance and 2) generates the desired torque precisely during interacting with a human. The effectiveness of the proposed design is verified by experiments.

16:30-18:30 — MoC01.50

Advanced Control Structure for Energy Management in Ground Coupled Heat Pump HVAC System, pp. 2448-2453

Pardo, Nicolas — Univ. Pol. de Valencia
Sala, Antonio — Univ. Pol. de Valencia
Montero, Alvaro — Univ.
Urchueguia, Javier — Univ. Pol. de Valencia
Martos, Julio — Univ. de Valencia

Over the last 15 years, computerized controls have become more and more common in our homes. The smart home looks at expanding the use of the computers into the difference parts of the home, creating a network that can be easily and conveniently controlled. The use of computer controls removes the need to actually flick a switch and allows elements of the home to respond automatically to the people living in it. Successful control and heating ventilating and air-conditioning (HVAC) systems is a primary concern in building project: in order to achieve the required comfort and energy efficiency goals, a lot of variables must be coordinated and kept at particular pre-designed operation points. The management control systems can be applied to try to achieve optimum settings for different operations in the complicated systems. To optimal settings must balance three aspects: (1) comfort, (2) energy efficiency, and (3) performance margins on order to be able to quickly adapt to unexpected disturbances. This work has used TRNSYS software package to model a HVAC system composed by a geothermal heat pump (GHP) and several fan-coils (FC) for a typical distribution of offices in the area of the Mediterranean Sea. In this model, a control structure has been designed using various configurations of cascade control to incorporate extra sensors and actuators in order to achieve PMV specifications and save energy.

MoC02 — 304A

Stability of Nonlinear Systems (Regular Session)

Chair: Jiang, Zhong-Ping — Pol. Univ.
Co-Chair: Ito, Hiroshi — Kyushu Inst. of Tech.

16:30-16:50 — MoC02.1

Remarks on ISS and Integral-ISS Stabilization with Positive Controls, pp. 2454-2459

Lin, Yuandan — Florida Atlantic Univ.
Wang, Yuan — Florida Atlantic Univ.
Jiang, Zhong-Ping — Pol. Univ.

We consider nonlinear systems with both control and disturbance inputs. The main problem addressed in this work is the design of state feedback control laws, achieving ISS and integral-ISS disturbance attenuation, with restricted control under the assumption that an appropriate control Lyapunov function is known. Our results generalize the previous results on ISS and integral-ISS stabilization to the restricted cases when controls are only allowed to take positive or bounded positive values.

16:50-17:10 — MoC02.2

Bilaterally Flexible Lyapunov Inequalities for Nonlinear Small-Gain Method Covering Iiss Systems, pp. 2460-2465

Ito, Hiroshi — Kyushu Inst. of Tech.

This paper develops a new tool to study stability of interconnection of integral input-to-state stable (iISS) systems. A sort of freedom is introduced into Lyapunov inequalities each system is to satisfy in addition to small-gain-type conditions. The purpose of this paper is to extend the technique of ``flexible Lyapunov inequalities'' developed previously for input-to-state stable(ISS) systems. The achievement is threefold. One is the employment of flexibility for both the systems connected with each other. The former technique only allows the flexibility to appear in one of the mutually connected systems. The second accomplishment is to cover iISS systems. The third is unification of the treatment of iISS and ISS systems. Establishment of stability is based on explicit construction of smooth Lyapunov functions.

17:10-17:30 — MoC02.3

Finite-Time Input-To-State Stability and Applications to Finite-Time Control, pp. 2466-2471

Hong, Yiguang — Chinese Acad. of Sciences
Jiang, Zhong-Ping — Pol. Univ.
Feng, Gang — City Univ. of Hong Kong

This paper extends the well-known concept, input-to-state stability (ISS), to finite-time control problems. In other words, a new concept, finite-time input-to-state stability (FTISS), along with related concepts such as finite-time input-output stability and finite-time small-gain theorems, is discussed, and then is applied to both the finite-time stability analysis and the finite-time stabilizing feedback design. With finite-time convergence, non-smoothness has to be considered, which poses serious technical challenges in the analysis and synthesis of closed-loop finite-time systems. It is found that FTISS plays a key role in the study of finite-time stability and stabilization of nonlinear systems.

17:30-17:50 — MoC02.4

Novel Delay-Dependent Exponential Stability of a Class of Fuzzy Cellular Neural Networks with Time-Varying Delays, pp. 2472-2477

Liu, Zhenwei — Northeastern Univ.
Zhang, Huaguang — Northeastern Univ.
Liu, Derong — Univ. of Illinois at Chicago

The global exponential stability of the neural networks is investigated for a new fuzzy cellular neural networks with time-varying delays. A novel delay-dependent stability criterion is derived based on Lyapunov stability theory and the linear matrix inequality. By transforming the fuzzy logic terms with time-delay, our criteria are less conservative than existing results. Two examples are provided to verify the effectiveness of the proposed results.

17:50-18:10 — MoC02.5

Improved Delay-Dependent Stability for a Class of Linear Systems with Time-Varying Delay and Nonlinear Perturbations, pp. 2478-2483

Yan, Xianbo — TIANJIN Univ.
Wang, Yijing — Tianjin Univ.
Zuo, Zhiqiang — Tianjin Univ.
Zhao, Huimin — Tianjin Univ.
Zhang, Guoshan — Tianjin Univ.

This note deals with the robust stability analysis for time-delay systems with nonlinear perturbations. Firstly, a new class of Lyapunov functional candidate is proposed to develop some new criteria by considering the additional useful terms and introducing some free-weighting matrices. Then, an augmented Lyapunov functional is introduced to establish a novel improved stability condition. All results obtained are given in terms of linear matrix inequalities. A numerical example is given to illustrate the effectiveness of the proposed methods.

18:10-18:30 — MoC02.6

New Delay-Dependent Criteria for Robust Stability of Uncertain Singular Systems, pp. 2484-2489

Gao, J. F. — Zhejiang Univ. Zhejiang Sci-Tech. Univ.
Su, Hongye — Zhejiang Univ.
Ji, Xiaofu — Zhejiang Univ.
Chu, Jian — Zhejiang Univ.

This note concerns the delay-dependent robust stability analysis for uncertain singular time-delay systems. The parameter uncertainty is assumed to be norm-bounded and possibly time-varying, while the time delay considered here is assumed to be constant but unknown.

By using a new Lyapunov-krasovskii functional which splits the whole delay interval into two subintervals and defines a different energy function on each subinterval, some delay-dependent conditions are presented for the singular time-delay system to be regular, impulse free and robustly stable. The obtained delay-dependent criteria are effective and less conservative than previous ones, which are illustrated by numerical examples.

MoC03 304B
Control of Constrained Systems II (Regular Session)

Chair: Utkin, Victor — ICS
Co-Chair: Lin, Zongli — Univ. of Virginia

16:30-16:50 MoC03.1
Analysis and Design of Switched Linear Systems in the Presence of Actuator Saturation and L2 Disturbances, pp. 2490-2495

Lv, Liang — Shanghai Jiao Tong Univ.
Lin, Zongli — Univ. of Virginia
Fang, Haijun — MKS Inst.

This paper considers the problem of disturbance tolerance/rejection for a family of linear systems subject to actuator saturation and L2 disturbances. For a given set of linear feedback gains, a given switching scheme and a given bound on the energy of the disturbances, conditions are established in terms of linear or bilinear matrix inequalities under which the resulting switched system is bounded state stable, that is, trajectories starting from a bounded set will remain inside the set or a larger bounded set. With these conditions, both the problem of assessing the disturbance tolerance/rejection capability of the closed-loop system and the design of feedback gain and switching scheme can be formulated and solved as constrained optimization problems. Disturbance tolerance is measured by the largest bound on the disturbances for which the trajectories from a given set remain bounded. Disturbance rejection is measured by the restricted L2 gain over the set of tolerable disturbances. In the event that all systems in the family are identical, the switched system reduces to a single system under a switching feedback law. It will be shown that such a single system under a switching feedback law has stronger disturbance tolerance/rejection capability than a single linear feedback law can achieve.

16:50-17:10 MoC03.2
Dynamic Linear System Synthesis with Account of Phase and Control Restrictions Via Sigma-Function Feedback, pp. 2496-2501

Utkin, Victor — ICS

In the paper linear dynamic systems problem stabilization with account of phase and controls restrictions synthesis methods are suggested. The suggested approach is based on the block synthesis method and the use of sigma-functions in the feedback chain, which are approximations of discontinuous functions. Besides the procedure decomposition into simple subproblems of lower dimension, the fact that state vector coordinates and a selection in the form of sigma functions are used as fictitious control (restricted in amplitude) provided an opportunity to solve the stabilization problem with account of state and control restriction.

17:10-17:30 MoC03.3
Constrained Stabilization of Bilinear Discrete-Time Systems Using Polyhedral Lyapunov Functions, pp. 2502-2507

Bitsoris, Georges — Univ. of Patras
Athanasopoulos, Nikolaos — Univ. of Patras, Greece

In this paper, the stabilization problem of discrete-time bilinear systems by linear state-feedback control is investigated. First, conditions guaranteeing the positive invariance of polyhedral sets with respect to nonlinear systems with second order polynomial nonlinearity are established. Then these results are used for the determination of linear state-feedback unconstrained and constrained control laws making a prespecified polyhedral set a domain of attraction of the resulting closed-loop system.

17:30-17:50 MoC03.4
Output Variance-Constrained LQG Control of Discrete-Time Systems, pp. 2508-2513

Lee, Ji-Woong — Pennsylvania State Univ.
Khargonekar, Pramod P. — Univ. of Florida

The constrained infinite-horizon LQG control problem can be solved via semidefinite programming if the state-control constraints are given by variance-bounds on linear functions of the state and control input. Given a nonzero initial state covariance matrix, each suboptimal dynamic output feedback controller is initially time-varying but reaches time-invariance after a finite number of time steps. This number of time steps can be determined iteratively via repetitive execution of semidefinite programs.

17:50-18:10 MoC03.5
A New Output Feedback Control for Nonlinear Differential-Algebraic-Equation Systems, pp. 2514-2519

Zang, Qiang — Southeast Univ.
Dai, Xianzhong — Southeast Univ.
Zhang, Kaifeng — Southeast Univ.

This note considers the problem of stabilization by output feedback for a class of nonlinear Differential-Algebraic-Equation systems. The output feedback controller is constructed which ensures the closed-loop systems asymptotically stable. Not based on separation-principle that is commonly adopted in the literature, the output feedback controller design is coupled with that of the non-initialized linear high gain state observer. The numerical simulation results illustrate the effectiveness of the proposed scheme.

18:10-18:30 MoC03.6
Off-Line Robustification of Explicit Control Laws, pp. 2520-2525

Rodriguez-Ayerbe, Pedro — Supelec
Olaru, Sorin — Supelec

The paper deals with the predictive control for linear systems subject to constraints, leading to piecewise affine control laws. The main goal is to reduce the sensitivity of these schemes with respect to the model uncertainties. This objective can be attained by considering worst-case (min-max) formulations, but generally this is leading to fastidious on-line optimisation which may reduce the range of application. Here a two stage predictive strategy is proposed, which synthesize in a first instant an analytical (continuous and piecewise linear) control law based on the nominal model and secondly robustify the central controller (the controller obtained when no constraint is active). This robustification is then expanded to all the space of the piecewise structure by means of its corresponding disturbance model.

MoC04 308
Applications of Nonlinear Control II (Regular Session)

Chair: Chiu, George T.-C. — Purdue Univ.
Co-Chair: Bates, Declan G. — Univ. of Leicester

16:30-16:50 MoC04.1
Acceleration Feedback Control of Hysteretic Base-Isolated Structures: Application to a Benchmark Case, pp. 2526-2531

Pozo, Francesc — Univ. Pol. de Catalunya (UPC)
Rodellar, Jose — Tech. Univ. of Catalonia
Acho, Leonardo — EUETIB-Univ. Pol. of Catalunya

The main objective of applying robust active control to base-isolated structures is to protect them in the event of an earthquake. Taking advantage of discontinuous control theory, a static discontinuous active bang-bang type control is developed using as a feedback only the measure of the velocity at the base. Moreover, due to that in many engineering applications, accelerometers are the only devices that provide information available for feedback, our velocity feedback controller could be easily extended by using just acceleration information through a filter. The main contributions of this paper are the development and application of (a) a static velocity feedback controller design, and (b) a dynamic acceleration feedback controller design, to a benchmark problem which is recognized as a state-of-the-art model for numerical experiments of seismic control attenuation. The performance indices show that the proposed controller behaves satisfactorily and with a reasonable control effort.

16:50-17:10 MoC04.2
Multiobjective Worst-Case Analysis of a Re-Entry Vehicle Control Law, pp. 2532-2537

Menon, Prathyush P — Univ. of Leicester
Postlethwaite, Ian — the Univ. of Leicester
Bennani, Samir — European Space Agency
Marcos, Andres — Deimos Space S.L.
Bates, Declan G. — Univ. of Leicester

This paper reports results of a joint study between ESA and the University of Leicester on worst-case analysis of NDI control laws for an industrial standard Reusable Launch Vehicle. Multiple performance objectives over a particular phase of the atmospheric re-entry are considered simultaneously in the analysis, yielding valuable information about the trade-offs involved in satisfying different clearance criteria. Two different multiobjective optimisation algorithms are employed to identify the pareto front of the multiple performance objectives. In the initial analysis, a fast, elitist, evolutionary multiobjective optimisation algorithm known as nondominated sorting genetic algorithm (NSGA-II) is employed. A hybrid multi objective optimisation algorithm which adaptively switches between three different strategies such as NSGA-II, differential evolution and the metropolis algorithm, is also developed and applied to the clearance problem. The results of our analysis show that the proposed optimisation-based approach has the potential to significantly improve both the reliability and efficiency of the flight clearance process for future re-entry vehicles.

17:10-17:30 MoC04.3

Robust Adaptive Control of Hard Disk Drives with Hysteresis Friction Nonlinearity in Mobile Applications, pp. 2538-2543

Ren, Beibei — National Univ. of Singapore
San, Phyo Phyo — National Univ. of Singapore
Ge, Shuzhi Sam — National Univ. of Singapore
Lee, Tong Heng — National Univ. of Singapore

In this paper, robust adaptive NN controller has been investigated for small form factor hard disk drives which is mainly used in mobile applications. The hysteresis friction nonlinearity from the pivot bearing degrades the servo performance, while hard disk drive servo system operates in track-following mode. To deal with the effect of hysteresis friction nonlinearity, adaptive hysteresis friction compensation with RBFNN approximation has been proposed. The effectiveness of proposed controller compared with conventional proportional-integral-derivative(PID) controller can be seen clearly through comprehensive simulation results.

17:30-17:50 MoC04.4

A New Nonlinear Control Methodology for Irrigation Canals Based on a Delayed Input Model, pp. 2544-2549

Benayache, Zohra — INPG
Besancon, Gildas — ENSIEG-INPG
Georges, Didier — ENSIEG - INPG

This paper is devoted to nonlinear feedback design for irrigation canals. Such systems are classically described by Saint-Venant nonlinear partial differential equations. Here instead, an ordinary differential equation model (still nonlinear) with a state-dependent input delay is used, on the basis of a model previously proposed in Litrico et al [2003]. The control design approach is based on a state prediction computation and the state predictor is constructed from a dynamic inversion in the same spirit as in Georges et al [2007]. The proposed methodology is analyzed and tested in simulation, first on the basis of the control model, and then using some ”more accurate” model.

17:50-18:10 MoC04.5

System Analysis of a Hybrid Two-Component Development Process for Xerography, pp. 2550-2555

Liu, Feng — Purdue Univ.
Chiu, George T.-C. — Purdue Univ.
Hamby, Eric S. — Xerox Corp.
Eun, Yongsoon — Xerox

In this paper, we will illustrate the utility of a control oriented model for a hybrid two component development process. More specifically, we will focus on the developability loss phenomenon observed in low throughput printings, where a monotonic increasing development voltage is required to achieve same amount of developed mass per unit area, which is highly correlated with the color appearance on the print images. For a given initial condition, the acceptable operating region for the development process is bounded by maximal and minimal toner mass levels as well as a maximal development voltage. We will demonstrate that the state trajectory will eventually leave the acceptable operating region in finite time for all continuous state feedback control involving the dispense input.

18:10-18:30 MoC04.6

Power-Based Control of Physical Systems: Two Case Studies, pp. 2556-2562

Garcia-Canseco, Eloisa — Univ. of Groningen
Jeltsema, Dimitri — Delft Univ. of Tech.
Scherpen, Jacquelien M.A. — Univ. of Groningen
Ortega, Romeo — LSS-SUPELEC

It is well known that energy–balancing control is stymied by the presence of pervasive dissipation. To overcome this problem in electrical circuits, the alternative paradigm of power–shaping control was introduced in (Ortega et al., 2003)—where, as suggested by its name, stabilization is achieved shaping a function akin to power instead of the energy function. In a previous work (Garcia-Canseco et al., 2006) we have extended this technique to general nonlinear systems. The method relies on the solution of a PDE, which identifies the open–loop storage function. Despite the intrinsic difficulty of solving PDEs, we show through some physical examples, that the power–shaping methodology yields storage functions corresponding to the power of the system. To motivate the application of this control technique beyond the realm of electrical circuits, we illustrate the procedure with two case studies: a micro–electromechanical system and a two–tank system.

MoC05 307

Fault-Tolerant Control II (Regular Session)

Chair: Yang, Soo Siang — Univ. of Malaya
Co-Chair: Feng, Chieh-Chuan — I-Shou Univ.

16:30-16:50 MoC05.1

On-Line References Reshaping and Control Reconfiguration for Non-Minimum Phase Nonlinear Fault Tolerant Control, pp. 2563-2569

Benosman, Mouhacine — TL@National Univ. of Singapore
Lum, Kai-Yew — National Univ. of Singapore

In this paper we consider the problem of it graceful performance degradation, for affine non-minimum phase nonlinear systems. The method is an optimization based scheme, that gives a constructive way to re-shape on-line the output reference for the post-fault system, and explicitly take into account the actuators and states saturations. The on-line output reference reshaping is associated with an on-line, MPC-based, controller reconfiguration, that forces the post-fault system to track the new output reference. The effect of FDD uncertainties on the on-line controller reconfiguration stability are studied, to ensure at least boundeness of the closed-loop system's states. The reshaping and reconfiguration schemes are applied to the Caltech ducted fan numerical example, which is described by a non-minimum phase nonlinear model.

16:50-17:10 MoC05.2

Output Selection with Fault Tolerance Via Dynamic Controller Design, pp. 2570-2575

Li, Zhenhai — Loughborough Univ.
Zolotas, Argyrios — Loughborough Univ.
Jaimoukha, Imad M. — Imperial Coll. London
Grigoriadis, Karolos M. — Univ. of Houston

Input-Output selection/placement for control systems has been an attractive research topic in particular under fault-free conditions. In this paper we present a methodology of output selection in a closed-loop framework with a view of fault tolerance capability. The principles with regards to the selection of sensors are reduced hardware redundancy, reduced costs and easier implementation, and acceptable degraded performance when faults occur. The selection of sensors is based upon both closed-loop control and fault tolerance objectives by solving an H-infinity optimization problem for each group of sensors sets via Linear Matrix Inequalities (LMIs). The proposed scheme is applied to a practical example of ride quality improvement of a high speed rail vehicle.

17:10-17:30 MoC05.3

Latent and Small Fault Detection and Diagnosis for Dynamic Processes, pp. 2576-2581

Ge, Zhiqiang — Zhejiang Univ.
Song, Zhi-Huan — Zhejiang Univ.

Compared to large process faults, the latent and small ones are difficult to be detected. However, the accumulation of these faults may even more harmful to the process. A novel fault detection and diagnosis method is proposed which is based on similarity factor and a variable moving window. The new method is based on the idea that a change of process can be reflected in the distribution of the data, which can be detected more easily by the proposed similarity factor. Meanwhile, it has no Gaussian distribution limitation of the process data, since the mixed similarity factor is introduced. The independent component analysis (ICA) factor and the principal

component analysis (PCA) factor are used for similarity comparison for Gaussian and non-Gaussian information, respectively. Besides, in order to determine the dynamic step accurately and cut the computation cost, the conventional dynamic method is modified by using autocorrelation analysis. A case study of Tennessee Eastman (TE) benchmark process shows the efficiency of the new proposed method.

17:30-17:50 MoC05.4

Robust Fault-Tolerant Control for Systems with Extended Bounded-Sensor-Faults, pp. 2582-2587

Feng, Chieh-Chuan — I-Shou Univ.

In this paper an observer-based novel design of robust control system with an estimate scheme of sensor states to accommodate extended bounded-sensor-faults is proposed. The sensor faults taken into consideration are, in general, modeled as polytopic bounds in robust control framework and are usually given as a priori assumption. But, in practice, the sensors that are subject to fault are especially vulnerable to various conditions, such as temperature, humidity, etc. and, thus, their faults may fall outside the presumed polytopic bounds easily. An estimate scheme of sensor state is integrated into the observer-based control system where the sensor fault outside the presumed region is captured and, then, the notion of the well-known quadratic stability is used to stabilize the system, while, in the mean time, a robust performance measure of an output error signal is guaranteed in the presence of a set of extended admissible sensor faults. The effectiveness of the proposed approaches is shown by a numerical example.

17:50-18:10 MoC05.5

Sensor Fault Tolerant Controller for a Double Inverted Pendulum System, pp. 2588-2594

Yang, Soo Siang — Univ. of Malaya
Chen, Jie — Brunel Univ.
Mohamed, Haider Abbas F. — Univ. of Malaya
Moghavvemi, Mahmoud — Univ. of Malaya

This paper presents an Internal Model Control based structure to realise fault tolerance towards sensor faults. The proposed design implicitly embeds fault detection and controller elements requirements with considerations to stability and robustness towards uncertainties besides multiple faults environment. The performance of the proposed controller is demonstrated via multi input multi output and unstable system i.e. the double inverted pendulum system. Performance of the controller is compared with the well known HA; controller. Results show the potential of this controller for implementation to handle systems with multiple sensor faults and uncertainties.

18:10-18:30 MoC05.6

Adaptive Neural-Based Fault Tolerant Control for Nonlinear Systems, pp. 2595-2600

De La Fuente, Maria Jesus — Univ. De Valladolid. Q4718001C
Mateo, Victor — Univ. de Valladolid
Sainz, Gregorio — Univ. de Valladolid
Saludes, Sergio — Fundación Cartif

A neural network based fault tolerant control for unknown nonlinear systems is proposed. The faultless system is controlled by a nonlinear Internal Model Controller (IMC), where both the direct and inverse models of the plant are carried out by neural networks. Using the residual signal generated from the fault detection path, an extra neural-network fault compensation loop is introduced. This neural network is a two layer perceptron and the weights and bias are updated on-line by the modified-gradient approach, which tries to minimize the control error induced by the fault. In this context, a fault tolerant control scheme is obtained. This scheme is tested in simulation in a pH plant with good results.

MoC06 310A

Time Delay Systems: Stability Analysis (Regular Session)

Chair: Keel, Lee H. — Tennessee State Univ.
Co-Chair: Fridman, Emilia — Tel-Aviv Univ.

16:30-16:50 MoC06.1

Delay-Dependent Exponential Stability of Linear Distributed Parameter Systems, pp. 2601-2606

Fridman, Emilia — Tel-Aviv Univ.
Orlov, Yury — CICESE

Exponential stability analysis via Lyapunov-Krasovskii method is extended to linear time-delay systems in a Hilbert space. The operator acting on the delayed state is supposed to be bounded. The system delay is admitted to be unknown and time-varying with an a priori given upper bound on the delay. Sufficient delay-dependent conditions for exponential stability are derived in the form of Linear Operator Inequalities, where the decision variables are operators in the Hilbert space. Being applied to a heat equation and to a wave equation, these conditions are represented in terms of standard Linear Matrix Inequalities. The proposed method is expected to provide effective tools for robust control of distributed parameter systems with time-delay.

16:50-17:10 MoC06.2

A Delay Decomposition Approach to Stability of Linear Neutral Systems, pp. 2607-2612

Han, Qing-Long — Central Queensland Univ.

This paper is concerned with stability of linear neutral systems. Firstly, a new approach, a delay decomposition approach, is proposed to deal with the stability issue. The idea of the approach is that the delay interval is uniformly divided into N segments with N a positive integer, and a proper Lyapunov-Krasovskii functional is chosen with different weighted matrices corresponding to different segments in the Lyapunov-Krasovskii functional. Secondly, based on the delay decomposition approach, some new delay-dependent stability criteria for linear neutral systems are derived. These criteria are much less conservative and include some existing results as their special cases. Numerical examples show that significant improvement using the delay decomposition approach is achieved over some existing method even for coarse delay decomposition.

17:10-17:30 MoC06.3

Necessary and Sufficient Conditions for Delay-Dependent Asymptotic Stability of Linear Discrete Time Delay Autonomous Systems, pp. 2613-2618

Debeljkovic, Dragutin, LJ. — Univ. of Belgrade
Stojanovic, Sreten — assistant prof.

This paper offers new, necessary and sufficient conditions for delay-dependent asymptotic stability of systems of the form x(k+1)=A0x(k)+A1x(k_;h). The time-dependent criteria are derived by Lyapunov's direct method. Two matrix equations have been derived: matrix polynomial equation and discrete Lyapunov matrix equation. Also, modifications of the existing sufficient conditions of convergence of Traub and Bernoulli algorithms for computing the dominant solvent of the matrix polynomial equation are derived. Numerical computations are performed to illustrate the results obtained.

17:30-17:50 MoC06.4

Some Necessary and Sufficient Conditions of Stability on the Approximation of a Distributed Delay Control Law, pp. 2619-2624

Cardelli, Michel — IRCCyN
Boudey, Julien — IRCCyN

Since the end of the seventies, several authors have proposed to use a distributed delay in the control law for poles-assignment of time delay systems, i. e. a finite integral over the past values of the state or the command of the system. However, since ten years publications have showed that the implementation of such control laws, by the means of an approximation, is not self-evident. Back to this topic, this paper is concerned with the conditions of stability of the controlled system after approximation of the distributed delay and, limited to the first-order SISO case, constitute the first step of a larger study. So, the proof of the necessity and the sufficiency of a set of conditions, some of them well known, is given. It is followed by a criterion of stabilizability of the primary system based on its only parameters.

17:50-18:10 MoC06.5

Delay-Dependent Stability Criteria for Markovian Switching Networks with Time-Varying Delay, pp. 2625-2630

Sathananthan, Sivapragasam — Tennessee State Univ.
Beane, Carlos — Tennessee State Univ.
Keel, Lee H. — Tennessee State Univ.

A problem of feedback stabilization of hybrid systems with time-varying delay and Markovian switching is considered. Delay-dependent sufficient conditions for stability based on linear matrix inequalities (LMI's) for stochastic asymptotic stability is obtained. The stability result depended on the mode of the system and of delay-dependent. The robustness results of such stability concept against all admissible uncertainties are also investigated.

This new delay-dependent stability criteria is less conservative than the existing delay-independent stability conditions. An example is given to demonstrate the obtained results.

18:10-18:30 MoC06.6

Fast Step-Response Evaluation of Linear Continuous-Time Systems with Time Delay in the Feedback Loop, pp. 2631-2636

Piguet, Yves — Calerga Sarl
Muellhaupt, Philippe — Ec. Pol. Fed. de Lausanne

The simulation of step, impulse and ramp responses of linear continuous-time time-invariant single-input single-output systems with a pure time delay in the feedback loop is tackled. Contrary to systems without time delay where a conversion from Laplace transform to z transform with a zero-order hold allows for an exact response, delay in the feedback loop requires either an unbounded number of states or approximations. This paper proposes an approximation which fulfills a set of criteria, including exactness of the response over a specified multiple of the delay and the conservation of the stability or lack of stability. The approach is illustrated with examples.

MoC07 310B

Control Problems under Conflict or Uncertainties (Regular Session)

Chair: Turnau, Andrzej — AGH Univ. of Science and Tech.
Co-Chair: Cruz, Jose B — The Ohio State Univ.

16:30-16:50 MoC07.1

Enhancements for Contractive Receding Horizon Control, pp. 2637-2642

Chung, Hoam — Univ. of California, Berkeley
Polak, Elijah — Univ. of California
Sastry, Shankar — Univ. of California at Berkeley

We propose a new stability constraint for contractive receding horizon control (RHC), which was inspired by a non-monotone line search rule for optimization algorithms. Previously proposed stability constraints for contractive RHC can be seen as special cases of our new constraint. The new stability constraint guarantees asymptotic stability, but it does not ensure the monotone decrease of the state to zero. The non-monotone nature of our constraint is less restrictive than previous contractive constraints, and in principle, should result in a larger region of attraction (stability region). We present simulation results which show that this is in fact the case. We also present several enhancements which result in a faster system response and/or a larger stability region.

16:50-17:10 MoC07.2

Game of Defending a Target: A Linear Quadratic Differential Game Approach, pp. 2643-2648

Li, Dongxu — Ohio State Univ.
Cruz, Jose B — The Ohio State Univ.

Pursuit-evasion (PE) differential games have recently received much attention in military applications involving adversaries. We extend the PE game problem to a problem of defending target, where the roles of the players are changed. The evader is to attack some fixed target, whereas the pursuer is to defend the target by intercepting the evader. We propose a practical strategy design approach based on the linear quadratic game theory with a receding horizon implementation. We prove the existence of solutions for the Riccati equations associated with games with simple dynamics. Simulation results justify the method.

17:10-17:30 MoC07.3

Robust Filter Design for Sigma-Delta Modulators with One-Bit Quantizer and Analog Mismatch, pp. 2649-2654

Chou, Yung-Shan — Tamkang Univ.
Lin, Chun-Chen — Tamkang Univ.

A method for improving the signal-to-noise ratio (SNR) of single-stage sigma-delta modulators (SDMs) with one-bit quantizer is presented. It is well known that uncertainties and noises are sources of error which cause performance degradation. Specifically, the modulators are naturally subject to analog mismatch in capacitor values and finite amplifier gain, which are manifested as parametric uncertainties of the SDMs, whereas the quantization error due to the coarse quantizer is modeled as a bounded-peak additive noise. Robust stability margin optimization and suppression of the output swing of the non-ideal integrators are also considered in the integral design. Based on a frequently used linear model, we propose a new architecture for the SDMs. The associated digital filter is determined by robust control theory. For numerical illustration, comparisons between the proposed SDM and the conventional one are made. It is shown that the proposed SDM has an effective resolution of 16 bits.

17:30-17:50 MoC07.4

Model Identification Dedicated to the Time-Optimal Control, pp. 2655-2660

Turnau, Andrzej — AGH Univ. of Science and Tech.

A model identification procedure is applied to the well known benchmark problem of the pendulum hinged to a cart. There is a dynamical model of the entire system. The PWM control signal and DC motor impact introduced electrically by EMF are included. A concatenation of trajectories collected during several control experiments is used to fit the parameters of the pendulum-cart mathematical model. The identification of model parameters is dedicated to the control goal. Several collected points of trajectories are neglected. The model matching corresponds to intervals.

17:50-18:10 MoC07.5

A Probabilistic Algorithm for Mode Based Motion Planning of Agile Unmanned Air Vehicles in Complex Environments, pp. 2661-2668

Koyuncu, Emre — Istanbul Tech. Univ.
Üre, Naz1;m Kemal — Istanbul Tech. Univ.
Inalhan, Gokhan — Istanbul Tech. Univ.

In this work, we consider the design of a probabilistic trajectory planner for a highly manoeuvrable unmanned air vehicle flying in a dense and complex city-like environment. Our design hinges on the decomposition of the problem into a) flight controls of fundamental agile-manoeuvring flight modes and b) trajectory planning using these controlled flight modes from which almost any aggressive manoeuvre (or a combination of) can be created. This allows significant decreases in control input space and thus search dimensions, resulting in a natural way to design controllers and implement trajectory planning using the closed-form flight modes. Focusing on the trajectory planning part, we provide a three-step probabilistic trajectory planner. In the first step, the algorithm rapidly explores the environment through a randomized reachability tree search using an approximate line segment models. The resulting connecting path is converted into flight milestones through a line-of-sight segmentation. This path and the corresponding milestones are refined with a single-query Probabilistic Road Map (PRM) implementation that creates dynamically feasible flight paths with distinct flight mode selections. We address the problematic issue of narrow passages through non-uniform distributed capture regions, which prefer state solutions that align the vehicle to enter the milestone region in line with the next milestone to come. Numerical simulations in 3D and 2D demonstrate the ability of the method to provide real-time solutions in dense and complex environments.

18:10-18:30 MoC07.6

Asymptotic Disturbance Attenuation Properties for Continuous-Time Uncertain Switched Linear Systems, pp. 2669-2674

Lin, Hai — National Univ. of Singapore
Antsaklis, Panos J. — Univ. of Notre Dame

In this paper, the disturbance attenuation properties in the sense of uniformly ultimate boundedness are investigated for a class of switched linear systems with parametric uncertainties and exterior disturbances. The aim is to characterize the conditions under which the switched system can achieve a finite disturbance attenuation level. First, arbitrary switching signals are considered, and a necessary and sufficient condition is given. Secondly, conditions on how to restrict the switching signals to achieve finite disturbance attenuation levels are investigated. Two cases are considered here that depend on whether all the subsystems are uniformly ultimately bounded or not. The techniques are based on multiple polyhedral Lyapunov functions and their extensions.

MoC08 310C

Observer and Robust Estimator Synthesis (Regular Session)

Chair: Allgower, Frank — Univ. of Stuttgart
Co-Chair: Geromel, Jose C. — UNICAMP

16:30-16:50 MoC08.1

Robust H2 Filtering for Continuous Time Systems with Linear Fractional Representation, pp. 2675-2680

Korogui, Rubens H. — Univ. of Campinas

Geromel, Jose C. UNICAMP

This paper introduces a new approach to H2 robust filtering design for continuous-time LTI systems subject to linear fractional parameter uncertainty representation. The novelty consists on the determination of a performance certificate, in terms of the gap between lower and upper bounds of a minimax programming problem which defines the optimal robust equilibrium cost. The calculations are performed through convex programming methods, applying slack variables, known as multipliers, to handle the fractional dependence of the plant transfer function with respect to the parameter uncertainty. The theory is illustrated by means of a practical application involving an induction motor with uncertain leakage inductance.

16:50-17:10 MoC08.2

H2 and Hoo Filtering of Discrete-Time Markov Jump Linear Systems through Linear Matrix Inequalities, pp. 2681-2686

Fioravanti, André R. UNICAMP
Gonçalves, Alim P. C. UNICAMP
Geromel, Jose C. UNICAMP

This paper addresses the H2 and Hoo filtering design problems of discrete-time Markov jump linear systems. First, under the assumption that the Markov parameter is measured, the main contribution is on the LMI characterization of all filters such that the estimation error remains bounded by a given norm level, yielding the complete solution of the mode-dependent filtering design problem. Based on this result, a robust filter design to deal with convex bounded parameter uncertainty is considered. Second, from the same LMI characterization, a procedure for mode-independent filtering design is proposed. An example is solved for illustration and comparisons with the methods available in the literature.

17:10-17:30 MoC08.3

Robust H_; Filtering for Uncertain Discrete-Time Singular Systems, pp. 2687-2692

Lee, Ching-Min I-Shou Univ.
Wang, Wei-Sheng I-Shou Univ.

This paper concerns the robust H_; filtering problem for discrete-time singular systems with norm-bounded uncertainties in all system matrices of state equations. On the basis of the admissibility assumption of the uncertain singular systems, a set of necessary and sufficient conditions for the existence of the desired filters is established, and a normal filter design method under the linear matrix inequality framework is proposed. A numerical example is given to illustrate the application of the proposed method.

17:30-17:50 MoC08.4

An Observer That Converges in Finite Time Due to Measurement-Based State Updates, pp. 2693-2695

Raff, Tobias Univ. of Stuttgart
Allgower, Frank Univ. of Stuttgart

This paper presents a new observer that estimates the exact state of a linear continuous-time system in predetermined finite time. The finite convergence time of the proposed observer is achieved by updating the observer state based on the difference between the measured output and the estimated output at discrete time instants. Simulation results are presented to illustrate the convergence behavior and the applicability of the proposed observer.

17:50-18:10 MoC08.5

A Construction of Disturbance Observer to Cope with Frequency Variation and Its Application to Vibration Suppression Control System, pp. 2696-2701

Fuwa, Katsuhiko Nagaya Inst. of Tech.
Narikiyo, Tatsuo Toyota Tech. Inst.
Kandoh, Hisashi Nagaya Inst. of Tech.

In this paper, a synthesis method of new disturbance observer, which can cope with frequency variation, is proposed. The main idea is to synthesize the disturbance observer as a gain-scheduled controller. The proposed disturbance observer gives the same low sensitivity property for disturbances with frequency variation as the conventional disturbance observer does. As an application, we consider vibration suppression control system for a flexible beam with multiple vibration modes. By numerical simulations and experiments, the proposed control scheme is shown superior to the conventional disturbance observer with respect to vibration suppression as compared.

18:10-18:30 MoC08.6

Implementation of Disturbance Attenuation System Based on Frequency Estimation, pp. 2702-2707

Narikiyo, Tatsuo Toyota Tech. Inst.
Fuwa, Katsuhiko Nagaya Inst. of Tech.
Murano, Takeshi Toyota Tech. Inst.

A well-known control system that can reduce the adverse effects of disturbances is a disturbance observer. Whenever we apply disturbance observer, disturbance frequency should be known and constant. However, in many cases of industrial systems disturbance frequency is varied for some frequency range. Therefore, it may be difficult to reduce the adverse effect of such disturbance by use of the traditional disturbance observer. In this paper, a design method of disturbance attenuation system that can cope with the frequency variation (DOFV) is proposed. The main idea of this design method is to combine DOFV with frequency estimator that can estimate disturbance frequency in real time. Even though the proposed disturbance attenuation system is low degree and low gain controller, it has superior steady state characteristic. Numerical simulations and experiments show the usefulness of the proposed disturbance attenuation system.

MoC09 311C

Nonlinear System Identification I (Regular Session)

Chair: Wills, Adrian George Univ. of Newcastle
Co-Chair: Schön, Thomas, Bo Linköping Univ.

16:30-16:50 MoC09.1

Blind Maximum Likelihood Identification of Hammerstein Systems, pp. 2708-2713

Vanbeylen, Laurent Vrije Univ. Brussel
Pintelon, Rik Vrije Univ. Brussel
Schoukens, Johan Vrije Univ. Brussel

This paper handles the identification of discrete-time Hammerstein systems from output measurements only (blind identification). Assuming that the unobserved input is white Gaussian noise, that the static nonlinearity is invertible, and that the output is observed without errors, a Gaussian maximum likelihood estimator is constructed. Its asymptotic properties are analyzed and the Cramér-Rao lower bound is calculated. In practice, the latter can be computed accurately without using the strong law of large numbers. A two-step procedure is described that allows to find high quality initial estimates to start up the iterative Gauss-Newton based optimization scheme. The paper includes the illustration of the method on a simulation example.

16:50-17:10 MoC09.2

Maximum Likelihood Identification of Wiener Models, pp. 2714-2719

Hagenblad, Anna Linkoping Univ.
Ljung, Lennart Linköping Univ.
Wills, Adrian George Univ. of Newcastle

The Wiener model is a block oriented model having a linear dynamic system followed by a static nonlinearity. The dominating approach to estimate the components of this model has been to minimize the error between the simulated and the measured outputs. We show that this will in general lead to biased estimates if there is other disturbances present than measurement noise. The implications of Bussgang's theorem in this context are also discussed. For the case with general disturbances we derive the Maximum Likelihood method and show how it can be efficiently implemented. Comparisons between this new algorithm and the traditional approach confirm that the new method is unbiased and also has superior accuracy.

17:10-17:30 MoC09.3

Optimal Precision of Quantum System Parameter Estimation Subject to Instrumentation Constraints, pp. 2720-2725

Kosut, Robert SC Solutions

Maximizing the precision in estimating parameters in a quantum system subject to instrumentation constraints is cast as a convex optimization problem.

17:30-17:50 MoC09.4

NARX Model Identification with Error Filtering, pp. 2726-2731

Piroddi, Luigi Pol. di Milano
Lovera, Marco Pol. di Milano

Model identification of polynomial NARX models involves a lengthy and computationally intensive procedure for selecting the model structure among a possibly large set of candidate regressors. If the model structure is under-parameterized to reduce the burden of the model selection phase, unsatisfactory results are generally obtained. This inaccuracy problem can be somewhat circumvented by focusing the identification process on the obtainment of an accurate local model over a specific frequency range. Such frequency tailoring is achieved in the nonlinear modeling framework by direct error _ltering, as opposed to the data pre-filtering practice adopted in the linear context. This work discusses the application of error filtering to classical NARX model identi_cation methods. A simulation example is provided to show the performance of the proposed approach in deriving accurate local models, despite an underparameterized model structure. It is also shown that a proper error _ltering may increase the model accuracy in simulation with respect to available identi_cation techniques.

17:50-18:10 MoC09.5

Piecewise Linear Solution Paths for Parametric Piecewise Quadratic Programs, pp. 2732-2737

Roll, Jacob — Linköping Univ.

Recently, pathfollowing algorithms for parametric optimization problems with piecewise linear solution paths have been developed within the field of regularized regression. This paper presents a generalization of these algorithms to a wider class of problems, namely a class of parametric piecewise quadratic programs and related problems. By using pathfollowing algorithms that exploit the piecewise linearity, the entire solution paths can be very efficiently computed. Possible applications include design parameter selection for identification methods such as Direct Weight Optimization.

18:10-18:30 MoC09.6

Identification of Non-Parametric Nonlinear Systems with Low Degree Interactive Terms, pp. 2738-2743

Bai, Er-Wei — Univ. of Iowa

In this paper, an interactive term identification approach is proposed for identification of non-parametric nonlinear systems. The idea is to make a high-dimensional nonlinear identification problem into a number of low-dimensional problems and thus to effectively combat the problem of the curse of dimensionality. Convergence results are established in the paper and numerical results support the theoretical analysis and demonstrate that the proposed approach is an attractive alternative to existing nonlinear identification methods.

MoC10 311B

Prediction, Filtering and Smoothing III (Regular Session)

Chair: Stepanov, Oleg A. — Central Scientific Res. Inst. Elektropribor

Co-Chair: Broersen, Piet M.T. — Delft Univ. of Tech.

16:30-16:50 MoC10.1

Finite-Sample Bias Propagation in the Yule-Walker Method of Autoregressive Estimation, pp. 2744-2749

Broersen, Piet M.T. — Delft Univ. of Tech.

Lagged-product autocorrelation estimates have a small triangular bias. However, using them to compute an autoregressive model with the Yule-Walker method can give a strongly distorted spectral model in finite samples. The distortion is shown for examples where the reflection coefficients are not very close to one in absolute value. It will disappear asymptotically. An objective measure is presented to determine the smallest sample size for which the unbiased asymptotic theory is a fair approximation.

16:50-17:10 MoC10.2

Investigation of Linear Optimal Estimator, pp. 2750-2755

Stepanov, Oleg A. — Central Scientific Res. Inst. Elektropribor

Toropov, Anton — Central Scientific Res. Inst. Elektropribor

Features of the linear optimal estimator (LOE) that minimizes the root mean-square (RMS) criterion in the class of linear estimates in nonlinear problems are investigated. The equivalent linear models for measurements have been introduced for the LOE and the Cramer-Rao Bound. The features of the LOE in comparison with the optimal Bayesian estimator, which corresponds to the conditional mean, are studied. Some examples are considered to illustrate the results obtained.

17:10-17:30 MoC10.3

Design of Robust Hinf Observers for Nonlinear Systems Using a Multiple Model, pp. 2756-2761

Orjuela, Rodolfo — CRAN-INPL

Marx, Benoit — Centre de Recherche en Automatique de Nancy

Ragot, Jose — CRAN-INPL

Maquin, Didier — Inst. National Pol. de Lorraine

A particular class of multiple model, known as decoupled multiple model, is used in order to cope with the state estimation problem of nonlinear systems. This attractive kind of multiple model is characterized by submodels of which the state belong to spaces of various dimensions, in contrast to the popular Takagi-Sugeno multiple model where the dimensions of the state space of the submodels are identical. Thus the decoupled multiple model is suitable for modelling complex systems with variable structure in the operating range and this fact offers promising prospects in the modelling, control and diagnosis of complex non linear systems. An original procedure for designing a proportional observer and a proportional-integral observer ensuring Hinf performances is proposed. Sufficient conditions for ensuring the estimation error convergence are derived employing the LMI framework. Comparison between the state estimation provided by both observers is given via a simulation example.

17:30-17:50 MoC10.4

Robust State Estimation for Multi-Delayed Neural Networks: An LMI Approach, pp. 2762-2767

Yu, Li — Zhejiang Univ. of Tech.

Zheng, Ke — Zhejiang Univ. of Tech.

Zhang, Wen-An — Zhejiang Univ. of Tech.

The robust state estimation problem is studied in this paper for a class of neural networks with multiple time-varying delays and norm-bounded parameter uncertainties. The problem is to estimate the neuron states through available measured outputs such that for all admissible time-delays and parameter uncertainties, the dynamics of the estimation error is globally stable. A sufficient condition for the existence of such estimators for the multi-delayed neural networks is derived via the linear matrix inequality (LMI) approach, and a design procedure of the estimators is presented in terms of the feasible solutions to a certain LMI. Finally, a numerical example is given to demonstrate the effectiveness of the proposed method.

17:50-18:10 MoC10.5

Design of Observers for Takagi-Sugeno Systems with Immeasurable Premise Variables : An L2 Approach, pp. 2768-2773

Ichalal, Dalil — CRAN (CENTRE DE RECHERCHE EN AUTOMATIQUE DE NANCY)

Marx, Benoit — Centre de Recherche en Automatique de Nancy

Ragot, Jose — CRAN-INPL

Maquin, Didier — Inst. National Pol. de Lorraine

A new observer design method is proposed for Takagi-Sugeno systems with immeasurable premise variables. Since the state estimation error can be written as a perturbed system, then the proposed method is based on the L2 techniques to minimize the effect of the perturbations on the state estimation error. The convergence conditions of the observer are established by using the second method of Lyapunov and a quadratic function. These conditions are expressed in terms of Linear Matrix Inequalities (LMI). Finally, the performances of the proposed observer are improved by eigenvalues clustering in LMI region.

18:10-18:30 MoC10.6

A Result on State Estimation of Nonlinear Systems with Application to Fuel Cell Stacks., pp. 2774-2778

Benallouch, Mohamed — Louis Pasteur Univ.

Outbib, Rachid — Univ. of Aix-Marseille III

Boutayeb, Mohamed — Nancy Univ.

Laroche, Edouard — LSIIT

In this paper,the observation issue of the partial pressure of oxygen and nitrogen and the mass flow rate of dry air in the cathode channel of a fuel cell stack is addressed. The proposed approach considers the mass flow rate of dry air as an unknown input and uses the voltage and the total pressure as measurements. By using the Jacobian of the nonlinear functions and the convexity principe, the observer design problem is turned into a LMI feasibility problem. Simulation results with a detailed model show the good convergence properties of the observer.

MoC11 311A
Nonlinear Systems III (Regular Session)
Chair: Sakai, Satoru Chiba Univ.

16:30-16:50 MoC11.1
Limitations of Nonlinear Periodic Sampled-Data Control for Robust Stabilization, pp. 2779-2784
Schmid, Robert The Univ. of Melbourne

This paper presents a performance analysis of nonlinear periodically time varying sampled-data controllers acting upon a lineartime invariant plant. Time invariant controllers are distinguished from strictly periodically time varying controllers. For a given nonlinear strictly periodic controller, a time invariant controller is constructed. Necessary and sufficient conditions are given under which the time invariant controller gives strictly better control performance than the time invariant controller from which it was obtained, for the robust stabilization of L_p unstructured perturbations, for all p in[1,infty].

16:50-17:10 MoC11.2
Robust Observer-Based Output Tracking Control of Nonlinear Systems with Sensor Measurement Delays, pp. 2785-2790
Pan, Ya-Jun Dalhousie Univ.

In this note, a practical issue related to the measurement delay is addressed for the output tracking control of a class of nonlinear uncertain systems. Observer based sliding mode control approach is proposed. The measurement delay is constant and bounded. The sliding mode control can handle matched L_infty type system uncertainties with known bounding functions. However, the controller usually requires fully measurable and instantaneous states information without any delays. To deal with measurement time delay, a robust observer is constructed based on delayed output information from the sensor. Through designing the observer gain according to the Linear Matrix Inequality (LMI) techniques developed by Lyapunov Kravoskii method for time delay systems, the convergence of the estimation error with an uniform bound is ensured. Then the sliding mode control law is constructed based on estimated states. The convergence of the switching surface is ensured in finite time and the overall tracking error tends to be bounded due to the estimation error bound of the observer. Finally, a simulation example is presented to show the effectiveness of the proposed method.

17:10-17:30 MoC11.3
Partial Stabilization of a Class of Hydraulic Mechanical Systems with Casimir Functions, pp. 2791-2796
Sakai, Satoru Chiba Univ.

This paper gives a new modeling and passivity based control of a class of hydraulic mechanical systems with natural Casimir functions. First, we propose two stabilization methods, a new dynamic asymptotic stabilization method and a new partial stabilization method. Second, we give a new model of a class of fluid mechanical systems using Casimir functions. Furthermore, the proposed two stabilization methods are applied to the new model. Finally, the validity of our methods are confirmed by numerical simulation.

17:30-17:50 MoC11.4
Asymptotic Rejection of General Periodic Disturbances in Nonminimum-Phase Nonlinear Output-Feedback Systems, pp. 2797-2802
Ding, Zhengtao The Univ. of Manchester

This paper deals with asymptotic rejection of unmatched general periodic disturbances in nonminimum phase nonlinear output feedback systems. The steady state responses are defined for unstable systems subject to general periodic disturbances, and the generalized gain and phase are defined for stable systems subject to general periodic disturbances. Based on the new definitions, new results are obtained for the equivalent input disturbance and disturbance estimation. A L_p-convergent estimate of the equivalent input disturbance is incorporated in the control design to ensure the asymptotic rejection of unmatched general periodic disturbances while maintaining the stability of the nonlinear system.

17:50-18:10 MoC11.5
A High Gain Observer Based LMI Approach, pp. 2803-2807
Rodrigues, Mickael Univ. OF LYON 1; LAGEP UMR CNRS 5007
Hammouri, Hassan Univ. Claude Bernard
Mechmeche chokri, Chokri Ec. supérieure des sciences et Tech. de Tunis
Benhadj Braiek, Naceur Ec. Pol. de Tunisie

This paper deals with the observability analysis and the observer synthesis of a class of nonlinear systems. The observer that we consider has a constant gain and concerns a class of uniformly observable systems. A sufficient condition permitting to design such a constant gain observer is given. The calculation of this gain is based on LMI technics.

18:10-18:30 MoC11.6
Lyapunov Function Design Using Quantization of Markov Process, pp. 2808-2813
Nishimura, Yuki Hokkaido Univ.
Yamashita, Yuh Hokkaido Univ.

In this paper, we propose a Lyapunov function design method using a difference approximation scheme and quantization of the Markov process. First, we approximate a Lyapunov equation by a Schrodinger-like equation. Second, we obtain sufficient conditions for a function to be a Lyapunov function. Then, we provide a Lyapunov function design procedure.

MoC12 313
Iterative Learning Control II (Regular Session)
Chair: Galkowski, Krzysztof Univ. of Zielona Gora
Co-Chair: Sogo, Takuya Chubu Univ.

16:30-16:50 MoC12.1
Model-Free Based Optimal Iterative Learning Control for a Class of Discrete-Time Nonlinear Systems, pp. 2814-2819
Jin, Shangtai Beijing Jiaotong Univ.
Hou, Zhongsheng Beijing Jiaotong Univ.
Zhao, Ming Beijing Jiaotong Univ.

A pseudo-partial-derivative based dynamic linearization method is introduced, the method can transform general discrete-time nonlinear model into discrete-time time-varying linear model. Based on this discrete-time time-varying linear model, a novel norm-optimal iterative learning control (NOILC), called model-free based norm-optimal iterative learning control (MFNOILC), is proposed for a class of discrete-time nonlinear systems. Through rigorous analysis, the convergence of the proposed algorithm is proved. The simulation results show the effectiveness of the algorithm.

16:50-17:10 MoC12.2
An Algebraic Expression of Stable Inversion for Nonminimum Phase Systems and Its Applications, pp. 2820-2825
Sogo, Takuya Chubu Univ.

This paper proposes an algebraic expression of noncausal stable inversion based on the two-sided Laplace transform, which is a classic mathematical tool that has not been used extensively in the field of control engineering. This expression is advantageous in that the computing of stable inversion is reduced to simulation of the response of the plant and the reverse of time horizon without solving the boundary value problem of state-space equations as the conventional definition of stable inversion. An illustrative example demonstrates that this approach is useful to reduce the load of the programming for a search algorithm to determine the shape of a transition trajectory under the constraint of input saturation. As another application of the proposed expression, a method of iterative learning control is developed to obtain stable inversion for infinite dimensional systems. An experiment applying the iterative learning control to tip control of a flexible arm is reported to demonstrate the effectiveness of the method.

17:10-17:30 MoC12.3
Iterative Learning Control Based Ramp Metering Tracking Various Trajectories, pp. 2826-2831
Yan, Jingwen Beijing Jiaotong Univ.
Hou, Zhongsheng Beijing Jiaotong Univ.
Zhao, Ming Beijing Jiaotong Univ.

In this work, we apply the iterative learning control approach to address the traffic density control via ramp metering in a macroscopic level freeway environment. The traffic density control problem is formulated into an output tracking problem and the tracking trajectories are variable with time and iteration change.

Rigorous analyses and intensive simulations show that the iterative learning control method we proposed can deal with this kind of problem successfully.

17:30-17:50 MoC12.4

A 2D Systems Approach to Iterative Learning Control with Experimental Validation, pp. 2832-2837

Hladowski, Lukasz — Univ. of Zielona Gora
Galkowski, Krzysztof — Univ. of Zielona Gora
Cai, Zhonglun — Univ. of Southampton
Rogers, Eric — Univ. of Southampton
Freeman, Christopher Thomas — Univ. of Southampton
Lewin, Paul — Univ. of Southampton

In this paper we use a 2D systems setting to develop new results on iterative learning control for linear plants. It is well known in the subject area that a trade-off exists between speed of convergence and transient response. Here we give new results in this area by designing the control scheme using a strong form of stability for repetitive processes/2D linear systems known as stability along the pass (or trial). The resulting design computations are in terms of Linear Matrix Inequalities (LMIs) and they are also experimentally validated on a gantry robot.

17:50-18:10 MoC12.5

Asymptotic Stability of Uncalibrated Eye-In-Hand Visual Servoing: An Affine Invariance Perspective, pp. 2838-2843

Hao, Miao — Tsinghua Univ.
Sun, Zengqi — Tsinghua Univ.
Masakazu, Fujii — IHI Corp.

In this paper, asymptotic stability of uncalibrated eye-in-hand visual servoing is proved in an affine invariance approach. After a brief retrospection on the uncalibrated eye-in-hand visual servoing, the affine invariance framework is introduced with discussion in depth. Then the visual servoing algorithm is reconstructed in an affine invariance framework, or more precisely as an affine contravariance algorithm, with its complete asymptotic stability proved, proposed as a convergence theorem. The affine invariance approach enroots the series algorithm on a more solid and fruitful mathematical background and finally, the paper would discuss several potential research realms of the topic of visual servoing.

18:10-18:30 MoC12.6

A Fast Iterative Learning Control Approach to Rejection of Periodic Disturbances, pp. 2844-2849

Ha, In-Joong — Seoul National Univ.
Jang, Jung-Kook — Seoul National Univ.
Park, Jin-Won — Seoul National Univ.

Like the well-known RC (Repetitive Control) and AFC (Adaptive Feedforward Cancellation) methods, the new iterative learning control (ILC) method developed recently for the rejection of periodic disturbances also utilize the steady-state behavior of the closed-loop system and requires a settling time + some periods for the satisfactory rejection of periodic disturbances. However, in case of the new ILC method, an iterative update scheme is needed to achieve successful rejection of periodic disturbances ever in the presence of aperiodic disturbances and plant uncertainties. In this paper, we introduce the concept of dwell time instead of settling time to accelerate the rejection speed of the new ILC method. The effectiveness and practicality of the proposed method is demonstrated through mathematical performance analysis as well as various simulation results.

MoC13 314

Distributed Estimation and Consensus II (Regular Session)

Chair: Lee, Jin S. — Pohang Univ. of Science & Tech.
Co-Chair: Johansson, Mikael — Royal Inst. of Tech.

16:30-16:50 MoC13.1

Distributed Maximum Likelihood Estimation with Time-Varying Network Topology, pp. 2850-2855

Calafiore, Giuseppe — Pol. di Torino
Abrate, Fabrizio — Pol. di Torino

We consider a sensor network in which each sensor may take at every time iteration a noisy linear measurement of some unknown parameter. In this context, we study a distributed consensus diffusion scheme that relies only on bidirectional communication among neighbor nodes (nodes that can communicate and exchange data), and allows every node to compute an estimate of the unknown parameter that asymptotically converges to the true parameter. At each time iteration, a measurement update and a spatial diffusion phase are performed across the network, and a local least-squares estimate is computed at each node. We show that the local estimates converge to the true parameter value, under suitable hypotheses. The proposed scheme works in networks with dynamically changing communication topology, and it is robust to unreliable communication links and widespread failures in measuring nodes.

16:50-17:10 MoC13.2

Data Fusion of Unknown Correlations Using Internal Ellipsoidal Approximation, pp. 2856-2860

Zhou, Yan — Shanghai Jiao Tong Univ.
Li, Jianxun — Shanghai Jiao Tong Univ.

To avoid both the inconsistency of the Kalman filter and the performance conservation of the covariance intersection (CI) in the case of unknown correlations, an internal ellipsoidal approximation (IEA) method is proposed to fuse the local estimations. A numerical example of three-state radar tracking system is presented to illustrate the implementation and effectiveness of the proposed algorithm. From the simulation results in the cases that the sources are (p;) independent; (q;) correlated and the crosscovariance are exact known; and (r;) correlated with unknown cross-covariance, it is obvious to see that the IEA method, like CI, circumvents the need for prior knowledge of the correlations but it gets better fusion accuracy than CI.

17:10-17:30 MoC13.3

Faster Linear Iterations for Distributed Averaging, pp. 2861-2866

Johansson, Björn — Royal Inst. of Tech.
Johansson, Mikael — Royal Inst. of Tech.

Distributed averaging problems are a subclass of distributed consensus problems, which have received substantial attention from several research communities. Although many of the proposed algorithms are linear iterations, they vary both in structure and state dimension. In this paper, we investigate the performance benefits of adding extra states to distributed averaging iterations. We establish conditions for convergence and discuss possible ways of optimizing the convergence rates. By numerical examples, it is shown that the performance can be significantly increased by adding extra states. Finally, we provide necessary and sufficient conditions for convergence of a more general version of distributed averaging iterations.

17:30-17:50 MoC13.4

Asymptotically Unbiased Average Consensus under Measurement Noises and Fixed Topologies, pp. 2867-2873

Li, Tao — Chinese Acad. of Sciences

This paper is concerned with average-consensus control under directed topologies and random measurement noises. To attenuate the measurement noises, time-varying consensus gains are introduced in the protocol. It is shown that under the protocol designed, all agents' states converge to a common Gaussian random variable, whose mathematical expectation is just the average of the initial states, and the mean square static error vanishes as the number of agents increases to infinity under certain topologies. In addition, for the noise-free case, necessary and sufficient conditions are given on the network topology and consensus gains to achieve average-consensus; and for the noisy measurement case, by combining algebraic graph theory and stochastic analysis, necessary and sufficient conditions are given on the consensus gains to achieve asymptotically unbiased mean square average-consensus.

17:50-18:10 MoC13.5

Multi-Agent Consensus Using Both Current and Outdated States, pp. 2874-2879

Cao, Yongcan — Utah State Univ.
Ren, Wei — Utah State Univ.
Chen, YangQuan — Utah State Univ.

We propose a distributed consensus algorithm for multi-agent systems. In contrast to the standard consensus algorithm that relies on only current states, the proposed algorithm uses both current states and outdated states stored in memory. The proposed algorithm is analyzed under an undirected communication graph. It is shown that the proposed algorithm converges faster than the standard consensus algorithm while requiring identical maximum control effort if the outdated states are chosen properly. Simulation results demonstrate the effectiveness of the proposed algorithm.

18:10-18:30 MoC13.6

Observability Analysis for Networked Control Systems: A Graph Theoretic Approach, pp. 2880-2885

Boukhobza, Taha — Univ. Henri Poincaré Nancy 1
Hamelin, Hamelin — Nancy Univ.

This paper deals with the state and input observability analysis for Networked Control Systemswhich are composed of interconnected subsystems that exchange data through communication networks. The proposed method is based on a graph-theoretic approach and assumes only the knowledge of the system's structure. More precisely, for the so-called distributed decentralized and distributed autonomous observation schemes, we express, in simple graphic terms, necessary and sufficient conditions tocheck whether or not a considered subsystem is strongly observable. These conditions, which allows also to characterize all the strongly observable state and input components of each subsystem, are easy to check because they are based on comparison of integers and on finding paths in a digraph. This makes our approach suited to study large scale distributed systems.

MoC14 318

Control of Networks (Regular Session)

Chair: Zampieri, Sandro — Univ. di Padova
Co-Chair: Pavel, Lacra — Univ. of Toronto

16:30-16:50 MoC14.1

Trends in Networked Control Systems, pp. 2886-2894

Zampieri, Sandro — Univ. di Padova

16:50-17:10 MoC14.2

A Distributed Optimization Approach to Constrained OSNR Problem, pp. 2895-2900

Pan, Yan — Univ. of Toronto
Alpcan, Tansu — Deutsche Telekom Lab.
Pavel, Lacra — Univ. of Toronto

This paper studies constrained optical signal-to-noise ratio (OSNR) problem via a distributed optimization approach. In multi-channel optical systems, the signal over an optical link can be regarded as an interfering noise for others, which leads to OSNR degradation. Regulating the input optical power at the Source (transmitter) aims to achieve satisfactory OSNR level at the Destination (receiver) for each channel. Moreover, because all wavelength-multiplexed channels in a link share the same optical fiber, the total input power in a link has to be below the nonlinearity threshold, which corresponds to a link capacity constraint. We formulate the OSNR optimization problem as one of utility maximization with the objectives of achieving an OSNR target level for each channel while minimizing the interference and also satisfying the link capacity constraint. We derive conditions for the existence of a unique optimal solution, leading to a basis for an admission control scheme. By using a Lagrangian relaxation approach we propose two distributed update algorithms: a primal algorithm and a dual algorithm, and study their convergence properties both theoretically and numerically.

17:10-17:30 MoC14.3

Primal-Dual Power Control of Optical Networks with Time-Delay, pp. 2901-2906

Stefanovic, Nem — Univ. of Toronto
Pavel, Lacra — Univ. of Toronto

We study the effects of time-delay on the stability of a primal-dual controller applied to an optical communication network. Signal powers are adjusted at the sources while the links return dynamic pricing information. The objective of the source algorithm is to adjust the signal powers such that predefined OSNR targets are achieved according to the OSNR channel optimization problem. We incorporate time-delay into the closed loop system for the multi-source single-link case. Sufficient conditions for stability are derived based on a tuning parameter in the control algorithm. The work utilizes singular perturbation theory and Lyapunov-Razumikhin time-delay techniques. We also include simulations based on realistic network parameters.

17:30-17:50 MoC14.4

Dynamic Network Utility Maximization with Delivery Contracts, pp. 2907-2912

Trichakis, Nikolaos — Massachusetts Inst. of Tech.
Zymnis, Argyrios — Stanford Univ.
Boyd, Stephen P. — Stanford Univ.

We consider a multi-period variation on the network utility maximization problem that includes delivery constraints. We allow the flow utilities, link capacities and routing matrices to vary over time, and we introduce the concept of delivery contracts, which couple the flow rates across time. We describe a distributed algorithm, based on dual decomposition, that solves this problem when all data is known ahead of time. We briefly describe a heuristic, based on model predictive control, for approximately solving a variation on the problem, in which the data are not known ahead of time. The formulation and algorithms are illustrated with numerical examples.

17:50-18:10 MoC14.5

Global Stability Analysis of Primal Internet Congestion Control Schemes with Heterogeneous Delays, pp. 2913-2918

Papachristodoulou, Antonis — Univ. of Oxford
Peet, Matthew M — INRIA - Rocquencourt

The aim of network congestion control for the Internet is to allocate the available bandwidth to the users in a scalable, efficient, fair and distributed fashion. This paper is concerned with the stability properties of a class of such schemes in the presence of heterogeneous delays. In particular, we present a time-domain methodology for scalable, global stability analysis of primal network congestion control schemes for the Internet. The conditions we obtain are delay-dependent and are similar to the ones that were obtained previously based on the analysis of the linearized system. The structure of the dynamics for the sources and links allows the construction of appropriate Lyapunov certificates in a scalable way.

18:10-18:30 MoC14.6

A Novel AQM Scheme for Wireless Networks with BER Estimation, pp. 2919-2924

Wen, Tingting — Univ. of Manchester
Chen, Cailian — The Univ. of Manchester
Ding, Zhengtao — The Univ. of Manchester
Yang, T. C. — Univ. of Sussex

A novel active queue management(AQM) scheme is proposed to deal with the performance degradation of TCP in wireless scenario. One of the key sources causing performance degradation is the high bit error rate(BER), which is an intrinsic link characteristic of wireless network. A high-gain observer is constructed to estimate the effect of bit error of source data. With the estimated BER, the drop probability of queuing packets can be adapted to time-varying link conditions and network loads so that it reduces the queue oscillation and maintains good throughput. Simulation results show that the proposed scheme outperforms RED(Random Early Detection) algorithm with strong robustness to time-varying scenarios of wireless networks.

MoC15 317

Greenhouses and Controlled Agricultural Production (Regular Session)

Chair: Camacho, Eduardo — Univ. of Seville
Co-Chair: van Straten, G — Wageningen Univ.

16:30-16:50 MoC15.1

A Volterra Model of the Greenhouse Temperature Using Natural Ventilation, pp. 2925-2930

Gruber, Jorn Klaas — Univ. de Sevilla
Rodríguez-Díaz, Francisco — Univ. of Almería
Bordons, Carlos — Univ. de Sevilla
Guzman, Jose Luis — Univ. of Almeria
Berenguel, Manuel — Univ. of Almeria
Camacho, Eduardo — Univ. of Seville

Model-based control techniques are commonly applied to control the greenhouse climate. As well-known, these techniques require accurate models for adequate results. Several first-principle models have been developed for the greenhouse climate control problem considering all the physical and physiological processes. However, these models are too complex to be used for control purposes. On the other hand, empirical models based on input/output real data allow to obtain better results and less complex model structures. In the Mediterranean areas the main problem is cooling the greenhouse and this leads to natural ventilation as a standard tool.

This paper presents the development and the results of a Volterra model for the greenhouse temperature including the crop effect and using natural ventilation.

16:50-17:10 MoC15.2

Effect of Innaccurate Measurements on Energy Consumption in Greenhouse Horticulture, pp. 2931-2936

Bontsema, Jan — Wageningen Univ. and Res. Centre
Gieling, Theo H. — Wageningen Univ. and Res. Centre
Kornet, Jan George — Wageningen Univ. and Res. Centre
Swinkels, Gert-Jan — Wageningen Univ. and Res. Centre
Van Henten, Eldert Jan — Wageningen Univ.

The influence of inaccurate sensors, used in practice in greenhouse climate control, on the energy consumption of greenhouse horticultural production is investigated. It is shown that the inaccuracy of sensors, caused for instance by improper maintenance, leads to a higher energy use.

17:10-17:30 MoC15.3

Discrete Model Based Greenhouse Environmental Control Using the Branch & Bound Algorithm, pp. 2937-2943

Ferreira, Pedro — Unilever R&D Port Sunlight
Ruano, Antonio — Univ. of Algarve

In this paper we propose the application of the Branch-and-Bound search algorithm to discrete model-based predictive control of greenhouses. The temperature control strategy is a mixture of temperature integration and difference between day and night temperatures. The general approach is presented and strategies are proposed in order to achieve a faster coverage of the solutions search space with reduced probability of loosing the optimal solution. The control energy requirements depend largely on the cost function coefficients and the evolution of the external climate. Fixed coefficients do not fully exploit the external climate predicted evolution in order to reduce energy consumption. A simple method is proposed to adapt on-line the cost function coefficients in a way that reduces energy consumption without significantly affecting control accuracy. The methods are briefly described and a subset of experimental and simulation results are presented.

17:30-17:50 MoC15.4

On Evaluating Optimality Losses of Greenhouse Climate Controllers, pp. 2944-2949

van Straten, G — Wageningen Univ.
Van Willigenburg, L.G. — Wageningen Univ.

Optimal operation strategies for greenhouse crop cultivation can be computed with open loop dynamic optimization. These solutions are obtained off-line, and are valid under nominal weather conditions only. On-line, feed-back control is needed to cope with deviations from the nominal weather. One of the issues in practical control is how to link the off-line nominal solution to on-line control. One option is to use a receding horizon controller with the same goal function as used off-line, but enhanced with a term based on the co-state of the slow crop states to encapsulate the long term goals. Loss measures are introduced to evaluate this solution against various other approximate solutions proposed in the literature. To our knowledge this is the first time that various sub-optimal solutions are clearly listed and analysed. A simplified, but transparent, example is used to illustrate the various losses. One of the results is that receding horizon optimal control with an adapted goal function is superior to other more common control solutions.

17:50-18:10 MoC15.5

Intelligent Irrigation in Grapevines: A Way to Obtain Different Wine Characteristics, pp. 2950-2955

Capraro, Flavio — Univ. Nacional de San Juan (UNSJ)
Schugurensky, Carlos — Univ. Nacional de San Juan
Vita, Facundo — INTA San Juan
Tosetti, Santiago — Univ. Nacional de San Juan
Lage, Andres — Univ. Nac. San Juan
Patino, H. Daniel — Univ. Nacional de San Juan

This work presents the field implementation of an intelligent irrigation controller, applied to grapevine crops. The proposed irrigation system includes the moisture measurements and the development of an intelligent control system, in order to maintain the moisture level around a set value. Moisture reference value for different irrigation treatments, such as water stress or field capacity, is decided by the user according to the desired enological grape quality. This technology is an appropriate tool for crops managing and, in addition helps to overcome difficulties imposed by a growing water demand and to reduce extraction costs.

18:10-18:30 MoC15.6

Water Irrigation Control for Sunagoke Moss Using Intelligent Image Analysis, pp. 2956-2961

Hendrawan, Yusuf — Osaka Prefecture Univ. Japan, GraduateSchoolofLifeandEnvir

A novel technique suitable for noninvasive measurements of moss water content is presented. In this paper, colour image sensing is applied for measuring moss water content. Sunagoke moss *Rhacomitrium canescens* has been utilized as an active greening material to mitigate the urban heat island effect. The goal of this paper is to develop an intelligent image analysis system for water irrigation optimal control in Sunagoke moss. The combination of RGB components (green:red ratio, blue index, blue value and green index) using statistical pattern recognition can estimate water content and define the distribution of water condition in every pixel of Sunagoke moss images. The combination of colour image sensing and Artificial Neural Network (ANN) successfully described the relationship between water content and colour features i.e. average green index, average blue index, blue mean value, browning area index, green canopy index and average green:red ratio. This system is helpful to explore a new way of water spraying in Sunagoke moss plant factories based on computer vision. We propose a water irrigation technology of plant factory to realize the automation and precision farming. Precision water spraying system based on computer vision is important, not only for spraying the water scientifically, but also for improving the efficiency of spraying and decreasing the non- or off-target spraying to prevent over watering.

MoC16 316

Economic and Management Systems III (Regular Session)

Chair: Andreeski, Cvetko — Faculty of Tourism and Hospitality
Co-Chair: Goubko, Mikhail — Inst. of Control Sciences of Russian Acad. of Sciences

16:30-16:50 MoC16.1

Optimal Hierarchies in Firms: A Theoretical Model, pp. 2962-2967

Goubko, Mikhail — Inst. of Control Sciences of Russian Acad. of Sciences
Mishin, Sergey — Inst. of Control Sciences of Russian Acad. of Sciences

A normative economic model of management hierarchy design in firms is proposed. We seek for the management hierarchy that minimizes the running costs. Along with direct maintenance expenses these costs include wastes from the loss of control. The results include analytic expressions for the optimal hierarchy attributes: span of control, headcount, efforts distribution, wages differential, etc, as functions of exogenous parameters. They are used to analyze the impact of environment parameters on a firm's size, financial results, employees' wages and shape of hierarchy. The detailed analysis of this impact can help draw up policy recommendations on rational bureaucracy formation in firms.

16:50-17:10 MoC16.2

Combined Gesture-Speech Recognition and Synthesis Using Neural Networks, pp. 2968-2973

Roncancio, Catalina — CARTIF
Gomez Garcia-Bermejo, Jaime — CARTIF Foudation
Zalama, Eduardo — Fundación Cartif

Sign languages such as Spanish Sign Language (LSE) are the primary communication way among members of the Deaf community. However this language is not widely known outside of this community. The techniques for automatic recognizing hand signs proposed in this paper allow creating systems which can help deaf people to communicate with others, by providing them with computer tools for assisted communication or potentially with a fully automatic portable sign-language-to-speech translation system. The aim of this research it to implement a self-organizing neural network based technique for hand sign recognition, using self organizing map (SOM) and learning vector quantization (LVQ) based algorithms. The two classifiers are then combined to make the final decision. SOM and LVQ classifiers are training for the 26 signs of the manual alphabet and the speech synthesizer concatenate the different phones, diphones and triphones stored in the database to generate the right words in artificial speech. Finally, the system is to contribute to the implementation of meaningful human machine interactions in a workstation, mainly for welfare applications.

17:10-17:30 MoC16.3

Leadership Approach for Managing in Distributed Team, pp. 2974-2979

Koednok, Sukumarl — Vongchavalitkul Univ.

This article reported on the working process of a distributed team and the leadership approach for managing a distributed team. The objective of this Article is to demonstrate how to manage a distributed team to achieve the operational excellence. The discussion focused on the capability of many organizations to allow a distributed team working in their organizations to achieve the highest benefit. However, method to overcome the barrier that occurs when working in distributed team is more challenging. For a better understanding of this model, the article also provided good examples of distributed team effective models of famous organizations. The leadership styles that are identified in this article are applied from transformational leadership theories, which are the key success factors in terms of managing distributed team. There are six steps that would be helpful for managing distributed team, which are strategically selecting team members, developing a vision in order to manage each location in the same directional goals, developing commitment and trust, creating organizational leadership by building empowered teams and facilitating organizational learning and evaluating team performance and reselecting team members in case that problems can not be solved. Finally, there are other recommendations that were provided in this article to assist the leader to increase the efficiency and effectiveness in managing a distributed team to get the maximum benefit of it.

17:30-17:50 MoC16.4

Simplified Azbel Model for Fitting Mortality Tables (I), pp. 2980-2983

Andreeski, Cvetko — Faculty of Tourism and Hospitality
Vasant, Pandian — Univ. Tech. Petronas

Since the 1825 there is Gompertz mortality function for estimation of mortality data. All the attempts of finding appropriate mortality function lead to functions that are not easy to fit with the actual mortality data. The most recent researches (Azbel) offer simple function for fit mortality tables. Common characteristic of all these functions are difficulty of fitting data. We need to use numerical approach to find the appropriate values of function parameters to fit the function to the mortality data. In this paper we suggest simplified Azbel model which offers more simple technique of fitting data, the well known maximum likelihood estimator. This function is simplified to one parameter function and offers fitting data with one equation.

17:50-18:10 MoC16.5

Quality Based Model for Reverse Logistics: A KM View, pp. 2984-2989

Wadhwa, S — Indian Inst. of Tech. New Delhi
Madaan, Jitendra — Indian Inst. of Tech. New Delhi

Reverse Logistics comprises of all operations and decision making related to the reverse-flow of used products from customers to the manufacturers. It involves reuse of used products, remanufacturing or recycling, surplus inventory and packaging materials based on their configuration as well as condition. Excellent literature, related to quality modeling has been available for many years. A lot of discussion has taken place extolling the virtues of flexibility and its effect on the overall successful operation of enterprises. Considering in its generic form, quality based modeling can be applied to develop it as a flexible product recovery system. This paper examines the feasibility and practicality of applying a quality based self-assessment approach with a focus on flexibility for reverse logistic system improvements .It suggests that demonstration simulation models can play an important role in sharing the flexible work flow structures and the improvements in them. It is proposed that self-assessment based quality models to be developed to promote flexibility related issues, while dealing with the reverse logistics problems. One such model is presented and discussed in this paper.

MoC17 320A

Recent Automation Technologies in Shipbuilding Industry I
(Highlight Session)

Chair: Kim, Jae-Hoon — Samsung Heavy Industries
Co-Chair: Park, Youngjun — Samsung Haevy Industries, Co., Ltd.
Organizer: Kim, Jae-Hoon — Samsung Heavy Industries
Organizer: Park, Youngjun — Samsung Haevy Industries, Co., Ltd.

16:30-16:50 MoC17.1

Study of the Spray Gun Trajectory for Inner Hull Block Structures (I), pp. 2990-2991

Kim, Sangwhee — Samsung Heavy Industry
Park, Youngjun — Samsung Haevy Industries, Co., Ltd.
Eun, Jong-Ho — Samsung Heavy Industry

Manual spray painting application has limitations and problems causing irregular film thickness coverage that reworking process must be repeated until the quality requirements are fully satisfied. This problem directly impacts with the service life of the ship. It has been concluded that the painting automation is the definite solution to solve the problem, because it can provide with consistent performance of paint film thickness. In this paper, an effective spray gun trajectory generation minimizing the relative film thickness variations, calculating method of optimizing the number of painting strokes, confined area corner painting method considering the dynamics effects of the painting system, and maximizing the production rates are discussed.

16:50-17:10 MoC17.2

A Study on Operating Strategy for Automated Painting System in Inner Double Hull Blocks (I), pp. 2992-2995

Kim, Byung-Su — Samsung Heavy Industries co.,Ltd
Park, Youngjun — Samsung Haevy Industries, Co., Ltd.
Eun, Jong-Ho — Samsung Heavy Industry

The demand for automation in the shipbuilding industry is increasing continuously, as a result of which so much production automation equipment has been developed in various processes. For example, fields such as welding and cutting have been researched and developed extensively. However, in the case of painting process, it has not been given much attention. So through this paper we intend to propose what we have to do and how communication must be initiated and efficiently used among the sub-modules of a monitoring and operating system used for automated painting systems in inner double hull blocks.

17:10-17:30 MoC17.3

The State of the Sprayed Paint Measuring System: Through Monitoring the Spray Cone Profile (I), pp. 2996-2997

Kim, Joon kil — Samsung Heavy Industry
Kim, Sangwhee — Samsung Heavy Industry
Ji, Sang gi — Samsung Heavy Industry.Co.Ltd
Park, Youngjun — Samsung Haevy Industries, Co., Ltd.

The automation of painting process in shipbuilding is arisen as vital issue because of the insufficiency of painting workers and frequent quality claims. The increase of the painting quality is the main achievement made by the automation of the painting process. In order to maintain the good painting quality, even though the spray depth, angle and velocity are considered principally, measuring the state of the sprayed paint is as important as above parameters. In this paper, the system which measures the state of the sprayed paint through monitoring the spray profile to use the laser diode and vision sensor is proposed for the increase of the painting quality. To apply this system at the preparation of the painting, we expect to not only increase of the accuracy of the thickness but also calculate the adjustment amount of CPS data if the measuring results do not equal to the predetermined spray profile.

17:30-17:50 MoC17.4

Development of Semi-Automatic Painting System for Longitudinal Stiffeners in Double Hull Blocks (I), pp. 2998-3003

Lee, Dong Hoon — stx shipbuilding co.,ltd.
Kim, Ho Kyeong — stx shipbuilding co.,ltd.
Lim, Rae Soo — stx shipbuilding co.,ltd.
Kim, Eun Tae — stx shipbuilding co.,ltd.

Leem, Hyo Kwan STX shipbuilding

Painting works in double hull blocks are very difficult and dangerous because working space is isolated and narrow. The structure in double hull blocks is too complex to apply automatic painting equipments. For these reasons, every shipyard still applies manual painting process which causes delay in ship construction and low quality. Therefore, the purpose of this study is to develop the semi-automatic painting system inside double hull blocks. It consists of two main equipments. One is the semi-automatic painting machine to paint structure members inside double hull blocks and the other is the supplement machine to install and move the former. By applying the developed system, productivity and painting quality can be increased and workmen's accident and injuries can be reduced.

17:50-18:10 MoC17.5

Design of a Four Legged Parallel Walking Robot to Go through a Narrow Hole (I), pp. 3004-3008

Park, Kun-Woo Changwon Nat'l Univ.

This paper designs a four legged parallel walking robot to go through a narrow hole. Topology design is conducted for a leg mechanism composed of four legs, base and ground, which constitute a redundant parallel mechanism. This mechanism is subdivided into four sub-mechanism composed of three legs. A motor vector is adopted to determine the 6x8 Jacobian of the redundant parallel mechanism and the 6x6 Jacobian of the sub-mechanisms, respectively. The condition number of the Jacobian matrix is used as an index to measure a dexterity. We analyze the condition numbers of the Jacobian over the positional and orientational walking space. The analysis shows that a sub-mechanism has lots of singularities within workspace but they are removed by a redundant parallel mechanism improving a dexterity. From the results, we can propose a parallel typed walking robot to enlarge walking space and stability region. The robot is designed by inserting an intermediate mechanism between upper and lower leg mechanisms. The robot is reasonably small so that it can go through a narrow hole.

18:10-18:30 MoC17.6

Environment Measurement and Object Recognition for Autonomous Mobile Robot's Navigation in Automated Shipbuilding (I), pp. 3009-3010

Hong, Jin IL Samsung Heavy Industry.Co.Ltd
Lee, Hyunki KAIST
Park, Youngjun Samsung Haevy Industries, Co., Ltd.

Nowadays many parts of shipbuilding process are automated, but the painting process is not, because of the difficulty of automated on-line painting quality measurement, harsh painting environment and the difficulty of robot navigation. However, the painting automation is necessary, because it can provide consistent performance of painting film thickness. Furthermore, autonomous mobile robots are strongly required for flexible painting work. However, the main problem of autonomous mobile robot's navigation is that there are many obstacles which are not expressed in the CAD data. To overcome this problem, environment measurement, obstacle detection and recognition are necessary. In this paper the environment measurement and object recognition algorithms are introduced in shipbuilding process.

MoC18 320B

Recent Development of Intelligent Robots II: Mobility (Highlight Session)

Chair: Park, Sangdeok Korea Inst. of Industrial Tech. (KITECH)
Co-Chair: So, ByungRok Korea Inst. of Industrial Tech. (KITECH)

16:30-16:50 MoC18.1

Biomimetic Locomotion Control of a Quadruped Walking Robot (I), pp. 3011-3016

Choi, Hyoukryeol Sungkyunkwan Univ.
Koo, Igmo Sungkyunkwan Univ.
Kang, Tae Hun Phohang Inst. of Intelligent Robotics
Vo, GiaLoc Sungkyunkwan Univ.
Trong, Tran Duc Sungkyunkwan Univ.
Song, Young Kuk Sungkyunkwan Univ.

In this paper, a new biomimetic control method for a quadruped walking robot is proposed. The method is derived by the observation of the gravity load receptor and stimulus-reaction mechanism of quadrupeds' locomotion, and the study of the stances on walking and energy efficiency. Though the controller is simple, it provides a useful framework for controlling a quadruped walking robot. In particular, by introducing a new rhythmic pattern generator the heavy computational burden to be paid on solving kinematics is relieved. The effectiveness of the proposed method is validated via a dynamic simulation and experimental works in a quadruped walking robot, called AiDIN(Artificial Digitigrade for Natural Environment).

16:50-17:10 MoC18.2

QuadTrack-II: A Remotely Operated Mobile Robot with Four Articulated Tracks (I), pp. 3017-3020

Choi, Youngsoo Korea Atomic Energey Res. Inst.
Jeong, Kyungmin Korea Atomic Energey Res. Inst.
Seo, Youngchil Korea Atomic Energey Res. Inst.
Lee, Sung-uk Korea Atomic Energy Res. Inst.
Cho, Jaiwan Korea Atomic Energey Res. Inst.
Jung, Seungho Korea Atomic Energey Res. Inst.
Kim, Seungho Korea Atomic Energey Res. Inst.

This paper introduces a remotely operated robotic system being developed for urban search and rescue. QuadTrack-II has four modular track arms which can be driven independently to get a traction force. The modular track arms can also be rotated with respect to their arm axes to lift the body or step over larger obstacles. It has some observation module for gathering information of disaster areas. Inside main body frame, it can carry a small serial multi-linked mobile robot to collapsed areas to find human victims under the rubbles. This paper describes the structures of the robot and some advantages of mobile robotic system with articulated modular tracks and shows some experimental result for various environments.

17:10-17:30 MoC18.3

Foot Trajectory Generation of Hydraulic Quadruped Robots on Uneven Terrain (I), pp. 3021-3026

Kim, HyoungKwon Korea Inst. of Industrial Tech.
Kwon, Ohung Hanyang Univ.
Won, Daehee Korea Inst. of Industrial Tech.
Park, Sangdeok Korea Inst. of Industrial Tech. (KITECH)
Kim, Tae Ju KITECH
Kim, Sang-Seok Div. for Applied Robot Tech. Korea Inst. of Indust

This paper proposes trot pattern generation and online control methods for a legged robot to carry heavy-loads and move fast on the uneven terrain. The trot pattern is generated from the frequency modulated pattern generation method based on the frequency modulated oscillator in order for the legged robots to operate outdoors with the static and dynamic mobility. The efficiency and performance of the proposed are verified through the computer simulation and experiments using qRT-1/-2. In experiments, qRT-2 which is a 2-legged and 2-wheeled robot and a front drive system vehicle with hydraulic linear actuators is used. The robot has trotted gaits at speeds up to 1.3 m/s on the even surface, walked up and down the 20 degree inclines, and walked at 0.7 m/s on the uneven surface. Also it has carried over 100 kg of the total weights including over 40 kg of the payload.

17:30-17:50 MoC18.4

Walking Pattern Generation for Planar Biped Walking Using Q-Learning (I), pp. 3027-3032

Lee, Jungho KAIST
Oh, Jun Ho KAIST

In this research, a stable biped walking pattern is generated using reinforcement learning. The biped walking pattern is chosen as a simple third order polynomial. To complete the walking pattern, four boundary conditions are needed. Initial position and velocity and final position and velocity of the joint are selected as boundary conditions. In order to find the proper boundary condition value, a reinforcement learning algorithm is used. Also, desired motion or posture can be achieved using the initial and final position. The final velocity of the walking pattern is chosen as a learning parameter. To test the algorithm, a simulator that takes into consideration the reaction between the foot of the robot and the ground was developed. The algorithm is verified through a simulation.

17:50-18:10 MoC18.5

Subminiature Surveillance Robots for Socail Safety (I), pp. 3033-3034

Kim, Eun Seok	Convex Co.,Ltd.
Han, Man Gi	Convex Co.,Ltd.
Kim, Hyun Joo	Convex Co.,Ltd.
Yim, Choong Hyuk	Convex Co.,Ltd.
Song, Jae-Bok	Korea Univ.
Kim, Byeong Sang	Korea Univ.

A portable subminiature surveillance robot for social safety is composed of mechanical parts, control parts and interface modules. The robot is able to jump and move on the flat or rough grounds such as a gravelly road, with various interface modules and different functions. It can be used to guard, patrol, search and detect in small, limited or dangerous areas where people or big robots cannot enter. It is also able to be controlled remotely. This study intends to detail the development of each component of the robot, and to look into the future plan and its expected effects.

18:10-18:30 MoC18.6

Educational Robotic Construction Kit: Bioloid (I), pp. 3035-3036

Han, Jea-Kweon	ROROTIS Co., LTD.
Ha, In-Yong	ROBOTIS Co., LTD.
Kim, Byoung-Soo	ROBOTIS Co., LTD.

Bioloid is an educational robotic construction kit for building robots using special modular DC servo blocks. These smart serially controlled servos allow the user to build multiple types of robots such as humanoid, puppy, spider or car. In this paper, we have introduced the concept and contents of Bioloid. It is suitable for both the people who try to study robots without professional backgrounds and who are interested in various area of a robot such as dynamics, vision control or speech recognition. For this reason, we are convinced that it will contribute to development of robot industry.

MoC19 320C

Control of Cooperative, Mobile Minirobots – Robotsoccer

(Invited Session)

Chair: Kopacek, Peter	Vienna Univ. of Tech.
Co-Chair: Han, Man-Wook	Vienna Univ. of Tech.
Organizer: Han, Man-Wook	Vienna Univ. of Tech.
Organizer: Kopacek, Peter	Vienna Univ. of Tech.

16:30-16:50 MoC19.1

Robotsoccer (I), pp. 3037-3041

Kopacek, Peter	Vienna Univ. of Tech.

Robot soccer was introduced with the purpose to develop intelligent cooperative multi-robot (agents) systems (MAS). From the scientific point of view a soccer robot is an intelligent, autonomous agent, carrying out tasks together with other agents in a cooperative, coordinated and communicative way. Robot soccer provides a good opportunity to implement and test MAS algorithms for current and future industrial applications. Generally robot soccer is a good test bed for the development of MAS. The robots in a team have a common goal – to kick the ball in the opponent goal and to avoid goals against the own team. The cooperation and coordination of actions by means of communication are necessary. In this paper the development of three generations of mini robots for robot soccer, in the FIRA categories Miro- and Narosot, are described. Finally some industrial applications as a “spin-off” of robot soccer are shortly presented.

16:50-17:10 MoC19.2

Humanoid Robot System, HanSaRam-VII for RoboMarathon in HuroCup (I), pp. 3042-3047

Yoo, Jeong-Ki	Korea Advanced Inst. of Science and Tech.
Kim, Yong-Duk	Korea Advanced Inst. of Science and Tech. (KAIST)
Lee, Bum-Joo	Korea Advanced Inst. of Science and Tech.
Park, In-Won	Korea Advanced Inst. of Science and Tech.
Kim, Jong-Hwan	Korea Advanced Inst. of Science and Tech.

This paper presents the recent development of small-sized humanoid robot, HSR (HanSaRam)-VII, which is developed to participate in HuroCup which is one of the game categories of FIRA (www.FIRA.net). As HuroCup is composed of seven kinds of competitions, humanoid robots participating in this league have to be capable of various tasks such as weight lifting, basketball, marathon, etc. HSR-VII is designed to have high degrees of freedom, distributed planner-reactor architecture using PDA and embedded computer. This distributed control architecture includes vision processing, navigation and on-line walking pattern generation algorithm. In addition, time-domain passivity control algorithm is introduced to guarantee the stable walking pattern generation. The performance of the system is demonstrated through the RoboMarathon.

17:10-17:30 MoC19.3

Active Balancing Reflexes for Small Humanoid Robots (I), pp. 3048-3053

McGrath, Sara	Univ. of Manitoba
Baltes, Jacky	Univ. of Manitoba
Anderson, John E	Univ. of Manitoba

This paper describes three balancing-reflex algorithms (threshold control, PID control, and hybrid control) that were implemented on a real 8 DOF small humanoid robot equipped with a two-axis accelerometer sensor. We term our approach a model-free approach, since it does not require a mathematical model of the underlying robot. Instead the controller attempts to recreate successful previous motions (so-called baseline motions). In our extensive tests, the basic threshold algorithm proves the most effective overall. All algorithms are able to balance for simple tasks, but as the balancing required becomes more complex (ie, controlling multiple joints over uneven terrain), the need for more sophisticated algorithms becomes apparent.

17:30-17:50 MoC19.4

Towards MiroSot Robots with PFGA and DSP-Based Image Processing On-Board (I), pp. 3054-3058

Jesse, Norbert	Univ. of Dortmund

Fast self-location and collision-free navigation is a crucial pre-requisite for autonomous robots in real-world environments. Usually robots are equipped with a variety of sensors, but for obvious reasons vision systems are by far the most informative and reliable source for object location and path planning. In this paper, we present a new DSP- and FPGA-based image processing system for FIRA MiroSot robots endowed with 4 local VGA cameras. The use of FPGAs to link and pre-process camera data allows an enormous flexibility with regard to the number and type of cameras used. This kind of miniaturization for a processing system, as well as the low cost of components, can open new applications for image processing systems.

17:50-18:10 MoC19.5

Quantitative Comparison of Color Systems for Robot Soccer Applications (I), pp. 3059-3064

Weiss, Norman	Vienna Univ. of Tech.
Jesse, Norbert	Univ. of Dortmund

Robot soccer has evolved into a very dynamic and competitive field within the last few years, many different robot soccer leagues now exist. Most of the leagues rely on computer vision in one form or another to gather information about the game situation – the position of a team's robots, the position of the opponent's robots and the ball. While some problems robot soccer vision posed have been solved in the last few years, many still exist. One of the most notable current problems is robot vision systems capable of coping with (potentially sudden) lighting changes. In this work, we will deal with one aspect of all vision systems that has a major impact on their performance: the choice of color system. This work aims at a quantitative comparison of color systems with focus on applications in robot soccer vision. We will evaluate the power of the color systems in question regarding color recognition and color discrimination as well as their behavior in changing lighting conditions.

18:10-18:30 MoC19.6

Control of a Humanoid Robot Based on the ZMP Method (I), pp. 3065-3069

Han, Man-Wook	Vienna Univ. of Tech.
Timofte, Gabriel	Tech. Univ. “Gheorghe Asachi”, Romania

Many biped walking robots are already introduced. Intelligent Handling and Robotics – IHRT at the Vienna University started developing a humanoid robot, which can be used as a servant at home. One part of the research works deals with the development of a method for controlling the stability of a biped robot in the stationary state based on the well known ZMP. This paper describes the control method of the angular momentum of walking robots through the manipulation of the zero moment point (ZMP).

MoC20 321C
Latest Development in Mobile Machines (Invited Session)

Chair: Chen, Xiaoqi	Univ. of Canterbury
Co-Chair: Virk, Gurvinder	Massey Univ.
Organizer: Chen, Xiaoqi	Univ. of Canterbury
Organizer: Virk, Gurvinder	Massey Univ.

16:30-16:50 MoC20.1
Unmanned Marine Vehicles at CNR-ISSIA (I), pp. 3070-3075
Caccia, Massimo — CNR-ISSIA

This paper discusses the requirements, design and operational aspects of the Unmanned Marine Vehicles (UMVs), namely the Romeo Remotely Operated Vehicle (ROV) and the Charlie Unmanned Surface Vehicle (USV), developed at CNR-ISSIA, Genova, Italy for robotics research and scientiŽc applications, pointing out the synergies between the development of underwater and surface unmanned vehicles.

16:50-17:10 MoC20.2
System Identification and Modelling of Front Wheel Drive Electric Wheelchairs (I), pp. 3076-3081

Chen, Xiaoqi	Univ. of Canterbury
Chase, J. Geoffrey	Univ. of Canterbury
Patrick, Wolm	Univ. of Canterbury

A wireless data acquisition and control platform has been developed to model electric powered wheelchairs. The test-bed integrates sensors, embedded controller, and the motorised mechanical system. Real time data acquisition and analysis is performed in dSpace. The motion control is executed via RS232 Bluetooth and Radio-Control receiver. Test procedures have been designed to find parameters of the wheelchairs, including centre of gravity, moment of inertia, and electric constants. These parameters can then be used in dynamics modeling. Both kinematics model and force model of the wheelchair have been established, using Simulink as a platform to derive the model. The developed experimental setup not only facilitates system identification and modelling of motorised wheelchairs, and wheeled mobile robots in general; but also serves as an excellent case study for mechatronics and control design.

17:10-17:30 MoC20.3
Analysis and Implementation of Swimming Backward for Biomimetic Carangiform Robot Fish (I), pp. 3082-3086

Zhou, Chao	Inst. of Automation,Chinese Acad. of Sciences
Nahanvandi, Saeid	Deakin Univ.
Gu, Nong	Deakin Univ.
Cao, Zhiqiang	Inst. of Automation,Chinese Acad. of Sciences
Wang, Shuo	Chinese Acad. of Sciences
Tan, Min	Inst. of Automation, Chinese Acad. of Sciences

The swimming backward for biomimetic carangiform robot fish is analyzed and implemented in this paper. The swimming law of the carangiform robot fish is modified according to the European Eel swimming mode based on the multiple-link structure to implement the backward motion. The motion mode difference between the eel and carangiform fish is discussed, and a qualitative kinematic analysis of the carangiform swimming in water is given to analyze the propulsion produced by the undulation of the multi-links tail. The experiments conducted demonstrate the good performance of the proposed method, and the results are given.

17:30-17:50 MoC20.4
Dynamic Target Tracking Control for a Wheeled Mobile Robots Constrained by Limited Inputs (I), pp. 3087-3091

Huang, Loulin	Massey Univ.
Tang, Liqiong	Massey Univ.

This paper focuses on the controller design for a wheeled mobile robot to track a moving target when its control inputs (linear and angular velocities) are limited. This issue is significant in practice, as the unpredicted target motions may cause the control actions beyond the robot's capability. In the paper, after the system model is formulated in a form suitable for the controller design, a Lyapunov function considering the limits of the robot's control efforts into consideration is proposed. A control law setting the robot's linear and angular velocities is then obtained. The conditions for asymptotic target tracking by the robot are also established. Simulation results are provided to verify the effectiveness of the approach.

17:50-18:10 MoC20.5
Constrained Control Allocation for Linear Systems with Internal Dynamics (I), pp. 3092-3097

Liao, Fang	National Univ. of Singapore
Lum, Kai-Yew	National Univ. of Singapore
Wang, Jian Liang	Nanyang Tech. Univ.

This paper presents a new control allocation design method for overactuated linear systems with internal dynamics and input constraints. The control inputs are designed to implement constrained control allocation and guaranteed stability of the closed-loop system. An LMI-based sufficient condition is provided to solve the control allocation problem. The proposed approach is demonstrated by a linear tailless aircraft model.

18:10-18:30 MoC20.6
Mobile Robotic Issues for Urban Search and Rescue (I), pp. 3098-3103

Virk, Gurvinder	Massey Univ.
Gatsoulis, Yiannis	Univ. of Leeds
Parack, Muddassir	Biogene Ltd
Kherada, Afsha	Biogene Ltd

The paper considers three important issues in the design and utilisation of teleoperated urban search and rescue robot systems, namely localisation, locomotion and human-robot interfaces. Prototype systems are designed, developed and presented. For the localisation aspects a cost effective infrared beacon based system is presented for 2D applications. For the locomotion aspects a four-limbed adaptive articulated tracked vehicle is presented having the capability of changing its mode of operation to overcome large obstacles and move effectively in unstructured environments. For the human-robot interaction aspects, key user-centric metrics are proposed and investigated to assess the effect on overall system performance. The metrics considered are situation awareness, tele-presence and workload. Experimental results for all three aspects are presented.

MoC21 321B
Servo Control for Storage Systems and Precision Devices III (Invited Session)

Chair: Yamaguchi, Takashi	Hitachi Global Storage Tech.
Co-Chair: Hori, Yoichi	Univ. of Tokyo
Organizer: Yamaguchi, Takashi	Hitachi Global Storage Tech.

16:30-16:50 MoC21.1
Time-Varying Compensation for Mid-Frequency Repeatable Runout in Hard Disk Drives Via a Linear Feedback Scheme (I), pp. 3104-3109

Thum, Chin Kwan	A*STAR Data Storage Inst.
Du, Chunling	Data Storage Inst.
Chen, Ben M.	National Univ. of Singapore
Ong, Eng Hong	A*STAR Data Storage Inst.
Tan, Kim Piew	A*STAR Data Storage Inst.

Conventional add-on feedback filters for mid-frequency (mid-f) repeatable runout (RRO) compensation in a hard disk drive (HDD) servo system either have a long filter transient or constitute a large sensitivity hump and poor stability margins. This paper presents a novel linear time-varying (LTV) group filtering scheme for the compensation of a few mid-f RRO harmonics. While having a short filter transient that ensures a fast disturbance attenuation, the proposed group filter does not cause any substantial unnecessary sensitivity function gain amplification at the steady state. Implementation results show the effectiveness of the proposed scheme used to compensate two mid-f RRO harmonics simultaneously.

16:50-17:10 MoC21.2
Robust and Quick Response Tracking Servo System for High Rotational Speed Optical Disk System (I), pp. 3110-3115
Ohishi, Kiyoshi — Nagaoka Univ. of Tech.

Miyazaki, Toshimasa — Nagaoka National Coll. of Tech.
Yoshida, Yasuharu — Nagaoka Univ. of Tech.
Kamigaki, Yoshiya — Nagaoka Univ. of Tech.
Koide, Daiichi — JAPAN BROADCASTING Corp.
Tokumaru, Haruki — JAPAN BROADCASTING Corp.

Generally, tracking control for optical disk system is accomplished by the feedback control designed by using PID control, repetitive control and so on. However, it is difficult to reduce the tracking error on condition of high disk rotation speed. In the near future, the disk rotation speed of the optical disk system becomes higher than 10000[rpm]. Therefore, the tracking servo system for optical disk system must have the new structure and highly performance. This paper proposes a new free parameter and desgin method of feedback servo system, which suppresses the high speed periodic disturbance. It has the widebandwidth and high gaim margin. Moreover, in order to suppress this periodic disturbance, this paper proposes a new control structure of robust feedforward servo system, which includes the prediction of tracking error, a new design method of disturbance observer and the zero error phase tracking control. The experimental results point out that the proposed system well regulates the high precision tracking servo control on condition of the disk rotation speed 8000[rpm], which is equal to CD system of 40 X speed.

17:10-17:30 MoC21.3

High-Gain Servo Controller for Optical Disk Drives and the Initial Value Compensation (I), pp. 3116-3117

Urakawa, Yoshiyuki — Sony Corp.
Yuichi, Suzuki — SONY

As optical disks are removable and have some distortions, servo systems of optical disk drives must be robust, especially at low frequency. We proposed the high-gain servo controller with complex zeros, which is the same 2nd order controller as conventional controllers, and realizes a much higher gain at low frequency. Decrease of servo error was confirmed, but the controller increased overshoot of initial value responses. We also proposed applying the initial value compensation to suppress the overshoot.

17:30-17:50 MoC21.4

Active Tape Steering Control System (I), pp. 3118-3123

Xia, Lu — Carnegie Mellon Univ.
Messner, William — Carnegie Mellon Univ.

Lateral tape motion (LTM) in tape drives hinders accurate servo head positioning and can cause damage to the tape. It is one of the major obstacles to developing high density, high performance tape drives.This paper presents the development an active tape steering system to reduce LTM. A robust controller is designed using the Robust Bode (RBode) Plot, which translates an robust performance criterion into boundary functions on the open-loop Bode plot of a compensated SISO system. With the RBode plot robust controllers can be directly synthesized with classical loop shaping.

17:50-18:10 MoC21.5

Positioning of Large-Scale High-Precision Stage with Vibration Suppression PTC (I), pp. 3124-3129

Sakata, Koichi — Yokohama National Univ.
Fujimoto, Hiroshi — Yokohama National Univ.
Saiki, Kazuaki — Nikon Corp.

In the positioning system of the large-scale high-precision stage, the primary resonance mode appears in low frequency even in the high stiffness stage. The resonance mode is a major obstacle of fast and precise positioning. In this paper, we apply vibration suppression PTC (Perfect Tracking Control) which can control the resonance mode actively on the large- scale stage. Finally, simulations and experiments are performed to show the advantages of the vibration suppression PTC.

18:10-18:30 MoC21.6

Nano-Positioning of an Electromagnetic Scanner with a MEMS Capacitive Sensor (I), pp. 3130-3135

Huang, Xinghui — Seagate Tech.
Lee, Ju-Il — Seagate Res.
Ramakrishnan, Narayanan — Seagate Tech.
Bedillion, Mark — Seagate Tech.
Chu, Patrick B. — Seagate Tech.

This paper presents the control design and experimentation of a prototype electromagnetic scanner with an integrated capacitive linear and rotational position sensor for small form factor probe storage. An array of probe heads is to be precisely positioned in X/Y linear and rotation directions so that high areal density (>1 terabit/in^2) and high data throughput can be achieved. The scanner has X/Y motion capabilities with a linear stroke of about 300 um. It can also generate rotational motion with offset actuators to compensate for disturbances, mechanical tolerance and nonlinearities. System characterization, modeling, MIMO control design and simulation, and preliminary experimental results are presented. The feasibility of rotation control with the developed capacitive sensor and offset actuators is experimentally confirmed.

MoC22 321A

Control of Mechanical Systems (Regular Session)

Chair: Fradkov, Alexander L. — Acad. of Sciences of Russia
Co-Chair: Chang, Dong Eui — Univ. of Waterloo

16:30-16:50 MoC22.1

Control of Wave Motion in the Chain of Pendulums, pp. 3136-3141

Fradkov, Alexander L. — Acad. of Sciences of Russia
Andrievsky, Boris — Inst. for Problems of Mechanical Engin.

The problem of controlled excitation of oscillations in a chain of N coupled pendulums is considered. Such a problem may arise when studying different physical and mechanical systems and is also of interest for design of prospective laboratory equipment for control education. The simulation results for the chain of 50 pendulums are given. The multi-pendulum mechatronic setup from 50 computer-controlled coupled pendulums, developed in the IPME RAS, Saint Petersburg, is presented.

16:50-17:10 MoC22.2

Control of Interconnected Mechanical Systems, pp. 3142-3147

Sabanovic, Asif — Sabanci Univ.
Sabanovic, Nadira — Sabanci Univ.
Ohnishi, Kouhei — Keio Univ.

In this paper control systems design approach, based on siding mode methods, that allows maintain some functional relation – like bilateral or multilateral systems, establishment of virtual relation among mobile robots or control of haptic systems - is presented. It is shown that all basic motion control problems - trajectory tracking, force control, hybrid position/force control scheme and the impedance control for the interacting systems- can be treated in the same way while avoiding the structural change of the controller and guarantying stable behavior of the system In order to show applicability of the proposed techniques simulation and experimental results for high precision systems in microsystems assembly tasks are presented..

17:10-17:30 MoC22.3

Jet-Scheduling Control for SpiderCrane: Experimental Results (I), pp. 3148-3154

Buccieri, Davide — Ec. Pol. Fed. de Lausanne
Salzmann, Christophe — Ec. Pol. Fédérale de Lausanne
Muellhaupt, Philippe — Ec. Pol. Fed. de Lausanne
Bonvin, Dominique — EPFL

SpiderCrane is a three-dimensional crane, whose main particularity lies in the absence of large inertial moving parts. This paper presents experimental results obtained with the novel jet-scheduling control methodology that is based on differential flatness. Jet scheduling consists essentially in using measurements to regenerate the derivatives associated with a reference trajectory. Through this regeneration, the feedforward control law, which is computed from the reference trajectory using the flatness property, is transformed into a feedback control law. Jet-scheduling control takes full advantage of the dynamic possibilities of SpiderCrane as it allows operation far away from the quasi-static mode of operation. In contrast to proportional-like compensators, the proposed control scheme does not over-react whenever the load is displaced in a persistent way, mainly because only higher derivatives are scheduled. Furthermore, the position

of the upper pulley can be adapted without requiring a change in the load position, that is, without over-pulling the main cable. This general compliance makes the control methodology ``user friendly'' without cutting down on dynamic performance. Both point stabilization and trajectory tracking can be implemented.

17:30-17:50 MoC22.4

Stabilization of a 2D-SpiderCrane Mechanism Using Damping

Assignment Passivity-Based Control (I), pp. 3155-3160

Kazi, Faruk — Indian Inst. of Tech. Bombay
Banavar, Ravi N. — Indian Inst. of Tech.
Muellhaupt, Philippe — Ec. Pol. Fed. de Lausanne
Bonvin, Dominique — EPFL

In this paper, we present a modeling and control strategy for a cable suspended structure called the 'SpiderCrane'. By avoiding heavy mobile components, the design of this crane makes it particularly useful for work requiring high speeds. The modeling of such a multiple cable mechanism is challenging due to the number of constraints arising from cable interactions. From a control theoretical point of view, such mechanical systems are underactuated, which gives rise to challenging control issues.

17:50-18:10 MoC22.5

Some Results on Stabilizability of Controlled Lagrangian Systems by Energy Shaping (I), pp. 3161-3166

Chang, Dong Eui — Univ. of Waterloo

We provide necessary and sufficient conditions for Lyapunov stabilizability and exponential stabilizability by the energy shaping method for the class of all linear controlled Lagrangian systems of an arbitrary degree of under-actuation, and for the class of all controlled Lagrangian systems of one degree of under-actuation. We give a sufficient condition for asymptotic stabilizability for the class of all controlled Lagrangian systems of one degree of under-actuation. For a general controlled Lagrangian system, we give only necessary conditions for Lyapunov stabilizability and exponential stabilizability by energy shaping. In addition, we make a new derivation of the Euler-Lagrange matching conditions both in a simple tensor form and in a coordinate-dependent form, for which we make effective use of gyroscopic forces.

18:10-18:30 MoC22.6

Bounded Attitude Stabilization: Real-Time Application on Four-Rotor Mini-Helicopter, pp. 3167-3173

Guerrero Castellanos, Jose Fermi — GIPSA-Lab. INPG-UJF-CNRS
Marchand, Nicolas — GIPSA-Lab. CNRS
Lesecq, Suzanne — INPG/UJF/CNRS
Delamare, Jérôme — INPG-LEG

This paper deals with the global stabilization of a rigid body by means of a bounded quaternion-based feedback. In addition to input bounds, the nonlinear control takes into account the slew rate limits. The proposed control scheme is generic and can be applied to all systems falling in the framework of rigid bodies. Furthermore, its extreme simplicity rendering it suitable for embedded implementation. It is also shown that the control strategy can be applied to attitude stabilization of a four-rotor mini-helicopter despite gyroscopic effects appear that are not present in the rigid body framework. Several real-time experiments have been performed on a real mini-helicopter in order to show the effectiveness of the proposed control approach.

MoC23 323

Large Scale Complex Systems: Theory (Regular Session)

Chair: Brdys, Mietek M.A. — Univ. of Birmingham
Co-Chair: Bakule, Lubomir — Acad. of Sciences of Czech Republic

16:30-16:50 MoC23.1

Fast and Accurate Modeling of Distributed RLC Interconnect and Transmission Line in Time and Frequency Domains, pp. 3174-3179

Wang, Sheng-Guo — Univ. of North Carolina – Charlotte
Wang, Ben — IBM

This paper presents the closed forms of the state space models and the recursive algorithms of the transfer function models for fast and accurate modeling of large scale complex systems of the evenly or unevenly distributed RLC interconnect and transmission lines. Considered models include the distributed RLC interconnect lines with or without external source and load connection. The effective closed forms do not involve any matrix inverse, factorization, or multiplication, thus dramatically reduce the computation complexity. Especially, the computation complexity of the closed forms for any evenly or unevenly distributed RLC interconnect line circuits is only O(1) or O(m) respectively, where m is much less than N, N is the system order, and m represents the number of even sections which compose the uneven interconnect line. The features of new recursive algorithms are two recursive s-polynomials and their low computation complexity too. Illustration examples are provided to demonstrate the results in both time and frequency domains. The results can be applied to the RLC interconnect analysis and model reduction as a key to new approach, and to control systems with transmission lines, internet or delay lines.

16:50-17:10 MoC23.2

Expert-Statistical Processing of Data and the Method of Analogs in Solution of Applied Problems in Control Theory, pp. 3180-3185

Mandel', Alexander Solomonovich — Trapeznikov Inst. of Control Sciences of RussianAcademy of S
Belyakov, Alexei Gennadievich — Trapeznikov Inst. of Control Sciences of Russian Acad. of
Semenov, Dmitry Andreevich — Trapeznikov Inst. of Control Sciences

The paper provides an outline of the expert-statistical approach to developing control and identification systems. An expert-statistical method of data processing designed for forecasting short time series is discussed in detail. New adaptive algorithms for inventory control are described. The usage of these algorithms in applied expert-statistical systems to support decision making process is discussed.

17:10-17:30 MoC23.3

Timing and Deadlock-Freeness in Continuous Petri Nets, pp. 3186-3191

Vazquez, Carlos Renato — Univ. de Zaragoza
Mangini, Agostino Marcello — Pol. di Bari
Mihalache, Ana — Univ. tehnica Gh. Asachi
Recalde, Laura — Univ. De Zaragoza
Silva, Manuel — Univ. De Zaragoza

Timing an (discrete or continuous) unforced net model reserves deadlock-freeness, but not the stronger liveness property, in general. The converse is not true, and if the autonomous net model has deadlocks, the timing may transform it into deadlock-free. Under infinite servers semantics, here we investigate the conditions on the firing rates of continuous timed models that makes deadlock-free a given timed system.

17:30-17:50 MoC23.4

Tracking Control of Timed Continuous Petri Net Systems under Infinite Servers Semantics, pp. 3192-3197

Xu, Jing — National Univ. of Singapore
Recalde, Laura — Univ. De Zaragoza
Silva, Manuel — Univ. De Zaragoza

A Lyapunov-function-based control algorithm is proposed for timed continuous Petri Net (contPN) systems working under infinite servers semantics. A timed contPN is a switched linear system and its control signal must be non-negative and upper bounded by a function of system states. An input variable transformation is applied to convert the system to a set of integrators plus static constraints. Then, a low-and-high gain algorithm is proposed for step-tracking. To improve transient performance, planning of the reference target is further discussed.

17:50-18:10 MoC23.5

Moment Matching Model Order Reduction in Time-Domain Via Laguerre Series, pp. 3198-3203

Eid, Rudy — Tech. Univ. München
Lohmann, Boris — Tech. Univ. München

A new time-domain model order reduction method based on the Laguerre function expansion of the impulse response is presented. The Laguerre coefficients of the impulse response of the reduced-order model, which is calculated using a projection whose matrices form basis of appropriate Krylov subspaces, match, up to a given order, those of the original system. In addition, it is shown that the obtained reduced-order model in time-domain, is equivalent to the one obtained by the classical moment matching around a single expansion point in frequencydomain. Accordingly, a new time-domain interpretation for the rational interpolation problem is deduced.

18:10-18:30 MoC23.6

Communication and State Realization in Decentralized Supervisory Control of Discrete-Event Systems, pp. 3204-3209

Mannani, Amin — Concordia Univ.
Gohari, Peyman — Concordia Univ.

This paper continues the authors' previous work on studying the communication among decentralized supervisors for a distributed Discrete-Event System (DES) in the framework of Distributed Supervised DES (DSDES). Given an already available centralized supervisor for a distributed DES, it relates a language property of this supervisor, called weak joint observability, to a property of the state-based realization of the supervisor, referred to as the existence of the Independent Updating Functions (IUFs). The latter property means that the decentralized implementation of the supervisor relies on each agent's independent observation of the DES dynamic evolution and entails simpler, delay-robust, and possibly cheaper communication; issues currently under investigation. Examples illustrate the applicability of the approach.

MoC24 324

Fault Tolerant Control (Invited Session)

Chair: Kinnaert, Michel — Univ. Libre de Bruxelles
Co-Chair: Dixon, Roger — Loughborough Univ.
Organizer: Kinnaert, Michel — Univ. Libre de Bruxelles
Organizer: Dixon, Roger — Loughborough Univ.

16:30-16:50 MoC24.1

Reconfigurable Control of Hammerstein Systems after Actuator Faults (I), pp. 3210-3215

Richter, Jan — Ruhr-Univ. Bochum
Lunze, Jan — Ruhr-Univ. Bochum

A new method for the control reconfiguration of stable Hammerstein systems after actuator faults is described. The class of Hammerstein systems contains input-saturated systems, which are ubiquitous in practice. The new reconfiguration approach uses a virtual actuator that permits to keep the nominal controller in the loop. The concept of virtual actuators is extended to reflect the nonlinear plant characteristics. A systematic procedure for virtual actuator design is presented that guarantees closed-loop stability. The approach is experimentally verified using a system of coupled tanks.

16:50-17:10 MoC24.2

Closed-Loop Subspace Predictive Control for Fault Tolerant MPC Design (I), pp. 3216-3221

Dong, Jianfei — Delft Univ. of Tech.
Verhaegen, Michel — Delft Univ. of Tech.
Holweg, Edward — SKF

Subspace predictive control (SPC) is recently seen in the literature for joint system identification and control design. This combination enables automatically tuning the parameters in conventional model predictive control (MPC); and therefore provides a solution to the problem of fault tolerant MPC design. The existing SPCs either deal with open-loop data or depend on the information of the controller in a closed loop. In this paper we introduce a new closed-loop SPC method, which is independent of any controller information. Both the analytic solution to the unconstrained case and the quadratic programming problem for the constrained case are formulated. A recursive solution for updating the SPC control law is proposed. A fault tolerant MPC scheme is then developed based on the recursive algorithm, whose effectiveness is demonstrated on tolerating a fault in a steer-by-wire actuator.

17:10-17:30 MoC24.3

Sensor Fault Diagnosis of Wind Turbines for Fault Tolerant (I), pp. 3222-3227

Wei, Xiukun — Delft Univ. of Tech.
Verhaegen, Michel — Delft Univ. of Tech.
van Engelen, Tim — Energy Res. Centre of the Netherlands (Ec.

This paper aims at the blade root moment sensor fault detection and isolation issue. The underlying problem is crucial to the successful application of the individual pitch control system which plays a key role for reducing the blade loads of large offshore wind turbines. In this paper, a wind turbine model is built based on the closed loop identification technique, where the wind dynamics is included in the model. The fault detection issue are investigated based on the residual generated by Kalman filter. The additive faults and multiplicative faults are investigated respectively. For the additive fault case, the mean value change detection of the residual and the generalized likelihood ratio test are utilized respectively. On the other hand, the multiplicative fault is handled by the variance change detection of the residuals. The fault isolation issue is proceeded with the help of dual sensor redundancy. Simulation results show that the proposed approach can be successfully applied to the underlying issue.

17:30-17:50 MoC24.4

Modelling of High Redundancy Actuation Utilising Multiple Moving Coil Actuators (I), pp. 3228-3233

Davies, Jessica — Loughborough Univ.
Steffen, Thomas — Loughborough Univ.
Dixon, Roger — Loughborough Univ.
Goodall, R.M. — Loughborough Univ.
Zolotas, Argyrios — Loughborough Univ.
Pearson, John — BAE Systems

This paper presents the modelling of a moving coil actuator for use as an element in a High Redundancy Actuator (HRA). A single element model is derived from first principles and verified using experimental data. This model is subsequently used to describe an approach to deriving models of multi-element HRAs and determine the effect of a variety of faults, chosen to be appropriate for the electro-magnetic technology, on the behaviour of multi-element assemblies.

17:50-18:10 MoC24.5

Failure Modes and Probabilities of a High Redundancy Actuator (I), pp. 3234-3239

Steffen, Thomas — Loughborough Univ.
Davies, Jessica — Loughborough Univ.
Dixon, Roger — Loughborough Univ.
Goodall, R.M. — Loughborough Univ.
Pearson, John — BAE Systems
Zolotas, Argyrios — Loughborough Univ.

A high redundancy actuator (HRA) is composed of a high number of actuation elements, increasing both the travel and the force over the power of an individual element. This provides inherent fault tolerance, because when an element fails, the capabilities of the actuator may be reduced, but it does not become dysfunctional. This paper analyses the likelihood of different reductions in capabilities, based on the reliability of the actuation elements used. The result is a probability distribution that quantifies the capability of the high redundancy actuator. Together with the required capabilities, this determines the fault tolerance of the actuator.

18:10-18:30 MoC24.6

Threshold Selection Based on Closed-Loop Performance for Fault Detection Schemes (I), pp. 3240-3245

Aberkane, Samir — UHP, NANCY 1
Kinnaert, Michel — Univ. Libre de Bruxelles

The threshold selection issue is considered in a fault detection system which is a part of an active fault tolerant control scheme. The proposed approach takes explicitly into account the closed-loop performance of the regulated system. Indeed, the threshold is selected to ensure optimal regulation performance over a specified time horizon, while taking into account possible malfunctions affecting the system. More specifically sensor faults, like bias or drift, are considered in combination with a reconfiguration scheme made of software sensors. A numerical algorithm based on randomization techniques is provided and its running is illustrated on a numerical example of FTC for a winding machine.

MoC25 328

Model Reduction and Realtime Optimization and Control (Regular Session)

Chair: Van den Hof, Paul M.J. — Delft Univ. of Tech.
Co-Chair: Lee, Jong Min — Univ. of Alberta

16:30-16:50 MoC25.1

Real-Time Dynamic Optimization of Batch Crystallization Processes, pp. 3246-3251

Mesbah, Ali — TU Delft
Kalbasenka, Alex — TU Delft
Huesman, Adrie — Delft Univ. of Tech.
Kramer, Herman — TU Delft
Van den Hof, Paul M.J. — Delft Univ. of Tech.

An on-line optimization strategy is developed and applied to a semi-industrial crystallization process. The seeded fed-batch crystallizer is represented by a nonlinear moment model. An optimal control problem pertinent to maximization of the batch crystal yield is solved using the sequential optimization approach. As the dynamic optimizer requires knowledge of the states of the system, an extended Luenberger-type observer is designed to estimate the unmeasured state variable, i.e. solute concentration. Real-time implementations of the proposed strategy reveal the effectiveness of closed-loop optimal control of the crystallizer. The superior performance of the closed-loop implementation to that of the open-loop implementation is attributed to the distinct role of the observer in the feedback control structure that not only accounts for the plant-model mismatch by state adaptation, but also enables disturbance handling. Experimental results also demonstrate that the application of the proposed optimal control strategy leads to a substantial increase in the crystal volume fraction at the end of the batch, while the reproducibility of batches with respect to the product crystal size distribution is sustained.

16:50-17:10 MoC25.2

Parametric Approximation of Piecewise Quadratic Value Functions for the Control of Complex Systems, pp. 3252-3257

Nosair, Hussam — Univ. of Alberta
Lee, Jong Min — Univ. of Alberta

We present a new technique for approximate dynamic programming that is suitable for control of large-scale systems with complex dynamics. The approach improves closedloop performances from a starting control policy by incrementally updating a value function on-line based on the Bellman's optimality equation. The value function is approximated as a map between the state and the associated cost-to-go value to circumvent the "curse-ofdimensionality." The approximation method uses piecewise quadratic representations of the value function, and can considerably reduce the computational requirement compared to the instance-based methods, which store all the historical data and retrieve them for calculating optimal control actions. Hybrid and nonlinear examples are included to demonstrate the applicability of the approach.

17:10-17:30 MoC25.3

Evolutionary Improvement Algorithm with Statistical Learning Method for Process Real-Time Optimization, pp. 3258-3262

Choi, Seungjune — Seoul National Univ.
Kim, Seunghyok — Seoul National Univ.
Yoon, En Sup — Seoul National Univ.

This study proposes an effective framework for process real-time optimization and data-driven modeling method. The proposed RTO framework with evolutionary improvement algorithm does not wait for the steady-state and it corrects the set-point continuously through the similar way which genetic algorithm exploit to find optimal points. It can deal with higher frequency disturbances and is less influenced by control system performance. Moreover, it is able to address the convergence to suboptimal. Also, this study proposes statistical learning model (modified Support Vector Machine) that is used in RTO framework. It is able to handle highly-nonlinearity and carry out parameter tuning easily. The performance of proposed method was successfully illustrated by means of RTO example.

17:30-17:50 MoC25.4

On-Line Optimizing Control for a Class of Batch Reactive Distillation Columns, pp. 3263-3268

Pérez-Correa, Sandra — Univ. Autónoma Metropolitana
González, Pablo — Univ. Autónoma Metropolitana - Iztapalapa
Alvarez, Jesus — Univ. Auto. Metropolitanta-Iztapal

The problem of designing an on-line optimizing output-feedback (OF) controller for the class of reaction: A + B <-> C + D of batch reactive distillation columns with temperature measurements is addressed. The joint process-control design problem is solved within a constructive framework, by combining relative degree and detectability structures concepts in the light of particular system features. The result is an OF control scheme that decides the total reflux period and batch durations, and manipulates the reflux rate over the withdrawal period. The proposed approach is illustrated with a case example (esterification of ethanol and acetic acid) through numerical simulations, yielding a closed-loop operation which is similar to the open-loop ones previously obtained via direct optimization.

17:50-18:10 MoC25.5

A Balancing Approach to Model Reduction of Polynomial Nonlinear Systems, pp. 3269-3273

Siahaan, Hardy B. — International Res. Inst. of Stavanger (IRIS)

This paper considers a computational approach to obtain a reduced order model for polynomial nonlinear systems. The approach is based on balancing generalized gramians of polynomial systems and truncating the systems based on the balanced generalized gramians. The approach utilizes sum of squares programming for its computational purposes.

18:10-18:30 MoC25.6

Model Reduction of Systems with Traveling Waves Using Projection Methods, pp. 3274-3279

Nauta, Maarten — Eindhoven Univ. of Tech.
Weiland, Siep — Eindhoven Univ. of Tech.
Backx, Ton — Eindhoven Univ. of Tech.

Proper Orthogonal Decomposition (POD) based projection methods are an impor- tant tool for the reduction of complex nonlinear models. Large reductions in model order can be frequently be obtained due to the exploitation of correlations between model states that exist for representative behavior of the model. However, when this model behavior includes traveling waves or shock fronts these methods perform less well as a large number of modes is required to capture this type of behavior. This paper investigates the use of correlation to pre-process simulation data such that bi-orthogonal projection can subsequently be applied to obtain a reduced model that is of low order.

MoC26 327

Separation Control (Regular Session)

Chair: Ozgen, Canan — Middle East Tech. Univ.
Co-Chair: Koivo, Heikki — Helsinki Univ. of Tech.

16:30-16:50 MoC26.1

Prediction of Concentrate Grade in Industrial Gravity Separation Plant – Comparison of Rpls and Neural Network, pp. 3280-3285

Remes, Antti Juhani — Helsinki Univ. of Tech.
Vaara, Niina — Outokumpu
Saloheimo, Kari — Outotec
Koivo, Heikki — Helsinki Univ. of Tech.

Control of the concentrate quality is usually one of the main targets in the operation of mineral concentrator processes. Availability of the estimates of end product properties in advance – based on upstream process measurements – offers an opportunity to develop higher level control strategies for the unit processes. Here, the recursive PLS and adaptive neural network models are compared in the prediction of the concentrate grade at a gravity separation plant. The methods are applied in the Outokumpu Tornio Works Kemi Mine plant data. The chromite concentrate grade can be predicted relatively accurately based on the slurry properties measured in the grinding circuit. Accordingly, the predicted chromite grade decreases about 0.2 %-units when the slurry D50 passing size is increased by 10 %. This enables further development of the grinding control, especially the control of the slurry particle size, to meet the concentrate specifications.

16:50-17:10 MoC26.2

Hierachical Intelligent Optimization Blending System Based on Production Indices for Lead-Zinc Sintering Process, pp. 3286-3291

Wang, Yalin — Central South Univ.
Yang, Chunhua — Central South Univ.
Gui, Weihua — Central South Univ.
Ling, Xiang — Central South Univ.

In lead-zinc sintering process, various kinds of lead-zinc concentrates and returning powder from ineligible sintering production are blended and then sintered in updraft sintering machine to produce agglomerate for imperial smelting process. It is required to determine a proper mixture ratio for these materials blended to assure sintering production indices such as agglomerate composition and sintering permeability. Considering the relations between the mixture ratio and the production indices, an intelligent integrated model is firstly constructed to predict agglomerate compositions, which consists of Expertise-and-Mechanism-based model and Supervised Distributed Neural Networks. Based on the composition prediction model and reasoning rules for mixture ratio modification, a hierachical intelligent optimization strategy with expert reasoning is proposed to determine an optimal mixture ratio, which includes multi-objective optimization for the first blending process and area optimization for the second blending process. Practical running results show that the qualified rates of agglomerate compositions are increased by about 7% and the fluctuation of sintering permeability is reduced by 7.0 % through proper blending process according to the optimal mixture ratio, which effectively stabilizes the imperial smelting process.

17:10-17:30 MoC26.3

Utilizing 3D Height Measurement in Particle Size Analysis, pp. 3292-3297

Kaartinen, Jani — Helsinki Univ. of Tech.
Tolonen, Antti — Helsinki Univ. of Tech.

This paper introduces a novel approach for performing non-invasive particle size analysis for a material stream running on a standard conveyor belt. The measurements, carried out with a 3D laser scanner and a measuring belt weigher, are accurate, robust and real world physical measures. The 3D data obtained with the laser scanner enables more accurate analysis than the spatial monochrome or colour images that are commonly used in this field. In this paper the proposed analysis method is used in mineral processing application to get information about the particle size distribution of the ore flow from the mine to the screening station at the surface. This information can be used to optimize operation of the semi autogenous grinding station. However, with certain limitations, the analysis method can be utilized in different kinds of applications.

17:30-17:50 MoC26.4

Computer Vision Based Interface Level Control in a Separation Cell, pp. 3298-3303

Jampana, Phanindra — Univ. of Alberta
Shah, Sirish — Univ. of Alberta
Kadali, Ramesh — Suncor Energy Inc.

Bitumen extraction from oil sands is the core process in the production of oil from oil sands. This floatation process is carried out in large vessels called separation cells. Optimal control of the interface between the Bitumen froth and Middlings in these cells can result in a significant improvement in Bitumen recovery and increase in process efficiency downstream, resulting in large economic benefits. The major impediment in the implementation of such a control system is the lack of safe and reliable sensors for interface level detection. Traditional instruments such as nuclear gauges, capacity probes etc. are either unsafe or do not give reliable estimates. This work describes a novel sensor for interface level detection, developed using computer vision techniques on video frames captured from a sight glass camera. Specifically,State-space model based Particle filtering is used to provide estimates of the interface level and its quality. It is shown that the algorithm is robust to lighting changes and process abnormalities. Industrial results show highly improved control performance when estimates of the sensor are used in the control loop.

17:50-18:10 MoC26.5

State Estimation for a Reactive Batch Distillation Column, pp. 3304-3309

Bahar, Alm1;la — Middle East Tech. Univ.
Ozgen, Canan — Middle East Tech. Univ.

An Artificial Neural Network (ANN) estimator is designed to predict the composition values of a reactive batch distillation system inferentially. The estimator for the reactive batch distillation system, which is recently a preferred industrial operation for specialty chemicals production, is designed using temperature measurements throughout the column. The reflux ratio of the batch distillation column is also used as input to the ANN as well as temperature values. The ANN used is an Elman network with two hidden layers; having 20 neurons in the first hidden layer, three neurons in the second hidden layer, and four neurons in the output layer. The performance of the designed network is tested in open-loop and it is found that, it is possible to predict the product compositions by using the designed ANN estimator which can be used in the control of the product compositions.

18:10-18:30 MoC26.6

State and Ore Hardness Estimation in Semiautogenous Grinding, pp. 3310-3315

Cuevas, Alejandro — Pontificia Univ. Católica de Chile
Cipriano, Aldo — Pontificia Univ. Catolica de Chile

Semiautogenous milling is difficult to control both because of its non-linear behavior and the effects of overloading due to increases in the ore charge or variations in ore characteristics. Advanced control strategies and operational change detection methods are thus in need of strengthening using techniques such as state estimation. Non-linear state estimation is a complex task for which various solutions have been proposed, such as the extended Kalman filter, the particle filter and the moving horizon estimator. In this study we present firstly a quantitative comparison of these estimation methods using a dynamic model validated with mill data. The comparison indicates that in addition to its lower computational requirements, the extended Kalman filter delivers the best performance in robustness and estimation error. Next, we propose a method for estimation of changes in the soft ore proportion of ore feed. Finally, we test this method by simulation and with real data.

MoC27 326
Power Electronics Applications (Invited Session)

Chair: Albea, Carolina — Univ. of Seville
Co-Chair: Xu, Jian-Xin — National Univ. of Singapore
Organizer: Albea, Carolina — Univ. of Seville

16:30-16:50 MoC27.1

Adaptive Control of the Boost Inverter with Load RL (I), pp. 3316-3321

Albea, Carolina — Univ. of Seville
Gordillo, Francisco — Univ. de Sevilla
Canudas de Wit, Carlos — CNRS-GIPSA-Lab.

This paper proposes an adaptive control for the nonlinear boost inverter with non-resistive load in order to cope with unknown resistive load as well as unknown inductive load. The adaptive control is accomplished by using a state observer to one side of the inverter with a quadratic Lyapunov function and by measuring the states variables. The stability of the complete system is analyzed by means of singular perturbation analysis. The adaptation of the both parameters is tested by using simulations.

16:50-17:10 MoC27.2

Direct Torque Tracking PI-Controller Design for Switched Reluctance Motor Drive Using Singular Perturbation Method (I), pp. 3322-3327

Sahoo, Sanjib — National Univ. of Singapore
Panda, Sanjib — National Univ. of Singapore
Xu, Jian-Xin — National Univ. of Singapore
Yurkevich, Valery D. — Novosibirsk State Tech. Univ.

The problem of torque tracking PI-controller design for switched reluctance motor (SRM) drive is discussed, where SRM magnetization characteristics are highly nonlinear, and torque is a complex and coupled function of phase current and rotor position. A distinctive feature of the control system designed is that two-time-scale motions are artificially forced in the closed-loop system by the selection of control law parameters. Hence, singular perturbation method is used to analyze the closed-loop system properties. Stability conditions imposed on the fast and slow modes, and a sufficiently large mode separation rate, can ensure that after fast ending of the fast-motion transients, the torque tracking error dynamics are as desired by the control system design specifications and they are insensitive to SRM nonlinearities. An accurate polynomial model of a prototype SRM magnetization characteristics is used for simulation studies of the proposed controller. However, only a simple trapezoidal profile for SRM inductance is used for calculation of the control voltage. Simulation results for constant motor torque at different speeds show that motor peak-to-peak torque ripples are minimized to about 5% of the average torque, especially for low speed operation

17:10-17:30 MoC27.3

Inter Power Electronic Building Blocks Communication Over Two Optical Rings (I), pp. 3328-3332

Cucej, Zarko — Univ. of Maribor
Truntic, Mitja — Univ. of Maribor
Milanovic, Miro — Univ. of Maribor
Benki — Univ. of Maribor
;, Karl

Power electronic building blocks initiated and sponsored by the Office of Naval Research, are based on the integration of power semiconductor elements with some degree of intelligence and data communication capability in compact form. % This article addresses the communication issues between power electronic building blocks. A study case of Inter PEBB communication is described, based on two-optical ring topology and the possibility of complete implementation in a single FPGA for slave nodes.

17:30-17:50 MoC27.4

Frequency Domain Based Repetitive Control of Three Phase Boost PWM Rectifier under Distorted Supply Voltage Conditions (I), pp. 3333-3338

Wu, Xinhui — National Unversity of Singapore
Panda, Sanjib — National Univ. of Singapore
Xu, Jian-Xin — National Univ. of Singapore

This paper presents a digital plug-in frequency domain based repetitive control scheme for minimizing the even order harmonics at the output dc link voltage and odd order harmonics in the line currents under the distorted and unbalanced supply voltage conditions. The proposed current controller consists of a conventional PI controller and a frequency domain based plug-in repetitive controller. Based on the mathematical model of the three-phase PWM boost rectifier under the generalized supply voltage conditions, the control task is divided into: (a) dc-link voltage harmonics control and (b) line side current harmonics control. The plug-in repetitive controller is designed to achieve line side currents with low THD for the three phase PWM boost rectifier. The repetitive control learning algorithm is designed in frequency domain instead of commonly used time domain and provides the flexibility of choosing different learning gains and phase delay compensations individually for each harmonic component. The experimental test results obtained from a 1.6 kVA laboratory based PWM rectifier confirm that the THD of the line side current can be reduced from 21.09% to 4.12% with the insertion of the plug-in frequency domain based repetitive controller.

17:50-18:10 MoC27.5

Implementation of Fuzzy-Logic State Controller in FPGA for Step-Down Converter (I), pp. 3339-3343

Truntic, Mitja — Univ. of Maribor
Milanovic, Miro — Univ. of Maribor
Cucej, Zarko — Univ. of Maribor

This paper describes the implementation of fuzzy control algorithm (state controller with adjustable gains by fuzzy sets) in DC-DC Buck converter. All tasks are implemented by FPGA. Fuzzy sets are tuned by genetic algorithm of-line by using Fuzzy-logic and genetic toolbox in MATLAB. Fuzzyfication and defuzzyfication algorithms are implemented in real time in Field Programmable Gate Array (FPGA). Whole control algorithm is solved in 150~ns. The switching frequency of buck-converter PWM units is 200 kHz. This work is experimentally verified.

18:10-18:30 MoC27.6

High Performance Repetitive Control of an Active Filter under Varying Network Frequency (I), pp. 3344-3349

Costa-Castelló, Ramon — Univ. Pol. de Catalunya
Malo, Shane — Univ. Pol. de Catalunya (UPC)
Grino, Robert — Univ. Pol. De Catalunya

Shunt active power filters are power electronics devices that are connected in parallel with nonlinear and reactive loads to compensate these characteristics in order to assure the quality of the electrical distribution network. This work proposes and designs a controller, based on combined feedforward and feedback actions, the last using repetitive control, to obtain a good closed-loop performance (power factor close to 1 and load current harmonics and reactive power compensation) in spite of the possible frequency variations that can occur in the electrical network. It is known that these variations clearly affect the performance of the usual discrete-time implementations of the repetitive based controllers. The paper analysis the effect of these variations and describes the architecture of the controller, its design, and the mechanism to compensate the network frequency variations. Some experimental results that show the good performance of the closed-loop system are also included.

MoC28 330A

Automotive Control and Estimation Using Look-Ahead Road Information (Invited Session)

Chair: Johansson, Karl Henrik — Royal Inst. of Tech.
Co-Chair: Nielsen, Lars — Linköping Univ.
Organizer: Johansson, Karl Henrik — Royal Inst. of Tech.
Organizer: Nielsen, Lars — Linköping Univ.

16:30-16:50 MoC28.1

Design of a Well-Behaved Algorithm for On-Board Look-Ahead Control (I), pp. 3350-3355

Hellström, Erik — Linköping Univ.
Aaslund, Jan — Linköping Univ.
Nielsen, Lars — Linköping Univ.

A look-ahead controller is developed for a heavy diesel truck that utilizes information about the road topography ahead of the vehicle when the route is known. A dedicated prediction model is formulated where special attention is given to properly include gear shifting. The nature of the problem is analyzed for the purpose of optimization, and a well performing dynamic programming algorithm is tailored. A key step for satisfactory solutions with a sufficiently low computational effort is to avoid numerical problems. The focus here is the choice of discretization method, and it turns out that a basic analysis give decisive insight into the interplay between the criterion and the discretization errors. The resulting algorithm is demonstrated to perform well in real on-line tests on a highway.

16:50-17:10 MoC28.2

Real Time Control of Hybrid Electric Vehicle on a Prescribed Road (I), pp. 3356-3361

Kermani, Saďda — INRETS
Delprat, Sebastien — Univ. of Valenciennes et Hainaut Cambresis
Guerra, Thierry Marie — Univ. of Valenciennes
Trigui, Rochdi — INRETS

Hybrid vehicles use two energy sources for their propelling. In order to investigate an optimal splitting of the power flows between the engine and the electric machine, an optimal control algorithm is recalled. A new formulation using maps allows a very fast solving this problem which then may be used in real time control. In the particular case of a hybrid vehicle on a prescribed route, a new control strategy is proposed. It consists in computing an optimal control on the prescribed route and then updating the computed values in order to cope with the difference between the actual and prescribed vehicle route

17:10-17:30 MoC28.3

Energy Management for a Hybrid Solar Vehicle with Series Structure (I), pp. 3362-3367

Arsie, Ivan — Univ. of Salerno
Di Martino, Raffaele — Univ. of Salerno
Rizzo, Gianfranco — Univ. of Salerno
Sorrentino, Marco — Univ. of Salerno

A study on optimal energy management on a Hybrid Solar Vehicle (HSV) with series structure is presented. Previous results obtained by optimal design analysis for HSV confirmed the relevant benefits of such vehicles with respect to conventional cars in case of intermittent use in urban driving (city-car), and that economical feasibility could be achieved in a near future. In order to develop a supervisory control for a HSV prototype under development at University of Salerno, a study on the performance achievable by an intermittent use of the ICE powering the electric generator is presented. In particular, the effects of engine thermal transients on fuel consumption and HC emissions are studied and discussed. The optimal ICE power trajectory is found by solving a non-linear constrained optimization that suitably accounts for fuel mileage and state of charge, also considering solar contribution during parking mode.

17:30-17:50 MoC28.4

Optimal Speed on Small Gradients - Consequences of a Non-Linear Fuel Map (I), pp. 3368-3373

Ivarsson, Maria — Scania
Aaslund, Jan — Linköping Univ.
Nielsen, Lars — Linköping Univ.

Consequences of non-linearities in sfc, i.e. specific fuel consumption, of a heavy truck combustion engine are studied. A quasi-static analysis gives valuable insights into the intrinsic properties of the studied problem, i.e. minimization of fuel consumption on small gradients. Two objective functions are shown to give different optimal velocity trajectories on a constant gradient due to non-linearities in sfc. When a constraint is set to keep to a final time, switching between two speeds is optimal. Instead, if consumed time is part of the objective function, in addition to fuel consumption, keeping to one constant speed is optimal. However, the different optimal solutions still show similarities. For a certain significant non-linearity a specific speed range is shown to be unreachable, independent of objective function. Also under more realistic conditions, a dynamic analysis, implemented by a numerical optimizer, confirms that an alternating speed profile is optimal for the case of fixed final time.

17:50-18:10 MoC28.5

Approximate Dynamic Programming Applied to Parallel Hybrid Powertrains (I), pp. 3374-3379

Johannesson, Lars — Chalmers
Egardt, Bo S. — Chalmers Univ. of Tech.

The extra degree of freedom offered in hybrid electric vehicles have inspired many researchers to formulate and solve optimal control problems of various kinds. This paper presents an Approximate Dynamic Programming scheme that efficiently solves the optimal power split between the internal combustion engine and the electric machine in parallel hybrid powertrains. Gear switches and switches between hybrid and pure electric mode are formally treated. The scheme combines two ideas to reduce the computational time of the iterations performed in the dynamic programming. First, the value function is approximated using piecewise linear functions on a sparse grid. Secondly, by using model approximation the iterations performed in the dynamic programming are reduced to solving scalar quadratic problems. In the simulations the approximation scheme is able to find a good approximation of the optimal control trajectory.

18:10-18:30 MoC28.6

Road Grade Estimation for Look-Ahead Vehicle Control (I), pp. 3380-3385

Sahlholm, Per — Scania CV AB
Johansson, Karl Henrik — Royal Inst. of Tech.

Look-ahead cruise controllers and other advanced driver assistance systems for heavy duty vehicles require high precision digital maps. This contribution presents a road grade estimation algorithm for creation of such maps based on Kalman filter fusion of vehicle sensor data and GPS positioning information. The algorithm uses data from multiple traversals of the same road to improve previously stored road grade estimates. Measurement data from three test vehicles and six road traversals have been used to evaluate the quality of the obtained road grade estimate compared to a known reference. The obtained final grade estimate compares favourably to one acquired from a specialized road grade measurement vehicle with a DGPS receiver and inertial measurement unit.

MoC29 330B

Active Suspension (Regular Session)

Chair: Bokor, Jozsef — Hungarian Acad. of Sciences
Co-Chair: Gaspar, Peter — Computer & Automation Inst. of HAS

16:30-16:50 MoC29.1

The Design of a Two-Level Controller for Suspension Systems, pp. 3386-3391

Gaspar, Peter — Computer & Automation Inst. of HAS
Szederkenyi, Gabor — Computer and Automation Res. Inst. Hungarian
Szabo, Zoltan — Hungarian Acad. of Sciences
Bokor, Jozsef — Hungarian Acad. of Sciences

In this paper, the design of a two-level controller is proposed for active suspension systems. The required control force is computed by applying a high-level controller, which is designed using a Linear Parameter Varying (LPV) method. The suspension structure contains nonlinear dynamics of the dampers and the springs. The model is augmented with weighting functions specified by the performance demands and the uncertainty assumptions. The actuator generating the necessary control force is a highly nonlinear system, for which a low-level backstepping-based force-tracking controller is designed. The operation of the two-level controller is illustrated through simulation examples.

16:50-17:10 MoC29.2

Potential of Low Bandwidth Active Suspension Control with Continuously Variable Damper, pp. 3392-3397

Koch, Guido — Tech. Univ. München
Fritsch, Oliver — Tech. Univ. München
Lohmann, Boris — Tech. Univ. München

Due to rising customer demands for driving comfort, the integration of controlled active and semi-active elements in modern vehicle suspension systems has increased considerably. A significant number of upper class vehicle suspensions is either equipped with continuously variable dampers or low bandwidth actuators. However, the combination of these suspension elements is not applied so far. In this paper active quarter car models are used to design time-invariant LQR controllers for specific road conditions. By optimizing the controller weights and damping ratio based on a new iterative optimization procedure, the potential of road adaptive low bandwidth systems with continuously variable dampers is clearly highlighted. It is shown that ride comfort can be significantly increased while satisfying given constraints for ride safety (maximum tire deflections) and suspension travel. The achievable performance is compared to passive and high bandwidth active suspension systems using carpet plots.

17:10-17:30 MoC29.3

Multi-Objective Preview Control of Active Vehicle Suspensions, pp. 3398-3403

Akbari, Ahmad — Tech. Univ. of Munich
Lohmann, Boris — Tech. Univ. München

This paper develops an LMI-based solution for the design of a discrete-time multi-objective preview controller, and considers it for an active vehicle suspension system. A quarter car model, which captures many features of real structures, is used in this study and hence the look-ahead preview control is considered. To provide ride comfort for a wide range of road irregularities, H_infty norm is used as a comfort measure, while generalized H_2 is used to care for the constraints on suspension working space, tire deflection and actuator saturation. Moreover, to ensure desired stability margins for the feedback part of the system, pole location constraints are considered in the design. The effects of inclusion of preview information in control law on ride comfort, ride safety, working space and power requirements, for various road profiles, are examined. The results demonstrate the effectiveness of the preview-included multi-objective design to pure feedback scheme.

17:30-17:50 MoC29.4

Nonlinear Control of Full-Vehicle Active Suspensions with Backstepping Design Scheme, pp. 3404-3409

Hu, Jia-Wei — National Chi Nan Univ.
Lin, Jung-Shan — National Chi Nan Univ.

This paper proposes a nonlinear backstepping control strategy to improve the inherent tradeoff between ride comfort of passengers and suspension travel. Passenger comfort in ground vehicles usually depends on a combination of vertical motion (heave) and angular motion (pitch and roll). Suspension travel means the space variation between vehicle body and tires. Our active suspension design has the ability to cope with these two conflicting objectives for improving the tradeoff between them. The novelty is in use of the nonlinear filter whose effective bandwidth depends on the magnitudes of suspension travel. Hence, the nonlinear design allows the closed-loop system to behave differently in various operating regions. As a result, the excellent performance of full-vehicle active suspension is demonstrated in simulations compared to a standard passive suspension system.

17:50-18:10 MoC29.5

A Self Tuning Suspension Controller for Multi-Body Quarter Vehicle Model, pp. 3410-3415

Poussot, Charles — INPG/ENSIEG
Drivet, Aline — TEC de Monterrey
Sename, Olivier — INPG
Dugard, Luc — CNRS-INPG-UJF
Ramírez-Mendoza, Ricardo A. — ITESM Campus Monterrey

In this paper we derive both LTI (Linear Time Invariant) and LPV (Linear Parameter Varying) controllers according to the Hinf methodology, based on a simple two degree-of-freedom quarter vehicle model using an industrial criterion to handle the compromise between comfort and suspension deflection. As such a model is very simplified, a validation of these control designs is performed on a multi-body dynamical model of the quarter vehicle, much closer to a realistic car which makes the solution interesting for implementation issues.

18:10-18:30 MoC29.6

Sliding Mode Controllers for Active Suspensions, pp. 3416-3421

Koshkouei, Ali — Coventry Univ.
Burnham, Keith J. — Coventry Univ.

This paper presents a method for controlling a quarter-car hydraulic active suspension system using SMC techniques. The method guarantees the stability of the existence of a sliding mode and also the stability of the overall system. The proposed method includes many phases. At first phase, the suspension dynamics is controlled via the actuator between the sprung and unsprung masses. Then the spool valve displacement dynamics is considered to control the current of the servo valve. Since there is unknown parameter in the system an adaptation law is proposed to yield an appropriate estimate

MoC30 330C
Guidance and Robust Control of Information Spacecraft
(Invited Session)

Chair: Somov, Yevgeny — Samara Scientific Center, Russian Acad. of Sciences
Co-Chair: Çimen, Tayfun — ROKETSAN Missiles Industries Inc.
Organizer: Somov, Yevgeny — Samara Scientific Center, Russian Acad. of Sciences

16:30-16:50 MoC30.1
Guidance and Robust Gyromoment Precise Attitude Control of Agile Observation Spacecraft (I), pp. 3422-3427

Somov, Yevgeny — Samara Scientific Center, Russian Acad. of Sciences
Butyrin, Sergey — Samara Scientific Center, Russian Acad. of Sciences
Somov, Sergey — Samara Scientific Center, Russian Acad. of Sciences

Some problems on guidance and robust gyromoment attitude control of agile spacecraft for remote sensing the Earth surface are considered. Elaborated methods for dynamic research of the spacecraft programmed angular motion at principle modes under external and parametric disturbances, partial discrete measurement of the state and digital control of the gyro moment cluster by the few-excessive gyrodine schemes, are presented.

16:50-17:10 MoC30.2
Local Orbital Frame Predictor for LEO Drag-Free Satellites (I), pp. 3428-3433

Canuto, Enrico — Pol. di Torino
Massotti, Luca — ESA - ESTEC

This paper is concerned with on-board real-time position and rate prediction of the spacecraft centre-of-mass as input data to local orbital frame (LORF) determination for Low-Earth Orbit drag-free satellites. Study and simulation results are justified by Drag-Free and Attitude Control of the GOCE satellite (Gravity field and steady-state Ocean Circulation Explorer), the LORF being the instantaneous reference for satellite attitude and scientific data. The paper focuses on modeling issues to obtain an accurate orbit dynamics at lower frequencies for reducing integration error because of the narrow-band filter requested by the assumed wide-band measurement errors. A further remedy in this sense is the addition of a second order disturbance dynamics leaving unexplained bounded noise components. Simulated results are presented with reference to GOCE mission.

17:10-17:30 MoC30.3
Design and Implementation of Robust Symmetric Attitude Controller for ETS-VIII Spacecraft (I), pp. 3434-3439

Nagashio, Tomoyuki — Univ. of Electro-Communications
Kida, Takashi — Univ. of Electro-Communications
Ohtani, Takashi — Japan Aerospace Exploration Agency
Hamada, Yoshiro — Japan Aerospace Exploration Agency

This paper studies the robust attitude control of the large flexible communication satellite ETS-VIII. As a controller candidate, we propose a two-degrees-of-freedom control based on robust direct velocity and displacement feed-back, in order to develop a baseline of future controller design technology for this class of spacecraft. For the purpose, the spacecraft modeling and controller synthesis methods are discussed. Then, the controller implementation for on-orbit control experiment is shown with some simulation results.

17:30-17:50 MoC30.4
Modeling and Adaptive Attitude Control of Large Spacecrafts in View of Flexible Structure (I), pp. 3440-3445

Rutkovsky, Vladislav Yu. — Inst. OF CONTROL SCIENCES
Zemlyakov, Stanislav — Inst. of Control Sciences of RAS
Sukhanov, Victor — Inst. OF CONTROL SCIENCES
Glumov, Victor — Inst. OF CONTROL SCIENCES

The paper discusses computerized angular motion equations of large spacecrafts, whose structural flexibility is determined by large-size solar battery panels. Reorientation dynamics problems caused by structural flexibility and inaccurate settings of object model parameters are considered. An adaptive system for control of such objects is suggested. The system allows for a robust control and stability with respect to vibrations. Both robustness and stability are achieved by using a flexible modes Kalman filter and by providing optimal phase oscillation conditions for switching of control actions.

17:50-18:10 MoC30.5
A Landmark Based Nonlinear Observer for Attitude and Position Estimation with Bias Compensation, pp. 3446-3451

Vasconcelos, José Fernandes — Inst. Superior Técnico
Cunha, Rita — Inst. Superior Técnico, Inst. for Systems and
Silvestre, Carlos — Inst. Superior Tecnico
Oliveira, Paulo Jorge — Inst. Superior Técnico

This paper addresses the problem of estimating position and attitude of a rigid body based on landmark coordinate readings and biased velocity measurements. Using a Lyapunov function conveniently defined by the landmark measurement error, a nonlinear observer on SE(3) is derived. The resulting position, attitude, and biases estimation errors are shown to converge exponentially fast to the desired equilibrium points. The observer terms are explicit functions of the landmark measurements and velocity readings, exploiting the sensor information directly. Simulation results for trajectories described by time-varying linear and angular velocities are presented to illustrate the stability and convergence properties of the observer, supporting the application of the algorithm to autonomous air vehicles and other robotic platforms.

18:10-18:30 MoC30.6
Spacecraft Parameter Estimation by Using Predictive Filter Algorithm (I), pp. 3452-3457

Myung, Hyunsam — KAIST
Bang, Hyochoong — KAIST

An approach to estimate spacecraft system parameters is proposed in this paper. Oftentimes, spacecraft is under uncertainties of the system as well as internal and external disturbances which have different aspects each other. The moment of inertia of spacecraft is unknown especially when it is under considerable fuel consumption or equipped with deployable structures. This study aims to estimate the moment of inertia of the spacecraft body as well as its attitude and angular rate by using predictive filtering algorithm. Crassidis and Markley developed a predictive filtering algorithm for nonlinear estimation under a large system model error. This approach focuses not on the specific sources of model error described in the equations of motion but the resultant model error vector driving errors on the system dynamics. Therefore, we are not able to update the system model since the estimated model error has no additional information about the system. This paper establishes a method to apply the predictive filtering algorithm for nonlinear spacecraft parameter estimation by defining a new model error vector for parameters. This study shows different sources of the model error can be separated for estimation, and reveals excellent estimation results. Proposed algorithm is verified by numerical simulation studies.

MoCCC 401
Milestone Report by IFAC Coordinating Committee on Bio and Ecological Systems (CC8) (Milestone Session)

Chair: Feng, David Dagan — Hong Kong Pol. Univ.

16:30-18:30 MoCCC.1
Bio and Ecological Systems: Challenges, Accomplishments and Forecasts, pp. 3458-3469

Carson, Ewart — City Univ.
Feng, David Dagan — Hong Kong Pol. Univ.
Pons, Marie-Noelle — ENSIC
Soncini-Sessa, Rodolfo — Pol. di Milano
van Straten, G — Wageningen Univ.

The complexities of the dynmic processes and their control associated with bio- and ecological systems offer many challenges for the control engineer. Applying dynamic modelling and control can aid understanding of their complexities. Moreover,using such complex systems as test-beds for new control methods can highlight their limitations (e.g. in relation to system identification) and thus act as a catalyst for methodological advance. This paper continues the theme of exploring opportunities and achievements in applying modelling and control in the bio- and ecological domains.

TuPL1 Auditorium (301)
Robust Control in Biology: From Genes to Cells to Systems by Francis J. Doyle III, (Plenary Session)
Chair: Cho, Dong-il Dan — Seoul National Univ.

08:00-09:00 TuPL1.1
Robust Control in Biology: From Genes to Cells to Systems, pp. 3470-3479
Doyle III, Francis Joseph — Univ. of California at Santa Barbara

Natural control systems are paragons of optimality. Over millennia, these architectures have been honed to achieve robust regulation of a myriad of processes at the levels of genes, proteins, cells, and entire systems. One of the more interesting aspects of these circuits, and one of the challenges for control research, is unraveling the multi-scale, hierarchical control that achieves robust performance in the face of stochastic perturbations. These perturbations arise from both intrinsic sources (e.g., inherent variability in the transcription machinery), and extrinsic sources (e.g., environmental fluctuations). Robustness in key performance variables to particular perturbations is shown to be achieved at the expense of strong sensitivity to other perturbations.

In this talk, several biological examples will be used to highlight robustly regulated behavior, including: circadian timekeeping in neuronal cells; the unfolded protein response and its connection to Alzheimer's and diabetes; and programmed cell death (apoptosis). A key insight from these examples is that control at the cellular network level guides many properties in a manner that is distinct from control at the intracellular level.

A variety of tools from systems theory are employed in this research, including the structured singular value, sensitivity measures (with extensions to limit cycle behavior and stochastic systems), and discrete stochastic simulations. Those tools complement the high throughput biological assays that are used to interrogate the natural control circuits.

TuPL2 Auditorium (301)
Stochastic Learning and Optimization - a Sensitivity-Based Approach by Xi-Ren Cao (Plenary Session)
Chair: Kucera, Vladimir — Czech Tech. Univ. in Prague

09:00-10:00 TuPL2.1
Stochastic Learning and Optimization - a Sensitivity-Based Approach, pp. 3480-3492
Cao, Xi-Ren — Hong Kong Univ. of Sci. & Tech.

We introduce a sensitivity-based view to the area of learning and optimization of stochastic dynamic systems. We show that this sensitivity-based view provides a unified framework for many different disciplines in this area, including perturbation analysis, Markov decision processes, reinforcement learning, and identification and adaptive control. Many results can be simply derived and intuitively explained by using two performance sensitivity formulas. In addition, we show that this sensitivity-based view opens up new directions for future research. For example, the event-based optimization, which has advantages over the state-based approaches, may be developed with this sensitivity-based view.

TuA01 Atlantic Hall
Systems and Signals I (Poster Session)
Chair: Zaytoon, Janan — Univ. of Reims
Co-Chair: Veres, Sandor M — Univ. of Southampton

10:30-12:30 TuA01.1
Robust H-Infinity Control for Neutral Uncertain Switched Nonlinear Systems Using Multiple Lyapunov Functions, pp. 3493-3498
Li, Li-li — Northeastern Univ. China
Dimirovski, Georgi Marko — Dogus Univ. of Istanbul
Zhao, Jun — The Australian National Univ.

This paper focuses on the problem of robust H-infinity control for a class of switched nonlinear systems with neutral uncertainties via the multiple Lyapunov functions approach. Uncertainties are allowed to appear in channels of state, control input and disturbance input. Conditions for the solvability of the robust H-infinity control problem and design of both switching law and controllers are presented. As an application, a hybrid state feedback strategy is proposed to solve the standard robust H-infinity control problem for nonlinear systems when no single continuous controller is effective.

10:30-12:30 TuA01.2
Effect Output Noise in Iterative Learning Control, pp. 3499-3502
Liu, Shaojie — The Univ. of sheffield
Owens, David H. — The Univ. of Sheffield

In this paper Iterative Learning Control(ILC) algorithm is analysed for a linear-time invariant SISO model with the effect of output noise and its properties derived. If the original plant is positive, it is shown that by using a fixed learning gain algorithm, the tracking error will converge and be predicted. Finally, through computational experiments, we confirm the correctness of the proposed properties.

10:30-12:30 TuA01.3
An Improved Clonal Selection Algorithm Based Optimization Method for Iterative Learning Control Systems, pp. 3503-3508
Li, Hengjie — Lanzhou Univ. of Tech.
Hao, Xiaohong — Lanzhou Univ. of Tech.
Owens, David — the Univ. of Sheffield
Zhang, Lei — lanzhou Univ. of Tech.

Abstract: In this paper an improved Clonal Selection Algorithm (CSA) is proposed as a method to implement optimality based Iterative Learning Control algorithms. The strength of the proposed method is that it not only can cope with non-minimum phase linear plants and nonlinear plants but also can deal with constraints on input conveniently by a specially designed mutation operator. In addiction, because more priori information was used to decrease the size of the search space, the probability of the clonal selection algorithm converging rapidly to a global optimum was increased considerably. Simulations show that the convergence speed is satisfactory regardless of the nature of the plant.

10:30-12:30 TuA01.4
Model-Free Adaptive Control for a Class of Nonlinear Discrete-Time Systems Based on the Partial Form Linearization, pp. 3509-3514
Hou, Zhongsheng — Beijing Jiaotong Univ.
Jin, Shangtai — Beijing Jiaotong Univ.

The NARMA model is an exact representation of the input-output behavior of finite-dimensional nonlinear discrete-time dynamical systems in the neighborhood of the equilibrium state. However, it is inconvenient for purposes of adaptive control due to its nonlinear dependence on the control input, even by using the neural network method. In this paper, we introduce a so called model-free adaptive control (MFAC) method, which is based on some new dynamical linearization model and concept, the partial form linearization (PFL) and the pseudo-partial derivative (PPD) of a SISO nonlinear discrete-time system. The model-free means that the controller design is only based on the I/O data of the controlled plant, no training process, no structure information and no model are needed. Rigorous analysis and extensive simulations have shown that it has BIBO stability and performs very well.

10:30-12:30 TuA01.5
A Neural Network Observer-Based Approach for Synchronization of Discrete-Time Chaotic Systems, pp. 3515-3520
Naghavi, S.Vahid — Shiraz Univ.
Safavi, Ali Akbar — Shiraz Univ.

This paper presents a new approach to solve synchronization problem of a large class of discrete chaotic systems. The chaotic systems can be reformulated as an appropriate class of linear parameter varying (LPV) systems. Then, based on the LPV representation, a neural network observer-based approach is proposed to solve the synchronization problem. The simulation results show the advantages of combining the LPV techniques and the neural networks to determine the appropriate observer gain within the context of chaotic system synchronization.

10:30-12:30 TuA01.6
Robust Adaptive Control of Time-Delay Nonlinear Systems Via TS Recurrent Fuzzy CMAC Approach, pp. 3521-3526
Chiu, Chian-Song — Chung-Yuan Christian Univ.

This paper proposes an adaptive TS recurrent fuzzy CMAC (TS-RFCMAC) model based control of uncertain time-delay nonlinear systems. First, we introduce a TS-RFCMAC network and its application on system modeling. Next, a TS-RFCMAC controller is developed based on parallel distributed compensation and adaptive control laws. Even if uncertain local subsystem matrices and fuzzy sets exist in the model, asymptotic stability is assured by proper gain design and adaptive learning laws. Since all the weights (including recurrent weights) are also on-line adjusted, the proposed controller is more suitable for applying to uncertain time-delay systems. Finally, the simulation results show the expected performance.

10:30-12:30 TuA01.7

Disturbance Rejection in Neural Network Model Predictive Control, pp. 3527-3532

Jazayeri Moghadas, Seyed Ali — K. N. Toosi Univ. of Tech.
Fatehi, Alireza — K.N. Toosi Univ. of Tech.
Sadjadian, Houman — K. N. Toosi Univ. of Tech.
Khaki Sedigh, Ali — K.N. Toosi Univ. of Tech.

Neural Network Model Predictive Control (NN-MPC) combines reliable prediction of neural network with excellent performance of model predictive control using nonlinear Levenberg-Marquardt optimization. It is shown that this structure is prone to steady-state error when external disturbances enter or actual system varies from its model. In this paper, these model uncertainties are taken into account using a disturbance model with iterative learning which adaptively change the learning rate to treat gradual effect of the model mismatch differently from the drastic changes of external disturbance. Then, a high-pass filter on error signal is designed to distinguish disturbances from model mismatches. Practical implementation results as well as simulation results demonstrate good performance of the proposed control method.

10:30-12:30 TuA01.8

Iterative Identification and Control Satisfying Classical Robustness Measures, pp. 3533-3538

Berger, Marcus A. R. — Univ. Federal de Campina Grande
Barros, Péricles R. — Univ. Federal de Campina Grande

In this paper it is presented an iterative procedure for closed loop controller tuning applying a relay experiment. The phase margin is evaluated and a model is identified using constraints. This model is improved at high frequencies employing frequency data from the same experiment, the improved model is used to estimate the gain margin. The controller redesign is performed minimizing a frequency domain criterion based on gain and phase margins that are classical measures of robustness in addition to the crossover frequency. The procedure is applicable for a large number of processes types and safely approach specifications using a few experiments. Examples illustrate the properties of the design scheme.

10:30-12:30 TuA01.9

Adaptive FIR Filtering under Minimum Error/Input Information Criterion, pp. 3539-3543

Chen, Badong — Tsinghua Univ.
Hu, Jinchun — Tsinghua Univ.
Li, HongBo — Tsinghua Univ.
Sun, Zengqi — Tsinghua Univ.

In this paper, we use the mutual information between error/input as the cost function for adaptive filtering. For the finite-impulse response (FIR) filter, the connections between the minimum error/input information (MEII) criterion and traditional mean-square error (MSE) criterion are investigated. We show that, for Gaussian case, the MEII criterion is equivalent to the well-known orthogonality condition. Based on the MEII criterion and kernel density estimation, we derive a stochastic gradient algorithm. Simulation results emphasize the effectiveness of this new algorithm.

10:30-12:30 TuA01.10

Fast-Array Implementation of Adaptive IIR Filter in Feed-Forward Active Noise and Vibration Control Systems, pp. 3544-3549

Montazeri, Allahyar — Iran Univ. of Science and Tech.
Zavari, Keivan — Iran Univ. of Science and Tech.
Poshtan, Javad — Iran Univ. of Science and Tech.
Roosta, Alireza — Shiraz Univ. of Tech.

In this paper an RLS-based adaptive controller for active noise and vibration control systems is presented. This adaptive controller is designed based on feed-forward architecture and uses IIR filter as the control filter. Because the derived algorithm for ANVC systems is based on RLS recursion, its computational complexity is of order O(n^2) which is too high for real-time implementations. Besides, it is also vulnerable to round-off and finite precision errors that may occur in real-time implementation of the algorithm. Since the aim is to test the algorithm in an experimental duct a fast array implementation of the algorithm is proposed. This fast array form is used the extended the fast array algorithms for FIR filter which is studied in literature before. The proposed fast array solution of the algorithm not only reduces the computational complexity to the order of O(n) with the same performance, but also because of its matrix nature it has good numerical stability in real-time applications which is a necessity in active noise and vibration control applications.

10:30-12:30 TuA01.11

Computationally Efficient Sub-Optimal Mid Course Guidance Using Model Predictive Static Programming (MPSP), pp. 3550-3555

Dwivedi, Prasiddha Nath — DRDO
Bhattacharyaa, Abhijit — DRDO
Padhi, Radhakant — Indian Inst. of Science

For a homing interceptor, suitable initial condition must be achieved by mid course guidance scheme for its maximum effectiveness. To achieve desired end goal of any mid course guidance scheme, two point boundary value problem must be solved online with all realistic constrain. A Newly developed computationally efficient technique named as MPSP (Model Predictive Static Programming) is utilized in this paper for obtaining suboptimal solution of optimal mid course guidance. Time to go uncertainty is avoided in this formulation by making use of desired position where midcourse guidance terminate and terminal guidance takes over. A suitable approach angle towards desired point also can be specified in this guidance law formulation. This feature makes this law particularly attractive because warhead effectiveness issue can be indirectly solved in mid course phase.

10:30-12:30 TuA01.12

Sliding Sector Design for Nonlinear Systems, pp. 3556-3561

Korondi, Peter — Budapest Univ. of Tech. and Ec.
Hashimoto, Hideki — Univ. of Tokyo
Sziebig, Gabor — Budapest Univ. of Tech. and Ec.

The main contribution of this paper is a new method for sliding surface sector design to reduce the chattering. A new approach enables a systematic design based on the key idea that the Tensor Product (TP) model transformation is capable of decomposing sectors, furthermore it can define a High Order Singular Value Decomposition (HOSVD)-based canonical sector system. It is partially combination of sector sliding mode control, the classical manifold design for the linear system and HOSVD-based canonical description of a wide class of nonlinear systems. Experimental results of a DSP-controlled single-degree-of-freedom motion-control system are presented.

10:30-12:30 TuA01.13

Repetitive and Iterative Learning Controllers Designed by Duality with Experimental Verification, pp. 3562-3567

Ali Alsubaie, Muhammad — Univ. of Southampton
Cai, Zhonglun — Univ. of Southampton
Freeman, Christopher Thomas — Univ. of Southampton
Lewin, Paul — Univ. of Southampton
Rogers, Eric — Univ. of Southampton

A duality theory existing between iterative learning and repetitive control for linear time-invariant systems has been reported. This paper considers the application of this duality in the design of such controllers for a non-minimum phase experimental facility and a three-axis gantry robot, where the task performed can be configured in either mode of operation. The models used in the design work have been obtained using frequency domain tests conducted on the physical plants. The control design has been performed for both systems, and verified using simulation studies in the case of the gantry robot and experimentally obtained test results in the case of the non-minimum phase plant.

10:30-12:30 TuA01.14

Intelligent Control, Based on Reinforcement Learning, for Batch Thermal Sterilization of Canned Foods, pp. 3568-3573

Syam, Syafiie — Univ. of Valladolid
Garcia, Miriam — CSIC
Vilas, Carlos — CSIC
Tadeo, Fernando — Univ. of Valladolid Q4718001C
Alonso, Antonio A. — IIM-CSIC
Martinez, Ernesto — Ingar

A control technique based on Reinforcement Learning is proposed for controlling thermal sterilization of canned food. Without using an *a-priori* mathematical model of the process, the proposed Model-Free Learning Controller (MFLC) aims to follow a temperature profile during two steps of the process: first heating by manipulating the saturated steam valve and then cooling by opening the water valve) by learning. From the defined state-action space, the MFLC agent learns the environment interacting with the process batch to batch and then using a tabular state-action mapping. The results show the advantages of the proposed technique for this kind of processes.

10:30-12:30 TuA01.15

Closed Reentrant Queueing Networks under Affine Index Policies: Throughput Bounds, Examples and Asymptotic Loss, pp. 3574-3579

Morrison, James R. — KAIST
Juen, Joshua — Central Michigan Univ.

We extend linear programming performance evaluation methods to closed reentrant queueing networks. The approach automatically generates the parameters for a surrogate of the differential cost function and enables us to obtain bounds on the system throughput at reduced computational cost than exact solution methodologies. A comparison study of the bounds with the actual performance for tractable examples is conducted. The results show that the bounds can be quite good, in particular for unbalanced networks. For the closed version of a well known unstable network, we investigate the performance of the bounds and explore the asymptotic loss of the system.

10:30-12:30 TuA01.16

Control Synthesis Approach for DES Modelled by Petri Nets, pp. 3580-3585

Bekrar, Rebiha — Reims Univ.
Messai, Nadhir — Univ. de Reims Champagne-Ardenne
Essounbouli, Najib — Reims Univ.
Hamzaoui, Abdelaziz — Professor
Riera, Bernard — Reims Univ.

This paper presents a control synthesis approach for discrete event systems (DES) modelled by ordinary Petri Nets (PN) to solve a forbidden state problem. The PN herein considered are transitions controllable and contain measurable and non measurable places. The proposed PN controller is synthesised using the influence paths of the forbidden transitions. The latter are deduced from the PN reachability graph. The designed PN controller is maximally permissive because it prevents the occurrence of forbidden markings and guarantees exactly the desired behaviours. The proposed approach is illustrated by an example.

10:30-12:30 TuA01.17

Toward an Intelligent Distributed Safety Instrumented Systems : Dependability Evaluation, pp. 3586-3591

Mkhida, Abdelhak — ENSAM Meknes
Thiriet, Jean-Marc — CNRS-INPG-UJF
Aubry, Jean-François — INPL

In this paper, the modeling and thus the performance evaluation relating to the dependability are treated for structures which have intelligence in the instruments constituting the Safety Instrumented Systems (SIS) in order to determine the contribution of the intelligent instruments in the safety applications. The dynamic approach using the Stochastic Petri Nets (SPN) is proposed and the metrics used for the evaluation of the dependability of the Intelligent Distributed Safety Instrumented Systems (IDSIS) refer to two modes of failures mentioned by the safety standards : mode of dangerous failure and mode of safe failure.

10:30-12:30 TuA01.18

Robust Tasking of Airborne Sensing Nodes for Network Availability (I), pp. 3592-3597

Wu, Neng Eva — Binghamton Univ.
Guo, Yan — Binghamton Univ.
Ruschmann, Matthew — Binghamton Univ.

This paper considers tasking a finite number of cooperative agents to randomly emerging targets for their removal. Faults occur when some agents engaged in a mission are expired. Agents are subject to threat at a level determined by the number of targets present. On the other hand, the rate at which a target is removed depends on the number of cooperative agents assigned to it. Faults effectively change the network architecture and therefore degrade the network performance. Designs of control policies that determine the number of agents assigned are based on the network life when expired agents cannot be replenished, and on the network availability when expired agents are replenished at a certain rate. Tasking process is described by a discrete event system in the form of a queuing network, where agents are servers and targets are customers. Optimal policies are determined by solving a Markov decision problem. To facilitate the reader's understanding of the motivation, and of the problem, the agents are specialized to networked pairs of airborne sensors that are tasked to locate non-cooperating microwave transmitters as targets.

10:30-12:30 TuA01.19

Designing Dependable Dynamic Workflows through a Reflective PN-Based Approach (I), pp. 3598-3605

Capra, Lorenzo — Univ. of milan

The management of dynamic workflows needs adequate formal models and support tools to handle in a safe way changes occurring during workflow operation. A common approach is to pollute models with details that do not regard the workflow behavior, rather its evolution. That hampers analysis, reuse and maintenance in general. We propose and discuss the adoption of a recent Petri net-based reflective model to support dynamic workflow design, by addressing a localized open problem: how to determine what tasks should be redone and which ones do not when transferring a workflow instance from an old to a new template. The idea behind is that keeping functional aspects separated from evolutionary ones, applying evolution to a workflow template only when necessary, results in a clean reference model of dynamic workflows on which the ability of verifying major workflow properties favors a dependable evolution.

10:30-12:30 TuA01.20

Hierarchical Modelling and Verification Based on Petri Net Components with Multiple Import Interfaces, pp. 3606-3611

Kuessel, Uwe — RWTH Aachen
Padberg, Julia — Tech. Univ. Berlin
Abel, Dirk — RWTH-Aachen Univ.

This paper introduces the modelling of discrete event based system and the veri-fication of their properties using Petri net components. It is particularly interesting to apply a component based veri-fication approach in order to hierarchically structure Petri nets and to verify their properties component-wise. Here, a new theoretical notion is exemplified that facilitates modelling. This extension allows the definition of multiple import interfaces. Multiple import interfaces allow the component to import more than one other component and so simplifies the modeller's task as it provides means for a ``divide and conquer'' strategy.

10:30-12:30 TuA01.21

Response-Time Control of a Processor-Sharing System Using Virtualized Server Environments, pp. 3612-3618

Kjćr, Martin Ansbjerg — Lund Univ. LTH
Kihl, Maria — Lund Inst. of Tech. Lund Univ.
Robertsson, Anders — LTH, Lund Univ.

Feedback in server systems has during last years gained much interest in order to fulfill still increasing demands on performance and optimization regarding, for example, quality of service (QoS) requirements. In this paper we expand a previously published feedback-based prediction scheme for controlling a single server queue together with a new control strategy. These control structures have the benefit over other previously suggested control structures that no off-line estimation of the required work is needed. In addition, our solutions maintain or improve the performance, regarding average response time and loss of computational resources.

10:30-12:30 TuA01.22

Algorithms for Online Implementations of Explicit MPC Solutions, pp. 3619-3622

Sui, Dan — NUS
Feng, Le — The Norwegian Univ. of Science and Tech.

Hovd, Morten — Norwegian Univ. of Tech. and Science

One of the key problems in Model Predictive Control (MPC) is the inherent on-line computational complexity, which restricts its application to slow dynamic systems. To address this issue, multi-parametric programming technique is introduced in MPC (explicit MPC), where the optimization effort is moved off-line. The optimal solution is given in an explicitly piecewise affine function defined over a polyhedral subdivision of the set of feasible states. Instead of solving an optimization problem, the on-line work is simplified to identify the region the current state belongs to and simply evaluate the piecewise affine function. Hence, identifying of the member of the solution partition that contains a given point (referred to as a point location problem) impacts on the time to implement the explicit controller in real-time, which is one component of the complexity of explicit MPC. In this paper, two simple algorithms for point location problems are proposed to efficiently implement of explicit MPC solutions, which aim at reducing the number of polyhedral sets that are candidates to contain the state at the next time instant.

10:30-12:30 TuA01.23

Predictive Control of Nonlinear Hybrid Systems Using Generalized Outer Approximation, pp. 3623-3628

Nandola, Naresh — IIT Bombay
Bhartiya, Sharad — IIT Bombay

This paper presents an efficient optimization algorithm for mixed integer nonlinear programming (MINLP) problem resulting from multiple partially linearized (MPL) model based control of nonlinear hybrid dynamical system (NHDS). The algorithm uses structural information of the canonical MPL framework and derives comparatively easier quadratic programming (QP) primal problem as well as an MILP master problem for generalized outer approximation (GOA) algorithm, a decomposition based solution strategy for MINLP. Computational efficiency of the algorithm over the branch and bound strategy is demonstrated using a simulated benchmark three-spherical tank system.

10:30-12:30 TuA01.24

Flood Prevention of the Demer River Using Model Predictive Control, pp. 3629-3634

Barjas Blanco, Toni — KULeuven
De Moor, Bart L.R. — Katholieke Univ. Leuven

In order to prevent flooding along the Demer in Belgium, the local water administrations has installed hyraulic structures and flood reservoirs along the river. Though these actions have reduced the damage and frequency of flooding events, simulations have shown that an improved regulation could further decrease the flood risk. In this study a real time control procedure is being developed by means of model predictive control. For this purpose a full hydrodynamic model of the river basin has been simplified and a conceptual river model built in order to limit the model computational times. Afterwards a model predictive controller is built and used for flood control. A comparison is made between the performances of the model predictive controller and the currently used controller.

10:30-12:30 TuA01.25

An Interpretation of Concurrent Hybrid Time Systems Over Multi-Clock Systems, pp. 3635-3640

Bujorianu, Manuela — Univ. of Twente
Bujorianu, Marius Constantin — Univ. of Twente
Langerak, Romanus — Univ. of Twente

In this paper, we present a multiclock model for real time abstractions of hybrid systems. We call Hybrid Time systems the resulting model, which is constructed using category theory. Such systems are characterized by heterogeneous timing, some components having discrete time and others continuous time. We define a timed (or clock) system as a functor from a category of states to a category of time values. We further define concurrent composition operators and bisimulation.

10:30-12:30 TuA01.26

A Hybrid Predictive Control Scheme for Hygrothermal Process, pp. 3641-3646

Oliveira, Gustavo Henrique da Costa — PUCPR
Ushijima, Luiz Henrique — PUCPR

This work is focused on developing control algorithms for hygrothermal process represented by mixed logical and dynamical models. An example is the closed newborn incubator. Such kind of system promotes a controlled micro-climate, with small heat transfer between the premature and the environment, leading to comfortable and healthful environment. This device can be represented by a piece-wise linear model having discrete values for the input signal range. A hybrid predictive control scheme is proposed for such a process. The algorithm can also be applied to different dynamic systems having the same characteristics and it is easy to be implemented in real-time environments. System identification results based on orthonormal basis functions for finding the set of linear transfer functions are discussed. Closed-loop control experiments, by using an actual laboratory pilot plant (full scale), are performed and presented to validate the proposed method.

10:30-12:30 TuA01.27

On Input-To-Output Stability of Switched Nonlinear Systems, pp. 3647-3652

Efimov, Denis — Inst. for Problems of Mechanical Eng.
Panteley, Elena V. — CNRS
Loria, Antonio — CNRS

The problem of input-to-output stability for switched nonlinear systems is considered.We investigate methods based both, on constant and average dwell-times. In particular, we show that constant dwell-time should depend on initial conditions and disturbances amplitudes to ensure global stability properties for a generic nonlinear switched system.

10:30-12:30 TuA01.28

Synchronization of Complex Dynamical Networks with Switching Topology: A Switched System Point of View, pp. 3653-3658

Zhao, Jun — The Australian National Univ.
Hill, David J. — The Australian National Univ.

In this paper, we study the synchronization problem for complex dynamical networks with switching topology. The synchronization problem is transformed into the stability problem for a time-varying switched system. We address two basic problems: synchronization under arbitrary switching topology, and synchronization via design of switching within a pre-given collection of topologies when synchronization can not be achieved by using any topology alone in this collection. For the both problems, we first establish synchronization criteria for general connection topology. Then, under the condition of simultaneous triangularization of the connection matrices, a common Lyapunov function and a single Lyapunov function are systematically constructed respectively by those of several lower-dimensional dynamic systems.

10:30-12:30 TuA01.29

Global Asymptotic Stability of the Limit Cycle in Piecewise Linear Versions of the Goodwin Oscillator, pp. 3659-3664

Salinas-Varela, Adrian Alberto — Univ. of Cambridge
Stan, Guy-Bart — Univ. of Cambridge
Goncalves, Jorge M. — Univ. of Cambridge

Conditions in the form of linear matrix inequalities (LMIs) are used in this paper to guarantee the global asymptotic stability of a limit cycle oscillation for a class of piecewise linear (PWL) systems defined as the feedback interconnection of a saturation controller with a single input, single output (SISO) linear time-invariant (LTI) system. The proposed methodology extends previous results on impact maps and surface Lyapunov functions to the case when the sets of expected switching times are arbitrarily large. The results are illustrated on a PWL version of the Goodwin oscillator.

10:30-12:30 TuA01.30

Method for Analysis of Synchronization Applied to Supermarket Refrigeration System, pp. 3665-3670

Wisniewski, Rafael — Danfoss A/S
Larsen, Lars Finn Sloth — Danfoss A/S

Synchronisation arises in dynamical systems that are composed of a number of interconnected subsystems. In the paper we study synchronization in a particular application - a supermarket refrigeration system. The temperature control in supermarket display cases is typically maintained by a number of distributed hysteresis controllers. Synchronization is here manifested by the opening and closing actions of expansion valves at the same time. Synchronization will be interpreted as a limit cycle in a state space created by transitions among piecewise-affine dynamical systems. Stability of the resultant limit cycle is examined by a Poincar´e like map. We show that the synchronisation takes place if the corresponding Poincaré map is stable.

10:30-12:30 TuA01.31

Square-Root Algorithms of Recursive Least-Squares Wiener Estimators in Linear Discrete-Time Stochastic Systems, pp. 3671-3676

Nakamori, Seiichi — Kagoshima Univ.

This paper addresses the QR decomposition and UD factorization based square-root algorithms of the recursive least-squares (RLS) Wiener fixed-point smoother and filter. In the RLS Wiener estimators, the Riccati-type difference equations for the auto-variance function of the filtering estimate are included. Hence, by the roundoff errors, in the case of the small value of the observation noise variance, under a single precision computation, the auto-variance function becomes asymmetric and the estimators tend to be numerically instable. From this viewpoint, in the proposed square-root RLS Wiener estimators, in each stage updating the estimates, the auto-variance function of the filtering estimate is expressed in a symmetric positive semi-definite matrix and the stability of the RLS Wiener estimators is improved. In addition, in the square-root RLS Wiener estimation algorithms, the variance function of the state prediction error is expressed as a symmetric positive semi-definite matrix in terms of the UD factorization method.

10:30-12:30 TuA01.32

Linear Least-Squares Estimation Based on Covariances from Multiple Correlated Uncertain Observations, pp. 3677-3682

Caballero-Águila, Raquel — Jaén Univ.
Hermoso-Carazo, Aurora — Granada Univ.
Jiménez-López, José Domingo — Jaén Univ.
Linares-Pérez, Josefa — Granada Univ.
Nakamori, Seiichi — Kagoshima Univ.

In this paper, the linear least-squares estimation problem of signals from correlated uncertain observations coming from multiple sensors is addressed. It is assumed that, at each sensor, the signal is measured in the presence of additive white noise and that the uncertainty in the observations is characterized by a set of Bernoulli random variables which are only correlated at consecutive time instants. Assuming that the probability and correlation of such variables are not necessarily the same for all the sensors, a recursive filtering and fixed-point smoothing algorithm is proposed. The derivation of such algorithm does not require the knowledge of the signal state-space model, but only the covariance functions of the processes involved in the observation equation of each sensor, as well as the probability and correlation of the Bernoulli variables modeling the uncertainty. Recursive expressions for the estimation error covariance matrices are also provided, and the performance of the estimators is illustrated by a numerical simulation example wherein a signal is estimated from correlated uncertain observations coming from two sensors with different uncertainty characteristics.

10:30-12:30 TuA01.33

Access and Service Rate Control in Queuing System, pp. 3683-3688

Miller, Boris — Monash Univ.

The problem of access and service rate control as a general optimization problem for controlled Markov process with finite state space is considered. By using the dynamic programming approach we obtain the explicit form of the optimal control in the case of minimizing cost given as a mixture of an average queue length, number of lost jobs, and service resources. The problem is considered on a finite time interval in the case of non stationary input flow. In this case we suggest the general procedure of the numerical solution which can be applied to a problems with constraints.

10:30-12:30 TuA01.34

Estimation of State and Measurement Noise Covariance Matrices by Multi-Step Prediction, pp. 3689-3694

Dunik, Jindrich — Univ. of West Bohemia in Pilsen
Simandl, Miroslav — Univ. of West Bohemia

Estimation of noise covariance matrices for linear or nonlinear stochastic dynamic systems is treated. The novel off-line technique for estimation of the covariance matrices of the state and measurement noises is designed. The technique is based on the multi-step prediction error and on knowledge of the system initial condition and it takes an advantage of the well-known standard relations from the area of state estimation techniques and least square method. The theoretical results are illustrated in numerical examples.

10:30-12:30 TuA01.35

Analysis on Behaviors of Controlled Quantum Systems Via Quantum Entropy, pp. 3695-3700

Abe, Tomonari — The Univ. of Tokyo
Sasaki, Tomotake — The Univ. of Tokyo
Hara, Shinji — The Univ. of Tokyo
Tsumura, Koji — Univ. of Tokyo

In this paper, we investigate the essential properties of finite dimensional measurement-based quantum feedback control systems using a kind of quantum entropy, or so-called linear entropy. We show how the terms appear in the stochastic master equation affect the purity of the conditional density matrix of the system, and clarify a limitation of control action via Hamiltonian. Moreover, applying the stochastic version of LaSalle's invariance theorem, we derive a sufficient condition under which the conditional density matrix converges in probability to the set of all pure states for any control input. The result shows a class of measurement which assures preparation of a pure state.

10:30-12:30 TuA01.36

FIR Filters for Stationary State Space Signal Models, pp. 3701-3706

Park, Jung Hun — Seoul National Univ.
Kwon, Wook Hyun — Seoul National Univ.

A new finite impulse response (FIR) prediction is presented for a state space signal model. The linear predictor proposed in this paper uses the finite number of inputs and outputs on the recent time interval while the infinite impulse response (IIR) predictor with feedback and recursion uses all inputs and outputs from the initial time to the current time. The Yule-Walker equations for the linear forward and backward predictions are obtained from the correlation among states at each time and the orthogonality principle. How to solve these equations without an inverse of a big matrix is discussed. It is shown through simulation that the proposed FIR predictor can be as robust to modelling uncertainties as conventional robust IIR predictors. It is also shown that the good performance is achieved even in the steady state without uncertainties.

10:30-12:30 TuA01.37

Depth Control of Autonomous Underwater Vehicle Based on Open Control Platform, pp. 3707-3712

Syahroni, Nanang — Pusan National Univ.
Seo, Young Bong — Pusan National Univ.
Choi, Jae Weon — Pusan National Univ.

This paper describes depth control of autonomous underwater vehicle (AUV) using a new approach of decentralized system environment using Open Control Platform (OCP), to accommodate in changing information and control components. An LQR control algorithm with Genetic Algorithm (GA) is employed for simulation. In the simulation results, we present empirical results that show how OCP could helps to increase the degree of machine intelligence, and demonstrated by simulation on the real-time network environment.

10:30-12:30 TuA01.38

Compromises between Feasibility and Performance within Linear MPC, pp. 3713-3718

Ding, Yihang — Univ. of Sheffield
Rossiter, J. Anthony — Univ. of Sheffield

This paper explores the issues of feasibility and performance within predictive control. Conventional thinking is that there is typically a trade off between performance and the volume of the feasible region. However, this paper seeks to show that the trade off is often not as stark as might be expected and in fact one can sometimes gain huge amounts in feasibility with an almost negligible loss in performance while using a simple and conventional MPC algorithm.

10:30-12:30 TuA01.39

Observer-Based Synchronization of Discrete-Time Chaotic Systems under Communication Constraints, pp. 3719-3724

Fradkov, Alexander L. — Acad. of Sciences of Russia
Andrievsky, Boris — Inst. for Problems of Mechanical Engin.
Andrievsky, Alexey — IPME RAS

The paper is devoted to the synchronization problem of the discrete-time chaotic systems, coupled by the link ("the communication channel") with the limited bit-per-step rate. The observer-based full-order coder is designed, ensuring decay of the synchronization error asymptotically for the case when channel imperfections and computation errors are neglected. It is shown that if the computations in the both master and slave nodes of the channel are identical, the synchronization error can be made close to the maximum achievable accuracy of the given computer depending only on the number of digits in the computer. If the calculations in the coder and decoder are not identical (e.g., if the computers on these nodes have different number of digits), after the some time interval of decreasing the synchronization error, the mis-synchronization occurs due to unstable properties of the chaotic systems. For this case, the practical synchronization may be ensured applying the fixed-point arithmetic calculations. The result is illustrated numerically on the example of synchronization chaotic Henon systems.

10:30-12:30 TuA01.40

Coordinated Control of Multiple Mobile Agents with Connectivity Preserving, pp. 3725-3730

Su, Housheng — Shanghai Jiao Tong Univ.
Wang, Xiaofan — Shanghai JiaoTong Univ.

The underlying topology of the network remaining connected frequently enough during the evolution is a basic assumption seen in many previous works on coordinated control in a network of multi-agent systems to guarantee the stability of the coordinated motion. However, for a given set of initial conditions, this assumption is very difficult to verify. In particular, connectivity of the initial network can not guarantee connectivity of the network during the evolution. In this paper, we propose a coordinated control protocol, which combines the roles of motion control and connectivity control. This protocol can enable the group to achieve velocity alignment and a desired group shape while preserving connectivity of the network during the evolution only if the initial network is connected. Moreover, we investigate the coordinated control with a virtual leader.

10:30-12:30 TuA01.41

Stochastic Switching Approach of Bilateral Teleoperation Systems: Part I - Theory, pp. 3731-3736

Walker, Kevin — Dalhousie Univ.
Pan, Ya-Jun — Dalhousie Univ.
Gu, Jason — Dalhousie Univ.

In this paper, new control strategies based on Linear Matrix Inequalities (LMIs) are proposed for bilateral teleoperation systems over networks with time delays and packet losses. The characteristics of the network are thoroughly incorporated in the design and are mainly discussed in two cases: random packet loss with constant time delays; and random packet loss with random time varying delays. Correspondingly, a stochastic switching control approach is designed for the system with random packet loss. The Markov Jump Linear Systems (MJLSs) framework is applied using time based controllers to guarantee Mean Exponential Stability. The tracking error is shown to be bounded by the rate of change of the external forces acting on the teleoperation system. Finally, simulation results with experimentally collected network data show the performance of the proposed scheme as well as how to fine tune the controller gain.

10:30-12:30 TuA01.42

Stochastic Switching Approach of Bilateral Teleoperation Systems: Part II - Experiment, pp. 3737-3742

Walker, Kevin — Dalhousie Univ.
Pan, Ya-Jun — Dalhousie Univ.
Gu, Jason — Dalhousie Univ.

In this paper, the theory of a new stochastic switching control strategy based on Linear Matrix Inequalities (LMIs) is applied to the bilateral teleoperation systems over networks with time delays and packet loss. The control algorithm in the theory part is here extended to a case with asymmetric communication channels. In the experiment, two identical 1-DOF (degree of freedom) manipulators are used as master and slave systems. The characteristics of the network with random time delays and packet loss are thoroughly incorporated in the design. Correspondingly, a stochastic switching control is proposed to ensure that the tracking error is bounded by the rate of change of the external forces acting on the system. Finally, experimental setup and results are extensively discussed.

10:30-12:30 TuA01.43

Synchronization of a Class of Multi-Agent Systems with Large Population, pp. 3743-3748

Liu, Zhixin — Acad. of Mathematics and Systems Sciences
Guo, Lei — Chinese Acad. of Sciences

Multi-agent systems arise from diverse fields of natural and artificial systems, and a typical case is that each agent has the tendency to behave as other agents do in its neighborhood described by a disk or ball. This is actually reflected by the well-known Vicsek model. Since this model is of fundamental importance in understanding the multi-agent systems, it has attracted much attention from researchers in recent years. In this paper, we will present a comprehensive theoretical analysis of the nonlinear Vicsek model in a random framework, without imposing any connectivity conditions on the system trajectories as did in most of the previous investigations. To be precise, we will show that for any givenmodel parameters, i.e., the interaction radius r and the agents' moving velocity v, the overall system will synchronize as long as the population size is large enough, which justifies the phenomenon observed previously in simulations by Vicsek et al. (1995). The proof is based on the recent work of Tang and Guo (2007) for linearized Vicsek model, and involves the use of spectral graph theory and multi-array martingale estimation theory.

10:30-12:30 TuA01.44

Stochastic Observer-Based Guaranteed Cost Control for Networked Control Systems with Packet Dropouts, pp. 3749-3754

Fang, Xiaosheng — Shanghai Jiaotong Univ.
Wang, Jingcheng — Shanghai JiaoTong Univ.

This paper is concerned with an observer-based guaranteed cost control (GCC) problem for networked control systems (NCSs) with random data packet dropouts. Both the sensor-to-controller (S/C) and controller-to-actuator (C/A) packet dropouts are modeled by two mutually independent stochastic variables satisfying Bernoulli binary distribution. The resultant observer-based controller guarantees that the closed-loop system is stochastically exponentially mean-square stable and the cost function value is not more than a specified upper bound. The controller design problem is transformed to a convex optimization problem, which can be solved by a linear matrix inequality (LMI) approach. A numerical example is given to illustrate the effectiveness of the proposed design method.

10:30-12:30 TuA01.45

Set-Valued State Estimation for Uncertain Continuous-Time Systems Via Limited Capacity Communication Channels, pp. 3755-3760

Cheng, Teddy M. — Univ. of New South Wales
Malyavej, Veerachai — The Mahanakorn Univ. of Tech.
Savkin, Andrey V. — Univ. of New South Wales

This paper addresses a problem of set-valued state estimation for uncertain continuous-time systems via limited capacity communication channels. The uncertainty of the systems satisfies an integral quadratic constraint. Using results from the robust Kalman filtering, we design a coder/decoder-estimator pair that allows us to construct set-valued state estimate of the systems via communication channels.

TuA02 304A

Stabilization of Nonlinear Systems I (Regular Session)

Chair: Isidori, Alberto — Univ. of Rome "La Sapienza"
Co-Chair: Loria, Antonio — CNRS

10:30-11:10 TuA02.1

State-Dependent Riccati Equation (SDRE) Control: A Survey, pp. 3761-3775

Çimen, Tayfun — ROKETSAN Missiles Industries Inc.

Since the mid-90's, State-Dependent Riccati Equation (SDRE) strategies have emerged as general design methods that provide a systematic and effective means of designing nonlinear controllers, observers, and filters. These methods overcome many of the difficulties and shortcomings of existing methodologies, and deliver computationally simple algorithms that have been highly effective in a variety of practical and meaningful applications. In a special session at the 17th IFAC Symposium on Automatic Control in Aerospace 2007, theoreticians and practitioners in this area of research were brought together to discuss and present SDRE-based design methodologies as well as review the supporting theory. It became evident that the number of successful simulation, experimental and practical real-world applications of SDRE control have outpaced the available theoretical results. This paper reviews the theory developed to date on SDRE nonlinear regulation for solving nonlinear optimal control problems, and discusses issues that are still open for investigation. Existence of solutions as well as stability and optimality properties associated with SDRE controllers are the main contribution in the paper. The capabilities, design flexibility and art of systematically carrying out an effective SDRE design are also emphasized, demonstrating how several situations that prevent the direct application of the SDRE technique, such as the existence of state and control constraints, can be readily handled using this method.

11:10-11:30 TuA02.2

A Note on Robust Output Feedback Stabilization of Nonlinear Nonminimum Phase Systems, pp. 3776-3780

Isidori, Alberto — Univ. of Rome
Marconi, Lorenzo — Univ. di Bologna

This paper investigates a few issues related to the problem of robust output feedback stabilization of nonlinear non-minimimum phase systems. In order to cope with (unstructured) parametric uncertainties we insist on well-known high-gain design principles which, however, are integrated with robust zero-assignment procedures to handle possible unstable zero dynamics. In this respect we propose two possible zero-assignment arguments. The Żrst relies upon an output redesign obtained by means of a "feed-through" compensator. Interestingly enough, we show how existing results on this subject can be cast in terms of the resulting feed-through / high-gain design paradigm. In the second, by drawing inspiration from known results for linear systems which go under the name of vibrational-feedback, the output redesign is achieved by using time- varying periodic controllers. Remarkably, we show how the resulting design framework is able to deal also with severe uncertainties in the high-frequency gain of the controlled system by thus obtaining results which turn out to be interesting also in a linear setting.

11:30-11:50 TuA02.3

Feedback Stabilization of the TORA System Via Interconnection and Damping Assignment Control, pp. 3781-3786

Morillo, Atilio — Univ. del Zulia
Ríos-Bolívar, Miguel — Univ. de Los Andes
Acosta, Vivian — Univ. de Los Andes

In this work, we consider the feedback stabilization of the so-called Translational Oscillator with a Rotational Actuator (TORA) system by applying the Interconnection and Damping Assignment (IDA) control methodology. To achieve this goal, the mechanical system is firstly transformed into the general port controlled Hamiltonian form and, then, the IDA design procedure is applied to synthesize the stabilizing control law. The Hamiltonian structure of the closed loop system is preserved and asymptotic stability of the mechanical position is achieved, which is verified by digital simulations.

11:50-12:10 TuA02.4

Control under Quantization, Saturation and Delay: An LMI Approach, pp. 3787-3792

Fridman, E. M. — Tel-Aviv Univ.
Dambrine, Michel — Univ. de Valenciennes et du Hainaut-Cambrésis

This paper studies quantized and delayed state-feedback control of linear systems. We consider two types of quantization: quantized feedback and quantized state. The quantizer may be either unconstrained or saturated with a given quantization error bound. The delay is supposed to be time-varying and bounded. The controller is designed with the following property: all the states of the closed-loop system (starting from a neighborhood of the origin in the saturated case) exponentially converge to some bounded region in the state space. The design procedure is given in terms of Linear Matrix Inequalities (LMIs), derived via Lyapunov-Krasovskii functional and comparison principle.

12:10-12:30 TuA02.5

An Inner-Loop Controller Guaranteeing Robust Transient Performance for Uncertain MIMO Linear Systems, pp. 3793-3798

Back, Juhoon — Korea Univ.
Shim, Hyungbo — Seoul National Univ.
Joo, Young Jun — Seoul National Univ.

An output-feedback controller has been recently proposed that has the following features: (1) it is an inner-loop controller so that it can be added on the existing closed-loop system working in harmony with a pre-designed (possibly non-robust) outer-loop controller, (2) it robustifies the closed-loop system in a way that the uncertain plant under external disturbance becomes a nominal plant without any disturbance, (3) it recovers the trajectory of the nominal closed-loop system in time domain. However, it is restricted to the single-input-single-output systems. In this paper, we extend this result for a class of multi-input-multi-output (MIMO) linear systems having the same number of inputs and outputs. The used tools in this synthesis are the singular perturbation theory and the multi-variable circle criterion.

TuA03 304B

Advances in Higher Order Sliding Mode Control (Invited Session)

Chair: Shtessel, Yuri B. — Univ. of Alabama at Huntsville
Co-Chair: Levant, Arie — Tel - Aviv Univ.
Organizer: Shtessel, Yuri B. — Univ. of Alabama at Huntsville
Organizer: Levant, Arie — Tel - Aviv Univ.
Organizer: Fridman, Leonid M. — Univ. of Mexico

10:30-11:10 TuA03.1

Homogeneous High-Order Sliding Modes (I), pp. 3799-3810

Levant, Arie — Tel - Aviv Univ.

Homogeneity features of dynamic systems are known to provide for a number of general practically important features. In particular, the finite-time convergence is easily proved, and the asymptotic accuracy is readily calculated in the presence of input noises, delays and discrete sampling. General uncertain single-input-single-output regulation problems are only solvable by means of discontinuous control via the so-called high-order sliding modes (HOSM). The homogeneity approach facilitates the design and investigation of new HOSM controllers, featuring such attractive properties as practical continuity of the control in the presence of noises. Robust output-feedback controllers are produced, using robust exact homogeneous differentiators. The asymptotic accuracy of the obtained controllers is the best possible under given circumstances. The dangerous chattering effect is removed by means of a standard procedure. The resulting systems are robust with respect to the presence of unaccounted-for fast stable dynamics of actuators and sensors. Simulation results and applications are presented in the fields of control, signal and image processing.

11:10-11:30 TuA03.2

Blood Glucose Regulation Via Double Loop Higher Order Sliding Mode Control and Multiple Sampling Rate (I), pp. 3811-3816

Kaveh, Parisa — Univ. of Alabama in Huntsville
Shtessel, Yuri B. — Univ. of Alabama at Huntsville

Diabetes is a serious disease during which the body's production and use of insulin is impaired, causing glucose concentration level to increase in the bloodstream. The blood glucose dynamics is described using the Bergman minimal model. Higher order sliding mode control techniques, including the prescribed convergence law, the smooth second order, the quasi-continuous, and the super-twisting control algorithm, are studied for the double loop robust stabilization of the glucose concentration level of a diabetic patient in presence of the parameter variations and meal disturbance. In the inner loop super-twisting control stabilizes the glucose pump-actuator that yields a dynamical collapse of the loop. In the outer loop the higher order sliding mode controller generates a command to the pump-actuator in terms of insulin injection rate. The higher order sliding mode differentiator is employed to facilitate the controllers. The efficiency of the proposed controllers and observers/differentiators, i.e. robustness and high accuracy, in presence of physical disturbances like food intake and parametric uncertainties is confirmed via simulations. Two sampling rates are successfully employed in the simulations: a smaller one for the system and the controller and the larger one for the glucose sensor.

11:30-11:50 TuA03.3

Observation and Separation Principle for the Chattering-Free Control of Multi-Input Systems with Simplex Sliding Mode (I), pp. 3817-3822

Bartolini, Giorgio — Univ. of Cagliari
Punta, Elisabetta — National Res. Council of Italy - CNR
Zolezzi, Tullio — Univ. of Genoa

In this paper a method to simultaneously achieving the two main objective of smoothing the control while maintaining ideally infinite frequency regimes is particularized to the simplex sliding mode method. The present paper proposes a simplex sliding mode control logic based on the time derivative of the control vector. This practice, beside the standard chattering reduction effect, has the important consequence of making possible the control of a rather wide class of uncertain systems nonlinear in the control. In the uncertain case the increment of the relative degree implicit in the proposed approach requires the introduction of second order sliding mode observer. A separation theorem is proven and sufficient conditions for the finite time convergence of both the estimation and tracking errors are found in terms of further requirements on the control amplitude.

11:50-12:10 TuA03.4

On the Transfer Properties of Second-Order Sliding Mode Control Systems (I), pp. 3823-3829

Pisano, Alessandro — Univ. di Cagliari
Fridman, Leonid M. — Univ. of Mexico
Boiko, Igor — IMB Controls
Usai, Elio — Univ. degli Studi di Cagliari

A comprehensive approach to the input/output analysis of a class of secondorder sliding mode control (2-SMC) systems is developed. Linear SISO plants with the “generalized suboptimal” 2-SMC algorithm are investigated. It is shown that in order to evaluate the properties of robustness against the presence of external perturbations the generalized suboptimal controller can be replaced by a proper constant gain, which is called “equivalent gain”. The approximate DF method, and the theoretically exact LPRS method, are developed for computing the equivalent gain. It results from the presented analysis that the considered algorithm possesses an higher equivalent open-loop gain as compared to the standard relay. A thoroughly discussed worked example confirms the theoretical results and shows the feasibility of the presented procedures.

12:10-12:30 TuA03.5

On ZOH Discretization of Higher-Order Sliding Mode Control Systems (I), pp. 3830-3835

Wang, Bin — Royal Melbourne Inst. of Tech.
Yu, Xinghuo — RMIT Univ.

In this paper, the zero-order-hold (ZOH) dicretization of higher-order sliding mode control (SMC) systems is studied. The equivalent control based SMC systems with relative degree higher than one is first formulated into a canonical form which is easy for control design. Theoretical results for the ZOH-discretized SMC systems with relative degree higher than one are given, including accurate estimates of the bounds of steady states and higher order sliding mode functions. Simulation results are presented to show the effectiveness of the analysis.

TuA04 308

Applications of Nonlinear Control III (Regular Session)

Chair: Hammouri, Hassan — Univ. Claude Bernard
Co-Chair: Laila, Dina Shona — Imperial Coll. London

10:30-10:50 TuA04.1

Control of Oriented Mechanical Systems: A Method Based on Dual Quaternion, pp. 3836-3841

Han, Dapeng — National Univ. of Defense Tech.
Wei, Qing — National Univ. of Defense Tech.
Li, Zexiang — Hong Kong Univ. of Science & Tech.
Sun, Weimeng — National Univ. of Defense Tech.

This paper focuses on a new type of control laws for oriented mechanical systems. The starting point is dual quaternion and its properties. Logarithm of dual quaternion is defined, based on which control laws are developed, tackling both regulation and tracking problems using logarithmic feedback. The control laws are shown to have several merits, including global asymptotically convergence, computational efficiency, and proper handling of the coupling between rotation and translation. Simulation results validate our design.

10:50-11:10 TuA04.2

Nonlinear Observer and Output Feedback Design for a Combustion Engine Test Bench, pp. 3842-3847

Laila, Dina Shona — Imperial Coll. London
Gruenbacher, Engelbert — Linz Center of Mechatronics

Combustion engine control depends strongly on the availability and the quality of the signals involving in the controller construction. In general, not all signals are available through measurement, and therefore an observer is necessary to realize the controller. This paper proposes an observer design for a combustion engine test bench. The observer is used to estimate the torque and the rotation angle of the engine, based on the measurement of the engine and the dynamometer speeds. The convergence of the observer is proved, and separation principle is also shown. The observer is then used to construct an output feedback controller for set point tracking of the test bench. Numerical simulations are performed, showing the performance of the observer and comparing the performance of the output feedback with the state feedback controller. Moreover, the effect of combustion oscillation which causes a vibration noise is taken into account, and the use of internal model based filter to handle the noise is presented.

11:10-11:30 TuA04.3

Adaptive Backstepping Control for Vibration Reduction in a Structure with Frictional and Hysteretic Actuators, pp. 3848-3853

Zapateiro, Mauricio — Univ. of Girona
Karimi, Hamid Reza — Univ. of Girona
Luo, Ningsu — Univ. of Girona

This paper presents an alternative solution to the vibration problem in civil engineering structures. This kind of structures are characterized by the uncertainties of the parameters that describe their dynamics, such as stiffness and damping coefficients. Moreover, the actuators used to mitigate the vibrations caused by earthquakes are usually nonlinear devices with frictional or hysteretic dynamics. In order to account for the uncertainties and the nonlinearities, an adaptive backstepping controller is proposed. Semiactive control force is applied to the structure through a magnetorheological damper together with a passive frictional actuator that isolates the base of a 10-story building. The effectiveness of the controller is shown by comparing the simulation results of the cases when the structure is isolated and when it is not.

11:30-11:50 TuA04.4

Lyapunov Based Control for Non Isothermal Continuous Stirred Tank Reactor, pp. 3854-3858

Hoang, Ngoc Ha — Univ. Claude Bernard Lyon 1
Couenne, Francoise — Univ. of Lyon 1
Jallut, Christian — Univ. Claude Bernard Lyon 1
Le Gorrec, Yann — Univ. of Lyon, Lyon 1

In this contribution we apply the approach of passivity proposed by Ydstie for physico-chemical processes. The originality of this work lies in the fact we consider a thermodynamically nonlinear consistent model for a continuous stirred tank reactor to built the appropriate Lyapunov function for stabilization purpose. Indeed the kinetics of reaction modelled by Arhenius law leads to non linear model with multiple steady state. We propose to stabilize the reactor around the instable point. In order to apply the Ydstie approach, we assume that the fluid remains homogeneous. This assumption permits to use the concavity property of the entropy function to build the Lyapunov function. We propose feedback laws in order to ensure the closed loop properties of the Lyapunov function. Finally we propose some simulation results.

11:50-12:10 TuA04.5

Nonlinear Implicit On-Line Observer : Application to the Estimation in Binary Distillation Columns, pp. 3859-3864

Mota Grajales, Rafael — Inst. Tecnologico de Tuxtla Gutiérrez
Nadri, Madiha — Univ. Claude Bernard Lyon 1
Hammouri, Hassan — Univ. Claude Bernard

The current demand for more complex models has initiated a shift away from state- space models towards models described by both dynamic and algebraic equations, so-called implicit systems. These models arise as the natural product of real processes. In this paper, we consider design of observers for a class of implicit systems. The proposed observer combines the dynamic Newton-Raphson algorithm as well as a high gain method. It is described by differential equations and it can be initialized outside the algebraic constraints. The main results of the paper include conditions that ensure the exponential convergence of the observer error. Design methodology is presented and the performance of the proposed observer illustrated using an application to a binary distillation column model. Keywords: Nonlinear system, implicit system, high gain observer, constant gain.

12:10-12:30 TuA04.6

Adaptive Observer and Kalman Filtering, pp. 3865-3870

Benzemrane, Khadidja	CNRS / Evry Univ.
Damm, Gilney	IBISC Lab. CNRS/Evry Univ.
Santosuosso, Giovanni L.	Univ. di Roma Tor Vergata

In this paper the problem of the speed estimation of an Unmanned Aerial Vehicle is addressed, when only the standard outputs (acceleration, angles and angular speeds) are available for measurement. We focus our analysis on a prototype drone - a 4 rotors helicopter robot- which is not equipped with GPS related devices and relies on the Inertial Measurement Unit (IMU) only. Two different approaches have been compared. The first one uses a classical method based on Kalman Filtering while the second solution is provided in the frame of adaptive observation theory. These estimators have been tested in two situations : when exact measurements are available and in the more realistic case of noisy acceleration measurements

TuA05 307

Switching Stability and Control I (Regular Session)

Chair: Fikar, Miroslav	STU in Bratislava
Co-Chair: Yoon, Tae-Woong	Korea Univ.

10:30-10:50 TuA05.1

On Stability of Switched Differential Algebraic Systems -- Conditions and Applications, pp. 3871-3876

Pendharkar, Ishan	Indian Inst. of Tech. Bombay, India.
Wulff, Kai	Tech. Univ. of Berlin
Raisch, Joerg	Tech. Univ. Berlin

We obtain an efficient parametrization that ensures stability of switched linear systems under arbitrary switching. Apart from stability analysis, our results are useful for addressing several important system theoretic problems, e.g.designing controllers that ensure robustness against arbitrary combinations of sensor or actuator failure. We illustrate our results by considering control of a distillation column.

10:50-11:10 TuA05.2

Polynomial Approximation of Closed-Form MPC for Piecewise Affine Systems, pp. 3877-3882

Kvasnica, Michal	Slovak Univ. of Tech. in Bratislava
Christophersen, Frank J.	ETH - Swiss Federal Inst. of Tech.
Herceg, Martin	Slovak Univ. of Tech. in Bratislava
Fikar, Miroslav	STU in Bratislava

This paper addresses the issue of the practical implementation of closed-form Model Predictive Controllers (MPC) to processes with very short sampling times. Such questions come in consideration when the solution to MPC problems is expressed in a so-called parametric or closed-form fashion. The underlying idea of this paper is to approximate the optimal control law defined over state space regions by a higher degree polynomial which then guarantees closed-loop stability, constraint satisfaction, and a bounded performance decay. The advantage of the proposed scheme lies in faster controller evaluation and lower storage demand compared to currently available techniques.

11:10-11:30 TuA05.3

Stabilization of Switched Discrete-Time Systems with Time-Varying Delay, pp. 3883-3888

Leite, Valter J. S.	CEFET/MG - Campus Div.
Miranda, Marcio Fantini	Federal Univ. of Minas Gerais

A convex approach is proposed to deal with switched discrete-time systems with time-varying delays. It uses a parameter dependent Lyapunov-Krasovskii functional that allows to assure the robust stability or the robust stabilization of a switched system for arbitrary switching functions. The analysis and the design conditions are formulated as simple feasibility tests of linear matrix inequalities (LMIs). The presented conditions encompass previous results found in the literature, yielding less conservative and convex design methods. The design conditions can take into account the rate of variation of delay and deal with decentralized control. A design example is presented to illustrate the efficacy of the proposed LMI conditions, including some time-simulations.

11:30-11:50 TuA05.4

Robust Tracking Control for Switched Linear Systems with Time-Delay: An Average Dwell Time Approach, pp. 3889-3894

Li, Qing-Kui	Northeastern Univ.
Dimirovski, Georgi Marko	Dogus Univ. of Istanbul
Zhao, Jun	The Australian National Univ.

Robust tracking control for switched linear systems with time-delay is investigated in this paper. Sufficient conditions for the solvability of robust tracking control problem are developed. Based on the theories of functional differential equations, the norm bound of the reference state of time-delay system is given. An average dwell time approach and piecewise Lyapunov functional method are utilized to design the switching control laws. By using linear matrix inequalities, the controller design problem can be solved efficiently. A simulation example shows the effectiveness of the proposed switching control laws.

11:50-12:10 TuA05.5

Asymptotic Tracking of Non-Sinusoidal Periodic References: A Switched Linear Internal Model Approach, pp. 3895-3900

Rossi, Carlo	Univ. of Bologna
Tilli, Andrea	Univ. of Bologna
Toniato, Manuel	Univ. of Bologna

The regulation theory is a very robust way to achieve the asymptotic tracking of input references on Linear Time-invariant systems generated by an exosystem. Nevertheless, the classical regulation theory cannot be applied to the asymptotic tracking of non-sinusoidal periodic references having an infinite number of harmonics (as triangular waves). In literature many methods have been proposed to deal with this kind of problem. In this paper a novel approach based on a Switched Linear Internal Model is proposed by presenting some preliminary results. This approach seems particularly promising in terms of robustness to disturbances not “captured” by the internal model and this is the main motivation of starting this study.

12:10-12:30 TuA05.6

Tracking Control for Switched Linear Systems with Time-Delay, pp. 3901-3906

Li, Qing-Kui	Northeastern Univ.
Dimirovski, Georgi Marko	Dogus Univ. of Istanbul
Zhao, Jun	The Australian National Univ.

Tracking control for switched linear systems with time-delay is investigated in this paper. Sufficient conditions for the solvability of the tracking control problem are given respectively for the cases that the state of system is measurable and non-measurable.When the state is measurable, we design a switching control law to achieve the H_{infty} model reference tracking performance. When the state is not available, the design of a switching control law based on measured output instead of the state information is considered. Lyapunov function methods are utilized to the stability analysis and controller design for the switched linear systems with time-delay. By using linear matrix inequalities and convex optimization techniques, the controller design problem can be solved efficiently. The simulation examples show the validity of the switching control laws.

TuA06 310A

Time Delay Systems: Stabilisation and Control (Regular Session)

Chair: Kucera, Vladimir	Czech Tech. Univ. in Prague
Co-Chair: Arunsawatwong, Suchin	Chulalongkorn Univ.

10:30-10:50 TuA06.1

Affine Parameterization of Cascade Control with Time Delays, pp. 3907-3912

Zitek, Pavel	Czech Tech. Univ.
Kucera, Vladimir	Czech Tech. Univ. in Prague
Vyhlidal, Tomas	Czech Tech. Univ. in Prague

The cascade control architecture is a standard solution in control engineering practice for industrial plants with considerable time delays. In this paper, the set of all stabilizing cascade controllers in parametric form is presented for such plants. The parameterization is based on the use of the so-called RQ meromorphic functions expressing the time delay character of the plant and the controller. The parameter enters any closed-loop transfer function in an affine manner. The performance is specified in terms of disturbance rejection and the 'slave' controller gain is considered as the key parameter of the affine parameterization. Unlike in most literature on the subject, the primary controlled output is not considered to be directly dependent on the secondary controlled variable. The disturbance rejection potentials are discussed for various options of controlled plants with delays and the varying role of the secondary controlled output option is investigated.

10:50-11:10 TuA06.2

Asymptotic Sensitivity Properties of Davison Type Integral Controllers for Time-Delay Plants, pp. 3913-3918

Ishihara, Tadashi	Fukushima Univ.
Zheng, Liang An	National Kaohsiung Univ. of Applied Sciences
Guo, Hai-jiao	Tohoku Gakuin Univ.

Sensitivity properties of the Davison type integral controllers for time-delay plants are discussed on the assumption that the observer gain matrix is fixes and the cheap control is used to determine the feedback gain matrix. It is shown that the Davison type integral controller can be expressed as a limit of the standard predictor-based LQG controller. The explicit representation of the asymptotic sensitivity matrix is obtained by a simple limiting procedure for the standard problem. A numerical example is presented to illustrate the difference from the standard predictor-based LQG controller.

11:10-11:30 TuA06.3

Rejection of Persistent Bounded Disturbance for a Class of Time-Delay Systems, pp. 3919-3922

Sun, Man	Beihang Univ.
Jia, Yingmin	Beihang Univ.
Du, Junping	Beijing Univ. of Posts and Telecommunications
Yu, Fashan	Henan Pol. Univ.

This paper considers the problem of persistent bounded disturbance rejection for a class of time-delay systems by Lyapunov function and positively invariant set analysis method. Sufficient conditions for internal stability and L_{1}-performance analysis are given in terms of linear matrix inequalities (LMIs). Based on which, a dynamic output-feedback controller is then designed. All the obtained results are delay-dependent, and therefore, are less conservative. A numerical example is included to illustrate the proposed method.

11:30-11:50 TuA06.4

H_{infty} Output Feedback Control for Singular Systems with Time-Varying Delay, pp. 3923-3927

Li, Lin	BeiHang Univ.
Jia, Yingmin	Beihang Univ.
Du, Junping	Beijing Univ. of Posts and Telecommunications
Yu, Fashan	Henan Pol. Univ.

This paper is devoted to the problem of H-inf output feedback control for linear singular systems with state time-varying delay. The purpose is to design a non-singular dynamic output feedback controller to ensure that the closed-loop system is regular, impulse free and stable with a prescribed H-inf performance level. Using the linear matrix inequality (LMI) approach, a new delay-dependent stability criterion is obtained by introducing a free-weighting matrix when estimating the upper bound of the derivative of Lyapunov Functional. And the corresponding stability controller design algorithm is proposed. Finally, a numerical example is included to demonstrate the effectiveness of the proposed method.

11:50-12:10 TuA06.5

Stability and Stabilization of Retarded Fractional Delay Differential Systems, pp. 3928-3933

Nguyen, Van Quang	Chulalongkorn Univ.
Arunsawatwong, Suchin	Chulalongkorn Univ.

The main objective of this paper is twofold. First, we devise a stabilty test for determining whether a linear retarded fractional delay differential system has no characteristic roots in a specified right half of the complex plane. Second, we develop a practical method for computing the abscissa of stability (defined as the largest of the real parts of the characteristic roots) for this type of system. The method is based on a known technique which makes repeated use of a stability test, thereby avoiding the calculation of all the roots. The stability test and the method for computing the abscissa of stability provides useful computational tools for the design of fractional differential systems using the method of inequalities as well as other numerical optimization approaches. Numerical examples are also given.

12:10-12:30 TuA06.6

Memoryless Control to Drive States of Delayed Continuous-Time Systems within the Nonnegative Orthant, pp. 3934-3939

Hmamed, Abdelaziz	Faculty of Science Dhar Elmhraz
Benzaouia, Abdellah	Faculty of Science Semlalia
Rami, Mustapha Ait	Chinese Univ. of Hong Kong
Tadeo, Fernando	Univ. of Valladolid Q4718001C

The stabilization problem for the class of linear continuous-time systems with fixed but unknown delay is solved when the additional condition that the states are nonnegative is studied. In particular, the synthesis of state-feedback controllers is solved by giving necessary and sufficient conditions in terms of Linear Programs. The solution is also extended to stabilization by bounded control (including nonnegative control) and stabilization under uncertainty.

TuA07 310B

Dynamic Games and Applications (Invited Session)

Chair: Freiling, Gerhard	Univ. Duisburg-Essen
Co-Chair: Abou-Kandil, Hisham	Ec. Normale Sup. Cachan
Organizer: Abou-Kandil, Hisham	Ec. Normale Sup. Cachan
Organizer: Jungers, Marc	CNRS - Nancy Univ. ENSEM

10:30-10:50 TuA07.1

A Stackelberg Game Approach to Mixed H2/H_infinity Control (I), pp. 3940-3945

Jungers, Marc	CNRS - Nancy Univ. ENSEM
Trelat, Emmanuel	Univ. of Paris Sud (Orsay)
Abou-Kandil, Hisham	Ec. Normale Sup. Cachan

The H2/Hinf robust control problem is formulated as a Stackelberg differential game where the leader minimizes an H2 criterion while the follower deals with the Hinf constraint. For a closed loop information structure in the game, the necessary conditions to solve such a constrained optimization problem are derived for the finite time horizon case. It is shown that such an approach leads to a singular control and the Stackelberg strategy degenerates due to the omnipotence of the leader. Using conjugate times theory, we prove that the derived necessary conditions are also sufficient.

10:50-11:10 TuA07.2

Coupled Riccati Differential Equations Arising in Connection with Nash Differential Games (I), pp. 3946-3951

Freiling, Gerhard	Univ. Duisburg-Essen

We provide iterative procedures for the numerical computation of stabilizing solutions of two types of coupled matrix Riccati differential equations arising in connection with Nash differential games using open loop or feedback strategies. Here we assume that these equations are associated with positive systems. The proposed procedures are based on solutions of uncoupled symmetric or nonsymmetric Lyapunov equations.

11:10-11:30 TuA07.3

The Open-Loop Linear Quadratic Differential Game for Index One Descriptor Systems (I), pp. 3952-3957

Engwerda, Jacob	Tilburg Univ.
Salmah, Salmah	Gadjah Mada Univ.

In this paper we consider the linear quadratic differential game for descriptor systems that have index one. We derive both necessary and sufficient conditions for existence of an open-loop Nash equilibrium.

11:30-11:50 TuA07.4

Robust Stackelberg Equilibrium for a Multi-Scenario Two Players Linear Affine-Quadratic Differential Game (I), pp. 3958-3963

Jimenez-Lizarraga, Manuel	Autonomous Univ. of Nuevo León, México.
Poznyak, Alexander S.	CINVESTAV-IPN

This paper presents the formulation of a new concept dealing with a Robust Stackelberg equilibrium for a multi scenario or mutiple models of a linear affine-quadratic game. The game dynamic is given by a family of N different possible differential equations (Multi-Model representation) with no information about the trajectory which is realized. The robust Stackelberg strategy for each player must confront with all possible models simultaneously. The problem consists in the designing of min-max strategies for each player which guarantee an equilibrium for the worst case scenario. Based on the Robust Maximum Principle, the general conditions for a game to be in Robust Stackelberg Equilibrium are also presented. A numerical procedure for resolving the case of LQ differential game is designed.

11:50-12:10 TuA07.5

Solutions in Nonantagonistic Positional Differential Games with Vector Payoff Functionals (I), pp. 3964-3969

Kleimenov, Anatolii — Inst. of Mathematics and Mechanics of Ural Branch of the Rus

Nonantagonistic two-person differential game with fixed final time and with vector terminal payoff functionals for players is considered. Both the players act in the class of strategies defined as arbitrary functions of a position of the game and a precision parameter. A formalization of the game is given. A concept of a solution of the game is introduced. It is shown that the problem of finding the solutions of the game is reduced to a problem of constructing program controls of players satisfying some special conditions. Two examples are considered. The first one is devoted to control motions of a material point on the plane. The second one deals with repeated prisoners' dilemma.

12:10-12:30 TuA07.6

Asymptotic Epsilon-Nash Equilibrium for 2nd Order Two-Player Nonzero-Sum Singular LQ Games with Decentralized Control, pp. 3970-3975

Wang, Xu — Ohio State Univ.
Cruz, Jose B — The Ohio State Univ.

We propose a new equilibrium concept: asymptotic µ;-Nash equilibrium for 2nd order two-player nonzero-sum games where each player has a control-free cost functional quadratic in the system states over an infinite horizon and each player's control strategy is constrained to be continuous linear state feedback. Based on each player's singular control problem, the asymptotic µ;-Nash equilibrium implemented by partial state feedback is constructed and the feedback gains can be found by solving a group of algebraic equations which involves the system coefficients and weighting matrices in the cost functionals. As an illustration of the theories discussed in this paper, a numerical example is given where the partial state feedback gains can be found explicitly in terms of the system coefficients and weighting matrices in the cost functionals.

TuA08 310C

Robust Controller Synthesis I (Regular Session)

Chair: Scherer, Carsten W. — Delft Univ. of Tech.
Co-Chair: Polyak, Boris T. — Moscow Inst. of Control Sciences

10:30-10:50 TuA08.1

Invariant Ellipsoids Approach to Robust Rejection of Persistent Disturbances, pp. 3976-3981

Shcherbakov, P.S. — Moscow Inst. of Control Sciences
Topunov, Michael — Inst. for Control Science
Polyak, Boris T. — Moscow Inst. of Control Sciences

Considered is the problem of optimal rejection of persistent exogenous disturbances in dynamic systems. A robust formulation is given for the case where the matrix coefficients are subjected to norm-bounded uncertainties; the solution technique based on the invariant ellipsoids concept is developed. The approach is exemplified through a well-known benchmark control problem for a mechanical two-mass-spring system.

10:50-11:10 TuA08.2

Calculation of All $H_{\∞}$ Robust Stabilizing Gains for SISO LTI Systems, pp. 3982-3987

Söylemez, Mehmet Turan — Istanbul Tecnical Univ.
Bayhan, Nevra — Istanbul Univ.

Robust stabilization of continuous time single-input single-output (SISO) linear time invariant (LTI) systems with multiplicative uncertainties is considered in this paper. In particular, it has been shown that all gains that robustly stabilize a given uncertain SISO LTI system can be found by utilizing a generalization of the Nyquist theorem. The method proposed involves calculation of roots of two real polynomials and does not require any search or gridding over a parameter, and as a result offers computational advantages over existing methods in literature.

11:10-11:30 TuA08.3

Continuous and Discrete-Time Path-Following Design of Mixed H2/Hinf State-Feedback Controllers, pp. 3988-3993

Ostertag, Eric — Univ. of Strasbourg I

Among the few methods available to solve bilinear matrix inequalities (BMIs) occurring in control design, the path-following method, published some years ago for continuous-time systems, appears to be one of the best approaches, as far as linearization methods are concerned. However few details are given in the literature about its implementation. Here, this method is applied to the design of mixed H2 / H_; controllers, for continuous-time systems as well as for discrete-time systems, with full details of the algorithm and some improvements over the one which has been published for this kind of application in the continuous-time case a few years ago. The results obtained in both cases with a numerical example are compared with those given by a direct BMI-solving program.

11:30-11:50 TuA08.4

H_{infty} Tracking with Preview for Linear Systems with Impulsive Effects-State Feedback and Full Information Cases, pp. 3994-3999

Nakura, Gou — Osaka Univ.

In this paper we study H_{infty} tracking problems with preview by state feedback and full information for linear systems with impulsive effects on the finite time interval. We mainly consider the case that our systems are affected by discrete disturbance at jump instants.We mainly consider the problem that the reference signals are previewed in a fixed time interval and present state feedback and full information control laws for the H_{infty} tracking problems. Our theory can be applied into robust H_{infty} tracking problems with preview considering upper bounded uncertainties.

11:50-12:10 TuA08.5

H_{infty} Tracking with Preview by Output Feedback for Linear Systems with Impulsive Effects, pp. 4000-4005

Nakura, Gou — Osaka Univ.

In this paper we study H_{infty} tracking problems with preview by output feedback for linear systems with impulsive effects and the sampled-observation on the finite and infinite time interval. We consider the problems that the reference signals are previewed in a fixed time interval and known {it a priori} over a whole time interval, and present feedback control laws for the H_{infty} tracking problems. Our theory can be also applied into the sampled-control system with the control input realized through a zero-order hold and the sampled-observation.

12:10-12:30 TuA08.6

Reduced Complexity Existence Conditions for Robust L2-Gain Feedforward Controllers for Uncertain Systems Using Dynamic IQCs, pp. 4006-4011

Kose, Emre — Bogazici Univ.
Scherer, Carsten W. — Delft Univ. of Tech.

For uncertain systems described in the standard LFT form, we consider the problem of designing robust L2-gain disturbance feedforward controllers if the uncertain blocks are described by integral quadratic constraints (IQCs). For technical reasons related to the feedforward problem we work with the duals of the constraints involved in robustness analysis using IQCs. Based on an elimination of the controller parameters, we develop in this paper reduced complexity LMI conditions for the existence of a stable feedforward controller that guarantees a given L2-gain for the closed-loop system.

TuA09 311C

Nonlinear System Identification II (Regular Session)

Chair: Schön, Thomas, Bo — Linköping Univ.
Co-Chair: Wills, Adrian George — Univ. of Newcastle

10:30-10:50 TuA09.1

Parameter Estimation for Discrete-Time Nonlinear Systems Using EM, pp. 4012-4017

Wills, Adrian George — Univ. of Newcastle
Schön, Thomas, Bo — Linköping Univ.
Ninness, Brett — Univ. of Newcastle

In this paper we consider parameter estimation of general stochastic nonlinear state-space models using the Maximum Likelihood method. This is accomplished via the employment of an Expectation Maximisation algorithm, where the essential components involve a particle smoother for the expectation step, and a gradient-based search for the maximisation step. The utility of this method is illustrated with several nonlinear and non-Gaussian examples.

10:50-11:10 TuA09.2

On the Consistency of Certain Identification Methods for Linear Parameter Varying Systems, pp. 4018-4023

Butcher, Mark Edward John — Ec. Pol. Federal de Lausanne
Karimi, Alireza — Ec. Pol. Federale de Lausanne
Longchamp, Roland — Ec. Pol. Federale De Lausanne

The consistency of identification methods for input-output models of Linear Parameter Varying systems is considered. In order to perform a consistency analysis the applicability of ergodicity is required, which is not obvious with these types of nonstationary systems. It is therefore shown that, when the scheduling parameter satisfies certain conditions, an ergodicity-type result can be applied to the signals considered. An analysis is then carried out for two cases: that of noise-free measurements of the scheduling parameter, and then the more realistic case of noisy scheduling parameter measurements. The latter is shown to be an errors-in-variables type problem. Since the least squares technique does not give consistent estimates, the instrumental variables method is proposed to achieve this property. The analysis carried out is reinforced by simulation results.

11:10-11:30 TuA09.3

Identification of Nonlinear Volterra Models by Means of Diffusive Representation, pp. 4024-4029

Casenave, Céline — LAAS-CNRS
Montseny, Gerard — LAAS-CNRS

We introduce a new identification method for nonlinear Volterra models of the form Hx = f(u, x) with H a causal convolution operator. It is mainly based on a suitable parameterization of H deduced from the so-called diffusive representation, devoted to state representations of integral operators. Following this approach, the complex dynamic nature of H can be summarized by a few numerical parameters on which the identification of the dynamic part of the model will focus. For illustration, we implement this method on a concrete numerical example.

11:30-11:50 TuA09.4

Nolinear System Identification Based on Local Sub-Model Networks, pp. 4030-4035

Sun, Lianming — The Univ. of Kitakyushu
Sano, Akira — Keio Univ.

Local sub-model networks based nonlinear approximated model and the identification algorithm are developed for nonlinear system. The structure of local sub-model is selected through a criterion with respect to both the approximation accuracy and model simplicity for the further applications. The computional load of identification does not change so much with the increaing of number of sub-models. The sub-model can be a linear model, or a simple block-oriented nonlinear model to improve the model accuracy and convergence performance of the identification algortihm.

11:50-12:10 TuA09.5

Adaptive Hinging Hyperplanes, pp. 4036-4041

Xu, Jun — Tsinghua Univ.
Huang, Xiaolin — Tsinghua Univ.
Wang, Shuning — Tsinghua Univ.

The model of adaptive hinging hyperplanes (AHH) is proposed in this paper for black-box modeling. It is based on Multivariate Adaptive Regression Splines (MARS) and Generalized Hinging Hyperplanes (GHH) and shares attractive properties of the two. By making a modification to the basis function of MARS, AHH shows linear property in each subarea. It is proved that AHH model is identical to a special case of the Generalized Hinging Hyperplanes (GHH) model, which has a universal representation capability for continuous piecewise linear functions. AHH algorithm is developed similar to MARS algorithm. It is adaptive and can be executed quickly, hence has power and flexibility to model unknown relationships. In addition, due to the piecewise-linear property, AHH is preferred to MARS when modeling high-dimensional dynamic systems, especially when the sample size is small and under noise conditions.

12:10-12:30 TuA09.6

A Neuro-Based EM-Particle Smoothing Algorithm for Identification of Nonlinear State Space Models, pp. 4042-4047

Gorji daronkolaei, Aliakbar — Amirkabir Univ. of Tech.
Menhaj, Mohammad Bagher — Amirkabir Univ. of Tech.

The expectation maximization(EM) algorithm and particle filtering have been greatly used in many estimation problems. In this paper, we propose a combination of the EM algorithm and particle smoothing for identification of nonlinear state space models using artificial neural networks. After representing a radial basis function(RBF) neural network as a parametric structure for describing the state transition and output equations of a state space model, the EM algorithm is applied for updating parameters and estimating states of the nonlinear system. Moreover, the particle smoothing algorithm is used at the E phase for state estimation. Simulation studies show the fast convergence rate and satisfactory accuracy of the proposed method in identification of nonlinear plants whose state transition function, output structure or both are unknown.

TuA10 311B

Identification Algorithms and Applications (Regular Session)

Chair: Malti, Rachid — Univ. Bordeaux1
Co-Chair: Li, Li — The Univ. of Melbourne

10:30-10:50 TuA10.1

Model Reduction for Linear Parameter-Dependent Systems, pp. 4048-4053

Li, Li — The Univ. of Melbourne

The paper considers the problem of model reduction for a class of linear parameter-dependent (LPD) systems. Three model reduction approaches: balanced truncation, balanced LQG truncation and gain-scheduled mathcal{H}_infty model reduction, are presented to reduce the dimension of LPD systems. For the former two approaches, conditions to proceed the reduction are given in terms of a finite number of linear matrix inequalities (LMIs); while the latter one involves LMIs with some additional rank constraint.

10:50-11:10 TuA10.2

Input-Adaptive Models Based Multiple-Model Algorithm for Maneuvering Target Tracking, pp. 4054-4059

Lan, Jian — Tsinghua Univ. P. R. China
Mu, Chundi — Tsinghua Univ.

The dynamic models with multilevel inputs are adopted in a kind of multiple model estimator for highly maneuvering target tracking. While the target maneuvers with the continuous time-varying accelerations, the estimator increases the levels to improve the percentage of coverage, which induces two problems: the increase of calculation burden and the decrease of the estimation precision due to the competition between the models. A multilevel inputs-adaptive multiple model (IAMM) algorithm is proposed, in which the inputs are adjusted according to the prior value and the on-line estimated maneuver parameters by introducing a dualistic distribution. The adaptabilities of the inputs can depict the actual maneuver process better compared with the static multilevel inputs. The simulation proves the effectiveness of IAMM algorithm compared with the IMM (Interacting Multiple Model) estimator with models containing multilevel static inputs.

11:10-11:30 TuA10.3

Simple Altitude Estimator Using Air-Data and GPS Measurements, pp. 4060-4065

Whang, Ick Ho — The Agency For Defense Development
Ra, Won-Sang — Agency for Defense Development

For obtaining the height information, a vertically damped inertial navigation system (INS) using the height reference of barometer measurements is conventionally instrumented. Since it requires delicate construction of INS system, in many cases, it has been costly. In this paper, a novel altitude estimation system is proposed by effectively combining the information of the GPS height and air data measurements such as ambient air pressure and temperature. Based on the fact that the barometer errors mainly consist of bias and scale factor errors, a filter to estimate the bias and scale factor using the GPS height is derived by means of multiple hypothesis Gaussian approximation filter technique. The estimated bias and scale factor is used to compensate the baro-altitude. Simulation results show that this method can construct a good altitude measurement system with relatively low cost.

11:30-11:50 TuA10.4

Wavelet Based OE Model Identification with Random Missing Data,

pp. 4066-4071

Geng, Lihui	Tsinghua Univ.
Zhang, Tao	Tsinghua Univ.
Xiao, Deyun	Tsinghua Univ.
Song, Jingyan	Tsinghua Univ.

Based on wavelet representation theory, this paper proposes a novel identification algorithm with random missing data under the condition that the identified dynamic process can be described as an output error (OE) model structure. This new algorithm mainly consists of two stages: one is the wavelet reconstruction, the other the prediction for missing data using the identified model. For the sake of its application, selection of the final iteration number and the adopted wavelet category is also considered. Finally, numerical simulations are given to verify the satisfactory effectiveness of the proposed algorithm.

11:50-12:10 TuA10.5

Channel Equalization Using Dynamic Fuzzy Neural Networks, pp. 4072-4077

Li, Ming-Bin	Nanyang Tech. Univ.
Er, Meng Joo	NTU

In this paper, a dynamic fuzzy neural network (DFNN) is applying for communication channel equalization problem. By combining fuzzy rules with the learning ability of neural networks, DFNN can achieve the advantages of both fuzzy logic and neural networks. The simulation results show that DFNN equalizer is superior to other equalizers such as recurrent neural network (RNN) and minimal resource allocation networks (MRAN) in terms of bit error rate (BER).

12:10-12:30 TuA10.6

Set Membership Estimation of Fractional Models in the Frequency Domain, pp. 4078-4083

Khemane, Firas	Univ. Bordeaux 1
Malti, Rachid	Univ. Bordeaux 1
Thomassin, Magalie	Univ. Bordeaux 1
Raissi, Tarek	Univ. Bordeaux 1

The main objective of this paper is to estimate the whole set of feasible parameters of a fractional di_;erentiation model, based on gain and phase frequency data. All parameters, including di_;erentiation orders, are expressed as intervals and then estimated using a bounded error approach. A contraction method named forward-backward propagation is _;rst applied to reduce the initial searching space. Then, a set inversion algorithm named SIVIA is applied on the reduced searching space to obtain the whole set of feasible parameters. One of the interesting points of this study is to show the separate contribution of gain and phase data on the _;nal estimation.

TuA11 311A

Adaptive Control of Systems I (Regular Session)

Chair: Bittanti, Sergio	Pol. di Milano
Co-Chair: Sugimoto, Kenji	Nara Inst. of Science and Tech.

10:30-10:50 TuA11.1

Can a Two-Link Manipulator Learn How to Write?, pp. 4084-4089

Alali, Basel	Nara Inst. of Science and Tech.
Hirata, Kentaro	NAIST, Nara Inst. of Sciense and Tech.
Sugimoto, Kenji	Nara Inst. of Science and Tech.

This paper considers a version of the problem of how to teach robots to write characters in an actual environment. In particular, a feedforward controller is designed for two-link manipulators to improve tracking performance despite limited knowledge of the surroundings. An adaptive scheme, called MIMO-FEL (Multi-input Multi-output Feedback Error Learning), is employed to achieve the objective. After convergence, the feedforward controllers are switched depending on the target character to be written. This switching strategy is a clear contrast with the precise identification approach, which uses a single general-purpose controller.

10:50-11:10 TuA11.2

Nonlinear Adaptive H-Infinity Control of Robotic Manipulators under Constraint, pp. 4090-4095

Miyasato, Yoshihiko	The Inst. of Statistical Mathematics

The problem of constructing nonlinear adaptive H-infinity control of robotic manipulators under costraints is considered in this paper. In the proposed control scheme, the trajectory converges to the desired constrained trajectory, and the constraint force also follows the desired constraint one. The resulting control strategy is derived as a solution of certain H-infinity control problem, where estimation errors of tuning parameters and errors of constraint forces are regarded as external disturbances to the process.

11:10-11:30 TuA11.3

Adaptive Control of a Scalar Linear Stochastic System with a Fractional Brownian Motion, pp. 4096-4101

Duncan, Tyrone E.	Univ. of Kansas
Pasik-Duncan, Bozenna	Univ. of Kansas

In this paper, an adaptive control problem is formulated and solved for a scalar linear stochastic system perturbed by a fractional Brownian motion and an ergodic (or averge cost per unit time) quadratic cost functional. The Hurst parameter for the fractional Brownian motion may take any value in (1/2, 1).

11:30-11:50 TuA11.4

Regulation of Linear Systems with Unknown Additive Sinusoidal Sensor Disturbances, pp. 4102-4107

Marino, Riccardo	Univ. di Roma Tor Vergata
Santosuosso, Giovanni L.	Univ. di Roma Tor Vergata
Tomei, Patrizio	Univ. of Roma Tor Vergata

Known linear stabilizable and detectable systems, which are allowed to be non minimum phase, are considered: the problem of tracking unknown output reference trajectories and rejecting unknown input disturbances when the output tracking error is affected by unknown additive sensor disturbances is addressed. All the exogenous signals to be tracked and/or to be rejected are assumed to be the sum of sinusoids: only upper bounds on their numbers are supposed to be known, along with a set in which the output disturbance frequencies may range. A constructive algorithm is proposed to drive the regulation error exponentially to zero. The regulation strategy includes an on-line detector of the number of excited frequencies and exponentially converging estimates of the exosystems parameters. An example containing a variable number of frequencies is worked out and simulated.

11:50-12:10 TuA11.5

Adaptive Visual Servoing of Robot Manipulators without Measuring the Image Velocity, pp. 4108-4113

Lizarralde, Fernando	Federal Univ. of Rio de Janeiro
Hsu, Liu	COPPE - Federal Univ. of Rio de Janeiro
Costa, Ramon R.	COPPE - Federal Univ. of Rio de Janeiro

The direct adaptive control of planar robot manipulators through visual servoing is considered. A solution is developed for image-based visual systems to allow tracking of a desired trajectory, when both camera calibration and robot dynamics are uncertain. In order to solve the MIMO parameter adaptive problem without using image velocity information, the adaptive camera calibration is formulated as a relative degree two MIMO adaptive control problem. A recently proposed Lyapunov/passivity-based adaptive control for relative degree two MIMO system based on SDU factorization is applied. The resulting adaptive calibration is then combined with an adaptive motion controller for the manipulator, which takes into account its uncertain nonlinear dynamics. The overall stability of the adaptive visual servoing system can be proved thanks to the explicit Lyapunov-like functions of both adaptation schemes.

12:10-12:30 TuA11.6

Direct and Indirect Stable Adaptive Control for Suspension Systems with MR Damper, pp. 4114-4119

Nilkhamhang, Itthisek	Keio Univ.
Mori, Tomoaki	Keio Univ.
Sano, Akira	Keio Univ.

The paper is concerned with stable adaptive schemes for semi-active control of suspension systems, which can deal with uncertainties in a nonlinear model of MR damper. To compensate for unknown nonlinear hysteresis dynamics of the MR damper, an adaptive inverse controller is implemented by indirect and direct methods. In the indirect method, on-line identification of a forward model of MR damper is executed. The direct method updates the inverse controller directly. Then a linear control scheme is designed and applied to the nonlinearly compensated system to give the desired damping force by taking into account the passivity of theMR damper. The effectiveness of the proposed adaptive semiactive control scheme is validated and the stability of the obtained total adaptive system is analyzed.

TuA12 313

Dependable Control of Discrete Event Systems I (Invited Session)

Chair: Faure, Jean-Marc — ENS Cachan
Co-Chair: Lesage, Jean-Jacques — ENS de Cachan
Organizer: Faure, Jean-Marc — ENS Cachan
Organizer: Lesage, Jean-Jacques — ENS de Cachan
Organizer: Frey, Georg — Univ. of Kaiserslautern

10:30-10:50 TuA12.1

Optimal Control of Multi-Layer Discrete Event Systems with Real-Time Constraint Guarantees (I), pp. 4120-4125

Mao, Jianfeng — Boston Univ.
Cassandras, Christos G. — Boston Univ.

We consider Discrete Event Systems (DES) involving tasks with dependability requirements in the form of real-time constraints. We seek to control their processing times so as to satisfy these constraints while also minimizing a given cost function. When tasks are processed by a single resource, it has been shown that there are structural properties of the optimal state trajectory for this problem that lead to a very efficient Critical Task Decomposition Algorithm (CTDA). For a DES with multiple resources, we consider a multi-layer network where each layer contains multiple nodes, each node may have multiple inputs and multiple outputs, and tasks are processed so that the real-time constraints apply on an end-to-end basis. Extending earlier results (where each layer contained a single node), we derive structural properties of the optimal solution that lead to the idea of introducing virtual deadlines at each node (except for the last layer) and decouple nodes so that the CTDA for single-node problems can be used. We prove that an appropriately constructed sequence of solutions of these simpler problems converges to the global optimum of the original problem and hence obtain an efficient scalable Multi-Layer Virtual Deadline Algorithm (MLVDA). We illustrate the efficiency of the MLVDA through numerical examples.

10:50-11:10 TuA12.2

Reliable and Safe Operation of Distributed Discrete-Event Controllers: A Networked Implementation with Real-Time Guarantees (I), pp. 4126-4131

Schmidt, Klaus — Univ. of Erlangen - Nuremberg
Schmidt, Ece G. — Middle East Tech. Univ.
Zaddach, Jorgos-Johannes — Siemens AG

Efficient controller synthesis approaches for discrete-event systems mostly provide a set of interacting distributed controllers that are potentially implemented in networked controller devices. Although the fulfillment of specified requirements and the absence of deadlocks is guaranteed by such methods on a logical level, timing issues due to controller communication are not incorporated. Recently, a formal communication model including real-time requirements for the reliable and safe operation of distributed discrete-event controllers has been proposed by the authors. In this paper, the real-time communication operation of such distributed controllers is discussed, and a sufficient condition for the network bandwidth in order to meet the specified real-time requirements is derived. A simulation study of a manufacturing system model with 50 distributed controllers supplements the theoretical result.

11:10-11:30 TuA12.3

Algebraic Synthesis of Dependable Logic Controllers (I), pp. 4132-4137

Hietter, Yann — ENS de Cachan
Roussel, Jean-Marc — ENS de Cachan
Lesage, Jean-Jacques — ENS de Cachan

This paper presents an algebraic method to synthesize control laws for logical system controllers. The starting point is a set of functional and dependable requirements expressed with algebraic relations or state models. We propose to synthesize control laws by solving a Boolean equation which represents all the requirements. The mathematical results that we have obtained allow to establish the exact form of the solutions if this equation has solutions. The first step of this method is the formalization of each requirement with Boolean relations between Boolean functions. Under this formulation, the requirements can be assembled and their coherence can be analyzed. This step consists in verifying if the Boolean equation, which represents all the requirements, has solutions. The third step is the synthesis of the control laws by solving this equation. At the end of this step, a parametric formulation of all the possible solutions is given. The fourth step of the method is the choice of a particular solution. This choice is made by the designer from heuristics. This method is illustrated with an example.

11:30-11:50 TuA12.4

Non-Coherent Modelling in Compositional Fault Tree Analysis (I), pp. 4138-4143

Sharvia, Septavera — Univ. of Hull
Papadopoulos, Yiannis Ioannis — Univ. of Hull

The inclusion of NOT gates in a fault tree creates a “non-coherent” structure in which not only the failure of a component but also the negation of failure, i.e. the working state of the component, can contribute to the undesirable effects on a system. This type of non-coherent modelling remains controversial; its usefulness is still debated among academics, which explains why NOT gates have not been included in the Fault Tree Handbook. In this paper, we review work on non-coherent fault trees and highlight circumstances where non-coherent modelling is appropriate and useful. We then describe an extension to HiP-HOPS (Hierarchically Performed Hazard Origin and Propagation Studies), a recently proposed compositional safety analysis method, that enables model-based synthesis and analysis of non-coherent fault trees. A small example is given to illustrate application of the extended method and demonstrate how this type of non-coherent modelling can give a more precise and ultimately more correct insight into failure behaviour.

11:50-12:10 TuA12.5

Agent Oriented Software-Development for Networked Embedded Systems with Real Time and Dependability Requirements in the Domain of Automation (I), pp. 4144-4149

Wannagat, Andreas — Univ. of Kassel, Faculty of Electrical EngineeringandComput
Vogel-Heuser, Birgit — Univ. of Kassel

A method for integrated development of multi agent PLC based control systems using IEC 61131-3 will be introduced. Dependability of technical plants will increase if control behaviour can be adapted during runtime. This is achieved by dynamic reconfiguration of faulty devices, e.g. sensors, at run-time. The replacement is based on analytical redundancy that is represented by a network of sensors and their interdependencies. This method supports the developer to sketch a suitable modular software-architecture in regards to the hardware-architecture and the specific requirements of real-time and dependability. The integration of classical methods like fault-tree-analysis and graph-theory enables the developer to build a knowledge-based system so that the agents would have the ability to recognize faults, seize the needed actions within their scope and fulfil their goal. Recent investigations using a model-plant showed the feasibilities of this approach.

TuA13 314

Sensor Networks (Regular Session)

Chair: Mareels, Iven — The Univ. of Melbourne
Co-Chair: Park, Chan Gook — Seoul National Univ.

10:30-10:50 TuA13.1

Model Based Information Fusion in Sensor Networks, pp. 4150-4155

Alriksson, Peter — Lund Univ.
Rantzer, Anders — Lund Univ.

In this paper, a model based sensor fusion algorithm for sensor networks is presented. The algorithm, referred to as distributed Kalman filtering is based on a previously presented algorithm with the same name. The weight selection process has been improved yielding performance improvements of several times for the examples studied. Also, solutions to both optimization problems involved in the iterative off-line weight selection process are given as closed form expressions. The algorithm is also demonstrated on a typical signal tracking application.

10:50-11:10 TuA13.2

Region Coverage for Planar Sensor Network Via Sensing Sectors,

pp. 4156-4161

Shi, Guodong — Chinese Acad. of Sciences
Hong, Yiguang — Chinese Acad. of Sciences

In this paper, asymptotical k-coverage of a planar sensor network with a sensing sector assigned to each node/sensor is considered. Sufficient conditions of the node density for the complete k-covering with probability approaching 1 are proposed when nodes deployment forms a planar Poisson point process and the sensing area of each node only covers a sector of a certain angle. Both fixed and varying sector direction cases are investigated, and related comparisons are also shown.

11:10-11:30 TuA13.3

Distributed Coverage Control in Sensor Network Environments with Polygonal Obstacles, pp. 4162-4167

Cassandras, Christos G. — Boston Univ.
Zhong, Minyi — Boston Univ.

We consider the problem of distributed coverage control for mobile sensor networks operating in environments cluttered with polygonal obstacles which interfere with both the navigation and sensing by the nodes. A gradient-based motion control scheme is developed to maximize the joint detection probability of random events in such mission spaces, taking into account the discontinuities that are introduced by obstacles in the sensing probability models. The optimization scheme requires only local information at each node. We also propose a modified objective function which allows a more balanced coverage when necessary. An interactive simulation environment has been developed through which we illustrate the adaptive and distributed properties of the coverage algorithm in a variety of mission spaces with obstacles.

11:30-11:50 TuA13.4

Optimal Power Analysis for Network Lifetime Balance in Hierarchy Networks, pp. 4168-4173

Wen, Rongrong — The Univ. of Melbourne
Mareels, Iven — The Univ. of Melbourne
Krongold, Brian Scott — Univ. of Melbourne

Energy scarcity is one of the most critical problems that occur in wireless sensor networks compared to traditional networks. However, by using spatial correlation, which is a characteristic of wireless sensor networks due to close field sampling, we could explore the problem further and address practical solutions. Based on a new cost criterion, two algorithms for power optimization amongst hierarchy networks are presented. Their implementation and implications are discussed in detail.

11:50-12:10 TuA13.5

Reformulating Kalman Filter Based Optimal Dynamic Coverage Control, pp. 4174-4179

Chen, Lingji — Scientific Systems Company Inc.
Mehra, Raman K. — Scientific Systems Co. Inc.

Our objective in this paper is to examine the problem formulation of one particular published result, make logical extensions, and consider the question of whether we should obtain solutions under such a formulation, or pursue alternative formulations. The problem considered in “A Kalman Filter-Based Control Strategy for Dynamic Coverage Control” by I. I. Hussein is for a network of mobile sensors with limited range to traverse and estimate a spatially-decoupled scalar field. In that paper the optimal trajectories are generated by an online procedure that minimizes the trace of the instantaneous covariance of the estimation error obtained from Kalman Filtering, using a finite set of admissible control inputs. We extend the formulation by observing that the procedure can be performed offline, that the cost function can be defined over a finite horizon, and that the set of control inputs can be a continuum. We illustrate, with simple examples, the kind of solutions that can be obtained using dynamic programming, and ask the question “Is this the type of trajectories that we want?” Alternative formulations are suggested and are left for future work.

12:10-12:30 TuA13.6

Coverage Control with Information Decay in Dynamic Environments, pp. 4180-4185

Hübel, Nico — Univ. Stuttgart
Hirche, Sandra — Tech. Univ. Muenchen
Gusrialdi, Azwirman — Tokyo Inst. of Tech.
Hatanaka, Takeshi — Tokyo Inst. of Tech.
Fujita, Masayuki — Tokyo Inst. of Tech.
Sawodny, Oliver — Univ. of Stuttgart

In this paper a method for coverage control for a convex region D subset of R^2 in a dynamic environment is studied. An information map is introduced in which the information about each point is decaying with respect to time s.t. the robots must revisit them periodically. Also a time-varying density function is used for modeling moving points of interest. The considered gradient based control approach causes the cost function to stay within the desired bounds. But due to the non-stationary problem setup caused by the information decay it does not converge to a single point but to a bounded set, such that the robots keep gathering information continuously. With this method it is possible to gather information about several points of interest within the region D with only a few robots. In the end simulation results are presented to outline the effectiveness of the proposed control law.

TuA14 318

Control Over Networks I (Regular Session)

Chair: Yu, Li — Zhejiang Univ. of Tech.
Co-Chair: Guan, Zhi-Hong — Huazhong Univ. of Science & Tech.

10:30-10:50 TuA14.1

H-Infinite Filtering of Network-Based Systems with Random Delays, pp. 4186-4191

Song, HongBo — Zhejiang Univ. of Tech.
Yu, Li — Zhejiang Univ. of Tech.
Zhang, Wen-An — Zhejiang Univ. of Tech.

The H_; filtering problem is studied for a class of network-based systems with random network-induced delays in discrete-time domain. The considered random delay between the sensor and the filter may be longer than one sampling period and is modeled as a Markov chain. The filtering error system is modeled as a Markovian switched time-delay system and by using a properly constructed Lyapunov function, sufficient conditions for the existence of the H_; filters are presented in terms of linear matrix inequalities. Convex optimization problem is also formulated to design the desired H_; filter which guarantees the stochastic stability and an optimal H_; disturbance attenuation level for the filtering error system. An illustrative example is finally given to prove the effectiveness of the proposed method

10:50-11:10 TuA14.2

Measurement Delay Estimation for Kalman Filter in Networked Control Systems, pp. 4192-4197

Pohjola, Mikael — Helsinki Univ. of Tech.
Koivo, Heikki — Helsinki Univ. of Tech.

This work presents a method to estimate an unknown varying delay of measurements and subsequent Kalman filtering in the networked control system (NCS) framework. The delay estimation algorithm is based on the Gaussian error model and a network delay model, either a probability distribution or a Markov-chain. This method is used to tackle the problem with varying delays in a NCS. The undelayed output of the plant is estimated with a Kalman filter and used for control. The probability of a wrong delay estimate is derived. The estimation and control performance is evaluated with simulations. From the control perspective, it has comparable performance to the case with known delays.

11:10-11:30 TuA14.3

Passivity of Infinite--Dimensional Linear Systems with State, Input and Output Delays, pp. 4198-4203

Hadd, Said — The Univ. of Liverpool
Zhong, Qing-Chang — The Univ. of Liverpool

In this note we present sufficient conditions to guarantee the passivity of linear systems with state, input and output delays in Hilbert spaces. Our approach is mainly based on the transformation of such systems into distributed parameter systems.

11:30-11:50 TuA14.4

Stabilization of Networked Control Systems with Random Delays: A New Multirate Method, pp. 4204-4209

Guan, Zhi-Hong — Huazhong Univ. of Science & Tech.
Yang, Chun-Xi — Huazhong Univ. of Science and Tech.
Huang, Jian — Huazhong Univ. of Science and Tech.

In this paper, stability issues for a class of Networked control systems (NCSs) with random delays is discussed where random delays are less than one sensor period or more than one sensor period but bounded. A new multirate method is proposed to formulate the union model for both short and long random delays. The sufficient conditions on the existence of stabilizing controllers are established when the transition probability matrix is known. V-K iteration approach is employed to calculate mode-independent and mode-dependent state-feedback gains.

11:50-12:10 TuA14.5

Stability Analysis for a Class of Networked/Embedded Control Systems: Output Feedback Case, pp. 4210-4215

Fujioka, Hisaya — Kyoto Univ.

Motivated by the widespread use of networked and embedded control systems, an algorithm for stability analysis is proposed for sampled-data feedback control systems with uncertainly time-varying sampling intervals. The output feedback case with a dynamic compensator is considered. The algorithm is based on the robustness of related discrete-time systems against perturbation caused by the variation of sampling intervals. The validity of the algorithm is demonstrated by numerical examples.

12:10-12:30 TuA14.6

Controllability and Observability of Linear Discrete-Time Systems with Network Induced Variable Delay, pp. 4216-4221

Ionete, Catalin Cosmin — Univ. of Craiova
Cela, Arben — Groupe ESIEE
Ben Gaid, Mongi — IFP
Reama, Abdellatif — Univ.

This paper studies the controllability and observability of discrete-time systems with network-induced variable delays. Since controllability and observability are structural properties of systems, which are first checked before control design, we study if a controllable (resp. observable) non-delayed system can loose these properties if we augment the model with particular pure input-output variable delays caused by a situation of overload in the networked control architecture. We start our approach with a discrete-time multivariable linear time-invariant system with non-equal network-induced delays on control signals (inputs) and measures (outputs). The considered delays may only remain constant or increase with unitary increments. We prove that if a non-delayed system is controllable (resp. observable), then the network-delayed system is controllable (resp. observable) despite the monotonically-increasing delay values in each input/output channel. This general powerful result ensures further implementation of model-based predictive control strategies based on state observers methods for the considered model of networked control systems.

TuA15 317

Artificial Pancreas: Novel Applications of Modeling and Control in Biomedical Systems (Invited Session)

Chair: Vehi, Josep — Univ. de Girona
Co-Chair: Doyle, Francis — Univ. of California at Santa Barbara
Organizer: Vehi, Josep — Univ. de Girona
Organizer: Doyle, Francis — Univ. of California at Santa Barbara

10:30-10:50 TuA15.1

Prediction of Dynamic Glycemic Trends Using Optimal State Estimation (I), pp. 4222-4227

Percival, Matthew W. — Univ. of California
Bevier, Wendy C. — Sansum Diabetes Res. Inst.
Zisser, Howard — Sansum Diabetes Res. Inst.
Jovanovic, Lois — Sansum Diabetes Res. Inst.
Seborg, Dale — Univ. of California
Doyle, Francis — Univ. of California at Santa Barbara

Efficacious therapeutic regimens to treat type 1 diabetes mellitus require devices capable of continuous feedback control; recent advances in medical technology mean that such devices are now available. Any closed-loop controller would require a predictive aspect to avoid sluggish control related to delays in insulin action, or hypoglycemia from an overdose of insulin. Using clinical data and an adaptive version of the simple Bergman minimal model (Bergman et al., 1979), glycemic prediction was performed. Model parameters were estimated using clinical data. An augmented state Kalman filter was then used to estimate parameters dynamically. Predictive accuracy varied from subject to subject, with median R^2 values for the best validation days of 80% for 30 minute predictions. Such techniques would be useful in a closed-loop control framework for adapting a glycemic controller to subject-based variations in insulin sensitivity.

10:50-11:10 TuA15.2

Implications of Meal Library & Meal Detection to Glycemic Control of Type I Diabetes Mellitus through MPC Control (I), pp. 4228-4233

Dassau, Eyal — Univ. of California Santa Barbara
Herrero, Pau — Univ. de Girona
Zisser, Howard — Sansum Diabetes Res. Inst.
Buckingham, Bruce — Stanford
Jovanovic, Lois — Sansum Diabetes Res. Inst.
Dalla Man, Chiara — Univ. of Padova
Cobelli, Claudio — Univ. of Padova
Vehi, Josep — Univ. de Girona
Doyle, Francis — Univ. of California at Santa Barbara

Recent technological progress in insulin pumps and continuous glucose monitors (CGM) are enabling development of an artificial ;-cell that will allow superior glycemic control for patients with type 1 diabetes mellitus (T1DM). A control algorithm that is implemented in such system will need to regulate basal insulin as well as to reject unmeasured disturbances, such as meals. A traditional approach is to combine feed-forward control as a means to overcome meal disturbances, where the user informs the controller on a meal and estimates the size of that together with PID control or Model Predictive Control (MPC) to address the regulation problem. This approach fails with T1DM adolescents and children because they often forget to give a pre-meal bolus and are poor at estimating meal sizes. A novel approach to overcome this problem is suggested in this paper by the combination of a meal library and a meal detection algorithm in the framework of Model Predictive Control (MPC). In this work, the challenging problem of an unannounced mixed meal is being addressed using this novel combination.

11:10-11:30 TuA15.3

In Silico Testing and in Vivo Experiments with Closed-Loop Control of Blood Glucose in Diabetes (I), pp. 4234-4239

Kovatchev, Boris — Univ. of Virginia
Raimondo, Davide Martino — Univ. of Pavia
Breton, Marc — Univ. of Virginia
Patek, Stephen D. — Univ. of Virginia
Cobelli, Claudio — Univ. of Padova

Diabetes technology is currently focused on developing the artificial pancreas – a closed-loop control algorithm linking continuous glucose monitoring (CGM) and subcutaneous insulin delivery. The future development of the artificial pancreas will be greatly accelerated by employing mathematical modeling and computer simulation. Such in silico testing would provide direction for clinical studies, outruling ineffective control scenarios in a cost-effective manner. Thus, computer simulation testing of closed-loop control algorithms is regarded as a prerequisite to clinical trials of artificial pancreas. We therefore present a system for in silico testing of control algorithms consisting of a simulated human metabolic system, simulated CGM and simulated insulin pump. Further, we present an overview of current in vivo clinical trials of CGM and closed-loop control and illustrate the positive effects of CGM by data collected in a clinical trial using the Freestyle Navigator™ (Abbott Diabetes Care, Alameda, CA).

11:30-11:50 TuA15.4

Robust Sliding Mode Closed-Loop Glucose Control with Meal Compensation in Type 1 Diabetes Mellitus (I), pp. 4240-4245

Garcia-Gabin, Winston — Univ. of Girona
Vehi, Josep — Univ. de Girona
Bondia Company, Jorge — Tech. Univ. of Valencia
Tarin, Cristina — Tech. Univ. of Valencia
Calm, Remei — Univ. de Girona

This work addresses the design of a robust closed-loop plasma glucose controller for Type 1 Diabetes Mellitus patients. The feedback controller is based on Sliding Mode Control (SMC) while robust feedforward boluses to compensate food intake are calculated in a robust way by means of an interval glucose predictor that minimizes the risk of hypoglycaemia. The designed controller has been validated in a virtual environment following standard protocols. The resulting control algorithm shows a considerable robustness regarding intra-patient variability in insulin sensitivity as well as an enhanced ability to handle disturbance rejection. The International Diabetes Federation guidelines for glycaemia targets in Diabetes Mellitus are fulfilled by the designed control strategy.

11:50-12:10 TuA15.5

Model Predictive Control of Glucose Concentration in Subjects with Type 1 Diabetes: An in Silico Trial (I), pp. 4246-4251

Magni, Lalo	Univ. of Pavia
Raimondo, Davide Martino	Univ. of Pavia
Dalla Man, Chiara	Univ. of Padova
De Nicolao, Giuseppe	Univ. di Pavia
Kovatchev, Boris	Univ. of Virginia
Cobelli, Claudio	Univ. of Padova

The feedback control of glucose concentration in type 1 diabetic patients using subcutaneous insulin delivery and subcutaneous continuous glucose monitoring is considered. A recently developed in-silico model of glucose metabolism is employed to generate virtual patients on which control algorithms can be validated against interindividual variability. An in silico trial consisting of 100 patients is used to assess the performances of a linear output feedback model predictive controller, designed on the basis of the in-silico model. More than satisfactory results are obtained in the great majority of virtual patients. The experiments highlight the crucial role of the anticipative feedforward action driven by the meal announcement information. Preliminary results indicate that further improvements may be achieved by means of a nonlinear model predictive control scheme.

12:10-12:30 TuA15.6

A Closed-Loop Artificial Pancreas Based on MPC: Human-Friendly Identification and Automatic Meal Disturbance Rejection (I), pp. 4252-4257

Lee, Hyunjin	Rensselaer Pol. Inst.
Bequette, B. Wayne	Rensselaer Pol. Inst.

Type 1 diabetes is characterized by a lack of insulin production from the pancreas, causing high blood glucose concentrations and requiring external insulin infusion to regulate blood glucose. A novel procedure of “human friendly” identification testing using multisine inputs is developed to estimate suitable models for use in an artificial pancreas. A human-friendly multisine input signal offers improved identifiability on the dynamics of insulin to glucose, not causing serious deviations from the normal glucose concentration and satisfying insulin delivery pump specifications within acceptable time periods. An integrated formulation of constrained MPC is considered in order to reduce risks of hypoglycemia and hyperglycemia. Furthermore, a set of meal detection and meal size estimation algorithms are developed to improve meal glucose disturbance rejection when incoming meals are unknown. Closed-loop performance is evaluated by simulation studies of a type 1 diabetic individual, illustrating the ability of the MPC-based artificial pancreas strategy to handle measured and unmeasured meals.

TuA16 316

National and Regional Economies (Regular Session)

Chair: Neck, Reinhard	Klagenfurt Univ.
Co-Chair: Wang, Long	Peking Univ.

10:30-11:10 TuA16.1

The Contribution of Control Theory to the Analysis of Economic Policy, pp. 4258-4269

Neck, Reinhard	Univ. of Klagenfurt

In this paper, we give a survey of applications of control theory to the analysis of economic policy problems. We discuss applications of closed-loop control and of optimum control theory, including deterministic, stochastic and decentralized optimum control. A critical evaluation of these approaches shows that for an empirically useful theory of economic policy, the application of dynamic game theory (which in itself originated from control theory) seems to be most promising.

11:10-11:30 TuA16.2

Collusion Helps Abate Environmental Externalities: A Dynamic Approach, pp. 4270-4273

Lambertini, Luca	Univ. of Bologna
Mantovani, Andrea	Univ. of Bologna

We investigate the bearings product market collusion on the abatement of polluting emissions in a Cournot oligopoly where production entails a negative environmental externality. We model the problem as a differential game and investigate the feedback solution of two alternative settings: a fully noncooperative oligopoly and a cartel maximising the discounted profits of all firms in the industry. Our analysis proves that the output reduction entailed by collusive behaviour may have a beneficial effect on steady state welfare, as a result of the balance between a higher market price and a lower amount of polluting emissions. This result opens a new perspective on the debate about the management of environmental externalities, which so far has mainly focussed on the design of Pigouvian taxation.

11:30-11:50 TuA16.3

Cooperation in Networked Prisoner's Dilemma with Individual Learning Feedback, pp. 4274-4279

Chen, Xiaojie	Coll. of Engineering, Peking Univ.
Fu, Feng	Coll. of Engineering, Peking Univ.
Wang, Long	Peking Univ.

We introduce a modified learning updating mechanism into the evolutionary Prisoner's Dilemma on Newman-Watts (NW) networks. During the evolutionary process, each individual updates its strategy according to individual deterministic switch in combination with a feedback between its score aspiration and actual score. And individual's score is a linear combination of individual's total payoff and local contribution to its neighbors. We study the cooperation level of the system under this learning feedback mechanism, and find that the cooperation level increases as the relative weight of the local contribution to the score increases. In addition, we focus on the influences of learning rate and intensity of deterministic switch in the strategy updating rule on cooperation. Simulations show that for much low intensity of deterministic switch, cooperation is independent of learning rate to a large extent, and full cooperation can be reached when relative weight is not less than 0.5. Otherwise, cooperation depends on the value of learning rate. Besides, the cooperation level is not sensitive to topological parameters of NW networks. To explain these simulation results, we provide corresponding analytical results of mean-field approximation, and find that simulation results are in good agreement with analytical ones. Our work may shed some light on the maintenance of cooperative behavior in social systems with individual learning feedback.

11:50-12:10 TuA16.4

Assosiative Search Models in Trading, pp. 4280-4284

Bakhtadze, Natalia	Inst. of Control Sciences of Russian Acad. ofSciences
Lototsky, Vladimir	Inst. of control Science of Russian Acad. of Science

The paper presents process identification algorithms for trading based on virtual models design using process data archives and knowledge bases. Fuzzy Associative Search Methods are used for identification algorithms development.

TuA17 320A

Recent Automation Technologies in Shipbuilding Industry II (Highlight Session)

Chair: Lee, Kyu-Yeul	Seoul National Univ.
Co-Chair: Lee, Ji-Hyoung	Hyundai Heavy Industries Co., Ltd.
Organizer: Lee, Kyu-Yeul	Seoul National Univ.

10:30-10:50 TuA17.1

Active Compliant Motion Control for Grinding Robot (I), pp. 4285-4289

Park, Juyi	Daewoo Shipbuilding and Marine Engineering
Kim, Soo Ho	Daewoo Shipbuilding & Marine Engineering co., KPU
Kim, Sungkwun	Korea Pol. Univ.

A grinding robot system is presented in this paper. Active compliant motion control is applied to keep contacting between grinding tool and work pieces and auto surface tracking algorithm was developed to trace the outline of work-pieces. For real implementation of the system, the shape of work pieces are informed through barcode and the piece’s dimension is measured with a laser distance sensor. Experimental results with the implemented system are also presented and discussions for further works are followed.

10:50-11:10 TuA17.2

Development of Automatic Welding System for Multi-Layer and Multi-Pass Welding (I), pp. 4290-4291

Kim, Yong-Baek — Hyundai Heavy Industries CO.,LTD
Kim, Jeom-Goo — Hyundai Heavy Industries CO.,LTD
Jang, Won-Taek — Hyundai Heavy Industries CO.,LTD
Park, Jong-ryon — Hyundai Heavy Industries Co., Ltd.
Moon, Hyung-Soon — Hyundai Heavy Industries CO.,LTD
Kim, Ji-On — Hyundai Heavy Industries CO.,LTD

According to increase of ultra-large containerships, the improvement of welding productivity and efficiency for thick plate welding become an important factor to reduce production time and costs. In the block assembly process at a shipbuilding yard or in a dock, manual welding or semi automatic welding that adopt small welding carriage is applied to the multi-layer weld. In this study, we had developed an automatic multi-layer welding system that full automatic welding is available for welding productivity and weld quality improvement. The system can weld automatically without additional welder's operation by using a touch sensor which can generate welding conditions based on the predefined weld database.

11:10-11:30 TuA17.3

Rail Running Mobile Welding Robot 'RRX3' for the Double Hull Ship Structure (I), pp. 4292-4297

Kim, Jongwon — Seoul National Univ. Mechanical and AerospaceEngineering
Lee, Kyu-Yeul — Seoul National Univ.
Kim, Tae-Wan — Seoul National Univ.
Lee, Donghun — Seoul National Univ.
Lee, Sungcheul — Seoul National Univ. Mechanical and AerospaceEngineering
Lim, Chaemook — Seoul National Univ. Mechanical and AerospaceEngineering
Kang, Sung-Won — Daewoo Shipbuilding & Marine Engineering co.

' Seoul National University' and ' Daewoo Shipbuilding & Marine Engineering' in Korea jointly developed a mobile welding robot, the ' Rail Runner' (RRX), which is able to freely move in both transverse and longitudinal directions, and perform welding tasks in double hull structures. Recently, RRX2, (the second version of RRX), was presented at 'Robotics and Applications 2007'. In this paper, the design, manufacturing, and application of RRX3, the third version of RRX, is described. The moving mechanism of RRX, which is able to move freely in a double hull structure, has two functions. 1) To move in a longitudinal direction by driving wheels using longi. faces as 'rails', and 2) To move in a transverse direction by sliding along supporting longi. faces using extension arms. The body of the RRX3 is composed of a 12-axis, 6-axis mobile platform that supports the RRX moving mechanism and a 6-axis welding robot to do the welding job. The main point in designing RRX3 is to make it capable of passing through a 600mm×800mm sized access hole, the entrance into an enclosed double hull structure. The full size of the manufactured RRX3 is 1825mm×495mm×569mm, and thus the RRX3 is able to pass through an access hole. The weight is 250kg with a 6-axis mobile platform, 6-axis welding robot, and mounted controller.

11:30-11:50 TuA17.4

Modularized Control Architecture of an Embedded Controller for Mobile Welding Robot in the Shipyard (I), pp. 4298-4303

Lee, Kyu-Yeul — Seoul National Univ.
Kim, Tae-Wan — Seoul National Univ.
Kim, Jongwon — Seoul National Univ. Mechanical and Aerospace Engineering
Ku, Nam-Kug — Seoul National Univ.
Hounyoung, Lim — Seoul National Univ.
Jongjin, Woo — Seoul National Univ.
Lee, Sang-Moo — Korea Inst. of Industrial Tech. (KITECH)
Kim, Soo Ho — Daewoo Shipbuilding & Marine Engineering co., KPU

The present study describes the development of controller hardware and control software for a mobile welding robot, which can move in the transverse and longitudinal directions (Moving Tasks), perform the welding tasks of the U-shaped parts and bracket parts in a double hull structure (Welding Tasks), and detect points of the welding path (Sensing Tasks). Controller hardware consists of a main controller and a welding machine controller. The main controller, which is mounted on the mobile welding robot, consists of a CPU board, a motion controller, and an incremental encoder type AC servo motor driver. The welding machine controller, which is mounted on the welding machine located on the outside of the double hull structure, controls the welding machine. Communication between the two controllers is made via the RS485. Control software consists of 4 layers: Task Manager, Task Planner, Actions for Task, and Task Executer. Each Layer consists of modules such as the Action Module, Motion Generator Module, Servo Module, etc. Suitable combinations of modules enable the control software to perform the required tasks. Control software is developed using C programming under QNX Operating System, which is well known to have a reliable hard-realtime performance

11:50-12:10 TuA17.5

Wireless Teaching Pendant for Mobile Welding Robot in Shipyard (I), pp. 4304-4309

Kim, Tae-Wan — Seoul National Univ.
Lee, Kyu-Yeul — Seoul National Univ.
Kim, Jongwon — Seoul National Univ. Mechanical and Aerospace Engineering
Oh, Min-Jae — Seoul National Univ.
Lee, Jie Hyeung — Daewoo Shipbuilding & Marine Engineering co., KPU

The teach pendant is a hand-held robot control terminal that provides a convenient means to move the robot, teach locations, and run robot programs. Nowadays, almost teaching pendant is connected with a robot controller using cable. The cable connection and the size of teaching pendant are not problems because a robot controller is separated with robot. However, a large size and wired teaching pendant is not suitable for a self-deriving mobile welding robot which has a controller inside.In this paper, using a personal data assistant, the wireless teaching pendant is developed for the mobile welding robot which can weld and move autonomously in the double hull structure of the ship. We also verify the functions and performance of wireless teaching pendant from the experiments.

12:10-12:30 TuA17.6

Development of Carriage-Type Welding Robot for Double Hull Assembly Line in Shipbuilding (I), pp. 4310-4311

Lee, Ji-Hyoung — Hyundai Heavy Industries Co., Ltd.
Kim, Jong-jun — Hyundai Heavy Industries Co., Ltd.
Kim, Jae-kwon — Hyundai Heavy Industries Co., Ltd.
Park, Jong-ryon — Hyundai Heavy Industries Co., Ltd.

This paper introduces a carriage-type welding robot which is to implement into double hull assembly line in shipbuilding. The developed robot consists of 5-axis carriage-type body, a controller, and a welding power supply and is capable of welding fully automatically such as a commercial industrial robot system without any interruption by an operator in a cell which consists of vertical weld-line and horizontal one. This is also characterized by not only automatic seam tracking ability and automatic feature-point detection function, but also an automatic generation function of job program. This system was already tested in a field and their performance had been proven successfully.

TuA18 320B

Recent Development of Intelligent Robots III: Vision & HRI (Highlight Session)

Chair: Choi, Jin Young — Seoul National Univ.
Co-Chair: Kim, Hong-Seok — Korea Inst. of Industrial Tech. (KITECH)

10:30-10:50 TuA18.1

Motion Planning for Non-Holonomic Mobile Manipulator Based Visual Servo under Large Platform Movement Errors at Low Velocity (I), pp. 4312-4317

Le Minh, Phuoc — Sungkyunkwan Univ.
Martinet, Philippe — Blaise Pascal Univ.

Kim, Hun Mo — Sungkyunkwan Univ.
Lee, Sukhan — Sungkyunkwan Univ.

A non-holonomic mobile manipulator (NMM) is termed here as a robotic system in which a manipulator is mounted on a non-holonomic mobile platform. This paper presents a method for planning a motion of NMM for effectively performing eye-on-hand visual servo especially when there are excessive errors in platform movement at low velocity due to friction, slippage, backlash, or flexibility. Due to excessive errors in platform movement at low velocity, direct application of a conventional method for manipulator based visual servo to a NMM may not be effective for generating servo motions. In this paper, we propose a method of generating servo motions for an NMM based visual servo, which is not affected by the excessive platform movement errors at low velocity. We achieve this by generating a series of discrete optimal poses of NMM on-line as a higher level plan for servo motion. More specifically, NMM is to move successively to the chosen poses while maintaining a proper velocity for avoiding excessive movement errors and satisfying non-holonomic constraints until it reaches the final poses where the manipulator alone can servo to the target object while the platform can be kept stationary. We use the virtual visual servo by E. Marchand and F. Chaumette to make sure that the manipulator is able to reach a target object without violating its joint limits, its boundary of workspace and singularities. The on-line selection of local mobile platform poses is based on a local random search. Finally, simulations on a redundant NMM are carried out to demonstrate the effectiveness of the proposed method.

10:50-11:10 — TuA18.2

Adaptive Visual Tracking for Surveillance Systems (I), pp. 4318-4323

Yun, Seok Min — SNU
Na, Jin Hee — SNU
Choi, Jin Young — Seoul National Univ.

In this paper, we propose a new hierarchical estimation approach for adaptive visual tracking. This approach includes incremental appearance model and hierarchical estimation: global estimation and local estimation. Local estimation is performed by the particle filter for dealing with non-linearities and non-Gaussian statistics, and global estimation is performed by Kalman filter to determine the scatter positions of particles for local estimation. By combining these two estimations, the number of particles used in local estimation can be reduced in global estimation, and it enables real-time tracking while maintaining or improving tracking abilities. Experimental results show the effectiveness and robustness of the proposed approach compared with those of existing tracking method.

11:10-11:30 — TuA18.3

Sensor Guided Laser Welding Robot System (I), pp. 4324-4329

Kim, Chang-Hyun — Korea Advanced Inst. of Science and Tech.
Choi, Tae-Yong — Korea Advanced Inst. of Science and Tech.
Lee, Ju-Jang — Korea Advanced Inst. of Science and Tech.
Suh, Jeong — Korea Inst. of Machinery and Materials
Park, Kyoung-Taik — Korea Inst. of Machinery and Materials
Kang, Hee-Shin — Korea Inst. of Machinery and Materials
Lee, Moon-Yong — Sungwoo Hitech Co., LTD
Kim, Sung-rak — Hyundai Heavy Industries Co., LTD.

In order to obtain a good result in the laser welding process, the laser welding technology for manufacturing an automobile body is studied in this research. The robot, the seam tracking system, and CW Nd:YAG laser are used for the laser welding robot system. Especially, the development of the laser-stripe sensor is highlighted. The laser-stripe sensor can measure the profile of the welding object and obtain the gap and seam line. Moreover, the working distance of the sensor can be varied. The control scheme of the whole system is also presented. The profile and gap measurement and the seam tracking experiments were carried out to validate the operation of the system.

11:30-11:50 — TuA18.4

Emotional Exchange of a Socially Interactive Robot (I), pp. 4330-4335

Kwon, Dong-Soo — KAIST
Kim, Young-Min — KAIST

This paper presents an emotional exchange framework for a socially interactive robot. The purpose of emotional exchange in social interaction between a robot and people is to make people feel that the robot is a believable living assistant, not a mere machine for information translation. Our emotional exchange framework is composed of the emotion recognition, generation, and expression systems. A user's emotion is recognized by multi-modality such as voice, dialogue, and touch. The robot's emotion is generated according to a psychological theory about cognitive emotions caused by the social interaction within people. Furthermore, the emotion intensity is regulated by the loyalty level of a robot to various users. The generated emotion is dynamically expressed by facial expression, gesture, and the musical sound of the robot. The proposed system, which is composed of all the three components that are necessary for a full emotional interaction cycle, is implemented in the real robot system and tested. The proposed framework can be a cornerstone for the design of emotion interaction and generation systems for robots.

11:50-12:10 — TuA18.5

Development of an Android for Emotional Expression and Human Interaction (I), pp. 4336-4337

Lee, Dong-Wook — Korea Inst. of Industrial Tech. (KITECH)
Lee, Tae-Geun — Korea Inst. of Industrial Tech. (KITECH)
So, ByungRok — Korea Inst. of Industrial Tech. (KITECH)
Choi, Moosung — Korea Inst. of Industrial Tech.
Shin, Eun-Cheol — KITECH
Yang, KwangWoong — KITECH
Baeg, Moon-Hong — KITECH
Kim, Hong-Seok — Korea Inst. of Industrial Tech. (KITECH)
Lee, Ho-Gil — Korea Inst. of Industrial Tech. (KITECH)

This paper presents the second version of an Android, EveR-2 developed in KITECH (Korea Institute of Industrial Technology). EveR-2 is a female robot which name derives from Biblical 'Eve' plus the letter 'R' for Robot. EveR-2 is a robot platform to implement and test emotional expressions and human interactions. She can express facial emotion and synchronize lip with voice. Also it can make gestures like human. She can sense visual and speech information from CCD cameras in her eyes and microphone. The head, upper body, and lower body which compose of total 59 DOFs(Degree Of Freedom) make behaviors, facial expressions, and lip sync. Software structure has the robot-oriented conversation using a dialogue database, and hardware structure is designed for embedding all motors and sensors into the human-scale space. EveR-2 can be applied to guidance service of an exhibition, oral narration of fairy tale, and singing, and conversation with humans.

TuA19 — 320C

Robot Manipulators I (Regular Session)

Chair: Gillet, Denis — Ec. Pol. Fédérale de Lausanne (EPFL)
Co-Chair: Lee, Joo-Ho — Ritsumeikan Univ.

10:30-10:50 — TuA19.1

Decoupling Neural Sliding Mode Control for Multi-Link Robots, pp. 4338-4342

Mu, Xiaojiang — Beijing Univ. of Tech.
Chen, Yangzhou — Beijing Univ. of Tech. Beijing, 100022,P.R.China

A decoupling neural sliding mode controller is given for trajectory tracking control of multi-link robots with external disturbances and uncertain system parameter errors. Different from general combining the sliding mode control (SMC) and neural network control (NNC), this approach decouples a robot with n links into n subsystems and the state response of each subsystem can be governed by a corresponding sliding mode manifold. The whole system is controlled by a whole sliding mode manifold selected to be a global fast terminal sliding mode manifold, which guarantees that the controlled system can reach the sliding mode manifold and equilibrium point in finite time. A radius basis function (RBF) neural network is applied to learn the limit of system parameter errors and external disturbances for every subsystem, and enforce sliding mode motion by minimizing the cost function that is with respect to the distance from the sliding mode manifold. The switching gain of sliding mode control can be automatically adjusted according to system parameter errors and external disturbances by RBF neural network's learning. The controller's chattering is reduced without sacrificing robustness, even eliminated after RBF neural network's learning for a short time. Moreover, the stability of the controlled system is proven and the convergence of tracking error is also proven by Lyapnov function. Simulation results verify the performance of the control scheme.

10:50-11:10 TuA19.2

Adaptive Tracking Control of Coordinated Nonholonomic Mobile Manipulators, pp. 4343-4348

Fang, Mu	Shanghai Jiaotong Univ.
Chen, Weidong	Shanghai Jiaotong Univ.
Li, Zhijun	Shanghai Jiao Tong Univ.

In this paper, adaptive control of multiple mobile manipulators carrying a common object in a cooperative manner with unknown inertia parameters and disturbances has been investigated. firstly, A complete dynamics consisting of the dynamics of mobile manipulators and the object is presented for coordinated multiple mobile manipulators. Then, adaptive control has been designed for compensating parametric uncertainties and suppressing disturbances. The control ensures that the output tracking errors of the system converge to zero whereas the internal force tracking error remains bounded and can be made arbitrarily small. Simulation studies show the effectiveness of the proposed scheme.

11:10-11:30 TuA19.3

Considering Passive Joints in Cooperative Manipulation As Functional Redundancy, pp. 4349-4354

From, Pĺl Johan	Norwegian Univ. of Science and Tech.
Gravdahl, Jan Tommy	Norwegian Univ. of Science & Tech.

In this paper, it is studied how a certain class of physical constraints can be represented by a continuous set of orientations and how this representation is especially suitable for representing the constraints imposed by revolute and spherical joints. Further, it is shown how this can be used to represent the freedom of passive joints. It is recognised that in cooperative manipulation, the representation developed can be used to show how the introduction of passive joints at the end of a kinematic chain gives the same advantages as functional redundancy for single manipulators. This is used to improve manipulability and performance. Similar to functional redundancy the freedom of the passive joint is task dependent and the type of the passive joint must be chosen with the task in mind. Due to this observation, this paper proposes to consider the last passive joint a part of the tool. The manipulator can then be a standard industrial manipulator with functional redundancy in the specifications of the orientation of the last joint. It is shown that by introducing a passive joint at the end of the manipulator chain the workspace is increased, the dynamic load carrying capacity is maintained or increased while each manipulator is given a freedom equal to functional redundancy.

11:30-11:50 TuA19.4

On Achieving Periodic Joint Motion for Redundant Robots, pp. 4355-4360

Michellod, Yvan	Ec. Pol. fédérale de Lausanne
Muellhaupt, Philippe	Ec. Pol. Fed. de Lausanne
Gillet, Denis	Ec. Pol. Fédérale de Lausanne (EPFL)

The consequence of the loss of involutivity of a specific set of vector fields on the periodicity of the joint motion is examined for redundant robots. An output task, defined as a one dimensional periodic closed curve embedded in a two dimensional working surface, is realized through the computation of joint velocities in the configuration space. Depending on the manner in which the joint velocity is computed from the end-effector velocity, the resulting joint motion can become unpredictable and of a chaotical nature, even though the end-effector movement is periodic and predictable. The paper proposes an improvement over classical pseudo-inverse computation of the joint motion by suitably selecting two involutive vector fields. This then leads to a constructive sufficient condition for the periodicity of the joints based on the usage of both the 1-form defining the output manifold and complementary integrable 1-forms. The results are illustrated on a five-link rotary redundant robot (5R robot).

11:50-12:10 TuA19.5

Dynamic Modeling and Identification of a Complex-Structured Parallel Robot, pp. 4361-4366

Kroneis, Jens	Univ. of Kaiserslautern
Müller, Peter Andreas	Univ. of Kaiserslautern
Liu, Steven	Tech. Univ. Kaiserslautern

In this paper a new strategy for dynamic modeling and parameter identification of complex parallel robots including parallel crank mechanisms is presented. Based on a model reduction strategy motivated by the structure of the parallel robot SpiderMill, kinematics and dynamics are derived in a compact form applying the modified Denavit Hartenberg method and the Newton-Euler approach. The obtained parameter-linear inverse dynamical description is reduced to a parameter-minimal form applying only an analytical reduction method. The rigid body parameters of the inverse dynamic model are identified by using optimized trajectories and linear estimators. Due to exclusively analytical reduction a physical interpretation of the parameters is possible. Through the whole modeling and verification process verified MSC.ADAMS models and Solid Edge models of the demonstrator SpiderMill are used.

12:10-12:30 TuA19.6

Passive Decomposition of Multiple Nonholonomic Mechanical Systems under Motion Coordination Requirements, pp. 4367-4373

Lee, Dongjun	Univ. of Tennessee-Knoxville

We propose a novel framework, which, under a certain geometric condition, enables us to decompose the second-order Lagrangian dynamics of the multiple nonholonomic mechanical systems into two decoupled systems according to the two most fundamental aspects of the group behaviour: shape system describing the formation aspect (i.e. group's internal shape); and locked system abstracting the maneuver aspect (i.e. group's overall motion). By controlling these decoupled locked and shape systems individually, we can then control the formation and maneuver aspects separately without any crosstalk between them. Moreover, the framework enables us to do this while respecting/utilizing the Lagrangian structure/passivity of the system's open-loop dynamics. Due to this property, we call this framework nonholonomic passive decomposition. A control design example with numerical simulation is also given to highlight some properties of the proposed framework.

TuA20 321C

Mobile Robot Control I (Regular Session)

Chair: Velasco-Villa, Martin	CINVESTAV-IPN
Co-Chair: Trächtler, Ansgar	Univ. of Paderborn

10:30-10:50 TuA20.1

Inverse Optimal Velocity Field Control of an Outdoor Blimp Robot, pp. 4374-4379

Fukao, Takanori	Kobe Univ.
Yuzuriha, Akito	Kobe Univ.
Suzuki, Takafumi	Kobe Univ.
Kanzawa, Takeshi	Kobe Univ.
Oshibuchi, Takashi	Kobe Univ.
Osuka, Koichi	Kobe Univ.
Kohno, Takashi	Japan Aerospace Exploration Agency
Okuyama, Masahiro	Japan Aerospace Exploration Agency
Tomoi, Yasuhito	Japan Aerospace Exploration Agency
Nakadate, Masaaki	Japan Aerospace Exploration Agency

A surveillance system is required to gather the suffering information in the stricken area safely and quickly after natural disasters. An autonomous blimp is the best option for this purpose. Inverse optimal velocity field control is proposed for the blimp to keep a desired trajectory. The desired trajectory based on velocity field is designed, and inverse optimal tracking control is applied to be robust to input uncertainties. The transient performance to the desired trajectory is very important to fly smoothly along the contour, because the blimp is affected by wind easily. The inverse optimal control is expected to improve the robustness to uncertainties of various dynamic parameters. Some experiments are performed to confirm the usefulness of the proposed method by using an outdoor blimp whose length is 12.2m.

10:50-11:10 TuA20.2

Multiobjective Optimization of Control Trajectories for the Guidance of a Rail-Bound Vehicle, pp. 4380-4386

Geisler, Jens — Univ. of Paderborn
Witting, Katrin — Univ. of Paderborn, Germany
Trächtler, Ansgar — Univ. of Paderborn
Dellnitz, Michael — Univ. of Paderborn

Self-optimization refers to the ability of a mechatronic system to autonomously adapt the way it performs its functions to changing environmental and operational conditions or user demands. In this work we propose to use multiobjective optimal control to enable the self-optimization of the guidance of a rail-bound vehicle. We consider different strategies to reduce the computational cost of the optimization. Most importantly, a two-degree-of-freedom controller is used to separate optimal trajectory generation from disturbance compensation. Also, in order to solve the multiobjective optimization problem, an approximation of the entire set of optimal compromises of the objectives, the so-called Pareto set, is computed offline at design time. From this, we can derive a collection of weighting vectors that capture the best trade-off between the objectives for different situations. Given this set of preselected weights, for the online optimization, the objective function can be taken to be a weighted sum that best matches the situation at hand. For the guidance system we consider three objectives. Preliminary offline simulation results are presented.

11:10-11:30 TuA20.3

A Method for Guidance of a Wheeled Mobile Robot Based on Received Radio Signal Strength Measurements, pp. 4387-4392

Teimoori Sangani, Hamid — The Univ. of New South Wales (UNSW)
Savkin, Andrey V. — Univ. of New South Wales

We propose a new guidance law for the problem of wheeled mobile robot (WMR) navigation towards an unknown target based on Received Signal Strength (RSS) Information. Given a mobile robot moving with a constant linear velocity, we use the miss-distance derivative as a measure for the angle at which the robot approaches the target. Miss-distance derivative is estimated from RSS, using a Robust Extended Kalman Filter (REKF). Having applied the proposed steering control law, termed Equiangular Navigation Guidance (ENG), the robot approaches the stationary or maneuvering target along a semi-equiangular spiral and eventually goes into a circular trajectory around it. In order to avoid circling, the algorithm is modified to decrease the robot's linear velocity to that of the target as it approaches the moving target and follow it in a smooth trajectory while preserving a safety distance from the target. Eventually, the performance of the guidance law and its effectiveness is confirmed with an extensive simulation study.

11:30-11:50 TuA20.4

Real-Time Sliding-Mode Adaptive Control of a Mobile Platform Wheeled Mobile Robot, pp. 4393-4399

Filipescu, Adrian — Univ. Dunarea de Jos of Galati
Stancu, Alexandru — Univ. Pol. de Catalunya (UPC)
Filipescu, Silviu — Univ. Dunarea de Jos of Galati
Stamatescu, Grigore — Pol. Univ. of Bucharest

This paper presents parameter identification and discrete-time adaptive sliding-mode controller applied to control the mobile platform Pioneer 3-DX wheeled mobile robot (WMR) with 5-DOF manipulator. The dynamic model for mobile robot with two driving wheels, time–varying mass and moment of inertia have been used in sliding-mode control. Two closed-loop, on-line parameter estimators have been used in order to achieve robustness against parameter uncertainties (robot mass and moment of inertia). Two sliding-mode adaptive controllers have been designed corresponding to angular and linear motion. This paper presents closed-loop, circular trajectory tracking real-time control for the mobile robot Pioneer 3-DX.

11:50-12:10 TuA20.5

A Receding-Horizon Formation Tracking Controller with Leader-Follower Strategies, pp. 4400-4405

Chen, Jian — Lab. for Mechatronics and Controls; JointAdvancedResearch
Sun, Dong — City Univ. of Hong Kong
Yang, Jie — Department of Precision Machinery and Inst. Univ.

This paper presents a receding-horizon leader-follower (RH-LF) controller for addressing the formation control problem of multiple nonholonomic mobile robots. The issues to be investigated include separation, bearing, and orientation deviation control between the leader and the followers, where the orientation deviation control is especially important to control precision. After the leader-follower formation problem is posed to a formation tracking problem, a receding-horizon formation tracking controller is proposed, which guarantees asymptotic convergence of the formation tracking error to zero. Simulations are performed to verify the effectiveness of the proposed control strategy.

12:10-12:30 TuA20.6

Bank-To-Turn Control for a Small UAV Using Backstepping and Parameter Adaptation, pp. 4406-4411

Jung, Dongwon — Georgia Inst. of Tech.
Tsiotras, Panagiotis — Georgia Inst. of Tech.

In this research we consider the problem of path following control for a small fixed-wing unmanned aerial vehicle (UAV). Assuming the UAV is equipped with an autopilot for low level control, we adopt a kinematic error model with respect to the moving Serret-Frenet frame attached to a path for tracking controller design. A kinematic path following control law that commands heading rate is presented. Backstepping is applied to derive the roll angle command by taking into account the approximate closed-loop roll dynamics. A parameter adaptation technique is employed to account for the inaccurate time constant of the closed-loop roll dynamics during actual implementation. The path following control algorithm is validated in real-time through a high-fidelity hardware-in-the-loop simulation (HILS) environment showing the applicability of the algorithm on a real system.

TuA21 321B

Low-Cost, High-Performance Sensor Technologies for Robotic and Consumer Applications (Invited Session)

Chair: Lee, In Ock — Ninety System Co.
Co-Chair: Kim, Byung-Geuk — Hagisonic Co., Ltd.
Organizer: Choi, Byoung-Doo — Seoul Univ.
Organizer: Cho, Dong-il Dan — Seoul National Univ.

10:30-10:50 TuA21.1

Improving Igs Ultrasonic Receiver Circuit of Low Cost Positioning Sensor for Ubiquitous Robotic Companion (I), pp. 4412-4417

Jin, JoCheol — Ninety system co.
Lee, In Ock — Ninety System Co.
Lim, Hyung Joon — Ninety System Co.
Shin, Joon Gyou — Ninety System Co.
Lee, Won Bok — Ninety System Co.
Lee, Chang Jin — Ninety System Co.

The localization system, iGS has three kinds of medium to detect the distance of a mobile object. As the medium of distance detection, iGS uses ultrasonic wave, RF signal, and Infra-Red vision. iGS using ultrasonic signal has the target market for reasonable price. If the ultrasonic signal can be used with a lower performance digital signal processor(DSP), the price of the ultrasonic receiver will be more reasonable. For reasonable price, the ultrasonic receiver has the circuitry to change the fast signal into the slow signal. Even if the DSP has low speed, the slowly transformed signal can be sampled at a slow rate. The positioning accuracy of the slowly transformed signal is proven with the comparison test. If the ultrasonic receiver has the circuitry to transform the fast signal into the slow signal, iGS using ultrasonic signal can be a cost effective solution for the ubiquitous robot companion.

10:50-11:10 TuA21.2

Wafer-Level Vacuum Packaged X and Y Axis Gyroscope Using the Extended SBM Process for Ubiquitous Robot Applications (I), pp. 4418-4423

Choi, Byoung-Doo — Seoul Univ.
Paik, Seung-Joon — SML electronics
Lee, Sangmin — Seoul National Univ.
Ko, Hyoungho — Seoul National Univ.
Yoo, Kwangho — SML Electronics, Inc.
Kim, Namkuk — Seoul National Univ.

Cho, Dong-il Dan — Seoul National Univ.

A wafer-level vacuum packaged x and y axis gyroscope is fabricated on a (111) SOI wafer using the extended SBM (sacrificial bulk micromachining) process. The gyroscope uses vertically offset combs to resonate the proof mass in the vertical plane, and lateral combs to sense the Coriolis force in the horizontal plane. The extended SBM process is a simple two-mask process, and because all structural parts and combs are defined in one mask level, there is no misalignment in any structural parts or comb fingers. The silicon-to-glass anodic bonding carried out in low vacuum is used for the encapsulation of the fabricated gyroscope. The fabricated x and y axis gyroscope resolves 0.7 deg/sec angular rate, and the measured bandwidth is 22 Hz. The input range and the output linearity are over ± 80 deg/sec and 1.03 %FSO, respectively. The fabricated vacuum packaged x and y axis gyroscope without align error is important component at the high performance multiple-axis gyroscopes. The multiple-axis gyroscopes are used in many applications such as recently interested ubiquitous robot, car navigation, game controller, vehicle safety system, and so on.

11:10-11:30 — TuA21.3

Robust Control Design for Resonance Damping of a Directional Microphone, pp. 4424-4429

Vargas, Henik — Binghamton Univ.
Wu, Neng Eva — Binghamton Univ.
Miles, Ron — Binghamton Univ.
Qu, Jinli — Binghamton Univ.

This work applies mu analysis and synthesis techniques to develop a robust strategy for damping resonant modes in micromachined directional microphones of the parallel capacitive type. By properly selecting a weighting function, a robust controller is successfully designed via the D-K algorithm. Linear simulations show that the resonant mode of a directional microphone can be flattened out, and pushed to a frequency beyond the sensitivity of the human ear. The closed loop responses are free of ringing effects observed in open loop even for the worst-case parameter values.

11:30-11:50 — TuA21.4

Development of an Automatic Recharging System for Intelligent Robots Using an Anisotropic Ultrasonic Sensor (I), pp. 4430-4431

Kim, Byung-Geuk — Hagisonic Co., Ltd.
Jang, Seung-Jin — Hagisonic Co., Ltd.
Park, Seon-Hong — Hagisonic Co., Ltd.
Choi, Duck-Hee — Hagisonic Co., Ltd.
Ahn, Youn-Kuk — Hagisonic Co., Ltd.

It is essential to supply electrical power continuously to mobile robots to keep moving. We studied how to make a mobile robot return to a recharging station autonomously by using specially designed ultrasonic sensors when a battery is low. A principle to calculate location and rotation angle of a mobile robot from recharging station was suggested. An anisotropic ultrasonic sensor system, we call it AniBatTM, made it possible, because the unique sensors had such a wide horizontal beam directivity ranging from 150Ú; up to 200Ú;. By only a few sensors, four sensors, an ultrasonic signal could be perceived within 180Ú; wide-open whole front area of a recharging station and the mobile platform was returned accurately to the station.

TuA22 — 321A

Design and Development Tools for Mechatronic Systems
(Regular Session)

Chair: Falcon, Jeannie — National Inst.
Co-Chair: Danielsson, Fredrik — Univ. West

10:30-10:50 — TuA22.1

Design of Hybrid Systems with Real-Time Processor and FPGA Targets, pp. 4432-4433

Falcon, Jeannie — National Inst.

Hybrid control systems integrate discrete logic combined with physical system dynamics. Discrete logic can be represented in a graphical, data flow language using a UML compliant statechart model. The physical system dynamics can also be integrated into the hybrid system by using in the same data flow language. The resulting system can execute on a real-time processor or on a system which includes both a processor and a field programmable gate array (FPGA).A case study is presented for a cruise control application.

10:50-11:10 — TuA22.2

New Mechatronics Development Techniques for FPGA-Based Control and Simulation of Electromechanical Systems, pp. 4434-4439

Kassas, Zaher — National Inst.
MacCleery, Brian — National Inst.

Field programmable gate arrays (FPGAs) have been widely adopted in high volume commercial applications, but not as much in the industrial control and simulation arenas. Due to the attractive features of FPGAs, such as their inherent flexibility, performance, parallelism, and low-level reconfigurability, industrial control design and simulation vendors have been creating the next generation FPGA development tool chains that are designed for engineers with little or no digital design expertise. The goal of these next generation system-level design tools is to empower control design, simulation, and signal processing engineers to harness the full power of the FPGA technology, while providing relatively competitive performance and resource usage, as compared to traditional text-based hardware description level (HDL) methods. This paper discusses some of the traditional challenges that prohibited wide adoption of FPGAs in the industrial control and simulation fields, and how new graphical system design tools are helping mechatronics engineers leverage the full power of FPGAs as deployment platforms. Moreover, it discusses some particularly useful development techniques for FPGA-based control and simulation in mechatronics applications.

11:10-11:30 — TuA22.3

General Time Synchronisation Method for PLC Programs Aiming at Virtual Verification and Development with CAPE Tools, pp. 4440-4445

Carlsson, Henrik — Univ. West
Danielsson, Fredrik — Univ. West
Lennartson, Bengt — Chalmers Univ. of Tech.

The latest state-of-the-art Computer Aided Production Engineering (CAPE) simulation technology offers OPC integration for PLC verification. A critical drawback with this technology has been identified and described within this paper. A new time synchronisation method and a simulation architecture are therefore presented and proposed. The time synchronisation method together with the architecture can be used when verifying and developing real-time dependent control logic for industrial control system, e.g. PLC with CAPE tools. The method described in this paper is general and should work on any PLCs that are compatible with the IEC 61131-3 standard. A test case was also carried out, showing that by disregarding time synchronisation it is impossible to verify real-time dependent PLC functions together with CAPE tools in a reliable way. However, the test case also shows that by applying the proposed time synchronisation method together with the described simulation architecture a successful industrial verification method is achieved.

11:30-11:50 — TuA22.4

A New Hardware-In-The-Loop Platform for the Evaluation of Adaptive Lighting Systems, pp. 4446-4451

Opfermann, Alexander — TU Dortmund
Bertram, Torsten — TU Dortmund
Baum, Dietmar — Hella KGaA Hueck & Co.
Karas, Peter — Hella KGaA Hueck & Co.

In this paper a new hardware-in-the-loop platform for the evaluation of adaptive lighting systems is presented. A standard industrial robot is actuated with input data from a vehicle dynamics simulation in order to position a pair of active frontlighting headlamps mounted at the tool center point. With this setup test drives can be simulated repeatedly under well defined environmental conditions at any time. A visual measurement system is presented that tracks the dynamic light distribution and thus provides data that can be related to subjective impressions by means of statistical analysis tools.

11:50-12:10 — TuA22.5

A New Motorcycle Simulator Platform: Mechatronics Design, Dynamics Modeling and Control, pp. 4452-4457

Nehaoua, Lamri — Evry Univ.
Hima, Salim — IBISC Lab. Evry val d'essone Univ.
Arioui, Hichem — Evry Val d'Essonne Univ.
Séguy, Nicolas — Evry Val d'Essonne Univ.

This paper gives a global dynamic analysis of a two wheeled riding simulator that we have built and instrumented for the study of drivers behavior. These studies concern drive situations in normal urban scenario as well as dangerous driving situations such as skidding.

The justification of the choice of the platform movements for a good feeling is discussed. Different models for inverse kinematics and dynamics are updated (with new hypotheses) for the Low-level control to ensure an efficient trajectories tracking. For this last point, we have proposed a simple scheme of PD controller, using the inverse dynamics of the platform. The results illustrate the good behavior of the platform and support its use in closed-loop with the driver in the simulation loop.

12:10-12:30 TuA22.6

Model-Free Control of Shape Memory Alloys Antagonistic Actuators, pp. 4458-4463

Gédouin, Pierre-Antoine	Ec. nationale d'ingénieurs de Brest
Join, Cédric	UHP-Nancy & ALIEN INRIA-Futurs
Delaleau, Emmanuel	Ec. nationale d'ingénieurs de Brest
Bourgeot, Jean-Matthieu	Ec. nationale d'ingenieurs de Brest
Arbab Chirani, Shabnam	ENIB
Calloch, Sylvain	ENSIETA

This paper deals with a first application of the new framework of model-free control to the promising technology of shape memory alloys actuators. In particular antagonistic shape memory alloys actuator. These devices are known to be difficult to model in a control perspective. Simulations results are exposed and some preliminary experimental results illustrates the paper.

TuA23 323

Radio Frequency Identification (RFID) Technology in Supply Chain Management I (Invited Session)

Chair: Dolgui, Alexandre	Ec. des Mines de Saint Etienne
Co-Chair: Monostori, Laszlo	Budapest Univ. of Tech. and
Organizer: Dolgui, Alexandre	Ec. des Mines de Saint Etienne
Organizer: Monostori, Laszlo	Budapest Univ. of Tech. and

10:30-11:10 TuA23.1

RFID Technology in Supply Chain Management: State of the Art and Perspectives (I), pp. 4464-4475

Dolgui, Alexandre	Ec. des Mines de Saint Etienne
Proth, Jean-Marie	INRIA

This paper provides a state of the art on RFID technology in Supply chain management. It presents technical characteristics of existing RFID systems, a guideline for RFID deployment, and some applications in Supply chains. The paper summarizes the advantages of RFID technology for inventory control and introduces some challenging problems and perspectives dealing with, in particular, privacy and authentication. In addition, there is a carefully selected recent bibliography in this domain.

11:10-11:30 TuA23.2

Direct Neural Network Based Service Level Control in RFID-Enabled Supply Chain (I), pp. 4476-4480

Hong, Seong Rok	Yonsei Univ.
Yoo, Jang Sun	Yonsei Univ.
Ko, Jong Myoung	Yonsei Univ.
Kim, Chang Ouk	Yonsei Univ.

In recent supply chain management, as the online use of inventory data becomes available with the development of Radio Frequency Identification (RFID) technology, it is now possible to monitor the performance measures in a timely fashion. Customer service level is a key performance measure that can be computed as the percentage of times that customer orders electronically received are fulfilled by on-hand inventory. Online monitoring of the service level enables the management paradigm to progress toward the closed loop based control which keeps revising the operation policy to reach a target service level. This paper proposes a closed loop supply chain control based on a direct neural network controller. Simulation based experiments were performed to test the performance of the controller against two kinds of unstable customer demand curves.

11:30-11:50 TuA23.3

Model Predictive Control for Scheduling and Routing in a Solid Waste Management System (I), pp. 4481-4486

Johansson, Ola M.	Lund Univ.
Johansson, Rolf	Lund Univ.

Solid waste collection and hauling account for the greater part of the total cost in modern solid waste management systems. In a recent initiative, 3,300 Swedish recycling containers have been fitted with level sensors and wireless communication equipment thereby giving waste collection operators access to real-time information on the status of each container. In a previous study (Johansson, 2006), analytical modeling and discrete-event simulation have been used to evaluate different scheduling and routing policies utilizing the real-time data, and it has been shown that dynamic scheduling and routing policies exist that have lower operating costs, shorter collection and hauling distances, and reduced labor hours compared to the static policy with fixed routes and pre-determined pick-up frequencies employed by many waste collection operators today. This study aims at further refining the scheduling and routing policies by employing a model predictive control (MPC) framework on the system. In brief, the MPC controller should minimize an objective cost function consisting of fixed and variable collection and hauling costs for a fixed future horizon by calculating a sequence tactical scheduling and routing decisions that satisfies system constraints using a receding horizon strategy.

11:50-12:10 TuA23.4

Repair-Control of Enterprise Systems Using RFID Sensory Data (I), pp. 4487-4492

Kohn, Wolf	Univ. of Washington
Brayman, Vladimir	Univ. of Washington

This paper describes a framework for implementing real-time enterprise planning, scheduling and control processes based on information provided by RFID sensing systems. The proposed framework is based on optimal control algorithms, and interfaces with existing ERP infrastructure. The objective is to respond autonomously to changes in the enterprise using a feedback configuration that minimizes disruptions. RFID sensing systems have the potential to provide the real time data needed to implement enterprise feedback functionality. The central concept presented in the paper is a real time repair schema implemented in a distributed architecture, that utilizes dynamical models described by differential equations with piece-wise continuous solutions.

12:10-12:30 TuA23.5

TRASER: An Open-Source Solution Platform for Cross-Company Transparency in Tracking and Tracing (I), pp. 4493-4498

Monostori, Laszlo	Computer and Automation Res. Inst. Hungarian
Ilie-Zudor, Elisabeth	Computer and Automation Res. Inst. HungarianAcademy of
Szathmári, Marcell	MTA SZTAKI
Kemény, Zsolt	MTA SZTAKI

Recent trends in industrial production are marked by rapid changes in structures of collaboration or competition, as well as the spreading of customized production and more intricate customer demands regarding quality and visibility of delivery processes. All this calls for efficient means of tracking and tracing beyond company borders—a technological step which is, in principle, available, yet, it is de facto restricted to isolated proprietary solutions excluding countless small and medium-sized enterprises from their application. The EU-funded project TraSer (Identity-Based Tracking and Web-Services for SMEs) was started with the goal of overcoming these obstacles by providing a free, open-source tracking and tracing solution platform which would allow SMEs to set up and maintain tracking and tracing services across company borders requiring low costs of initial investment and operation. The paper presents main goals and envisaged results of the project.

TuA24 324

Statistical and Parameter Estimation Based Methods (Regular Session)

Chair: Gao, Furong	Hong Kong Univ. of Sci & Tech.
Co-Chair: Shah, Sirish	Univ. of Alberta

10:30-11:10 TuA24.1

Stage-Oriented Statistical Batch Process Monitoring, Quality Prediction and Improvement, pp. 4499-4510

Yao, Yuan	Hong Kong Univ. of Science and Tech.

Gao, Furong — Hong Kong Univ. of Sci & Tech.

Multistage/multiphase is an inherent characteristic of many batch processes, which should be taken into consideration to ensure better batch process monitoring, analysis, quality prediction and improvement. In this paper, a series of stage-oriented multivariate statistical methods on such topics are reviewed. Then, the modeling problem of transition between stage and stage is discussed. A new proposed stage and transition identification and modeling method is introduced as a necessary complementary of the existing work.

11:10-11:30 — TuA24.2

A Polyreference Least Square Complex Frequency Domain Based Statistical Test for Damage Detection, pp. 4511-4516

Canales, Gilles Olivier — Univ. de Rennes I
Mevel, Laurent — IRISA/INRIA
Basseville, Michele — IRISA/CNRS

Some current approaches in damage detection have led to the implementation of statistical algorithms, based on the so-called ”local approach” assumption. The reference parameter is the modal signature of a state-space model of the studied system, and the tests aim at detecting small deviations in this signature without explicitly computing it. Moreover, the system inputs are assumed to be random white noises, modeling all the various and unknown influences on the system, either environmental or operational. Working with the outputs in time-domain, various tests were designed and experimented - e.g. the subspace-based chi-square test. On the other hand, efficient system identification algorithms working in the frequency domain have been designed, first dealing with experimental conditions - meaning there are known controlled inputs - but also offering promising perspectives with regards to the operational conditions - without any measurement of the inputs. In this paper, a frequency-domain statistical test for change detection is proposed, based on this recent frequency-domain modal analysis method and on the local approach to change detection.

11:30-11:50 — TuA24.3

Application of Bicoherence Analysis on Vibration Data for Condition Based Monitoring of Rotating Machinery, pp. 4517-4522

Halim, Enayet — Univ. of Alberta
Shah, Sirish — Univ. of Alberta
Choudhury, Md. Ali — Bangladesh Univ. of Engineering Tech.
Kadali, Ramesh — Suncor Energy Inc.

Bicoherence or Bispectrum analysis is emerging as a new powerful technique in signal processing, especially in areas where traditional linear spectral analysis provides insufficient information. It is most effective in analyzing systems with non-linear coupling between frequencies. Faults in rotating machineries leave their signature on the vibration signal sensors and generally manifest themselves as a non-linear transformation in the vibration signal. Bicoherence analysis detects and quantifies the presence of non-linearity in the signal and thus indicates the severity of the fault in the machine.

This paper demonstrates the use of bicoherence analysis on both simulated and rig-generated vibration data from a rub-effected rotor-stator system, and shows the application of bicoherence analysis on industrial data from final tailing pumps to detect impeller wear in an oil-sands plant.

11:50-12:10 — TuA24.4

Passive Robust Fault Detection Using Interval MA Parity Equations: Inverse vs Direct Image Tests, pp. 4523-4528

Guerra, Pedro — Tech. Univ. of Catalonia (UPC)
Puig, Vicenc — Univ. Pol. de Catalunya

In this paper, a passive robust fault detection test based on calculating the inverse image of an interval model (linear or non-linear but linear with respect to the parameters) expressed in MA form is presented. This relies on a consistency test which uses tools from interval analysis and zonotope arithmetic to check if there exists a member in the family of models described by an interval model that can explain the measured data. The proposed test is compared to the classical robust interval model fault detection approach based on the direct image. The main features of both tests will be extracted and advantages and drawbacks discussed using a motivational example. Finally, an application example based on the known quadruple-tank process is used to assess how the algorithms work.

12:10-12:30 — TuA24.5

An Adaptive DISSIM Algorithm for Statistical Process Monitoring, pp. 4529-4534

Zhao, Chunhui — Northeastern Univ.
Wang, Fuli — Northeastern Univ.
Mao, Zhizhong — Northeastern Univ.
Jia, Mingxing — Northeastern Univ.
Wang, Shu — Northeastern Univ.

Abstract: Recently, a novel multivariate statistical process monitoring method, known as dissimilarity algorithm(DISSIM), has been developed based on the idea that a change of operating condition can be detected by monitoring a distribution of process data set, where a dissimilarity index is introduced to quantitatively evaluate the difference between distributions of process data. However, as a fixed-model monitoring technique, it inevitably gives false alarms when applied to real processes involving slow changes. In this paper, an adaptive DISSIM(ADISSIM) algorithm is proposed for on-line updating to consecutively adapt to process slow-varying behaviors. The key to the proposed method is that whenever the old model is judged to be inefficient to capture the current normal operation status, a new monitoring model is developed by integrating the old model and the new updating data. The effectiveness of ADISSIM algorithm is successfully illustrated when applied to simulated data collected from a simple numerical process. The results clearly show that the proposed adaptive method is effective to accommodate the normal gradual changes and distinguish them from real process faults, thus providing a new feasible statistical monitoring method for the prevalent slow-varying processes.

TuA25 — 328

Process Modeling, Identifcation, and Estimation (Regular Session)

Chair: Moreno, Jaime A. — Univ. Nacional Autonoma de Mexico-UNAM
Co-Chair: Patton, Ron J. — Univ. of Hull

10:30-10:50 — TuA25.1

Integrated Design of Robust Controller and Fault Estimator for Linear Parameter Varying Systems, pp. 4535-4539

Weng, Zhengxin — Shanghai Jiaotong Univ.
Patton, Ron J. — Univ. of Hull
Cui, Ping — Shanghai Jiaotong Univ.

An integrated design of robust controller and fault estimator for linear parameter varying systems is presented in this paper. Based on gain-scheduled H_; design strategy and scaled bounded real lemma, a linear parameter varying controller is developed, which can generate both control signals and fault estimates. To demonstrate the effectiveness of the proposed method, an uncertain system with actuator faults is studied

10:50-11:10 — TuA25.2

Oil and Gas Production Optimization; Lost Potential Due to Uncertainty, pp. 4540-4547

Elgsćter, Steinar Morisbak — Norwegian Uni. Science & Tech.
Slupphaug, Olav — ABB
Johansen, Tor Arne — Norwegian Univ. of Science and Tech.

The information content in measurements of offshore oil and gas production is often low, and when a production model is fitted to such data, uncertainty may result. If production is optimized with an uncertain model, some potential production profit may be lost. The costs and risks of introducing additional excitation are typically large and cannot be justified unless the potential increase in profits are quantified.

In previous work it is discussed how bootstrapping can be used to estimate uncertainty resulting from fitting production models to data with low information content. In this paper we propose how lost potential resulting from estimated uncertainty can be estimated using Monte-Carlo analysis.

Based on a conservative formulation of the production optimization problem, a potential for production optimization in excess of 2% and lost potential due to the form of uncertainty considered in excess of 0.5% was identified using field data from a North Sea field.

11:10-11:30 — TuA25.3

Dynamic Modelling and Optimal Control of a Multicomponent Batch

Packed Distillation Column, pp. 4548-4553

Ceylan, Hatice	Middle East Tech. Univ.
Ozgen, Canan	Middle East Tech. Univ.

A dynamic model for the simulation of the batch operation of a multicomponent packed distillation column is developed. The accuracy of simulation code is verified by using two types of mixtures (cyclohexane-n-heptane-toluene and ethanol–water) theoretically and experimentally. An optimum internal reflux ratio profile is searched to maximize the distillate amount of a specified concentration for a given time by using capacity factor approach using MATLAB software.

11:30-11:50 TuA25.4

Dissipativity-Based Globally Convergent Observer Design for a Class of Tubular Reactors, pp. 4554-4559

Schaum, Alexander	Univ. Autónoma de México
Moreno, Jaime A.	Univ. Nacional Autonoma de Mexico-UNAM
Alvarez, Jesus	Univ. Auto. Metropolitanta-Iztapal

The problem of designing a globally convergent observer for a class of tubular reactors with boundary measurements is addressed. The problem is tackled by extending a dissipativity theory-based observer design for nonlinear finite-dimensional systems, which has been recently applied to a class of continuous stirred tank reactors. The underlying idea of the proposed observer approach consists in designing the tubular reactor data-assimilation scheme so that the estimation error dynamics are given by a two-dissipative system interconnection: one linear distributed dynamical system with the convective and diffusive mechanisms, and one nonlinear lumped static system with the reaction kinetics. The approach is applied to a tubular reactor with non-monotonic kinetics and boundary measurements, and the associated sufficient solvability condition was identified and interpreted in terms of dissipativity and dimensionless numbers with physical meaning.

11:50-12:10 TuA25.5

Principal Component Analysis Based Support Vector Machine for the End Point Detection of the Metal Etch Process, pp. 4560-4565

Han, Kyounghoon	Seoul National Univ.
Kim, Seunghyok	Seoul National Univ.
Park, Kun Joo	DMS Co., Ltd.
Yoon, En Sup	Seoul National Univ.
Chae, Heeyeop	Sungkyunkwan Univ.

An endpoint detection using the algorithm of principal component analysis based support vector machine was developed for the plasma etching process. Because many endpoint detection techniques use a few manually selected wavelengths, noise render them ineffective and it is hard to select the important wavelengths. So the principal component algorithm with the whole wavelengths has been developed for the more effective monitoring of end point. And the support vector regression was followed for the real-time end point detection with reduced wavelengths to save the processing time. This approach was applied and demonstrated for a metal etching process of Al and 0.5% Cu on the oxide stack with inductively coupled BCl2/Cl2 plasma.

TuA26 327

Modeling, Operation and Control of Power Systems I (Regular Session)

Chair: Weber, Harald	Univ. of Rostock
Co-Chair: Havel, Petr	Czech Tech. Univ.

10:30-10:50 TuA26.1

Design of Supplementary Controller for HVDC Using Memetic Algorithm, pp. 4566-4570

Haidari, Saeid	Electrical Engineering Department of
Farsangi, Malihe Maghfoori	Electrical Engineering Department ofShahidBahonarUniversity, Ker
Nezamabadi-pour, Hossein	Electrical Engineering Department of ShahidBahonarUniversity, Ke
Lee, Kwang Y.	Baylor Univ.

This paper investigates the ability of Memetic Algorithm (MA) in designing supplementary controller of High Voltage Direct Current (HVDC) link to damp the power system oscillations. A conventional lead-lag structure is considered for the supplementary controller. The aim of the proposed control strategy is to choose the best controller parameters in such a way that the dominant eigenvalues of the closed-loop system are shifted to the left-hand side of s-plane as far as possible. Also, the Real Genetic Algorithm (RGA) is used to design a supplementary controller for HVDC. The characteristic convergence and time simulation results show that both algorithms have good capability in solving the problem but MA gives better convergence characteristic.

10:50-11:10 TuA26.2

Adaptive Feed-Forward Cancellation Control of a Full-Bridge DC-AC Voltage Inverter, pp. 4571-4576

Malo, Shane	Univ. Pol. de Catalunya (UPC)
Grino, Robert	Univ. Pol. De Catalunya

Dc-ac inverters are needed in many applications. The full-bridge dc-ac inverter has been widely used in industry applications and trough the literature. If the nature of the load is not known a priori, some considerations should be taken in order to assure the quality of service to be provided by the inverter. When nonlinear loads are fed by a full-bridge dc-ac inverter, odd harmonics of the fundamental ac frequency are introduced into the output voltage shape. For the purpose of producing a good sinusoidal output voltage signal, the control strategy must be able to reject periodic output disturbances. Adaptive Feed-forward Cancellation (AFC) is a control technique that has been successfully used to selectively reject periodic output disturbances in continuous-time mechanical systems. This paper deals with the use of AFC to control the output voltage of an electrical system, in this case, a dc-ac full-bridge inverter, to produce a standard European ac voltage signal, 230 Vrms and 50 Hz, accomplishing the design of the controller directly in the z-domain.

11:10-11:30 TuA26.3

Discrete-Time Observer for Induction Machine in Presence Magnetic Saturation, pp. 4577-4582

Giri, Fouad	GREYC - Univ. de Caen
Elfadili, Abderrahim	Univ. Mohammed V, EMI , Rabat
Ouadii, Hamid	Ismra
Dugard, Luc	CNRS-INPG-UJF
Buche, Gabriel	INPG

We are considering the problem of state estimation in induction motors. One key feature of this work is that the problem is dealt with based upon a model that accounts for the saturation effect of the magnetic circuit characteristic. Indeed, magnetic saturation cannot be ignored, especially when high power machines are considered. The above model is first based upon to analyse the machine observability. Then, a continuous-time high-gain observer is presented and discretized for omplementation purpose. Timediscretization is necessary because real-time implementation can only be done using digital equipments. The discretization task constitutes a crucial issue due to the nonlinear feature of the (continuous) observer. It is coped with using the Taylor-Lie method and the (discrete-time) observer thus obtained is validated experimentally using an asynchronous motor of 7.5 KW.

11:30-11:50 TuA26.4

Design of a Supplementary Controller for SVC Using Immune Algorithm, pp. 4583-4587

Kyanzadeh, Saeid	Electrical Engineering Department of Shahid Bahonar
Farsangi, Malihe Maghfoori	Electrical Engineering Department ofShahidBahonarUniversity, Ker
Nezamabadi-pour, Hossein	Electrical Engineering Department of ShahidBahonarUniversity, Ke
Lee, Kwang Y.	Baylor Univ.

This paper investigates the ability of Immune Algorithm (IA) in designing a supplementary controller for Static Var Compensators (SVC) to damp the power system inter-area oscillation. For this the parameters of the supplementary controller are determined by IA using an eigenvalue-based objective function. The numerical results are presented on a 2-area 4-machine system to illustrate the feasibility of the proposed method. Also, to compare the results obtained by IA, a simple Genetic Algorithm (GA) is applied. Furthermore, to validate the designed controllers by IA and GA a supplementary controller is designed by HĄ¿ controller using loop shaping method. To show the effectiveness of the designed controllers, a three phase fault is applied at a bus. The simulation study shows that the designed controllers improve the stability of the system.

11:50-12:10 TuA26.5

Monte-Carlo Simulation of Electricity Transmission System Operation, pp. 4588-4593

Cerny, Vaclav	Univ. of West Bohemia
Janecek, Petr	Univ. of West Bohemia
Fialova, Andrea	Univ. of West Bohemia
Fantik, Josef	CEPS a.s.

One of basic system services that an electricity transmission system operator guarantees is power balance maintenance. The aim of this service is to keep power export/import to/from surrounding interconnected electricity transmission systems at a proposed value. The power quantity is a random variable. Therefore, a control strategy of the quantity consists in keeping amplitudes of a power balance deviation in specified boundaries. The operator uses so called ancillary services for this purpose. In order to verify that power reserves of particular ancillary services are large enough for guaranteeing reliable operation of the electricity transmission system a Monte-Carlo simulator has been developed and implemented. The simulator models dynamical behavior of the system under the power reserves constraints.

12:10-12:30 TuA26.6

Decentralized Nonlinear Control Method of Components in Power Systems Based on Differential-Algebraic Sub-System Models, pp. 4594-4599

Zhang, Kaifeng	Southeast Univ.
Dai, Xianzhong	Southeast Univ.
Zang, Qiang	Southeast Univ.

Complete nonlinear differential-algebraic equation (DAE) sub-system models are considered in the paper when designing controllers of components in power systems. First-principle models are nonlinear DAE sub-system models, but they use non-local measurable variables to describe the mutual relation (interconnection) between component and the AC grid, and thus they are not suitable for designing decentralized controllers. In the paper, component structural models are constructed, in which the local-measurable interface variables are used to describe the mutual relation between component and the AC grid. Thus, the proposed models are equivalent to the first-principle models in essence, and have two characteristics: with local measurable interconnections and index 1. These two characteristics make it possible to transform the component structural models to nonlinear ordinary differential equation (ODE) sub-system models with measurable interconnections. Thus, traditional nonlinear control methods which are suitable for nonlinear ODE systems could be developed and expanded to be suitable for designing component controllers.

TuA27 326

Computational Intelligence Approach in Modeling and Control (Invited Session)

Chair: Kuroe, Yasuaki	Kyoto Inst. of Tech.
Co-Chair: Watanabe, Keigo	Saga Univ.
Organizer: Kuroe, Yasuaki	Kyoto Inst. of Tech.

10:30-10:50 TuA27.1

A Fuzzy Kalman Filter Approach to the SLAM Problem of Nonholonomic Mobile Robots (I), pp. 4600-4605

Watanabe, Keigo	Saga Univ.
Dedduwa Pathiranage, Chandima	Saga Univ.
Izumi, Kiyotaka	Saga Univ.

This paper presents an alternative solution to simultaneous localization and mapping (SLAM) problem by applying a fuzzy Kalman filter using a pseudolinear measurement model of nonholonomic mobile robots. Takagi-Sugeno fuzzy model based on an observation for a nonlinear system is adopted to represent the process and measurement models of the vehicle-landmark system. The complete system of the vehicle-landmark model is decomposed into several linear models. Using the Kalman filter theory, each local model is filtered to find the local estimates. The linear combination of these local estimates gives the global estimate for the complete system. The simulation results shows that the new approach performs better, though nonlinearity is directly involved in the Kalman filter equations, compared to the conventional approach.

10:50-11:10 TuA27.2

Nonlinear System Modeling by Hybrid Genetic Programming (I), pp. 4606-4611

Hashimoto, Nozomi	Osaka Univ.
Kondo, Nobuhiko	Osaka Univ.
Hatanaka, Toshiharu	Osaka Univ.
Uosaki, Katsuji	Fukui Univ. of Tech.

Genetic Programming (GP) is a useful tool of nonlinear model building, however a simple use of GP often fails in numeric optimization since GP hangs on random number sampling in searching appropriate constant parameters in individual representing each model candidate. From this viewpoint a hybrid GP based nonlinear system identification method is proposed in this paper. We introduce a simple numerical optimization inspired by Particle swarm in GP operation to improve numeric optimization ability. Then, this hybridization is applied to nonlinear system identification by using GP. The applicability of the proposed method is shown by the results of some numerical experiments.

11:10-11:30 TuA27.3

Robust Autonomous Flight Control of an UAV by Use of Neural Networks (I), pp. 4612-4617

Nakanishi, Hiroaki	Kyoto Univ.
Inoue, Koichi	Osaka Sangyo Univ.

This paper describes a method to develop robust flight control systems for UAVs. It was difficult to develop flight control systems, because the helicopter dynamics is nonlinear. Moreover the flight environment is not fixed because of the atmospheric changes, such as the wind. The wind affects the attitude or velocities of the UAV, but the wind speed or direction is hard to predict, so the wind is usually categorized into stochastic uncertainties. An efficient method to design robust controllers by training neural networks is proposed in this paper. Neural networks trained by the proposed method are robust against stochastic uncertainties. In this paper, the small unmanned helicopter is focused on, and numerical results of altitude control are shown to demonstrate the effectiveness of our approach.

11:30-11:50 TuA27.4

Identification of a Class of Discrete Event Systems by Neural Networks - Sparse Realization - (I), pp. 4618-4624

Kuroe, Yasuaki	Kyoto Inst. of Tech.
Mori, Yoshihiro	Kyoto Inst. of Tech.

In analysis and design of a system, the first goal is to obtain an appropriate model of the system. Because of the complex dynamics of discrete event systems (DESs), it is very difficult to obtain a model of unknown DESs from given input and output data.This paper discusses an identification and realization method of a class of DESs by neural networks. We consider a class of DESs which is modeled by using finite state automata. In identification and realization of systems by using neural networks, it is essentially important to develop a suitable architecture of neural networks. We already proposed two neural network architectures: one is a class of recurrent neural networks and the other is a class of recurrent high-order neural networks, which are capable of representing FSA with the network size being smaller than the existing neural network models. We present an identification method of DESs, which makes it possible to obtain sparse realization, that is, to obtain networks with simpler structure. It is shown through numerical experiments that presented method makes it possible to obtain simpler neural networks which can exactly simulate target DESs.

11:50-12:10 TuA27.5

Neurofuzzy Modelling and Pattern Matching for Online Fault Detection and Isolation of Nonlinear DC Motors, pp. 4625-4630

Mok, Hing Tung	The Univ. of Hong Kong
Chan, Che Wai	Univ. of Hong Kong

An online fault detection and isolation scheme for nonlinear systems based on neurofuzzy modelling and pattern matching is developed in this paper. The system is first modelled offline by a neurofuzzy network using data obtained under normal operating conditions. Another neurofuzzy network is then used to model the residual, which is the difference between the output of the system and that from the neurofuzzy network. For online fault monitoring, it is necessary to construct first a fault database that contains fuzzy rules for all possible faults in the system. Recursive least squares algorithm is used to train the network online, from which the IF-THEN rules are extracted. Faults are isolated online by comparing these fuzzy rules with those in the fault database using a nearest neighbour classifier. A simulation example involving a nonlinear DC motor control system is used to demonstrate the implementation and performance of the proposed FDI scheme.

12:10-12:30 TuA27.6

Real-Time Level Plant Control Using Improved BELBIC, pp. 4631-4635

Masoudinejad, Mojtaba K.N. Toosi Univ. of Tech.
Khorsandi, Rahman Univ.
Fatehi, Alireza K.N. Toosi Univ. of Tech.
Lucas, Caro Prof.
Fakhimi, Siavash Univ.
Jamali, Mohammad Reza Univ. of Tehran

Brain emotional learning based intelligent controller (BELBIC) is based on computational model of limbic system in the mammalian brain. In recent years, this model was applied in many linear and nonlinear control applications. Previous studies show that this controller has fast response, simple implementation and robustness with respect to disturbances. It is also possible to define emotional signal based on control application objectives. But in the previous studies, internal instability of this controller was not considered and control task were done in limited time period. In this article mathematical description of BELBIC is investigated and improved to avoid internal instability. Simulation and implementation of improved model was done on level plant. The obtained results showed that instability of model has been solved in the new model without loss of performance by using Integral Anti Windup (IAW).

TuA28 330A

Hybrid Vehicle I (Regular Session)

Chair: Guzzella, Lino ETH Zurich
Co-Chair: Peng, Huei Univ. of Michigan

10:30-10:50 TuA28.1

Modelling of a PEM Fuel Cell System, pp. 4636-4641

Thanapalan, Kary Univ. of Glamorgan
Williams, Jonathan Univ. of Glamorgan
Liu, Guoping Univ. of Glamorgan
Rees, David Univ. of Glamorgan

This paper considers modeling and simulation study of a fuel cell system. A mathematical model of a Polymer Electrolyte Membrane (PEM) Fuel Cell system is presented in this paper. For the convenience of presentation, cathode flow, anode flow, the membrane hydration, and voltage output expressions of the PEM fuel cell system are given in the paper to bridge a generic model to the model of Fuel Cell Test station (FCT). Within the University research facilities, there is a PEM –FCT station available so the PEM-FCT is used for the simulation study. Comparisons are made between the simulation results from the mathematical model which is implemented in MATLAB/Simulink and FCT test data. A general agreement exists but where there are differences and anomalies the paper gave reasons for this. overall the PEM Fuel Cell (PEMFC) model represents the FCT station. The PEMFC model can be used for controller development to improve FCT system performance.

10:50-11:10 TuA28.2

Optimal Hybridization in Two Parallel Hybrid Electric Vehicles Using Dynamic Programming, pp. 4642-4647

Sundström, Olle ETH Zurich / Empa
Guzzella, Lino ETH Zurich
Soltic, Patrik Empa

This study explores different hybridization ratios of two types of parallel hybrid electric vehicles, a torque assist parallel hybrid and a full parallel hybrid, with equal power-to-weight ratio. The powertrain consist of an internal combustion engine, an electric motor, and a NiMH battery. The different hybridization ratios are compared by their optimal fuel consumption for eight different drive cycles. The optimal fuel consumption is determined using dynamic programming for each of the different hybridization ratios. In the full parallel hybrid the engine and motor can be decoupled while in the torque assist hybrid the engine and motor are always mechanically connected. Results show that there are not only lower fuel consumption for the full hybrid but the need for hybridization is lower than in the torque assist hybrid for all eight cycles. The hybridization ratio where a full hybrid have the same fuel consumption as the optimal torque assist hybrid can differ as much as 51%.

11:10-11:30 TuA28.3

Automated Modeling of Power-Split Hybrid Vehicles, pp. 4648-4653

Liu, Jinming Univ. of Michigan, Ann Arbor
Peng, Huei Univ. of Michigan

Hybrid electric vehicles (HEV) represent a promising technology to improve the fuel economy of ground vehicles in the near-term. Among the HEV configurations, the power-split configuration offers superior design and control flexibility and achieves highest overall efficiency. In this paper, a methodology to generate dynamic equations automatically for the power-split hybrid power-train is proposed. The designer only needs to specify the topology of the transmission: how the power sources, vehicle, the planetary gears and clutches are connected to each other. The dynamic model can then be generated automatically through a set of rules. This automated generation process makes it possible for a designer to explore different split hybrid configurations quickly and efficiently.

11:30-11:50 TuA28.4

Modeling of Voltage Hysteresis and Relaxation of HEV NiMH Battery, pp. 4654-4658

Ota, Yutaka Nagoya Inst. of Tech.
Hashimoto, Yoshihiro Nagoya Inst. of Tech.
Sakamoto, Masaru Nagoya Inst. of Tech.
Kiriake, Rei Nagoya Inst. of Tech.
Kobe, Takashi Nagoya Inst. of Tech.

SOC (State Of Charge) estimation based battery management is important for HEV (Hybrid Electric Vehicle) applications. There are many difficulties in SOC estimation of HEV NiMH (Nickel Metal Hydroxide) batteries, for example, gassing at charge, self discharge, hysteresis and relaxation of OCV (Open Circuit Voltage), memory effect during charge-discharge cycling, and so on. In this paper, a modeling of hysteresis and relaxation of HEV NiMH battery is investigated. Model structure is simple, and model parameters are fitted by using voltage and current measurements. Accuracy of modeling is evaluated by using experimental results of 7.2V, 6.5Ah NiMH battery module.

11:50-12:10 TuA28.5

Statistical Learning Applied to the Energy Management in a Fuel Cell Electric Vehicle, pp. 4659-4664

Cavalletti, Matteo Univ. Pol. delle Marche
Piovesan, Jorge Univ. of New Mexico
Abdallah, Chaouki T. Univ. of New Mexico
Longhi, Sauro Univ. Pol. delle Marche
Dorato, Peter Univ. of New Mexico
Ippoliti, Gianluca Univ. Pol. delle Marche

The paper considers a high efficiency energy management control strategy for a hybrid fuel cell vehicle using neural networks and Statistical Learning theory. Hybrid Electric Vehicles may potentially improve fuel economy, reduce emission gases, and achieve performance similar to conventional cars. The use of different power sources and the presence of different constraints makes the power management problem highly nonlinear. Probabilistic and statistical learning methods are used to design the weights of a neural networks to minimize the fuel consumption during a given path. Numerical results are obtained using the model of a real hybrid car, “Smile” developed by FAAM, using a stack of fuel cells as the primary power source in addition to ultracapacitors. The results are satisfactory in terms of fuel consuming and efficiency of ultracapacitors and batteries.

12:10-12:30 TuA28.6

Trip Based Nearly Global Optimal Power Management of Plug-In Hybrid Electric Vehicles Using Gas-Kinetic Traffic Flow Model, pp. 4665-4670

Gong, Qiuming Univ. of Wisconsin-Milwaukee
Li, Yaoyu Univ. of Wisconsin-Milwaukee

The plug-in hybrid electric vehicle (PHEV), utilizing more battery power, has become the next-generation HEV with great promise of higher fuel economy. Global optimization charge-depletion power management would be desirable. However, this has so far been hampered due the a priori nature of the trip information and the almost prohibitive computational cost of global optimization techniques such as dynamic programming (DP). This situation can be changed by the current advancement of Intelligent Transportation Systems (ITS) based on the use of on-board GPS, GIS, real-time and historical traffic flow data and advanced traffic flow modeling techniques. In this paper, gas-kinetic base trip modeling approach was used for the highway portion trip and for the

local road portion the traffic light sequences throughout the trip will be synchronized with the vehicle operation. Several trip models approaches were studied for a specific case. For DP based charge-depletion control of PHEV, the SOC is forced to drop to a specific terminal value at the final time of the trip. Simulation study has been performed on a hybrid SUV model from ADVISOR, for the different trip modeling approaches. The simulation results demonstrated significant improvement in fuel economy using DP based charge-depletion control compared to rule based control. The gas-kinetic based trip model for the highway portion can describe the dynamics of the traffic flow on highway with on/off ramps which may be missed by the model which used only the main road detectors data. The modeling approach shows a step to the more accurate trip model prediction which can be used for the power management of PHEV.

TuA29 330B
Semi-Active Suspension and Roll-Over Prevention (Regular Session)

Chair: Savaresi, Sergio — Pol. di Milano
Co-Chair: Hong, Keum-Shik — Pusan National Univ.

10:30-10:50 TuA29.1
Performance Analysis and Simulation of a New Industrial Semi-Active Damper, pp. 4671-4676

Aubouet, Sébastien — SOBEN SAS
Sename, Olivier — INPG
Talon, Benjamin — SOBEN SAS
Poussot, Charles — INPG/ENSIEG
Dugard, Luc — CNRS-INPG-UJF

This paper deals with modeling and control of a semi-active suspension made up with a new industrial semi-active damper, in order to improve comfort and road-holding level of the vehicle. In the past few years, many control strategies have been developed using linear suspension models. A nonlinear model of the industrial damper is developed with physical equations and integrated in a quarter vehicle model. Some tests are done on the real damper in order to validate the model. The comfort and road-holding level of the semi-active suspension are studied using some adapted criteria and compared to the passive ones using simulations. These results emphasize the performances improvement resulting from the control of the damper.(Industrial paper)

10:50-11:10 TuA29.2
Vehicle Chassis Control Using Adaptive Semi-Active Suspension, pp. 4677-4682

Velupillai, Sankaranarayanan — Postdoctoral Res.
Guvenc, Levent — Istanbul Tech. Univ.
Oncu, Sinan — Graduate student
Ozcan, Dincer — Graduate student

This paper presents an adaptive semi-active control strategy to improve the stability and performance of a light commercial vehicle equipped with four continuously varying dampers. A choice between ride comfort or road holding of the vehicle is made automatically using a rule based adaptive algorithm based on various factors such as roll rate and yaw rate. The damping factor or the controller configuration of each damper is modified using a rule based adaptive algorithm and this technique is named Individual Damping Control (IDC) in this paper. The vehicle roll and yaw stability are analyzed using this technique. Simulation results on a high-fidelity realistic computer model of a light commercial vehicle are presented to validate the proposed technique.

11:10-11:30 TuA29.3
Control of a Semi-Active MR-Damper Suspension System: A New Polynomial Model, pp. 4683-4688

Turnip, Arjon — PhD Student
Hong, Keum-Shik — Pusan National Univ.
Park, Seonghun — Pusan National Univ.

In this paper, numerical aspects of a sensitivity control for the semi-active suspension system with a magneto-rheological (MR) damper are investigated. A 2-dof quarter-car model together with a 6th order polynomial model for the MR damper are considered. For the purpose of suppressing the vertical acceleration of the sprung mass, the square of the vertical acceleration is defined as a cost function and the current input to the MR damper is adjusted in the fashion that the current is updated in the negative gradient of the cost function. Also, for improving the handling performance, a weighted absolute velocity of the sprung mass is added to the control law. The implementation of the proposed algorithm requires only the measurement of the relative displacement of the suspension deflection. The local stability of the equilibrium point of the closed loop nonlinear system is proved by investigating the eigenvalues of the linearized one. Through simulations, the passive suspension, the skyhook control, and the proposed sensitivity control are compared.

11:30-11:50 TuA29.4
Semi-Active Control Strategies for High-Performance Motorcycles, pp. 4689-4694

Savaresi, Sergio — Pol. di Milano
Spelta, Cristiano — Univ. degli studi di Bergamo
Moneta, Andrea — Pol. di Milano
Tosi, Filippo — Pol. di Milano
Fabbri, Luca — Piaggio Group
Nardo, Lorenzo — Aprilia
Previdi, Fabio — Univ. degli Studi di Bergamo

The topic of this paper is the design and analysis of a control system for a semi-active suspension in a 2-wheel vehicle. The control system is implemented via a semi-active electro-hydraulic damper located on the rear suspension of a hypersport-class motorbike. The entire design and analysis procedure is outlined: the semi-active damper is analyzed and characterized; a wide range of control strategies are implemented in the Electronic Control Unit (ECU) of the motorbike; a complete test-bench analysis of the vehicle is developed. The final result is a complete comparative analysis of a wide portfolio of different semi-active control strategies which shows the potential benefits of a semi-active suspension.

11:50-12:10 TuA29.5
Adaptive Rollover Prevention for Automotive Vehicles with Differential Braking, pp. 4695-4700

Solmaz, Selim — National Univ. of Ireland, Maynooth
Akar, Mehmet — Bogazici Univ.
Shorten, Robert — Nat. Univ. of Ireland

In this paper we present an adaptive controller implementation based on the multiple models, switching, and tuning (MMST) paradigm for preventing un-tripped rollover in automotive vehicles. Our approach relies on differential-braking to keep the value of the Load Transfer Ratio (LTR) below a threshold. We first employ multiple models to infer the unknown center of gravity height and the suspension parameters of the vehicle, which are subsequently used to switch to the corresponding rollover controller. The efficacy of the proposed switched multi–controller scheme is demonstrated via numerical simulations as compared to a robust controller implementation.

12:10-12:30 TuA29.6
Energy Saving Actuator Arrangements in an Actively Damped Engine Suspension System, pp. 4701-4706

Paschedag, Jörg — Tech. Univ. München
Koch, Guido — Tech. Univ. München
Lohmann, Boris — Tech. Univ. München

In this work, an active vibration control system is presented that reduces the transmission of engine induced vibrations to the chassis of a vehicle. In order to find system configurations which provide minimum energy consumption, six different configurations of actuator placement with two different actuator types are presented and analyzed regarding their power demands. Models for the test setup are derived and algebraic frequency dependent formulas for the calculation of average mechanical and electrical power consumption are deduced and discussed. The results of the analysis are compared to measurement data of an experimental test rig.

TuA30 330C
Satellite Navigation (Invited Session)

Chair: Jee, Gyu-In — Konkuk Univ.
Co-Chair: Krauss, Peter A. — Astrium GmbH
Organizer: Jee, Gyu-In — Konkuk Univ.
Organizer: Lee, Jang Gyu — Seoul National Univ.

10:30-10:50 TuA30.1
Modernized Spaceborne GNSS Receivers (I), pp. 4707-4712

Krauss, Peter A. — Astrium GmbH
Kühl, Christopher — Astrium GmbH

Mittnacht, Michael | Astrium GmbH
Heim, Jens | Astrium GmbH
Gottzein, Eveline | EADS

The further development of navigation receivers has to go hand in hand with the advances in the constellations for Global Navigation Satellite Systems (GNSS). As more and more features will be provided by the services of modernized GPS, GLONASS and the upcoming Galileo and COMPASS, the functions and performance of spaceborne GNSS receivers have to be extended as well. Today, the MosaicGNSS Receiver is operating in space using only the GPS L1 civil signal. Its successor, the LION Navigation Receiver, is currently under development for using all open civilian signals of GPS, Galileo and COMPASS.

10:50-11:10 TuA30.2

Preliminary Experiments of GPS/INS Based Integrity Monitoring Using MSAS Differential Correction Data (I), pp. 4713-4718

Tsujii, Toshiaki | Japan Aerospace Exploration Agency
Tomita, Hiroshi | Japan Aerospace Exploration Agency
Fujiwara, Takeshi | Japan Aerospace Exploration Agency
Harigae, Masatoshi | JAXA

Japan Aerospace Exploration Agency (JAXA) has developed several GPS/INS systems called GAIA (GPS Aided Inertial navigation Avionics) for over ten years and succeeded in automatic landing of unmanned experimental vehicle in differential mode. In order to use GAIA for civil aviation, JAXA has been developing a fault detection and exclusion (FDE) software for integrity monitoring based on filter bank method. On the other hand, a Japanese satellite based augmentation system, MSAS (MTSAT Satellite-based Augmentation System) is planned to be operational in 2007, and the test signal is transmitted. A flight experiment to collect MSAS data was conducted and GPS/MSAS data were used to compute horizontal protection level (HPL). The GPS/INS filter bank method showed a reduced HPL, compare to MSAS-based HPL.

11:10-11:30 TuA30.3

Fully Automatic Taxiing, Takeoff and Landing of a UAV Based on a Single-Antenna GNSS Receiver (I), pp. 4719-4724

Cho, Am | Seoul National Univ.
Kim, Jihoon | Seoul National Univ.
Lee, Sanghyo | Seoul National Univ.
Kim, Bosung | Seoul National Univ.
Park, Noha | Seoul National Univ.
Kim, DongKeon | Seoul National Univ.

This paper presents fully automatic control of an unmanned aerial vehicle (UAV) from taxiing and takeoff to landing based on a single-antenna GPS receiver. In this paper, inertial sensors such as gyros and accelerometers are not used at all to show the full potential of a single-antenna GPS receiver based attitude determination system. DGPS is implemented to give high accuracy position information for automatic taxiing, landing and takeoff on the runway. For a fixed wing aircraft, under the assumption of coordinated flight, the attitude information called as pseudo-attitudes can be estimated from the measurements of a single-antenna GPS receiver. Therefore full state variables for the automatic control can be obtained from single-antenna GPS receiver. In addition to GPS receiver, only an airspeed sensor is added because the velocity relative to the air is very important during landing and takeoff. The forward velocity is replaced with the airspeed obtained from Pitot tube. From linearized equations of motions around the steady state, LQR controllers for takeoff and landing are built. In particular, the flare controller that controls the pitch, altitude and airspeed of a UAV is designed. During flight tests, the aircraft taxies and takes off the runway, follows the predefined waypoint path, and then lands on the runway along the curved approach path, all fully automatically. Based on flight test results, a single-antenna GPS receiver can be used as a main sensor for a backup or a low-cost control system of UAVs.

11:30-11:50 TuA30.4

Comparative Performance Analyses of GPS Receivers under High-Dynamic Conditions (I), pp. 4725-4730

Kwon, Byung-Moon | Korea Aerospace Res. Inst.

The KSLV-I GPSR that is the first GPS receiver utilized on a satellite launch vehicle developed by KARI should operate normally under harsh environments such as extremely high vibration and shock, wide operating temperature range as well as high-dynamic conditions. Several terrestrial tests have been already done in order to verify performance of the KSLV-I GPSR before flight. This paper deals with comparative performance analyses between the KSLV-I GPSR and other two GPS receivers without velocity and altitude restrictions under high-dynamic conditions. The tracking capability and accuracy of the GPS receivers are compared using a GPS signal simulator with various scenarios like a centrifuge, a satellite launch vehicle, and a spacecraft.

11:50-12:10 TuA30.5

Realization of Initial Alignment Algorithm for Strapdown Inertial Navigation System Using Central Difference Filter, pp. 4731-4736

Ali, Jamshaid | NESCOM
Nzar, Muhammad | NESCOM

Alignment is the process whereby the orientation of the axes of an inertial navigation system is determined with respect to the reference system. In this paper, the initial alignment error equations of the strapdown inertial navigation system (SINS) with large initial azimuth error have been derived with inclusion of nonlinear characteristics. The central difference filter (CDF) has been used for solution of the alignment problem. Simulations have been carried out to validate and corroborate the stationary alignment case employing a strapdown inertial measurement unit (SIMU). A performance comparison between the extended Kalman filter (EKF), the unscented Kalman filter (UKF) and the CDF demonstrate that the accuracy of attitude error estimation using the CDF is better than that of using the EKF or the UKF.

12:10-12:30 TuA30.6

Lateral Guidance & Control Design for an Unmanned Aerial Vehicle, pp. 4737-4742

Samar, Raza | National Engineering & Scientific Commission
Ahmed, Shakil | NESCOM
Nzar, Muhammad | NESCOM

This paper presents guidance and control design for a UAV, and its six degrees-of-freedom nonlinear simulation results. The paper focuses on the lateral control and guidance aspects; longitudinal control aspects will be addressed separately in another paper. An introduction to the lateral mission, and guidance problem is given first. Waypoints for straight and turning flight paths are defined. Computation of various flight path parameters is discussed, including formulae for down-range (distance travelled along the desired track), cross-track deviation and heading error of the vehicle; these are then used in the lateral guidance algorithm. The lateral guidance law is then presented, followed by the design of a multivariable H_infinity controller for roll control and stability augmentation. The controller uses the ailerons and rudders for control. The reference roll angle is provided by the guidance law. The sensors available on-board the vehicle do not measure yaw-rate, hence a practical method of its estimation is proposed. The entire guidance and control scheme is implemented on a full nonlinear six degrees-of-freedom simulation of the vehicle. Simulation results are presented and discussed.

TuB02 304A

Stabilization of Nonlinear Systems II (Regular Session)

Chair: Khalil, Hassan K. | Michigan State Univ.
Co-Chair: Farza, Mondher | Univ. DE CAEN, ENSICAEN

14:00-14:20 TuB02.1

Global Set Stabilization of the Spacecraft Attitude Control Problem Based on Quaternion, pp. 4743-4748

Ding, Shihong | Southeast Univ.
Li, Shihua | Southeast Univ.
Li, Qi | Southeast Univ.

In this paper, we develop a global set stabilization method for the attitude control problem of spacecraft system based on quaternion. The control law which uses both optimal control and finite-time control techniques can globally stabilize the attitude of spacecraft system to an equilibrium set. First for the kinematic subsystem, we design a virtual optimal angular velocity. Then for the dynamic subsystem, we design a finite-time control law which can force the angular velocity to track the virtual optimal angular velocity in finite time. It is rigorously proved that the closed loop system satisfies global set stability. The control method is more natural and energy-saving. The effectiveness of the proposed method is demonstrated by simulation results.

14:20-14:40 TuB02.2

Approximate Feedback Linearization Using Multivariable Legendre Polynomials, pp. 4749-4754

Deutscher, Joachim — Univ. Erlangen-Nürnberg
Bäuml, Markus — Univ. Erlangen-Nürnberg

This paper presents a numerical approach to approximate feedback linearization. By using a Galerkin approach on the basis of multivariable Legendre polynomials an approximate solution to the singular PDE of the feedback linearization technique proposed by Kazantzis and Kravaris is determined. It is shown that the L_2-norm of the remaining nonlinearity in the resulting dynamics can be made small on a specified multivariable interval in the state space. Furthermore, a matrix equation is derived for determining the corresponding change of coordinates and feedback such that the proposed design procedure can easily be implemented in a numerical software package. A simple example demonstrates the properties of the new approximate feedback linearization.

14:40-15:00 TuB02.3

Averaging of Zero Dynamics for Systems Controlled by the Vertically Transverse Function Approach, pp. 4755-4760

Sosa Zúńiga, José Miguel — IPICYT, México
Lizárraga Navarro, David A. — IPICYT, México

In this paper, a method is explored to introduce dissipation in the closed-loop, zerodynamics systems that arise in the vertically transverse function approach (VTFA) recently proposed by the authors. The VTFA is an attempt to extend the transverse function approach (TFA) of Morin and Samson to deal with practical point-stabilization of a class of critical simple mechanical systems on Lie groups. This class comprises systems that are not kinematic reductions and hence fall beyond the scope of application of the TFA as originally formulated. The VTFA gives rise to a nontrivial zero dynamics that ultimately determines the qualitative nature of the trajectories and, in order to constrain the velocity (or “fiber”) coordinates to vanish asymptotically, as required in typical applications, dissipation must be injected into the zero dynamics. Reported below is a possible way to reach that goal based on the adjunction of additional auxiliary inputs, via generalized vertically transverse functions, and the use of nonlinear, high-order averaging theory. Also included is an illustrative example as well as numerical simulations suggesting that the feedback laws herein designed yield promising results.

15:00-15:20 TuB02.4

Switched Feedback Control for a Class of First-Order Nonholonomic Driftless Systems, pp. 4761-4766

Ishikawa, Masato — Kyoto Univ.

This paper is concerned with stabilizing feedback control for a class of nonholonomic driftless systems, whose controllability Lie algebra rank condition is satisfied by up to first-order Lie brackets. We propose a switched feedback law which drives all the initial states to the origin with bounded control inputs are bounded (as opposed unbounded, division-by-zero-type discontinuous control). The discontinuity of the feedback law takes place on a subspace defined by the 'parallelism' condition for the base and the fiber vectors in R^3. We also show that the complement of this discontinuity region is homotopic to SO(3) which is also isomorphic to S^2 times S^1. The proposed control law is examined by numerical simulations.

15:20-15:40 TuB02.5

Observer-Based Output Feedback Controller for a Class of Nonlinear Systems, pp. 4767-4772

Hajji, Sofien — GREYC Caen France, ENIS Sfax Tunisia
Farza, Mondher — Univ. DE CAEN, ENSICAEN
M'Saad, Mohammed — GREYC CNRS UMR 6072
Kamoun, Mohamed — ENIS, SFAX, TUNISIA

The design of an observer based output feedback controller for a class of uniformly observable nonlinear systems with an admissible tracking capability, is proposed. Two fundamental features of the proposed control scheme are worth to be mentioned. The first one consists in the high gain nature of the underlying state feedback control and observer designs. More specifically, a unified high gain control design framework is proposed thanks to the duality between control and observation. The second feature consists in incorporating a filtered integral action into the control design. The filtering is mainly motivated by measurement noise sensitivity reduction while the integral action allows to achieve a robust offset free performance in the presence of step like disturbances. The features of the proposed approach are illustrated using the induction motor model and simulation are performed in order to highlight the performance of the underlying observer based output feedback controller.

15:40-16:00 TuB02.6

Robust Output Feedback Control for a Class of Uncertain Switching Fuzzy Systems, pp. 4773-4778

Liu, Yi — Northeastern Univ.
Dimirovski, Georgi Marko — Dogus Univ. of Istanbul
Zhao, Jun — The Australian National Univ.

The problem of robust output-feedback control for a class of uncertain switching fuzzy control systems is investigated. Asymptotic stability of the observer, based on the error equation, is obtained by using the switching technique and the common Lyapunov function method. Switching laws are also designed via using single Lyapunov function method for observer equation such that the closed-loop system is asymptotically stable. The sufficient condition for the asymptotic stability of the uncertain switching fuzzy control system is transformed into standard solvable LMIs. An illustrative example along with the respective simulation results is give to demonstrate the effectiveness of the proposed design synthesis.

TuB03 304B

Advances in Higher Order Sliding Mode Observation and Estimation (Invited Session)

Chair: Shtessel, Yuri B. — Univ. of Alabama at Huntsville
Co-Chair: Spurgeon, Sarah K. — Univ. of Leicester
Organizer: Shtessel, Yuri B. — Univ. of Alabama at Huntsville
Organizer: Spurgeon, Sarah K. — Univ. of Leicester
Organizer: Fridman, Leonid M. — Univ. of Mexico

14:00-14:40 TuB03.1

High-Order Sliding-Mode Observation for Systems with Unknown Inputs (I), pp. 4779-4790

Fridman, Leonid M. — Univ. of Mexico
Davila Montoya, Jorge Angel — Univ. of Mexico (Univ. Nacional Autonoma de Mexico)
Levant, Arie — Tel - Aviv Univ.

Algorithms for observation, identification and fault detection of linear time-invariant strongly observable systems with unknown inputs are developed, based on high order sliding modes. The possibility of their extension is discussed to strongly detectable and nonlinear systems. Some applications of the proposed algorithms are presented.

14:40-15:00 TuB03.2

Second Order Sliding Mode and Adaptive Observers for a Chaotic System: A Comparative Study (I), pp. 4791-4796

Bejarano, Francisco — ENSEA
Ghanes, Malek — ENSEA
Barbot, Jean Pierre — ENSEA
Fridman, Leonid M. — Univ. of Mexico

In this paper two nonlinear observers for a chaotic system are compared. Moreover, the left invertible problem and the observability singularity are discussed. Thus, after a presentation of both observers, a comparison of the two proposed methods and a discussion are done on the basis of simulations results. The last part highlights the fact that the finite time observer is more sensible to the singularity observations, but less sensible to parameter uncertainties and noise in the output of the system.

15:00-15:20 TuB03.3

HOSM Observer for a Class of Non-Minimum Phase Causal Nonlinear MIMO Systems (I), pp. 4797-4802

Baev, Simon — Univ. of Alabama in Huntsville (UAH)
Shtessel, Yuri B. — Univ. of Alabama at Huntsville
Edwards, Christopher — Univ. of Leicester

A higher order sliding mode observer is proposed for asymptotic identification of the full state vector and the vector of unknown inputs for MIMO nonlinear causal systems with unstable internal dynamics.

The problem is addressed via consistent application of exact higher order sliding mode (HOSM) differentiators in conjunction with the method of stable system center (SSC). A numerical example illustrates the performance of the proposed algorithm.

15:20-15:40 TuB03.4

The Robustness of a Second Order Sliding Mode Approach to Human Gait Simulation (I), pp. 4803-4808

Steve, Lister Univ. of Leicester
Spurgeon, Sarah K. Univ. of Leicester
Jon, Scott Univ. of Leicester

Nonlinear control techniques such as the sliding mode approach can provide a useful alternative to computationally intensive optimisation strategies in the simulation of human gait. Application of the sliding mode approach has the added advantage that it can provide estimates of internal parameters/signals and can be used to measure and/or monitor the deviation from normal gait in patients who are suffering from conditions such as osteoarthritis, for example. Effectively the principle of the equivalent injection that has been long used for fault detection and diagnostics in engineering machinery can be seen to provide a useful new dimension to gait analysis. Any such model, however, requires apriori estimates to be made of the physical dimensions and muscle characteristics of an individual. The fidelity of any resulting gait analysis will be dependent upon the degree to which the system is sensitive to the selection of such parameters. This paper investigates the effect of inducing errors in the mass, scale and proportions of the individual when simulating the gait cycle of ten normal subjects using a second order sliding mode approach. Seven experiments were carried out to examine the influence of errors up to 50% in the assumed parameters of a three-dimensional musculoskeletal lower body model. The second order sliding mode based simulated gait process was concluded to be sufficiently robust to body segment parameter variation that the use of scaled default parameters can be justified in the gait simulator.

15:40-16:00 TuB03.5

Actuator Fault Diagnosis Using High-Order Sliding Mode Differentiator (HOSMD) and Its Application to a Laboratory 3D Crane (I), pp. 4809-4814

Chen, Wei-tian Simon Fraser Univ.
Wu, Qing Simon Fraser Univ.
Taffazoli, Esmaeil Simon Fraser Univ.
Saif, Mehrdad Simon Fraser Univ.

Actuator fault diagnosis problem is studied for a class of nonlinear systems with relative degrees from the inputs to the outputs higher than one. This type of nonlinear systems include many mechanical systems, and their actuator fault diagnosis problem can be very challenging because of nonlinearities and high relative degrees. In this paper, in order to solve the actuator fault diagnosis problem for the considered nonlinear systems, 2nd-order and 3rdorder sliding mode differentiators are used and actuator fault diagnosis schemes are proposed to achieve fault detection and isolation. Computer simulations are carried out to compare the efficacy of the proposed fault diagnosis schemes on a laboratory 3D Crane model with noisy measurements. The fault diagnosis schemes are further tested through experiments on a laboratory 3D Crane in terms of actuator fault detection and isolation.

TuB04 308

Applications of Nonlinear Control IV (Regular Session)

Chair: Xia, Xiaohua Univ. of Pretoria
Co-Chair: Xin, Xin Okayama Prefectural Univ.

14:00-14:20 TuB04.1

Constructive Invariant Manifolds to Stabilize Pendulum--Like Systems Via Immersion and Invariance, pp. 4815-4819

Acosta, José Ángel Univ. de Sevilla
Ortega, Romeo LSS-SUPELEC
Astolfi, Alessandro Imperial Col. London & Univ. of Rome Tor Vergata
Sarras, Ioannis Univ. Paris-Sud XI

The Immersion and Invariance control technique (I&I), is a method to design asymptotically stabilizing control laws for nonlinear systems, proposed in Astolfi & Ortega [2005]. The three design steps of I&I are: the definition of a target dynamics; the construction of an invariant manifold; and the design of a control law. The second step requires the solution of a partial differential equation (PDE) that maybe difficult to obtain. Here we show a constructive procedure to obviate the solution of the PDE, through the well--known cart and pendulum system. The procedure follows interlacing the first and second steps and invoking physical considerations.

14:20-14:40 TuB04.2

Numerical Methods Based Controller Design for Mobile Robots, pp. 4820-4827

Scaglia, Gustavo Univ. Nacional de San Juan
Quintero Montoya, Olga Lucia Univ. Nacional de San Juan
Mut, Vicente Univ. Nacional de San Juan (UNSJ), Argentina
di Sciascio, Fernando Univ. Nacional de San Juan

This paper presents the design of four controllers for a mobile robot such that the system may follow a pre-established trajectory. To reach this aim, the kinematic model of a mobile robot is approximated using numerical methods. Then, from such approximation, the control actions to get a minimal tracking error are calculated. Both simulation and experimental results on a PIONEER 2DX mobile robot are presented, showing a good performance of the four proposed mobile robot controllers.

14:40-15:00 TuB04.3

Analysis of the Energy Based Swing-Up Control for a Double Pendulum on a Cart, pp. 4828-4833

Xin, Xin Okayama Prefectural Univ.

Designing and analyzing controllers for underactuated systems with underactuation degree greater than one is still an open and challenging problem. In this paper, we study an unsolved problem of analyzing energy based swing-up control for a double pendulum on a cart, which has three degrees of freedom and only one control input.We present an original analysis of the convergence of the energy of the cart-double pendulum system. We show that for all initial states of the cart-double pendulum system, if the convergent value of the energy is not equal to the energy at the upright (up-up) equilibrium point, then the cart-double pendulum remains at its up-down, down-up, and down-down equilibrium points. Moreover, we show that these three equilibrium points are unstable. This shows that for almost all initial states of the cart-double pendulum system, as time approaches infinity, the energy of the cart-double pendulum system can be controlled to its energy at the upright equilibrium point. This paper provides insight into the energy based control approach to underactuated systems with underactuation degree greater than one.

15:00-15:20 TuB04.4

Model-Following Control of Nonlinear Systems Based on Virtual Constraints, pp. 4834-4839

Sawamura, Yoshihiro Tokyo Denki Univ.
Kojima, Shingo Tokyo Denki Univ.
Iwase, Masami Tokyo Denki Univ.
Hatakeyama, Shoshiro Tokyo Denki Univ.

In this study, we propose a nonlinear model-following control for underactuated systems. A model-following control design is based on the virtual constrains. The concept of virtual constraints control proposed by Shiriaev et. al. The model-following control is useful to realize the tracking system to a given reference model. In underactuated systems, a model-following control for fullactuated systems cannot be not utilized because there are limitations of coordinate transformation such as exact linearization. Thus this study deals with underactuated mechanical nonlinear systems. The design strategy is explained by taking a cart-pendulum as an example for this study. A cart-pendulum is controlled so that a virtual spring-mass-damper property is implemented to a pendulum. Some numerical simulations are performed to verify the effectiveness of the proposed method.

15:20-15:40 TuB04.5

Control of Pendulum-Like System with Multiple Nonlinearities, pp. 4840-4845

Ouyang, Hua Univ. of New South Wales at Australian Defence Force
Petersen, Ian Richard Univ. of New South Wales - ADFA
Ugrinovskii, Valery Univ. of New South Wales

This paper addresses a stability analysis problem and synthesis problem for pendulum-like systems with multiple nonlinearities. A method for analysing the Lagrange stability of a pendulum-like system with multiple nonlinearities is proposed. In order to study the synthesis problem, the paper develops an Extended Strict Bounded

Real Lemma for unstable systems. A sufficient condition for Lagrange stabilization is proposed in terms of an algebraic Riccati equation with a sign infinite solution. An algorithm is given to solve the algebraic Riccati equation for a Lagrange stabilizing solution and thus gives a control law to stabilize the system in the sense of Lagrange stability.

15:40-16:00 TuB04.6

Computing Guaranteed Bounds for Uncertain Cooperative and Monotone Nonlinear Systems, pp. 4846-4851

Gennat, Marc — Univ. of Wuppertal
Tibken, Bernd — Univ. of Wuppertal

Models of biological or technical applications are represented by nonlinear systems, which are defined by ordinary differential equations. These systems generally contain multiple uncertain or unknown parameters. These uncertainties result from measurement errors or from modeling, e.g. numerical modeling. For several applications, the guaranteed enclosure of all possible solutions of an initial value problem (IVP) of a given uncertain system is demanded. In general the calculation of guaranteed bounds of the given uncertain nonlinear system cannot be done directly, because the solution set of an IVP can be solved algebraically only in certain cases. Furthermore, most numerical methods which compute the solution of IVPs cannot handle systems with uncertain parameters. But for the class of cooperative systems tight guaranteed bounds for all solutions of the IVP can be computed. This class satisfies certain monotony conditions. Moreover the computation of guaranteed lower and upper bounds can be applied to a larger class of ordinary differential equations, which does not satisfy all conditions for uncertain cooperative systems. For this class of monotone systems the guaranteed enclosure can show some overestimation. Some examples illustrate the methods described in this contribution.

TuB05 307

Switching Stability and Control II (Regular Session)

Chair: Kurzhanski, A.B. — Univ. of California, Berkeley
Co-Chair: Junco, Sergio — Univ. Nacional de Rosario

14:00-14:20 TuB05.1

A Novel Method of Stability Analysis for Networked Control Systems, pp. 4852-4856

Sun, Xi-Ming — Glamorgan Univ.
Liu, Guoping — Univ. of Glamorgan
Rees, David — Univ. of Glamorgan
Wang, Wei — Dalian Univ. of Tech.

This paper studies the problem of stability analysis for a class of networked control systems (NCSs), whose control gain is assumed to be known. A switched delay system model different from existing ones is obtained based on the event-time-driven scheme. To solve the stability problem of the new NCSs' model, a new approach based on the Lyapunov functional exponential estimation (LFEE) method is introduced. Using this method, sufficient conditions are developed to guarantee exponential stability of the considered system. The results obtained are less conservative than existing ones, as is shown from both theory and example.

14:20-14:40 TuB05.2

Stability Guaranteed Predictive Control of Constrained Continuous-Time PWL Systems, pp. 4857-4862

Zou, Yuanyuan — Shanghai Jiao Tong Univ.
Li, Shaoyuan — Shanghai Jiao Tong Univ.

In this work, the stability of constrained continuous-time piecewise linear (PWL) systems in closed-loop is investigated based on model predictive control (MPC) and bounded control (BC). Firstly, bounded control framework is developed to stabilize the class of systems. Then, to reconcile the stability and optimality properties, a control strategy mixing model predictive control with bounded control is proposed further. For each subsystem, the switching idea is employed between model predictive controller and bounded controller for a set of all initial conditions within the stability region of the bounded controller. Switching laws of controllers in each subsystem are derived to safeguard against any possible instability and infeasibility under MPC. The switching constraints of regions between different subsystems are considered to ensure that the Lyapunov function for each subsystem is non-increasing wherever the mode is reactivated, thereby guaranteeing global closed-loop stability. The proposed method avoids computing terminal invariant set for guaranteeing stability and reduces on-line complexity of computing stabilizing controller for constrained continuous-time PWL systems. Finally, the implementation of the proposed method is illustrated with an example.

14:40-15:00 TuB05.3

A Model Reference Robust Control with Unknown High Frequency Gain Sign : General Case, pp. 4863-4868

Jiang, Xu — Beijing Univ. of Aeronautics and Astronautics
Lin, Yan — Beijing Univ. of Aeronautics and

In this paper, we discuss the model reference robust control for plants with relative degree greater than one and without the knowledge of high frequency gain sign. Based on an appropriate monitoring function, a switching scheme is proposed so that after a finite number of switching, the tracking error converges to a residual set that can be made arbitrarily small by properly choosing some design parameters. Furthermore, if some initial states of the closed-loop system are zero, we show that at most one switching is needed.

15:00-15:20 TuB05.4

Impulse Control Inputs and the Theory of Fast Feedback Control, pp. 4869-4874

Daryin, Alexander — Moscow State (Lomonosov) Univ.
Kurzhanski, A.B. — Univ. of California, Berkeley

This paper deals with problems of impulse control which allow control inputs consisting not only of delta functions but also of their higher derivatives (impulses of higher order). The controls are sought for in the form of feedback strategies which leads to the application of respective generalized dynamic programming techniques, where the role of traditional Hamilton–Jacobi–Bellman equations is taken by respective variational inequalities of similar structure. Further proposed are physically realizable approximations which converge to these ideal solutions. Since the ideal solutions allow to transfer a controllable system from one given position to another in zero time, their approximations lead us to physically realizable “fast” controls with piecewise constant realizations. Such feedback control inputs are then compared with traditional bang-bang type strategies and turn out to be more robust. Computational schemes for related problems of reachability and control synthesis are further described with examples of damping oscillating systems of high order in minimal time being demonstrated.

15:20-15:40 TuB05.5

A Case Study on Multiple Controller Adaptive Control, pp. 4875-4880

Felicio, Paulo, A.S.A. — Inst. Pol. de Setubal
Lourtie, Pedro — Inst. Superior T Cnico

This document reports work on the application of a Multiple Controller Adaptive Control algorithm based on fictitious reference signals. The algorithm has to select a controller in a small set of candidate controllers. The work shows steps towards a good selection of a cost functional and an analysis, based on recent stability results, shows why a cost function that is usual in other control methods is not suitable. With appropriate cost functional and set of controllers, simulations show the method is able to control a time varying process in the presence of measurement noise and loop delay, even outside the design interval for the parameter variation.

15:40-16:00 TuB05.6

A Lie Algebraic Approach to Design of Stable Feedback Control Systems with Varying Sampling Rate, pp. 4881-4886

Felicioni, Flavia — Univ. Nacional de Rosario
Junco, Sergio — Univ. Nacional de Rosario

This paper addresses the design of a controller family that, given a continuous-time linear plant sampled at a varying rate, asymptotically stabilizes the closed loop. Under the assumption of having a finite and known set of allowable sampling intervals, the problem is formulated as that of stabilizing a discrete-time switched system (DTSS). The solution approach consists in choosing the controller parameters in order for the Lie algebra generated by the closed-loop DTSS-matrices to be solvable, as this property guarantees the existence of a common Lyapunov function for the control system. The results can be applied to design digital controllers sharing resources, as it is the case of networked control systems, where the need of adapting the rate of task scheduling may originate significant sampling time variations.

TuB06 310A

Time Delay Systems: Robust Control (Regular Session)

Chair: Karimi, Hamid Reza — Univ. of Bremen

Co-Chair: Parlakci, Alpaslan — Istanbul Bilgi Univ.

14:00-14:20 TuB06.1

Design of Robust Delay-Dependent Guaranteed Cost Controller for Uncertain Nonlinear Neutral Systems: An LMI Descriptor Approach, pp. 4887-4892

Parlakci, Alpaslan — Istanbul Bilgi Univ.

In this paper, a novel robust delay-dependent guaranteed cost controller is introduced for a class of uncertain nonlinear neutral systems with both norm-bounded uncertainties and nonlinear parameter perturbations. A neutral memory state-feedback control law is chosen such that a quadratic cost function is minimized. On the basis of a descriptor type model transformation, an augmented descriptor form Lyapunov-Krasovskii functional is proposed. A linear matrix inequality (LMI) of synthesis condition is derived. Two numerical examples have been introduced to show the application of the theoretical results.

14:20-14:40 TuB06.2

Delay-Dependent Robust Control of Time-Delay Systems with Polytopic Uncertainty, pp. 4893-4898

Sun, Man — Beihang Univ.

Jia, Yingmin — Beihang Univ.

Du, Junping — Beijing Univ. of Posts and Telecommunications

Yuan, Shiying — Henan Pol. Univ.

In this paper, the delay-dependent robust control problem is considered for time-delay systems with polytopic uncertainty. Robust stabilizing controller and robust H_{infty} controller are designed by using a parameter-dependent Lyapunov function that can reduce the conservativeness when used in robust performance analysis and synthesis problems for polytopic systems. Furthermore, multichannel H_{infty} dynamic output-feedback controller is also designed. Numerical examples are included to illustrate the proposed method.

14:40-15:00 TuB06.3

Robust Mixed H2/Hinf Control of Uncertain Neutral Systems with Time-Varying Delays, pp. 4899-4904

Karimi, Hamid Reza — Univ. of Bremen

Luo, Ningsu — Univ. of Girona

This paper considers the problem of robust mixed H2/Hinf delayed state feedback control for a class of uncertain neutral systems with time-varying discrete and distributed delays. Based on the Lyapunov-Krasovskii functional theory, new required sufficient conditions are established in terms of delay-range-dependent linear matrix inequalities (LMIs) for the stability and stabilization of the considered system using some free matrices. The desired robust mixed H2/Hinf delayed control is derived based on a convex optimization method such that the resulting closed-loop system is asymptotically stable and satisfies H2 performance with a guaranteed cost and a prescribed level of Hinf performance, simultaneously. Finally, a numerical example is given to illustrate the effectiveness of our approach.

15:00-15:20 TuB06.4

Robust Adaptive Sliding Mode Control for a Class of Uncertain Hybrid Linear Systems with Markovian Jump Parameters, pp. 4905-4909

He, Youguo — Northeastern Univ.

Stankovski, Mile — SS Cyril and Methodius Univ.

Jing, Yuanwei — Northeastern Univ.

Dimirovski, Georgi Marko — Dogus Univ. of Istanbul

The robust sliding mode control problem of a class of uncertain hybrid linear systems with Markovian jump parameters is considered. Under the assumption of unknown upper bounds matched system uncertainties, the sufficient conditions are proposed to guarantee exponentially stable in mean square of reduced-order sliding mode system. Under the conditions of unknown upper bounds of system uncertainties, adaptive robust sliding mode control law is proposed. The control methods guarantees that the trajectory of system arrives at the sliding surface in finite time interval and is kept here thereafter. It has been shown that the sliding mode control problem for the Markovian jump systems is solvable if a set of linear matrix inequalities(LMIs)have solution. Latsly a simulation is given to illustrate the effectiveness of the proposed approach.

15:20-15:40 TuB06.5

Optimal Fractional Order Proportional Integral Controller for Varying Time-Delay Systems, pp. 4910-4915

Bhambhani, Varsha — Utah State Univ.

Chen, YangQuan — Utah State Univ.

Xue, Dingyu — Northeastern Univ.

In many industrial processes, the first order plus time delay (FOPDT) is still being widely used. FOPDT systems are also called “KLT systems (gain, delay, and time constant).” Considering uncertainties in the time delay, this paper attempts to answer this research question: “Will a fractional order controller help and do better?” In this paper, we first focus on fractional order proportional and integral controller (FOPI) for varying time-delay systems. Based on our previously proposed FOPI controller tuning rules using fractional Ms constrained integral gain optimization (F-MIGO), we tried to simultaneously maximize the jitter margin and ITAE performance (minimize ITAE performance index) for a set of hundred KLT systems having different time-constants and time-delay values. We observed that the optimization results in enlarged jitter margin of all systems at expense of a slight decrease in ITAE performance of delay dominated systems. Further, the F-MIGO optimization based tuning rules were summarized by approximation of optimized gain parameters and fractional orders alpha of the FOPI controller. Simulation results are presented to verify the proposed new tuning rules for best jitter margin and ITAE performance.

15:40-16:00 TuB06.6

Delay-Dependent Robust H_infinity Control of Uncertain Stochastic Delayed Systems, pp. 4916-4921

Chen, Yun — Hangzhou Dianzi Univ.

Xue, Anke — Hangzhou Dianzi Univ.

Lu, Renquan — Zhejiang Univ.

Zhou, ShaoSheng — Hangzhou Dianzi Univ.

Wang, JunHong — Hangzhou Dianzi Univ.

This paper is concerned with robust H_infty control for uncertain stochastic time-delay systems with norm-bounded parametric uncertainties. Based on an integral inequality and slack matrix technique, delay-dependent bounded real lemma (BRL) and the condition for the existence of robust H_infty controller are presented. For all the admissible parametric uncertainties, the designed controller guarantees the resulting closed-loop system is robustly mean-square asymptotically stable with a prescribed H_infty disturbance attenuation level. The results are formulated in terms of linear matrix inequalities (LMIs). Both model transformation and cross terms bounding techniques are avoided in the derivations. Two numerical examples are provided to show the advantage of the proposed method.

TuB07 310B

Linear Parameter-Varying Systems (Regular Session)

Chair: Koroglu, Hakan — Delft Univ. of Tech.

Co-Chair: Jetto, L. — Univ. di Ancona

14:00-14:20 TuB07.1

Gain Scheduled Observer State Feedback Controllers for Rational LPV Systems, pp. 4922-4927

Bouali, Anis — Ec. des Mines de Nantes / Inst. de Recherche en communicati

Yagoubi, Mohamed — Ec. des Mines de Nantes (IRCCyN)

Chevrel, Philippe — IRCCyN / Ec. des Mines de Nantes

This paper addresses the design of gain scheduled observer-based controllers for rational linear parameter varying systems (LPV). Such systems are equivalently recast as affine descriptor LPV systems. Based on this new realization a descriptor observer-based controller is designed by means of some new sufficient conditions given as LMIs. The stability of the descriptor closed-loop system is proved. A state space rational controller, with an observer-based structure, is then derived. The stability of the obtained rational closed-loop is also proved. A numerical example is presented to illustrate the efficiency of the method.

14:20-14:40 TuB07.2

LPV Control for Robust Attenuation of Non-Stationary Sinusoidal Disturbances with Measurable Frequencies, pp. 4928-4933

Koroglu, Hakan — Delft Univ. of Tech.
Scherer, Carsten W. — Delft Univ. of Tech.

Attenuation of sinusoidal disturbances with uncertain and arbitrarily time-varying, yet online measurable frequencies is considered. The disturbances are modeled as the outputs of an autonomous exogenous system, whose system matrix depends on some uncertain parameters and is skew-symmetric for all admissible parameter values. A procedure is then developed for the synthesis of an observer-based controller that uses the online measurements of the uncertain parameters to guarantee a desired level of attenuation at steady-state in the face of all admissible parameter variations. The controller is scheduled by the measurements of the uncertain parameters as well as the matrix-valued outputs of a unit that is also scheduled on the uncertain parameters. The synthesis procedure is based on solving a convex optimization problem in which the variables are subject to a set of parameter-dependent matrix inequality constraints, which can be relaxed into finitely many linear matrix inequalities. The procedure also provides options for improving the transient response.

14:40-15:00 TuB07.3

Gain Scheduling Using Time-Varying Kalman Filter for a Class of LPV Systems, pp. 4934-4939

Cha, Sung Han — RSISE, The Australian National Univ.
Anderson, Brian D.O. — Australian National Univ.
Rotkowitz, Michael — The Univ. of Melbourne

Current gain-scheduling approaches only assure stability when the underlying parameter varies sufficiently slowly, and hence stable closed-loop is not guaranteed for more general (i.e. faster) parameter variations. Shamma and Athans (1992) provides a solution to overcome this by computing Riccati Differential Equation (RDE) online for the current parameter value with the offline Algebraic Riccati Equation (ARE) solutions for every parameter value, which is computationally demanding. This paper achieves a very significant simplification, by showing how only a finite number of AREs need be used and the online RDE solutions can be computed by table look-up and matrix inversion. In simulations the method yields results indistinguishable from those achieved in Shamma and Athans (1992).

15:00-15:20 TuB07.4

LMI Based Stabilization of a Class of Switching LPV Systems, pp. 4940-4945

Jetto, L. — Univ. di Ancona
Orsini, Valentina — Univ. Pol. delle Marche

The stabilization problem of a class of discrete-time LPV systems is considered. The plant switches among different operating conditions and, as long as the process operates in a fixed mode, the physical parameters are varying inside a known compact set. The possibility of noisy parameter measurements is taken into account, the measure and the control matrices corresponding to each mode are assumed to be known and time-invariant. The problem solvability conditions are stated in terms of feasibility of a set of LMIs, and the closed-loop stability is proved assuming a sufficiently long permanence of each mode.

15:20-15:40 TuB07.5

Parameter Dependent State-Feedback Control of LPV Time Delay Systems with Time Varying Delays Using a Projection Approach, pp. 4946-4951

Briat, Corentin — INPG/ENSIEG
Sename, Olivier — INPG
Lafay, JeanFrancois — Ec. Centrale Nantes

This paper is concerned with the stabilization of LPV time delay systems with time varying delays by parameter dependent state-feedback. First a stability test with hinf performance is given through a parameter dependent LMI. This stability test is derived from a parameter dependent Lyapunov-Krasovskii functional combined with the Jensen's inequality. From this result we derive a state-feedback existence lemma expressed through a nonlinear matrix inequality (NMI). Using a result of the paper we are able to turn this (NMI) into a bilinear matrix inequality (BMI) involving a 'slack' variable. This BMI formulation is shown to be more flexible than the initial NMI formulation and is more adequate to be solved using algorithm such as 'D-K iteration'. The controller construction is provided by two different ways. We finally discuss on the relaxation method and we show the efficiency of our method through several examples.

15:40-16:00 TuB07.6

Crucial Aspects of Zero-Order Hold LPV State-Space System Discretization, pp. 4952-4957

Tóth, Roland — Delft Univ. of Tech.
Heuberger, Peter — Delft Univ. of Tech.
Van den Hof, Paul M.J. — Delft Univ. of Tech.
Felici, Federico — EPFL

In the framework of Linear Parameter-Varying (LPV) systems, controllers are commonly designed in continuous-time, but implemented on digital hardware. Additionally, LPV system identification is formulated exclusively in discrete-time, needing structural information about the plant, which is often provided by first principle continuous-time models. These imply that LPV system discretization is an important issue for both system identification and controller implementation. Discretization approaches of LPV state-space systems are introduced and analyzed in terms of approximation error, considering ideal zero-order hold actuation and sampling of the input-output signals and the scheduling parameter of the system. Criteria to choose appropriate sampling times with the investigated methods are also presented.

TuB08 310C

Robust Controller Synthesis II (Regular Session)

Chair: Wik, Torsten — Chalmers Univ. of Tech.
Co-Chair: Saeki, Masami — Hiroshima Univ.

14:00-14:20 TuB08.1

Model-Free PID Controller Optimization for Loop Shaping, pp. 4958-4963

Saeki, Masami — Hiroshima Univ.

In this paper, a data-driven model-free design method of PID controller is proposed for a single-input single-output linear time-invariant plant for a loop shaping problem where the integral gain is maximized under the maximum sensitivity constraint. This design problem is reduced to a linear programming problem. The constraints on the PID gains are given from many fictitious data, which are obtained by applying the wavelet transform to a step response. Our design method does not require the iteration of modeling and control design and the performance index refinement. Numerical examples show the robustness against measurement noise.

14:20-14:40 TuB08.2

Single-Parameter Tuning of PI Controllers: From Theory to Practice, pp. 4964-4969

Matusu, Radek — Tomas Bata Univ. in Zlin
Prokop, Roman — Tomas Bata Univ. in Zlin

The paper deals with influence of a single scalar positive tuning parameter on performance properties of the closed control loop which contains algebraically designed PI controller while the response quality is evaluated by the size of first under- or overshoots. The controller coefficients are calculated from general solutions of diophantine equations in the ring of proper and Hurwitz stable rational functions. Subsequently, these controllers can be tuned by the only parameter. The contribution brings simple tuning rules and, moreover, it presents their possible practical application during control of real laboratory model assumed as system with parametric uncertainty.

14:40-15:00 TuB08.3

Tank Reactor Temperature Control Using Quantitative Feedback Theory, pp. 4970-4975

Olesen, Veronica — Chalmers Univ. of Tech.
Breitholtz, Claes — Chalmers Univ. of Tech.
Wik, Torsten — Chalmers Univ. of Tech.

Temperature control of tank reactors with exothermic reactions is an acknowledgedly difficult task because of complex interacting phenomena, several nonlinearities and unstable dynamics. Traditionally, simple control functions are implemented, implying poor control performance and small operating windows. However, many advanced control schemes have been published, though in many applications they rely on too simplistic process models. Here, a control strategy using only a small number of linear controllers has successfully been applied to a rigorous reactor model, including the cooling system dynamics. The methodology is to first linearize the model in steady-state and relevant non-stationary points and let the resulting models define uncertainties in the frequency plane. Then Quantitative Feedback Theory (QFT) is used to ensure that robust feedback system specifications are fulfilled for all these uncertainties.

15:00-15:20 TuB08.4

Automated Synthesis of Fixed Structure QFT Controller Using Interval Constraint Satisfaction Techniques, pp. 4976-4981

Nataraj, P.S.V. Indian Inst. of Tech.
Deshpande, Manoj Indian Inst. of Tech. Bombay, Mumbai , INDIA

Robust controller synthesis is of great practical interest and its automation is a key concern in control system design. Automatic controller synthesis is still a open problem. In this paper a new, efficient method has been proposed for automated synthesis of a fixed structure quantitative feedback theory (QFT) controller by solving QFT quadratic inequalities of robust stability and performance specifications. The controller synthesis problem is posed as interval constraint satisfying problem (ICSP) and solved with interval constraint solver. The method is guaranteed to find all feasible controllers of given structure in the search domain. The proposed method is tested on two benchmark problems, and simple, low order controllers are successfully obtained in quick time.

15:20-15:40 TuB08.5

Fixed-Order Controller Design for Polytopic Systems Using Rank Deficiency in a Sylvester Matrix, pp. 4982-4987

Khatibi, Hamid EPFL
Karimi, Alireza Ec. Pol. Federale de Lausanne
Longchamp, Roland Ec. Pol. Federale De Lausanne

Fixed-order controller design for LTI-SISO polytopic systems is investigated using rank deficiency constraint on the controller Sylvester resultant matrix. It is shown that the non-convexity of fixed-order controller design problem can be contracted in a rank deficiency constraint on Sylvester resultant matrix of the controller. Then, an improved convex approximation of the rank deficiency constraint is used that leads to a convex fixed-order controller design problem represented via LMIs. The effectiveness of the proposed method is shown by applying it to an experimental system.

15:40-16:00 TuB08.6

Regularization of the Limiting Optimal Controller in Robust Stabilization, pp. 4988-4992

Iantchenko, Svetlana Lunds Univ.
Ghulchak, Andrey Lund Univ.

In this paper, we consider the problem of robust optimization for a system with uncertainty of rank one. The main result is the regularization procedure of the limiting optimal controller. We derive a method to obtain a low order suboptimal controller that provides a stability margin as close to the optimal one as necessary. The method is illustrated by two examples.

TuB09 311C

Nonlinear System Identification III (Regular Session)

Chair: Bai, Er-Wei Univ. of Iowa
Co-Chair: Medvedev, Alexander V. Uppsala Univ.

14:00-14:20 TuB09.1

A Recursive Method of Identification of Hammerstein Model Based on Least Squares Support Vector Machines, pp. 4993-4998

Chen, Kun Zhejiang Univ.
Wang, Haiqing Zhejiang Univ.
Song, Zhi-Huan Zhejiang Univ.

In the domain of industrial process modeling and control, Hammerstein model has been used widely to describe a class of nonlinear systems. Goethals et al. (2005) proposed a method based on Least Squares Support Vector Machines (LSSVM) to identify the input-output relationship of the Hammerstein model. Unfortunately, as the data points grow, this kernel learning approach costs much time correspondingly. Besides, Goethals's technique is not suitable for the on-line identification. To this end, a recursive nonlinear identification method is proposed in this paper. The basic idea is to get the recursive form of the parts of the high-dimensional matrix arisen from the optimization derivation, and get the estimation with the trick of sub-inverse matrix. With this new LSSVM approach, the Hammerstein model can be obtained recursively and much quickly, which is crucial to industrial applications that require online estimation and prediction. The simulation illustrates the validity and feasibility of the developed online identification method.

14:20-14:40 TuB09.2

Identification of NARX Hammerstein Models Based on Support Vector Machines, pp. 4999-5004

Al-Dhaifallah, Mujahed Univ. of Calgary
Westwick, David Univ. of Calgary

This paper presents a new algorithm for identification of NARX Hammerstein systems using support vector machines (SVMs) to model the static nonlinear elements. The SVM is fitted by minimizing an e-insensitive, L-1 cost function which is robust in the presence of outliers. Another advantage of this algorithm is that the value of the uncertainty level epsilon can be specified by the user which gives more control on the sparseness of the solution. The effect of this choice is demonstrated using simulations.

14:40-15:00 TuB09.3

Parametric Identification of Nonlinear Hysteretic Systems, pp. 5005-5010

Rochdi, Youssef Ec. D'INGENIEURS MOHAMMEDIA RABAT
Giri, Fouad GREYC - Univ. de Caen
Chaoui, Fatima-Zahra ENSET
Ikhouane, Faycal Univ. Pol. de Catalunya
Rodellar, Jose Tech. Univ. of Catalonia
Mohamed, Haloua Ec. Mohammadia d'Ingénieurs, Univ. Mohammed V Agdal

The hysteretic behaviour is an essential feature of many physical systems. Such a feature is conveniently accounted for in hysteretic systems modelling through the well known nonlinear Bouc-Wen equations. But these involve several unknown parameters and internal signals that are not all accessible to measurements. These difficulties make the identification of hysteretic systems a challenging problem. To cope with these issues, previous works are generally based on simplifying assumptions that amount to supposing, among others, that the Bouc-Wen equations describe an isolated physical element in which 'hysteretis' is the only dynamic feature. The point is that, even such a case, the control input should be an external driving force and no the displacement. In this paper, the hysteretic equations are let to be what they really are in most practical situations: just a part of the system dynamics. A multi-stage parametric identification scheme is designed and shown to recover consistently the system unknown parameters. The proposed solution is suitable for systems not tolerating large displacements (e.g. like buildings) as well as for situations where force sensors are not available.

15:00-15:20 TuB09.4

Gyro-Bias Estimation Filter Design for the Stabilization Accuracy Enhancement of Two Axes Gimbaled Sighting Systems, pp. 5011-5017

Atesoglu, Ozgur Aselsan Inc.
Nalbantoglu, Volkan Aselsan Inc.
Seymen, Burak ASELSAN INC.

In this study the development of a bias estimation technique for the gyroscopes used in stabilization of two axes gimbaled sighting systems is presented. Due to their size and cost limitations, generally, two axes gyroscopes with high bias values are used on such systems. These high bias values cause the sight-line to drift from the target direction and result in a need for frequent corrections from the operator. The proposed technique uses the aiding from the inertial navigation system (INS) of the host vehicle and the kinematical constraints to enable the complete attitude solution of the sighting system with only using a two axes gyroscope. This full attitude solution is used in designing an extended Kalman filter which estimates the gyroscope biases. As for the simulations, a dynamical model of the sighting system, carried on a host land vehicle, is developed and the performance improvement resulting from the bias corrections is demonstrated with simulations using this model.

15:20-15:40 TuB09.5

A Method of LPV Model Identification for Control, pp. 5018-5023

Zhu, Yucai Eindhoven Univ. of Tech.
Xu, Zuhua Zhajiang Univ.

Nonlinear process identification for control is studied. In identification test, the process is only tested (excited) along its operating-trajectory that includes various working points and transition periods. In model identification, a linear parameter varying (LPV) model is used. First linear models are identified using data sets at various working-points exclusive transition data; then the LPV model is identified by interpolating the linear models using total data. Sufficient conditions for a unique solution in parameter estimation will be given. Simulation study will be used to verify the effectiveness of the method. The identified model is suitable for model predictive control (MPC).

TuB10 311B
Estimation Error Quantification (Regular Session)
Chair: Ljung, Lennart — Linköping Univ.
Co-Chair: Campi, Marco — Univ. of Brescia

14:00-14:20 TuB10.1
Finite Sample Confidence Regions for Parameters in Prediction Error Identification Using Output Error Models, pp. 5024-5029
den Dekker, Arnold J. — Delft Univ. of Tech.
Bombois, Xavier — Delft Univ. of Tech.
Van den Hof, Paul M.J. — Delft Univ. of Tech.

The purpose of this paper is to evaluate the reliability in finite samples of different methods for constructing probabilistic parameter confidence regions in prediction error identification using Output Error (OE) models. The paper presents alternatives to the "classical method" of constructing asymptotically valid confidence regions, which is based on the asymptotic statistical properties of the parameter estimator. It is shown that if alternative test statistics are used, more reliable confidence regions for finite samples can be obtained. Particularly, it is demonstrated that the use of a test statistic based on the Fisher score allows the construction of exact confidence regions for finite samples.

14:20-14:40 TuB10.2
New Convergence Results for the Least Squares Identification Algorithm, pp. 5030-5035
Hu, Xiao-Li — AMSS, Chinese Acad. of Sciences
Ljung, Lennart — Linköping Univ.

The basic least squares method for identifying linear systems has been extensively studied. Conditions for convergence involve issues about noise assumptions and behavior of the sample covariance matrix of the regressors. Lai and Wei proved in 1982 convergence for essentially minimal conditions on the regression matrix: All eigenvalues must tend to infinity, and the logarithm of the largest eigenvalue must not tend to infinity faster than the smallest eigenvalue. In this contribution we revisit this classical result with respect to assumptions on the noise: How much unstructured disturbances can be allowed without affecting the convergence? The answer is that the norm of these disturbances must tend to infinity slower than the smallest eigenvalue of the regression matrix.

14:40-15:00 TuB10.3
On Identification of Cascade Systems, pp. 5036-5040
Wahlberg, Bo — Royal Inst. of Tech. (KTH)
Hjalmarsson, HÍkan — KTH
MÍrtensson, Jonas — KTH

The objective of this contribution is to discuss some aspects of system identification of cascade systems. Models of such systems are important in for example cascade control applications. We will restrict our attention to systems with one input signal and two output signals. First, we will analyze some fundamental limitations regarding the statistical properties of such estimates, and in particular why it can be difficult to identify cascade systems where the sub-transfer functions are close to each other. We will then show how an unstructured SIMO estimate can be used to find a cascade system model using an indirect prediction error method or balanced model reduction.

15:00-15:20 TuB10.4
Non-Asymptotic Model Quality Assessment of Transfer Functions at Multiple Frequency Points, pp. 5041-5046
Ko, Sangho — Korea Aerospace Univ.
Weyer, Erik — Univ. of Melbourne
Campi, Marco — Univ. of Brescia

In this paper we develop methods for evaluating uncertainties in the frequency response of a dynamical system based on finitely many input-output data points. We extend the "Leave-out Sign-dominant Correlation Regions" (LSCR) algorithm to deliver confidence regions with a guaranteed probability for the frequency response at multiple frequency points, and we introduce a computationally efficient scheme which enables confidence regions to be constructed separately at each frequency. Simulation examples illustrating the usefulness of the developed algorithm are provided.

15:20-15:40 TuB10.5
Relative Error Issues in Sampled Data Models, pp. 5047-5052
Goodwin, Graham C. — Univ. of Newcastle
Yuz, Juan I. — Univ. Técnica Federico Santa María
Aguero, Juan C — The Univ. of Newcastle

Most real world systems operate in continuous time. However, to store, analyze or transmit data from such systems the signals must first be sampled. Consequently there has been on-going interest in sampled data models for continuous time systems. The emphasis in the literature to-date has been on three main issues namely the impact of folding, sampled zero dynamics and the associated model error quantification. Existing error analyses have almost exclusively focused on unnormalized performance. However, in many applications relative errors are more important. For example, high performance controllers tend to invert the system dynamics and consequently relative errors underpin closed loop performance issues including robustness and stability. This motivates us to examine the relative errors associated with several common sampled data model types. This analysis reveals that the inclusion of appropriate zero dynamics is essential to ensure that the relative error converges to zero as the sampling period is reduced.

15:40-16:00 TuB10.6
Index Reduction of Index 1 DAE under Uncertainty, pp. 5053-5058
Tidefelt, Henrik — Linköping Univ.
Glad, Torkel — Linkoping Univ.

This paper examines an index reduction method for linear time-invariant differential algebraic equations, with uncertainty in the equation coefficients. When the bottom block of a block upper triangular leading matrix contains no elements that can be distinguished from zero, the natural action to take is to replace all numbers in the block by exact zeros, and then proceed with index reduction by differentiation. Conditions are given under which zeroing of an uncertain small block gives a small deviation in the solution.

TuB11 311A
Adaptive Control of Systems II (Regular Session)
Chair: Brown, Lyndon J. — Univ. of Western Ontario
Co-Chair: Do, Duc — The Univ. of Western Australia

14:00-14:20 TuB11.1
High Performance Control of an Active Heave Compensation System, pp. 5059-5064
Do, Duc — The Univ. of Western Australia
Pan, Jie — The Univ. of Western Australia

To compensate for heave motion, which has an adverse impact on the response of a drill-string or a riser, passive and active devices are usually used. Active heave compensators, whose control system is an essential part, allow conducting operations under more extreme weather conditions than passive ones. This paper presents a constructive method to design a nonlinear controller for an active heave compensation system using an electro-hydraulic system driven by a double rod actuator. The control development is based on Lyapunov's direct method and disturbance observers.

14:20-14:40 TuB11.2
Adaptive Control Design Based on Adaptive Optimization Principles, pp. 5065-5070
Kosmatopoulos, Elias — Tech. Univ. of Crete
Papageorgiou, Markos — Tech. Univ. of Crete

Recently, we introduced an adaptive control design for linearly parameterized multiinput nonlinear systems admitting a known Control Lyapunov Function (CLF) that depends on the unknown system parameters. The main advantage of that design is that it overcomes the problem where the estimation model becomes uncontrollable although the actual system is controllable. However, the resulted adaptive control design is quite complicated and, moreover, it exhibited poor transient behaviour in various applications. In this paper, we propose and analyze a new computationally efficient adaptive control design that overcomes the aforementioned shortcomings. The proposed design is based on an adaptive optimization algorithm proposed recently by the author, which makes sure that the parameters to be optimized (which correspond to the controller parameters in this paper) are modified so as to both lead to a decrease of the function to be minimized and satisfy a persistence of excitation condition. The main advantage of the proposed adaptive control design is that it can produce arbitrarily good transient performance outside the regions of the state space where the system becomes uncontrollable. It is also worth noticing that the class of systems where the proposed algorithm is applicable is more general than that of our previous work.

14:40-15:00 TuB11.3

An Efficient Adaptive Optimization Scheme, pp. 5071-5076

Kosmatopoulos, Elias — Tech. Univ. of Crete
Papageorgiou, Markos — Tech. Univ. of Crete

Adaptive optimization schemes based on stochastic approximation principles such as the Random Directions Kiefer-Wolfowitz (RDKW), the Simultaneous Perturbation Stochastic Approximation (SPSA) and the Adaptive Fine-Tuning (AFT) algorithms possess the serious disadvantage of not guaranteeing efficient transient behaviour due to their requirement for using random or random-like perturbations of the current parameter vector. The use of random or random-like perturbations may lead to particularly large values of the objective function, a fact that prevents the wide application of these algorithms to controller fine-tuning and adaptive and learning control where efficient transient performance is a prerequisite; in these applications, there may be cases where a small perturbation of a ``good'' parameter vector may lead to an unacceptable -- or, even worse, unstable -- closed-loop behavior. In this paper, we introduce and analyze a new algorithm for alleviating this problem. Mathematical analysis establishes efficient transient performance and convergence of the proposed scheme under a general set of assumptions. Simulation results demonstrate the efficiency of the proposed scheme.

15:00-15:20 TuB11.4

FPGA-Based Implementation of an Active Vibration Controller, pp. 5077-5082

Leva, Alberto — Pol. di Milano
Piroddi, Luigi — Pol. di Milano

This manuscript deals with the implementation of active noise and vibration control systems on very high-speed computational architectures, more specifically on Field Programmable Gate Arrays (FPGA). Starting from a particular application, namely the vibration control of a turbomolecular vacuum pump, general design considerations are devised. A feedforward controller is designed based on multiple adaptive notch filters and the filtered-x LMS algorithm. An implementation of the presented control technique is illustrated, and some tests are reported to show its efficiency.

15:20-15:40 TuB11.5

A New Critical Case for Adaptive Nonlinear Stabilization, pp. 5083-5088

Li, Chanying — Acad. of Mathematic and System Science, CAS
Guo, Lei — Chinese Acad. of Sciences

It is fairly well known that there are fundamental differences between adaptive control of continuous-time and discrete-time nonlinear systems. In fact, even for the seemingly simple SISO control system y_t+1 = theta_1f(yt) + ut + wt+1 with a scalar unknown parameter µ1 and noise disturbance fwtg, and with a known function f(.) having possible nonlinear growth rate characterized by |f(x)| = Theta(|x|^b) with b 1, the system is globally stabilizable by adaptive feedback if and only if b < 4. This was first found and proved by Guo (1997) for the Gaussian white noise case, and then proved by Li and Xie (2006) for the bounded noise case. Recently, a number of other type of "critical values" or "impossibility theorems" on the maximum capability of adaptive feedback were also found, mainly for systems with known control parameter as in the above model. In this paper, we will study the above basic model again but with additional unknown control parameter theta_2, i.e., ut is replaced by theta_2*ut in the above model. Interestingly, it turns out that the system is globally stabilizable if and only if b < 3. This is a new critical case for adaptive nonlinear stabilization, which has meaningful implications for the control of more general uncertain systems.

15:40-16:00 TuB11.6

Identification of Exponentially Damped Sinusoidal Signals, pp. 5089-5094

Lu, Jin — The Univ. of Western Ontario
Brown, Lyndon J. — Univ. of Western Ontario

A discrete-time internal model principle based adaptive algorithm for identifying signals composed of a sum of exponentially damped sinusoids is presented. The time varying state variables of an internal model principle controller in a feedback loop can provide estimates of the exponentially damped sinusoidal signal parameters, the damping factor and the frequency. By using additional integral controllers, the estimation errors can be eliminated. The convergence of the proposed algorithm is justified using discrete-time averaging theory. Simulation results demonstrate the performance of this algorithm for signal identification.

TuB12 313

Dependable Control of Discrete Event Systems II (Invited Session)

Chair: Papadopoulos, Yiannis Ioannis — Univ. of Hull
Co-Chair: Stursberg, Olaf — Tech. Univ. Muenchen
Organizer: Faure, Jean-Marc — ENS Cachan
Organizer: Lesage, Jean-Jacques — ENS de Cachan
Organizer: Frey, Georg — Univ. of Kaiserslautern
Organizer: Papadopoulos, Yiannis Ioannis — Univ. of Hull

14:00-14:20 TuB12.1

Verification of Fault Tolerance of Discrete-Event Object-Oriented Models Using Model Checking (I), pp. 5095-5100

Bonfe, Marcello — Univ. di Ferrara
Fantuzzi, Cesare — Univ. of Modena and Reggio Emilia
Secchi, Cristian — Univ. of Modena and Reggio Emilia

The Object-Oriented (O-O) approach have been recently used in the industrial automation to design logic control systems, thanks to the features of specification languages (e.g. UML) that can help to describe event-based behavioral requirements. In this paper, we aim to formalise an O-O framework for the design of modular logic controllers, in which faults occurring in the plant can alter the behavior of closed-loop system. Given the formal model of the system in terms of Kripke structures, it is possible to verify with model checking that even in case of faults the system do not violate given safety and liveness properties. Moreover, we will consider the case in which an O-O logic controller is refined applying the so-called “design-byextension” mechanism, in which case it is important to verify that the fault tolerance property is inherited by the refined system.

14:20-14:40 TuB12.2

Improving Large-Sized PLC Programs Verification Using Abstractions (I), pp. 5101-5106

Gourcuff, Vincent — Lurpa - ENS de Cachan
Faure, Jean-Marc — ENS Cachan
de Smet, Olivier — Lurpa - ENS de Cachan

This paper proposes a formal representation of logic controllers programs that is aiming at improving scalability of model-checking techniques, when verifying controllers' extrinsic properties. This representation includes only the states which are meaningful for properties proof and minimizes the number of variables that feature each state. Comparison with previously proposed representations, on the basis of three increasing complexity examples validates this representation and quantifies its efficiency.

14:40-15:00 TuB12.3

Property Patterns for the Formal Verification of Automated Production Systems (I), pp. 5107-5112

Campos, José Creissac — Univ. of Minho
Machado, José — Univ. of Minho
Seabra, Eurico — Univ. of Minho

In recent years, several approaches to the analysis of automation systems dependability through the application of formal verification techniques have been proposed. Much of the research has been concerned with the modelling languages used, and how best to express the automation systems, so that automated verification might be possible. Less attention, however, has been devoted to the process of writing properties that accurately capture the requirements that need verification. This is however a crucial aspect of the verification process. Writing appropriate properties, in a logic suitable for verification, is a skilful process, and indeed there have been reports of properties being wrongly expressed. In this paper we put forward a tool and a collection of property patterns that aim at providing help in this area.

15:00-15:20 TuB12.4

Comparing Simulative and Formal Methods for the Analysis of Response Times in Networked Automation Systems (I), pp. 5113-5118

Greifeneder, Jürgen — Univ. of Kaiserslautern
Liu, Liu — Univ. of Kaiserslautern
Frey, Georg — Univ. of Kaiserslautern

Networked Automation Systems (NAS) result from the increasing decentralization of automation systems using new network structures. Those structures are less expensive and more flexible than traditional ones. However, they introduce stochastic and coupled temporal behavior. Therefore, a detailed analysis is necessary accounting for the special characteristics of NAS. In this article, two approaches for the analysis of response times in NAS are presented. While simulation using Dymola/Modelica offers a user-friendly implementation of the system models, probabilistic model checking using PRISM gives more accurate and reproducible results in less time. The strengths and weaknesses of the two approaches are discussed based on a typical NAS scenario. The results are then validated by a large number of measured samples. It is demonstrated that quite accurate results are obtainable by both approaches.

15:20-15:40 TuB12.5

Efficient Representation for Formal Verification of Time Performances of Networked Automation Architectures (I), pp. 5119-5124

Ruel, Silvain — ENS de Cachan
de Smet, Olivier — Lurpa - ENS de Cachan
Faure, Jean-Marc — ENS Cachan

Networked automation architectures with Ethernet-based fieldbuses instead of traditional fieldbuses are more and more often used in industry, even for critical systems such as chemical or nuclear power plants. The strong safety requirements of these processes impose to evaluate the time performances of these complex architectures. Formal verification techniques are promising solutions to reach this objective. Hence, this paper focuses on the applicability of formal verification techniques to check time performances. On the basis of a case study, it is shown how formal models of networked automation architectures which are simple enough to be checked by existing timed model-checkers while yielding meaningful results can be developed.

15:40-16:00 TuB12.6

Verification of Uncertain Embedded Systems by Computing Reachable Sets Based on Zonotopes (I), pp. 5125-5130

Althoff, Matthias — Tech. Univ. München
Stursberg, Olaf — Tech. Univ. Muenchen
Buss, Martin — Tech. Univ. Muenchen

Formal verification using reachability analysis has been shown to be useful for detecting design failures for controlled embedded systems, and thus to improve dependability. If the state space is hybrid, however, the growth of complexity with the dimension of the continuous dynamics limits the applicability significantly. This paper proposes an efficient approach to computing reachable sets for hybrid systems with time-varying linear continuous dynamics and uncertain inputs. The key idea is to combine zonotopes and polytopes for set representation when reachable sets are intersected with the transition guards which determine the discrete behavior of the hybrid system. Different methods for conservatively transforming zonotopes into polytopes (and vice versa) are proposed and experimentally compared.

TuB13 314

Coordination of Multiagent Systems (Regular Session)

Chair: Xi, Yugeng — Shanghai Jiao Tong Univ.
Co-Chair: Namerikawa, Toru — Kanazawa Univ.

14:00-14:20 TuB13.1

Particle Swarms in Optimization and Control, pp. 5131-5136

van Ast, Jelmer Marinus — Delft Univ. of Tech.
Babuska, Robert — Delft Univ. of Tech.
De Schutter, Bart — Delft Univ. of Tech.

In the last decennium, particle swarms have received considerable attention in the fields of optimization and control. Inspired by swarms of social animals, such as birds, fish, and termites, simple behavior on the local level has been shown to result in useful complex behavior on the global level. Particle Swarm Optimization has proven to be a very powerful optimization heuristic, and swarm aggregation based on artificial potential fields enjoys a growing interest for controlling particles in a swarm. Especially the flexibility, scalability, and robustness to errors on a local level are intrinsic properties of swarms that have attracted the interest of researchers in applying swarm technology to various problems. In this contribution, we present an overview of the application of particle swarms for optimization and control of swarm aggregation.

14:20-14:40 TuB13.2

Distributed Formation Algorithm for Multi-Agent Systems with a Relaxed Connectivity Condition, pp. 5137-5142

Li, Xiaoli — Shanghai Jiao Tong Univ.
Xi, Yugeng — Shanghai Jiao Tong Univ.

This paper proposes a distributed formation algorithm for multi-agent systems with a relaxed connectivity condition. In our study, velocity information exchange among agents depends on the group communication topology, and the available position information flows among agents are determined by a special subgraph of the communication topology. Our distributed formation algorithm guarantees that once this subgraph is connected at some time instant, the topology will keep connected thereafter, and the formation objective of a multi-agent system is proved to achieve in a completely distributed style.

14:40-15:00 TuB13.3

Stable Swarming by Mutual Interactions of Attraction/Alignment/Repulsion: Fixed Topology, pp. 5143-5148

Li, Xiaohai — City Univ. of New York
Cai, Zhijun — Univ. of Iowa

In this paper we present a general decentralized controller for a swarm of mobile agents with fixed topology to move in a given environment. The controller utilizes the widely accepted hypothesis of Attraction/Alignment/Repulsion (A/A/R) interactions for fish schools in mathematical biology community. We assume that during the swarm’s motion, each agent can sense and interact with its neighbors via A/A/R interactions, while follow the path clue of the environment. The environment is assumed to have identical effect on all agents. Under the assumptions of connected graph, the controller is proved to make the velocities of all swarm members asymptotically converge to a common value. The advantage of this controller is that all the information it needs can be locally sensed, therefore, communication link and associated issues (such as communication noise and time delay) are avoided. Simulations of a swarm with a fixed topology are presented to verify the proposed controller

15:00-15:20 TuB13.4

Formation Control of Nonholonomic Multi-Vehicle Systems Based on Virtual Structure, pp. 5149-5154

Yoshioka, Chika — Kanazawa Univ.
Namerikawa, Toru — Kanazawa Univ.

This paper deals with formation control strategies based on Virtual Structure (VS) for multi-vehicle systems. We propose several control laws for networked multi-nonholonomic vehicle systems in order to achieve VS consensus, VS Flocking and VS Flocking with collisionavoidance.

First, Virtual Vehicle for the feedback linearization is considered, and we propose VS consensus and Flocking control laws based on a virtual structure and consensus algorithms. Then, VS Flocking control law considering collision avoidance is proposed and its asymptotical stability is proven.

Finally, simulation and experimental results show effectiveness of our proposed approaches.

15:20-15:40 TuB13.5

Rigid Formation Keeping and Formation Reconfiguration of

Multi-Agent Systems, pp. 5155-5160

Maithripala, D.H.A.	Texas A&M Univ.
Jayasuriya, Suhada	Texas A&M Univ.

A motion planning algorithm is presented for formation control of coordinating multi agents engaged in rigid formation keeping and formation reconfiguration. The multi agent system is separated into geometrically equivalent subsystems for distributed control. The proposed motion planning algorithm generates reference trajectories for each of these subsystems in real-time for online, distributed and autonomous control. Deriving the constrained kinematics eliminates the need for nonlinear programming to account for the system constraints, making the approach amenable to real-time control. A control strategy accounts for actuator/operating constraints to give dynamically feasible reference trajectories. Explicit consideration of actuator and operating limitations and nonholonomic constraints in the design of the reference trajectories, thereby addressing the important issue of dynamic feasibility, is one of the main contributions of the proposed approach. The motion planning algorithm is verified through simulations for a team of multi-agents moving in and switching between formations in a scouting scenario.

15:40-16:00 TuB13.6

Control of Formations of UAVs for Surveillance and Reconnaissance Missions, pp. 5161-5166

Kopfstedt, Thomas	Diehl BGT Defence GmbH und Co. KG
Mukai, Masakazu	Kyushu Univ.
Fujita, Masayuki	Tokyo Inst. of Tech.
Ament, Christoph	Tech. Univ. Ilmenau

This paper presents a method for control of formations of Unmanned Aerial Vehicles (UAVs) in urban environments with several obstacles. Therefore the trajectories for each UAV are planned using mixed integer quadratic programming (MIQP) to describe a minimization problem. The result of this minimization problem then characterizes a collision free trajectory for each UAV using the commanded formations to fulfil the missions. The description of the UAVs, the inter UAV collision avoidance, the collision avoidance with obstacles as well as the description of formations will be shown in detail together with some simulation results in this paper. In addition the introduction explains the fields of interest in such formations of UAVs and what kind of advantage they can bring in comparison to today's solutions. The novelty in the approach in this paper is the description of formations of UAVs used in combination with MIQP to change formations, to add additional UAVs into an existing formation and to split formations, simply by changing some parameters in the description of the formation.

TuB14 318

Control Over Networks II (Regular Session)

Chair: De Persis, Claudio	Sapienza Univ. of Rome
Co-Chair: Middleton, Rick	National Univ. of Ireland

14:00-14:20 TuB14.1

Optimal Controller Design for Networked Control Systems, pp. 5167-5172

Silva, Eduardo I	The Univ. of Newcastle
Quevedo, Daniel E.	The Univ. of Newcastle
Goodwin, Graham C.	Univ. of Newcastle

This paper addresses the problem of optimal control system design for networked control systems. We focus on a situation where the plant is single-input single-output and the communication link between the controller and the plant is signal-to-noise ratio constrained. In this setting, we characterize the controllers that minimize the tracking error variance, while respecting the channel signal-to-noise ratio constraint. We also provide a description of the optimal tradeoff curve in the performance versus signal-to-noise ratio plane and, as a byproduct, we establish easily computable bounds on the achievable performance. We illustrate our results with a numerical example based on a bit rate limited channel.

14:20-14:40 TuB14.2

Infimal Feedback Capacity for a Class of Additive Coloured Gaussian Noise Channels, pp. 5173-5178

Rojas, Alejandro J.	The Univ. of Newcastle
Middleton, Rick	National Univ. of Ireland
Freudenberg, James S.	Univ. of Michigan

In this paper we consider the infimal signal-to-noise ratio (SNR)required for stabilisation of a linear time invariant (LTI) scalar unstable plant over a class of additive coloured Gaussian noise channels. We apply recent results in the literature to obtain the feedback capacity of such a class of channels. We prove that the infimal SNR constrained LTI solution, when dealing with a scalar unstable plant, does achieve a channel feedback capacity equal to the infimal rate of transmission required for stability. The optimality of such channel feedback capacity is a non trivial result since we consider additive 1st order moving average (MA) and autoregressive moving average (ARMA) coloured noise.

14:40-15:00 TuB14.3

Repeated Poles in Feedback Over a Class of Signal-To-Noise Ratio Constrained Channels, pp. 5179-5184

Rojas, Alejandro J.	The Univ. of Newcastle
Yuz, Juan I.	Univ. Técnica Federico Santa María

In the present paper we obtain a closed form expression for the squared H_2^{perp} norm of a partial fraction expansion with repeated unstable poles. We also obtain a closed form expression for the squared H_2 norm of a partial fraction expansion with repeated stable poles. As an application we use the H_2^{perp} result to extend the closed form solution of the discrete-time linear time invariant (LTI) signal-to-noise ratio (SNR) constrained problem to the case of repeated unstable poles in the plant model.

15:00-15:20 TuB14.4

Characterization of a Complementary Sensitivity Property in Feedback Control: An Information Theoretic Approach, pp. 5185-5190

Okano, Kunihisa	The Univ. of Tokyo
Hara, Shinji	The Univ. of Tokyo
Ishii, Hideaki	Tokyo Inst. of Tech.

This paper addresses a characterization of a complementary sensitivity property in feedback control using an information theoretic approach. We derive an integral-type constraint of the complementary sensitivity function with respect to the unstable zeros of the open-loop transfer function. It is an analogue of Bode's integral formula for the sensitivity gain. To show the constraint, we first present a conservation law of the entropy and mutual information of signals in the feedback system. Then, we clarify the relation between the mutual information of a control signal and the unstable zeros of the open-loop transfer function.

15:20-15:40 TuB14.5

Robust Stabilization of Nonlinear Systems by Quantized and Ternary Control, pp. 5191-5196

De Persis, Claudio	Sapienza Univ. of Rome

Results on the problem of stabilizing a nonlinear continuous-time system by a finite number of control or measurement values are presented. The basic tool is a discontinuous version of the so-called semi-global backstepping lemma. We derive robust practical stabilizability results by quantized and ternary controllers and apply them to a few control problems.

15:40-16:00 TuB14.6

Internal Stability of Dynamically Quantised Control for Stochastic Scalar Plants, pp. 5197-5202

Gurt, Assaf	Univ. of Melbourne
Nair, Girish	Univ. of Melbourne

In this paper we study conditions under which an unstable stochastic scalar linear plant with unbounded noise can be internally stabilised using 'zooming'-like coding and control schemes having dynamic, finite-dimensional internal states. Such structures are known to be needed in communicationconstrained control when no bound on the plant noise is available. However, previous schemes were based on coders and controllers starting with identical internal states. In this paper, we remove this assumption and explicitly construct a finite-dimensional coding and control policy that yields mean square stability of all state variables, for a random initial plant state and arbitrary initial encoder and controller states. This holds for any bit rate down to the universal minimum of the Data Rate Theorem. Furthermore, we show that despite the unbounded noise, the error and proportional errors between the scaling factors of the encoder and controller tend to zero in mean square and almost sure senses respectively. This suggests that the policy will still maintainmean square internal stability in the presence of channel bit errors, provided the bit error rate is sufficiently low. We support these conclusions with simulations

TuB15 317

Biosignals Analysis and Interpretation (Regular Session)

Chair: Johansson, Rolf — Lund Univ.

Co-Chair: Bequette, B. Wayne — Rensselaer Pol. Inst.

14:00-14:20 TuB15.1

Temporal Pattern Recognition Using Spiking Neural Networks for Cortical Neuronal Spike Train Decoding, pp. 5203-5208

Fang, Huijuan — Huazhong Univ. of Science and Tech.
Wang, Yongji — Hauzhong Univ. of Science And Tech.
He, Jiping — Arizona State Univ.
Liu, Shan — Huazhong Univ. of Science and Tech.

Most experimental and decoding algorithm studies of brain neural signals assume that neurons transmit information as a rate coding, but recent studies on the fast cortical computations indicate that temporal coding is probably a more biologically plausible scheme used by neurons. We introduce spiking neural networks (SNN) which consist of spiking neurons propagate information by the timing of spikes to analyze the cortical neural spike trains directly without temporal information lost. The SNN based temporal pattern classification is compared with the conventional artificial neural networks (ANN) based firing rate analysis. The results show that the SNN algorithm can achieve higher accuracy, which demonstrates that temporal coding is a viable code for fast neural information processing and the SNN approach is suitable for recognizing the temporal pattern in the cortical neural signals.

14:20-14:40 TuB15.2

Automatic EEG Arousals Detection for Obstructive Sleep Apnea Syndrome, pp. 5209-5214

Sugi, Takenao — Saga Univ.
Kawana, Fusae — Toranomon Hospital
Nakamura, Masatoshi — Graduate School of Science and Engineering, Saga Univ.

EEG arousals are seen in EEG records as awakening response of human brain. Obstructive sleep apnea (OSA) is one of serious sleep disorders. Sevier OSA brings about EEG arousals and sleep of patients with OSAS is frequently interrupted. Number of respiratory-related arousals during the whole night PSG recordings is directly concerned with the quality of patients' sleep. Therefore, to detect EEG arousals in PSG record is significant task for clinical diagnosis. In this paper, the method for automatic detection of EEG arousals was proposed. In order to detected respiratory-related arousals effectively, threshold values were determined according to the pathological events as sleep apnea and EMG. If the resumption of ventilation (end of apnea) was detected, lower thresholds were adopted for detecting EEG arousals including relatively doubtful arousals. On the other hand, threshold maintains high when the pathological events were not detected. Proposed method was applied to the data of eight patients with OSAS, and accuracy of EEG arousals detection was verified by comparing the visual inspection. Effectiveness of the proposed method in clinical diagnosis was investigated.

14:40-15:00 TuB15.3

Analysis of Changes in the Beat-To-Beat P-Wave Morphology Using Clustering Techniques, pp. 5215-5220

Herreros, Alberto — Univ. of Valladolid
Baeyens, Enrique — Univ. of Valladolid
Carlson, Jonas — Univ. of Lund
Johansson, Rolf — Lund Univ.
Perán, J. Ramón — Univ. of Valladolid
Olsson, Bertil — Univ. of Lund

Several pathologies related to the atrial electrical activity can be detected in the electrocardiogram P-wave. A study on the beat-to-beat P-wave morphology changes of 89 ECG signals is performed in this article. An algorithm based on the embedding space techniques has been used to extract the P-wave information of the ECG. The P-waves obtained in several of these ECGs exhibit intermittent morphology changes. The morphologies have been classified by using the K-means clustering algorithm. The mechanism behind different P-wave morphologies and its possible pathophysiological importance remains to be clarified.

15:00-15:20 TuB15.4

Comparison Study of Biosignal Based Computer Interfaces Based on Fitts' Law Paradigm, pp. 5221-5226

Choi, Changmok — KAIST
Kim, Chunwoo — Seoul National Univ.
Kim, Jung — KAIST

This paper presents development of two different biosignal based computer interfaces for people with motor disabilities: 1) electromyography (EMG)-based computer interface (ECI) and 2) hybrid EMG-based computer interface (HECI). The ECI made both movements of a cursor and clicking from muscle contractions induced by volitional wrist movements. On the other hand, the HECI made movements of a cursor from the lower arm movements under a motion capture camera, and clicking from muscle contractions induced by volitional movements of index and middle fingers. These interfaces were tested by the experiments based on a Fitts' law paradigm in order to provide object evaluation of the interfaces. These results were also compared to a commercial brain computer interface was evaluated under the same test setup.

15:20-15:40 TuB15.5

A Two-Steps Sleep/wake Stages Classifier Taking into Account Artefacts in the Polysomnographic Signals, pp. 5227-5232

Zoubek, Lukáš — Univ. Joseph Fourier
Charbonnier, Sylvie — INPG/UJF
Lesecq, Suzanne — INPG/UJF/CNRS
Buguet, Alain — Univ. Claude Bernard Lyon 1
Chapotot, Florian — The Univ. of Chicago

This paper focuses on the development of an automatic system for sleep analysis. The system proposed in this paper combines two phases needed in sleep analysis. In a first step, an artefact detection system selects the polysomnographic signals (EEG, EOG, EMG) that are not corrupted by artefacts. In a second step, relevant features are extracted from the selected signals and classified using a neural network chosen among a bank of four neural networks. The four classifiers differ one from the others by the signals used for the classification. They were learnt using information provided by different combination of signals (EEG, EEG+EOG, EEG+EMG, EEG+EOG+EMG). Thus, the complete system enables the classification to be performed using relevant features computed from artefact-free signals, without losing too many data. The performance reached by the two-steps system is 85% of accuracy, calculated on 47 night sleep recordings.

15:40-16:00 TuB15.6

Chemotherapy Using Linear Analysis and Swarm Intelligence, pp. 5233-5238

Bavafa, Elham — Univ. of Tehran
Yazdanpanah, M. J. — Univ. of Tehran
Kalaghchi, Bita — Univ. of tehran

In this paper, a linear analysis of Gompertz equation will be introduced. By applying the analysis and the _;Least Square Error (LSE) method, the estimation of nonlinear relation between the drug dosage and the _;initial and final number of cancer cells, after a specified treatment gap, is possible. The new method is _;applied in combination with swarm intelligence, to find an estimation of optimal treatment program for _;chemotherapy with various cost functions. The main advantage of the analysis is that it reduces the _;corresponding search space of the swarm._;

TuB16 316

Systems and Control Sciences in Social Systems Applications (Invited Session)

Chair: Andreeski, Cvetko — Faculty of Tourism and Hospitality

Co-Chair: Mayer, Frédérique — Nancy Univ. - INPL

Organizer: Dimirovski, Georgi Marko — Dogus Univ. of Istanbul

14:00-14:40 TuB16.1

Applied System and Control Sciences to Social Systems: Globalization Age Paradigms (I), pp. 5239-5250

Dimirovski, Georgi Marko — Dogus Univ. of Istanbul

Modern advanced information technologies resulting from automation of control and decision processes along with ubiquitous communications have a multitude of impacts on development of national economies within the global economy. Thus all kinds of social systems, being essentially human centred systems, is a cross-, inter- and multi-disciplinary challenge to systems and control researchers. Social systems in modern civilization are reviewed from the systems science viewpoint and on the grounds of recent developments in control science and technology and with regard to globalization paradigm. The innovative systems approaches employing results from hybrid systems theory and dynamical networks are needed to address the now-old challenges of combined knowledge and technology transfer world-wide for sustainable development that may remedy climate change and some of the negative socio-economic aspects of globalization.

14:40-15:00 TuB16.2

Social Impact of Automation Trends and Issues: An Human Centred Systems Engineering Perspective (I), pp. 5251-5256

Mayer, Frédérique — Nancy Univ. - INPL

During the last decades, advanced information technologies have became more and more omnipresent to address new requirements and new needs of our e society. As a consequence of their increasing development, the social impact of information technologies, in general, and automation and control technologies, in particular, become so strong that it infers new behaviours of both humans and machines and modifies the traditional balance between technologies and society. In this perspective, systems thinking paradigm is challenging both academic and industrial communities for a better efficiency of information technologies in the human interaction loop and for a better characterisation of how both human and technologies interact with each other's. This paper addresses some systems thinking issues for an human centred systems engineering as an approach to design an automation technology as a complex "human-machine" whole in order to restore socio-technique equilibrium.

15:00-15:20 TuB16.3

Supplemental Ways for Improving International Stability Swiis (I), pp. 5257-5261

Kopacek, Peter — Vienna Univ. of Tech.

The IFAC TC on “Supplemental Ways for Improving International Stability – SWIIS” is one of the longest situated in IFAC. According to first ideas during the IFAC World Congress in Kyoto 1981 this IFAC – at that time - Working Group organised in 1983 the first Workshop in this highly interdisziplinary field in Austria. Meanwhile a Technical Committee in IFAC, SWIIS was always a bridge between (control) engineers and various other disziplines to open IFAC to other related fields. Because of the 25th anniversary a short history of SWIIS as well as a outlook in the future, emphasising new topics, will be given in this paper.

15:20-15:40 TuB16.4

Fuzzy Optimization with Robust Logistic Membership Function: A Case Study in for Home Textile Industry (I), pp. 5262-5266

Vasant, Pandian — Univ. Tech. Petronas
Andreeski, Cvetko — Faculty of Tourism and Hospitality

Many engineering optimization problems can be considered as linear programming problems where the all or sum of the parameters involved are linguistic in nature. These can only be quantified using fuzzy sets. The aim of this paper is to solve fuzzy linear programming problem where the parameters involved are fuzzy numbers with logistic membership functions. To explore the applicability of the present study a numerical example is considered determine monthly production planning and profit of home-textile group. To solve this problem LINGO Software is used.

15:40-16:00 TuB16.5

Systems Approaches to Sustainable Advancement of Developing Countries: Recent Contributions (I), pp. 5267-5272

Stankovski, Mile — SS Cyril and Methodius Univ.
Kolemisevska-Gugulovska, Tatjana — SS Cyril and Methodius Univ.
Dimirovski, Georgi Marko — Dogus Univ. of Istanbul

Advanced information technologies resulting from automation of control and decision expertise and their respective scientific disciplines have essential impacts on the development of national economies within the more and more globalized economy hence a decisive role in ameliorating current socio-economic problems in developing countries. Recent developments have put new emphasis on the IFAC activities dedicated to help improving the technological background of developing countries so as to assists their sustainable but accelerated developments. It is important to keep the focus should be on innovative systems approaches to combined knowledge and technology transfer to developing countries that may remedy their current state of the matters.

TuB17 **320A**

Recent Automation Technologies in Shipbuilding Industry III

(Highlight Session)

Chair: Hur, Jong Sung — Hyundai Heavy Industries Co., Ltd.
Co-Chair: Choi, Ho-Woong — Hyundai Heavy Industries Co., Ltd.
Organizer: Lee, Choong Dong — Hyundai Heavy Industries Co., Ltd.
Organizer: Hur, Jong Sung — Hyundai Heavy Industries Co., Ltd.

14:00-14:20 TuB17.1

Development of Multi Welding Robot System for Sub Assembly in Shipbuilding (I), pp. 5273-5278

Kang, Sung-Won — Daewoo Shipbuilding & Marine Engineering co.
Youn, Ho-Joong — Daewoo Shipbuilding & Marine Engineering Co.,Ltd.
Kim, Dong-Ho — Daewoo Shipbuilding & Marine Engineering Co., Ltd
Kim, Kang uk — Daewoo Shipbuilding & Marine Enineering Co. Ltd.,
Lee, Sang-Bum — Daewoo Shipbuilding & Marine Engineering Co.,Ltd.
Kim, Seong-Yeop — Daewoo Shipbuilding & Marine Engineering Co.,Ltd.
Kim, Soo Ho — Daewoo Shipbuilding & Marine Engineering co., KPU

In an effort to increase a productivity of welding process and to reduce the impact to workers from industrial disaster, the research in the field of welding automation is sharply increasing in shipbuilding industry. DSME had developed and successfully applied a welding robot system for grand assembly line in OKPO shipyard in 1997 and has recently developed multi welding robot system for the sub assembly line. This study describes the essential parts of welding automation for the sub assembly process of a hull when using industrial robots. Study includes description of auto detection process of work-pieces, off line program (OLP), host control program and high speed welding method.

14:20-14:40 TuB17.2

Development of Embedded Robot Controller for Shipbuilding (I), pp. 5279-5284

Kim, Won-Bae — Inst. for Advanced Engineering
Lee, Young Seok — Inst. for Advanced Engineering
Lee, Kyoung Don — Inst. for Advanced Engineering
Lee, Seung Ho — DAEWOO Shipbuilding & Marine Engineering
Kim, Soo Ho — Daewoo Shipbuilding & Marine Engineering co., KPU

This paper describes a development of a small and high-performance embedded controller system in order to apply it to a robot system for improving productivity in shipbuilding. The development of such an embedded controller was performed as a coherent design and development through applying a digital signal processor. The product developed in this study consists of a CPU board including vision functions, motion and driver boards for servo motor controls, and input/out and power board. Also, various communication protocols were implemented in the development process by considering their expansibility and flexibility. In addition, a robot controller system was developed to communicate external robot operation systems as a manner of wired and wireless communication. Furthermore, this study performed functional and environmental tests to verify the stable operation of such a robot controller under internal or external poor working conditions.

14:40-15:00 TuB17.3

A Dynamic Connection Scheme for User Interface of Process Control System in Offshore Plant (I), pp. 5285-5290

Moon, Daekeun — Hyundai Heavy Industries Co., Ltd.
Kim, Hagbae — Yonsei Univ.
Park, Jinho — Hyundai Heavy Industries Co., Ltd.
Park, Dongho — Hyundai Heavy Industries Co., Ltd.

In offshore plant, the process control system manages process variables and interfaces with all plant utilities. It consists of workstations, controllers and various field interface devices. Plant operators deal with a large variety of process variables using the Human-Machine Interface application (HMI) in operator stations, which is a software program to interact with plant operators and to communicate with the system server. In large-scale processes, the process control system has not only multiple system servers for system availability but also many operator stations for plant operators to manage easily the process. The main focus of our work is in a connection scheme of the HMI for linking to one of system servers without additional configuration works. The proposed scheme is adopted the fundamental concepts of autonomic computing and supports fault-tolerant and load-balanced features because it provides a dynamic connection according to the status of system servers. We implement the module for the proposed scheme as agent between the system server and the HMI, and then incorporate it into the process control system. Finally, the case study shows that the proposed scheme can provide reliable connection with system servers and efficient load status of system servers.

15:00-15:20 TuB17.4

Integrated Extension Alarm System for Machinery and Cargo Monitoring (I), pp. 5291-5292

Moon, Daekeun	Hyundai Heavy Industries Co., Ltd.
Cho, Deokhwan	Hyundai Heavy Industries Co., Ltd.
Park, Jinho	Hyundai Heavy Industries Co., Ltd.
Park, Dongho	Hyundai Heavy Industries Co., Ltd.

A marine automation system for merchant ships consists of machinery control & monitoring system and cargo control & monitoring system. Extension Alarm System (EAS) has been installed for machinery control & monitoring system to provide machinery alarms to bridge, cabins, and public areas. However, EAS of the latest marine automation systems requires the integrated functionality for both machinery and cargo monitoring. In this paper, we introduce general features of EAS and design Integrated Extension Alarm System (IEAS) for ACONIS-2000 system, which is the integrated marine automation system developed by Hyundai Heavy Industries co., ltd. Extension alarm panels of IEAS are classified by the system type and display the information received from the alarm server of ACONIS-2000. Therefore, IEAS can transfer machinery and/or cargo alarms to the on-duty engineer according to the system type of alarms. In addition, IEAS provides the flexibility of the alarm group and duty configuration.

15:20-15:40 TuB17.5

A Method of Reliability Improvement Based on IEC 61924 for the Integrated Navigation System (I), pp. 5293-5294

Choe, Hangsoeb	Hyundai Heavy Industries Co., Ltd
Kim, Kicheol	Hyundai Heavy Industries Co., Ltd
Park, Jinho	Hyundai Heavy Industries Co., Ltd.
Park, Dongho	Hyundai Heavy Industries Co., Ltd.

The purpose of an integrated navigation system (INS) is to provide a "high level safety system" for the functions and information needed by the officer in charge of the vessel. The INS supports the safety of navigation by evaluating inputs from several independent sensors, combining them to provide warnings of potential dangers and their integrity condition. This paper presents a method of reliability improvement for integrity monitoring and validity check of INS based on IEC61924.

15:40-16:00 TuB17.6

Development of a Ship Digital Relay Automated Evaluation Program (I), pp. 5295-5296

Choi, Ho-Woong	Hyundai Heavy Industries Co., Ltd.
Min, Byoung-Woon	Hyundai Heavy Industries Co., Ltd.
Lee, Byeong-Ho	Hyundai Heavy Industries Co., Ltd.
Kim, Jung-Han	Hyundai Heavy Industries Co., Ltd.

This paper presents the development of a novel ship digital relay automated evaluation program and its important aspects. The goal of relay's test automation concept is to use the relay expert's time as efficiently as possible. It shall be the tool to increase the depth of testing while decreasing the testing time, allowing the expert to use his valuable time to eliminate possible errors in the protection system. It is the ideal method to visualize, document and handle the complexity of powerful modern protection relays.

TuB18 320B

Recent Development of Intelligent Robots IV: Architecture & Applications (Highlight Session)

Chair: Park, Sooyong	Sogang Univ.
Co-Chair: Fahmy, A. A.	Cardiff Univ.

14:00-14:20 TuB18.1

Software Architecture-Based Approach to Self-Adaptive Function for Intelligent Robots (I), pp. 5297-5302

Kim, Dongsun	Sogang Univ.
Park, Sooyong	Sogang Univ.

An intelligent service robot helps human users with providing various services such as bringing a newspaper, recommending TV programs, and preparing meals. Each service can be accomplished by coordinating various motion actuations that are activated based on sensory data. Due to the limitation of robot computing-resources such as CPU time and memory, the software components that implement such motion actuations can not be loaded and executed at the same time as the complexity of the service increases. That is, those components may compete with each other for the limited computing-resources, and this may result an unexpected behavior of the robot. In this paper, we propose a software architecture-based approach for self-adaptive function that optimizes the use of computing resources by supporting dynamic re-deployment of software components. Organizations of motion actuations for providing services are modeled by software architecture that describes required components and their configurations. In our approach, when a resource problem is detected, components are re-deployed across single-board computers (SBCs) in the robot while maintaining the functional and quality requirements of the components and configuration among them represented in the software architecture. We designed the self-adaptive software framework and implemented a prototype of it. We also had an experiment of our approach on an infotainment robot, and successfully proved the effectiveness of the architecture-based self-adaptive function.

14:20-14:40 TuB18.2

A System Architecture of Wireless Communication for Fire-Fighting Robots (I), pp. 5303-5307

Park, Jung-Hyun	Advanced Inst. of Science and Tech. (KAIST)
Kim, Byung-Wook	Advanced Inst. of Science and Tech. (KAIST)
Park, Dong-Jo	Advanced Inst. of Science and Tech. (KAIST)
Kim, Moon-June	WIA Corp.

Robust communication systems between fire-fighting robots and remote operators are investigated. The communication system consists of two components; a digital packet data communication system and an analog image communication system. For a reliable data packet communication system, we adopted the commercial CDMA (Code Division Multiple Access) network architecture. Using the CDMA modules, it is possible to transfer serial data after a connecting procedure that is specified by the network service provider. Digital packet data communication systems transfer data packets back and forth in order to control fire-fighting robots and to monitor their status. Remote operators can view a video display of robot surroundings via an analog image communication system.

14:40-15:00 TuB18.3

Adaptive Fuzzy Neural Network for Inverse Modeling of Robot Manipulators, pp. 5308-5313

Pham, D T	Cardiff Univ.
Fahmy, A. A.	Cardiff Univ.
Eldukhri, E. E.	Cardiff Univ.

This paper presents a new systematic adaptive fuzzy neural network for inverse modelling of robot manipulators. An inductive learning algorithm is applied to generate the required inverse modelling rules from the robot's input/output records. A full differentiable fuzzy neural network is developed to construct the inverse models of the robot manipulator, while any adaptation technique, such as back-propagation algorithm, can be applied to tune the network parameters online.

15:00-15:20 TuB18.4

Concept and Scenarios of Intelligent Robotic Systems for Social Safety (I), pp. 5314-5315

An, MyungSeok Samsung Tech.
Cho, Hyun Woo SAMSUNG Tech.
Yoo, MyungHo Samsung Tech. Co., LTD.

In this paper, we will describe the development concept and scenarios of Intelligent Robotic System for Social Safety that includes the observation cameras, the mobile robots, and the monitoring system, etc. The system can observe specific wide areas with the concept and the scenarios that are for emergency as well as for normal situation.

15:20-15:40 TuB18.5

The Development of a Sevice Robot for Restaurant Serving and Guidance (I), pp. 5316-5317

Kang, Bokhyun YujinRobot Co., Ltd.
Stonier, Daniel YujinRobot Co., Ltd.
Shin, Kyungchul YujinRobot Co., Ltd.

A serving robot has been developed for use in a restaurant environment. Various conventional technologies were drawn from the fields of control, navigation, software interface design and artificial intelligence and adapted for commercialization in its development. This paper introduces the developmental process towards commercialization of such a product. As a result, we successfully developed various technologies for commercialization by implementing a system that abstracts the interface between the robot mainframe and the external systems.

15:40-16:00 TuB18.6

Healthcare Robot Technology Development (I), pp. 5318-5323

Yi, Sungil Korea Inst. of Industrial Tech.
Moon, Dongju Korea Inst. of Industrial Tech.
Yang, Yongjoo Korea Inst. of Industrial Tech.
Kim, Kangeun Korea Inst. of Industrial Tech.

The interest in a healthy and happy life for seniors has increased of late as the quality of life in old age has become a hot issue. Moreover, the interest in health has led industrial companies to concentrate on healthcare technology. Healthcare robot technology is one of the biggest issues in the robotics field, and many companies and institutes have sought to develop a healthcare robot technology. The healthcare robot must have certain abilities that would allow it to help a person mentally and/or physically. There is no common interface module, however, for healthcare robot platforms, and few robots that have healthcare abilities exist. Therefore, developing a common interface technology and applying the technology to robot platforms can pave the way for the development of a technology that could improve the physical and mental health of humans. This paper introduces the authors' research on a common interface module and a healthcare service robot platform. First, a common interface module is one that can be used in common in the healthcare robot area. The research on a common interface module contains the following technologies: biosignal processing modules; voice signal processing modules, which could recognize voice commands; control modules for robot actuators; and a human-friendly design for a healthcare system. Lastly, the research on a healthcare service robot platform contains three types of robot platforms: ChairBot for relaxation, RideBot for exercising, and LifecareBot for human emotions. Each robot platform has common interface modules for healthcare services and can provide specialized intelligent services based on their own objectives. In conclusion, the intellectual healthcare robot is expected to promote a new field and to pave the way for a new product.

TuB19 320C

Robot Manipulators II (Regular Session)

Chair: Song, Jae-Bok Korea Univ.
Co-Chair: Behera, Laxmidhar Indian Inst. of Tech. Kanpur

14:00-14:20 TuB19.1

Dynamic Analysis and Robust Control Design for Stewart Platform with Moving Payloads, pp. 5324-5329

Iqbal, Sohail Muhammad Ali Jinnah Univ.
Bhatti, Aamer Iqbal Muhammad Ali Jinnah Univ. Islamabad
Ahmed, Qadeer Muhammad Ali Jinnah Univ.

The novelty of the paper lies in an extended nonlinear model for the Stewart platform with moving payload. The models found in the existing literature are most of the time only valid for static loads with symmetric configurations, as reflected by the presumed assumption on Moments of Inertia (MOI) being static and symmetric. Such assumption precludes a wide range of systems having asymmetric or moving payloads e.g. stabilized platforms used to stabilize satellite antenna trackers or surgical tables etc. In this paper the actual MOI of the Stabilizing Stewart platform with moving payload are computed and used to parameterize the extended nonlinear model. This model is subsequently used for designing sliding mode controller. The control performance of the proposed algorithm is verified with computer simulations. These simulations demonstrate better stability properties and performance of the proposed dynamic model with much lower uncertainty bounds, as compared to that of the controller designed on the prevalent nonlinear model.

14:20-14:40 TuB19.2

Fault Diagnosis in Robotic Manipulators Using Joint Torque Sensing, pp. 5330-5334

Namvar, Mehrzad Sharif Univ. of Tech.
Aghili, Farhad Canadian Space Agency

Model uncertainty is an important factor hindering reliability of any model-based failure detection and identification (FDI) method. Use of joint torque sensing reduces significantly the complexity of robot modeling by excluding hardly-identifiable link dynamics from overall manipulator dynamics. Application of such model in the proposed FDI filter increases reliability of fault monitoring against modeling uncertainty. The proposed filter is based on a smooth velocity observer of degree 2n where n stands for the number of manipulator joints. No velocity measurement and assumption on smoothness of faults are used in the fault detection process.

14:40-15:00 TuB19.3

Closed-Loop Control in Image Processing for Improvement of Object Recognition, pp. 5335-5340

Grigorescu, Sorin Mihai Univ. Bremen
Ristic-Durrant, Danijela Univ. Bremen
Vuppala, Sai Krishna Univ. of Bremen
Graeser, Axel Univ. of Bremen

This paper presents the employment of a novel idea of inclusion of feedback control at different image processing levels to improve the robustness of object recognition. The proposed approach is intended to cope with object image color uncertainty that arises from changes in the illumination conditions during image acquisition. The focus is on the control of quality of binary segmented image, which represents the input to higher processing levels, feature extraction and recognition, of the image processing chain. The main idea behind this is that introduced closed-loops drive the current segmented image to the image of the desired, reference, quality so that higher processing levels are provided with reliable input image data. In this way, the reliability and robustness against external influences of the overall object recognition system is improved. The specifics and benefit of closed-loop control in image processing are considered throughout the presentation of the closed-loop object recognition in the robotic system FRIEND II. The benefit of the closed-loop image segmentation in service robotics is considered through the demonstration of results achieved for recognition of the object of interest from a working scenario of the system FRIEND II.

15:00-15:20 TuB19.4

Predictive Visual Feedback Control with Eye-In/to-Hand Configuration Via Stabilizing Receding Horizon Approach, pp. 5341-5346

Murao, Toshiyuki Advanced Inst. of Industrial Tech.
Kawai, Hiroyuki Kanazawa Inst. of Tech.
Fujita, Masayuki Tokyo Inst. of Tech.

This paper investigates vision based robot control via a receding horizon control strategy for an eye-in/to-hand system, as a predictive visual feedback control. Firstly, the dynamic visual feedback system with the eye-in/to-hand configuration is reconstructed in order to improve the performance of the estimation. Next, a stabilizing receding horizon control for the 3D dynamic visual feedback system, a highly nonlinear and relatively fast system, is proposed. The stability of the receding horizon control scheme is guaranteed by using the terminal cost derived from an energy function of the visual feedback system. Furthermore, simulation results are assessed with respect to the stability and the performance.

15:20-15:40 TuB19.5

Wall Juggling of One Ball by Robot Manipulator with Visual Servo, pp. 5347-5352

Nakashima, Akira	Nagoya Univ.
Kobayashi, Yosuke	Nagoya Univ.
Hayakawa, Yoshikazu	Nagoya Univ.

This paper propose a method to achieve wall juggling of a ball without rebound from a table by a racket attached to a robot manipulator with two visual camera sensors. The proposed method is composed of juggling preservation problem and ball regulation problem. The juggling preservation problem means going on hitting the ball iteratively. The ball regulation problem means regulating the hitting position of the ball. The juggling preservation problem is achieved by the tracking control of the racket position for a symmetry trajectory of the ball with respect to a horizontal plane. The ball regulation problem is achieved by controlling the racket orientation, which is determined based on a discrete transition equation of the hitting position of the ball. The effectiveness of the proposed method is shown by an experimental result.

15:40-16:00 TuB19.6

Inverse Kinematic Control Using Rotational and Joint Space Clustering with Visual Motor Coordination, pp. 5353-5358

Ray, Anjan Kumar	Indian Inst. of Tech. Kanpur
Behera, Laxmidhar	Indian Inst. of Tech. Kanpur

In this paper, the inverse kinematic control of a 6-DOF robot manipulator is achieved using visual motor coordination (VMC). Here the positional data is converted into image plane data of a pair of cameras. The Redundancy resolution is a prime goal for the robot manipulator with higher dimensional joint space than the task-space. In this work, we present five schemes for this redundancy resolution based on hybrid visual motor co-ordination (VMC) for a 6-dof robot manipulator by clustering the rotational space and joint space information with visual feedback from a pair of cameras. The proposed schemes are used with the extended Kohonen's Self Organizing Map (EKSOM) to find out the mapping from 3-dimensional positional task space to the 6-dimensional joint space of the manipulator. The neural network with EKSOM is modified to use the cyclic nature of angular displacement of joints. The visual feedback is obtained through a pair of calibrated cameras. So, each positional data is converted to corresponding camera coordinates and then the modified EKSOM has been trained to obtain the input-output mapping by combining the visual feedback and hybrid system model consisting of forward kinematics of the manipulator. These methods produce smooth joint movements for positional tracking. These schemes are successfully implemented on a model of 6-DOF PowerCube^{TM} robot manipulator from Amtec Robotics.

TuB20 321C

Mobile Robot Control II (Regular Session)

Chair: Marchand, Nicolas	GIPSA-Lab. CNRS
Co-Chair: Pieri, Edson Roberto De	Federal Univ. of Santa Catarina

14:00-14:20 TuB20.1

Path Tracking Control of a Flapping Micro Aerial Vehicle (MAV), pp. 5359-5364

Rifai, Hala	GIPSA-Lab.
Marchand, Nicolas	GIPSA-Lab. CNRS
Poulin, Guylaine	ENSIEG

This paper deals with the path tracking control for a flapping wing Micro Aerial Vehicle (MAV) taking into consideration the input saturations. Based on the aerodynamic theory, a simplified model of a high frequency flapping MAV is presented and its average is calculated. Equivalence between the time varying and mean models is shown through averaging theory. Hence, a bounded non linear control, designed using the average model, is applied to the time varying system to drive the position and orientation to desired values. Finally, the robustness with respect to external disturbances is tested.

14:20-14:40 TuB20.2

Path-Tracking Dynamic Model Based Control of an Omnidirectional Mobile Robot, pp. 5365-5370

Vázquez, Alejandro	Centro de Investigación y de Estudios Avanzados del IPN
Velasco-Villa, Martin	CINVESTAV-IPN
Del-Muro-Cuellar, Basilio	ESIME-Culhuacán IPN

Considering the dynamic model of an omnidirectional mobile robot (also known of a type (3,0)), in this work is addressed the Path-tracking control problem of this class of systems. The solution of the problem is obtained by considering some suitable modifications of the well known computed-torque control strategy usually used on the field of robot manipulators. The modifications considered in this work are due to the structural differences between a mobile robot and a classical rigid robot manipulator. It is formally proved that the proposed control strategy allows the convergence of the tracking errors and assures the closed loop stability of the system. The tracking strategy is evaluated by simulation, showing an acceptable performance.

14:40-15:00 TuB20.3

Neurocontrollers for Trajectory Tracking Problem of a Nonholonomic Mobile Robot, pp. 5371-5376

Martins, Nardęnio Almeida	UFSC - Univ. Federal de Santa Catarina
Bertol, Douglas Wildgrube	Federal Univ. of Santa Catarina
Lombardi, Warody C.	Federal Univ. of Santa Catarina
Pieri, Edson Roberto De	Federal Univ. of Santa Catarina
Castelan, Eugenio B.	Univ. Federal de Santa Catarina

In this paper, a trajectory tracking control for a nonholonomic mobile robot by the integration of a kinematic controller and a torque controller is investigated. The proposed torque controllers (PTCs) are based on a Gaussian radial basis function neural network (RBFNN) modeling technique, which are used to compensate the mobile robot dynamics, significant uncertainties and disturbances. Also, the PTCs are not dependent of the robot dynamics neither requires the off-line training process. The stability analysis and the convergence of tracking errors to zero, as well as the learning algorithms (for weights, centers, and widths) are guaranteed with basis on Lyapunov’s theory. In addition, the simulation results shows the efficiency of the PTCs.

15:00-15:20 TuB20.4

Trajectory Tracking Control of Skid-Steering Robot - Experimental Validation, pp. 5377-5382

Pazderski, Dariusz	Poznan Univ. of Tech.
Kozlowski, Krzysztof R.	Poznan Univ. of Tech.

In this paper authors consider the problem of practical stabilization of wheeled mobile robot equipped with skid-steering drive (also know as SSMR). The kinematic model of SSMR is approximated by kinematics of unicycle including small perturbation term which describes limited skidding effect. It is justified that SSMR can be regarded as a system with non-stationary first order nonholonomic constraint. Based on this result smooth control scheme robust to limited skidding is developed. The control law ensures practical stabilization in regulation and trajectory tracking case, i.e. position and orientation errors are bounded to the assumed but nonzero values. The effectiveness of control solution is justified and illustrated by experimental results.

15:20-15:40 TuB20.5

Adaptive Trajectory Tracking and Stabilization for Omnidirectional Mobile Robot with Dynamic Effect and Uncertainties, pp. 5383-5388

Huang, Hsu-Chih	National Chung-Hsing Univ.
Tsai, Ching-Chih	National Chung-Hsing Univ.

This paper presents an adaptive backstepping control method for trajectory tracking and stabilization of an omnidirectional wheeled mobile robot with parameter variations and uncertainties caused by friction and slip. The dynamic model of the robot with three independent driving omnidirectional wheels equally spaced at 120 degrees from one another is briefly introduced. With the dynamic model, the adaptive controller to achieve both trajectory tracking and stabilization is synthesized via adaptive backstepping approach. Experimental results are conducted to show the merit of the proposed control method.

15:40-16:00 TuB20.6

A Mobile Robot Path-Planning Approach under Unknown Environments, pp. 5389-5392

Cai, Zixing	Central South Univ.

Wen, Zhiqiang — Central South Univ.
Zou, Xiao-bing — Central South Univ.
Chen, Bai-fan — Central South Univ.

An inverse D* algorithm is presented in this paper for path-planning under unknown environments. In this inverse D* algorithm, the local potential energy around the current position is created firstly by defining the robot distance, then the leave point is searched to be regarded as the local goal position satisfying requirement of the rolling optimization. The leave point is searched locally and iteratively until the robot reaches the goal finally. The experimental results show the validity of our algorithm.

TuB21 321B
Measurement & Actuation (Regular Session)
Chair: Chase, J. Geoffrey — Univ. of Canterbury
Co-Chair: Tarn, Tzyh-Jong — Washington Univ.

14:00-14:20 TuB21.1
Event-Based Feedforward Control of a Drug Delivery System for Diabetes Care, pp. 5393-5398
Yang, Ruoting — Washington Univ.
Tarn, Tzyh-Jong — Washington Univ.
Zhang, Mingjun — Agilent Tech.

A new event-based feedforward control method for drug delivery system is presented. Compared with the traditional time-based feedback control, the proposed method shows great potential in dealing with measurement noise and unexpected disturbances. Instead of using time to drive the planner, we determine the reference trajectory with an intelligent event, which is directly derived from measurement. Therefore the proposed method inherits the advantages of both feedback and feedforward. Applications in drug delivery demonstrate promising robustness of this approach.

14:20-14:40 TuB21.2
Mass Measurement under Weightless Conditions by Relay Feedback Systems, pp. 5399-5404
Mizuno, Takeshi — Saitama Univ.
Takasaki, Masaya — Saitama Univ.
Ishino, Yuji — Saitama Univ.

The applicability of relay feedback to mass measurement was investigated. Two mass measurement systems were studied both theoretically and experimentally. One of them uses an on-off relay with hysteresis and switches force acting on the object in relation to the velocity of the object. The other contains an on-off relay with dead zone and switches force acting on the object in relation to the displacement. The principle of measurement, a fabricated apparatuse and measurement results were presented for each measurement system.

14:40-15:00 TuB21.3
An Adaptive Depth of Field Imaging System for Visual Servoing, pp. 5405-5410
Hong, Deokhwa — Korea Advanced Inst. of Science and Tech.
Janabi-Sharifi, Farrokh — Ryerson Univ.
Cho, Hyung Suck — KAIST

Limitations related to depth of field (DOF) is one of the most challenging issue for visuallyservoed micro-operations. Research on extending DOF had limited success for direct application to visual servoing. Recently, an all-optical system has also been proposed to extend DOF in imaging systems by spatial multiplexing of several Fresnel lenses. Before its application to visual servoing, high resolution of visual feedback must be warranted. This is particularly necessary for fine vision-based positioning tasks. Thus, providing an adaptive scheme for DOF according to objects' distribution will enable the system to obtain the best resolved image for a given distribution. The main contribution of this paper is a proposal for an adaptive DOF-extension scheme in micro-visual servoing while maintaining good resolution and SNR of the images related to target objects. Simulation results are provided to support the proposed method.

15:00-15:20 TuB21.4
Surface Reconstruction for a DIET Breast Cancer Screening System, pp. 5411-5416
Brown, Richard G — Univ. of Canterbury
Hann, Christopher E — Univ. of Canterbury
Chase, J. Geoffrey — Univ. of Canterbury
Ray, Lawrence E — Carestream Health

This paper outlines a method for accurately tracking surface motion on an actuated breast as part of a Digital Image-based Elasto-Tomography (DIET) breast cancer screening project. The tracking method is validated in both simulation and experiment on a silicon breast phantom which has similar elasticity characteristics to human breast tissue. Given mean reprojection error ranges between 0.3 and 0.5 pixels for 2M pixel cameras the end result is sub-millimetre surface tracking of a silicon phantom actuated at 100 Hz. This highly accurate, fast and low cost method of tracking is thus well suited to a DIET system.

15:20-15:40 TuB21.5
Combining PMD and Stereo Camera for Motion Estimation of a Mobile Robot, pp. 5417-5422
Joochim, Chanin — Univ. of Siegen
Roth, Hubert — Univ. Siegen
Netramai, Chayakorn — Univ. Siegen
Melnychuk, Oleksandr — Univ. Siegen

This paper introduces an improvement to the 6D motion estimation solution by combining the Photonic Mixer Device (PMD) and Stereo Camera. The main feature of the stereo camera is the higher resolution of the 2D image compared to the one from the PMD camera. Whereas the depth information derived from a PMD is usually far superior to the result from a stereo camera. This work hence proposes a combination scheme for the PMD and stereo camera in order to improve the results of the motion estimation. The combined setup was placed on a mobile robot and carried on the 6D motion estimation task using a provided artificial landmark. The robot was moved around while the combined setup simultaneously captures 3D images of the landmark from each new position. The motion was estimated based on the matching of the captured 3D images between two successive positions. The classical singular value decomposition (SVD) algorithm was used to solve the matching problem. The referent points for the SVD algorithm were extracted from the landmark using a robust corner detection algorithm. The experiments were fulfilled using 1) stereo 2) PMD and 3) combination of stereo and PMD camera. The results of these three arrangements are compared and the outcome of the comparing are presented.

15:40-16:00 TuB21.6
Robust PID Controller Design for a Micro-Actuator with Squeezed Gas Film Damping Effects, pp. 5423-5428
Vagia, Marialena — Univ. of Patras
Tzes, Anthony — Univ. of Patras

In this article the modeling aspects of an electrostatic microactuator with squeezed thin film damping effects are presented. The mu-Actuator is composed of a microcapacitor whose one plate is clamped on the ground while the other plate is floating on the air. Its highly nonlinear dynamic model is linearized at various operating points. A robust PID-controller is designed with its parameters-tuning relying on LMIs. This control effort of the PID-controller in collaboration with a feedforward term and a notch filter is applied to the system. Simulation results are used to investigate the efficacy of the suggested control architecture.

TuB22 321A
Neural Network Based Control (Regular Session)
Chair: Jung, Seul — Chungnam National Univ.
Co-Chair: Han, Min — Dalian Univ. of Tech.

14:00-14:20 TuB22.1
Novel Delay-Dependent Stability Criterion for Delayed Neural Networks, pp. 5429-5432
Yang, Bin — Dalian Univ. of Tech.
Wang, Hong — Dalian Univ. of Tech.
Jiang, Yanhong — Dalian Univ. of Tech.
Han, Min — Dalian Univ. of Tech.

A new augmented Lyapunov functional is constructed for delayed neural networks, free-weighting matrices technique is employed to derive the delay- dependent stability criterion. The derived criterion is formulated in terms of linear matrix inequality (LMI). A numerical example is given to demonstrate the effectiveness and applicability of the criterion.

14:20-14:40 TuB22.2
CPG Based Motion Control for an Underwater Thruster with

Undulating Long-Fin, pp. 5433-5438

Dong, Xiang	Inst. of Automation, Chinese Acad. of Sciences
Wang, Shuo	Chinese Acad. of Sciences
Cao, Zhiqiang	Inst. of Automation,Chinese Acad. of Sciences
Tan, Min	Inst. of Automation, Chinese Acad. of Sciences

A CPG based motion control approach is proposed for a biologically inspired underwater thruster with undulating long-fin. The characteristic of rhythmic motion patterns generated by CPG suits well to control the thruster, which has multiple fin rays coupled by membrane. Based on modified Matsuoka model, an artificial CPG controller consisting of ten neural oscillators with sensory information feedback is build. A novel method for phase control of the output signals is brought forward to makes it possible to control and regulate the output of the coupled oscillators on-line. And the experiment shows the CPG controller is valid to generate thrust by controlling the long fin.

14:40-15:00 TuB22.3

Implementation of a Neural Network Controller on a DSP for Controlling an Inverted Pendulum System on an X-Y Plane, pp. 5439-5443

Kim, Sung-Su	Chungnam National Univ.
Jung, Seul	Chungnam National Univ.
Lee, Geunhyeong	Chungnam national Univ.

This paper presents the hardware implementation of a neural network controller for controlling an inverted pendulum system on an x-y plane robot. The inverted pendulum system can move on an x-y plane while balancing the angle of the pendulum. Neural network algorithm is implemented on a cost effective DSP board in association with an FPGA chip. The reference compensation technique of neural network control scheme is used for on-line learning and control of the inverted pendulum system. Experimental results of tracking the circular trajectory while balancing the pendulum demonstrate to confirm the successful performance of the neural network hardware.

15:00-15:20 TuB22.4

Stability Criteria for Three-Layer Locally Recurrent Networks, pp. 5444-5449

Patan, Krzysztof	Univ. of Zielona Gora

The paper deals with a discrete-time recurrent neural network designed with dynamic neuron models. Dynamics are reproduced within each single neuron, hence the considered network is a locally recurrent globally feedforward. In the paper, conditions for global stability of the neural network considered are derived using the Lyapunov's second method.

15:20-15:40 TuB22.5

Redundant Robot Kinematics Control with HCMAC Neural Network Manipulability Enhancement, pp. 5450-5455

Rikovsky, Vladislav	Slovak Univ. of Tech.
Kozak, Stefan	Slovak Univ. of Tech. Faculty of Informatics and Info

The kinematics problems of redundant robots have been investigated for many years. A plenty of different robot redundancy usages were successfully implemented. In practice, e.g. redundant robot manipulability improvement, and robot obstacle avoidance are commonly used. Conventional methods use the manipulability gradient computation to improve the end-effector manipulability. However, the computational effort of this approach brings about many difficulties in real-time control when used with plenty of constraints. Recently, neural networks have found wide application in robotics, because of their feature to learn any complicated system model. This paper deals with new numerically efficient procedures and an application of HCMAC (Hierarchical Cerebellar Model Arithmetic Controller) neural network for manipulability gradient computation and consecutive robot control improvement. The conventional CMAC can be viewed as a basis function network (BFN) with supervised learning well-performing in the terms of its fast learning speed and local generalization capability for approximating nonlinear functions. Nevertheless, due to the redundant robot high-dimensional function approximation the conventional CMAC is enormously memory-demanding. HCMAC indeed has low memory requirements and very good learning ability. Furthermore, it shows a better performance compared with the conventional approach and conventional CMAC.

15:40-16:00 TuB22.6

Linear Induction Motor Sensorless Speed Control Based on T-S Fuzzy Design, pp. 5456-5461

Lian, Kuang-Yow	National Taipei Univ. of Tech.
Hung, Cheng-Yao	Chung-Yuan Christian Univ.
Chiu, Chian-Song	Chung-Yuan Christian Univ.

In this paper, a sensorless speed control for linear induction motors (LIMs) is developed based on fuzzy observer design. First, the LIMs is represented by a Takagi-Sugeno (T-S) fuzzy model. Next, the fuzzy observer is constructed to estimate the immeasurable states of mover speed and secondary flux, where the observer gains are obtained by solving a set of linear matrix inequalities (LMIs). To overcome the high nonlinearity, a two stage approach is applied to design the control law. Then, exponential convergence for both estimation error and tracking error is concluded. This indicates that the proposed sensorless controller possesses the feature of fast transient response and high robustness. Finally, simulations and experiments are carried out to verify the theoretical results and show satisfactory performance.

TuB23 323

Radio Frequency Identification (RFID) Technology in Supply Chain Management II (Regular Session)

Chair: Montreuil, Benoit	Faculté des sciences de l'administration, Univ. Laval
Co-Chair: Tsang, Albert H.C.	The Hong Kong Pol. Univ.
Organizer: Dolgui, Alexandre	Ec. des Mines de Saint Etienne
Organizer: Monostori, Laszlo	Budapest Univ. of Tech. and

14:00-14:20 TuB23.1

Optimized Sensor Network Design for Process Monitoring Based on Independent Component Analysis, pp. 5462-5469

Salahshoor, Karim	petroleum Univ. of Tech.
Kiasi, Fariborz	petroleum Univ. of Tech.

In this paper, a new sensor network design methodology has been proposed to improve the performance of ICA-based process monitoring approaches. Design procedure incorporates sensor cost, fault detectability and fault detection rate in the design formulation. The design problem has been transformed into an optimization problem. A genetic algorithm (GA) solver has been employed to yield optimal sensor locations for improved process monitoring. The proposed design methodology is evaluated on the Tennessee Eastman (TE) challenge benchmark problem. The simulation results demonstrate the effectiveness of the design procedure to enhance the process monitoring tasks with the less number of sensors for ICA approach.

14:20-14:40 TuB23.2

Contribution of Simulation in the Product Driven Systems Production Activity Control (I), pp. 5470-5475

Cardin, Olivier	IRCCyN
Castagna, Pierre	Univ. of Nantes
Chove, Etienne	IRCCyN

While promoting the emergence of product driven production activity control concept, the development of RFID technologies had many benefits on numerous elements of the Supply Chain. Indeed, product driven systems enable a great flexibility by decentralizing the decision centres. However, this decentralization does not allow any more to have a global vision, generally necessary for the system's production activity control. We suggest in this article to use simulation to obtain this global vision, in preparation for providing behaviour prevision functions.

14:40-15:00 TuB23.3

Impacts of RFID Deployment on Real Time Management of Retail Stores (I), pp. 5476-5481

Hakimi, Driss	Faculté des sciences de l'administration, Univ. Laval
Montreuil, Benoit	Faculté des sciences de l'administration, Univ. Laval
Ruiz, Angel	Faculté des sciences de l'Administration, Univ. Laval

The fast development of RFID and connective technologies is progressively changing the management of business units by introducing new challenges and appealing opportunities. In particular, promoters of connective technologies underline the abilities of these technologies to support decision making and, specifically, to increase supply chain performance. However, despite its huge potential, technology deployment does not ensure success unless it comes along with a reengineering process and appropriate integration efforts and tools. Keeping this in mind, this paper evaluates how different degrees of technology deployment impact the performance of retail stores and their relations with the rest of the supply chain.

15:00-15:20 TuB23.4

An Intelligent RFID-Based Electronic Anti-Counterfeit System (InRECS) for the Manufacturing Industry (I), pp. 5482-5487

Kwok, S. K. — The Hong Kong Pol. Univ.
Tsang, Albert H.C. — The Hong Kong Pol. Univ.
Ting, Siu Lun — The Hong Kong Pol. Univ.
Lee, W.B. — The Hong Kong Pol. Univ.
Cheung, Benny C.F. — The Hong Kong Pol. Univ.

Radio Frequency Identification (RFID) is a potent technology that manufacturing enterprises can deploy to enhance supply chain management, inventory control and asset management effectiveness. However, counterfeit prevention is seldom addressed in these RFID applications. The quality image of reputable manufacturers is vulnerable to the damage caused by the expanding flow of counterfeit products in today's global market. To combat the counterfeit problem, this paper proposes an Intelligent RFID-based Electronic Anti-Counterfeit System (InRECS) that will deliver accurate and global supply chain visibility with intelligent feedback into inventory and materials transfer processes. A case study will also be presented to highlight the benefits the proposed system can bring to the supply chain participants.

15:20-15:40 TuB23.5

Implementing the Concept of Product-Driven Control Using Wireless Sensor Networks: Some Experiments and Issues, pp. 5488-5493

Gouyon, David — Nancy Univ.
David, Michael — Nancy Univ.

In the dynamically moving context of mass-customization of products, new manufacturing control architectures, based on the consideration of highly distributed, autonomous, adaptable and efficiently cooperating units integrated by a plug-and-operate approach, seem to be efficient alternatives. Amongst them, the concept of a product-driven distributed control promotes an active role of the product in its own manufacturing. This paper focuses on the possibilities to implement this concept on a case study using wireless sensor networks.

15:40-16:00 TuB23.6

Structural Approach for Sensor Placement with Diagnosability Purpose, pp. 5494-5499

Yassine, Abed Alrahim — Inst. National Pol. de Grenoble
Ploix, Stephane — Inst. National Pol. de Grenoble
Flaus, Jean-Marie — E.N.S.I.E.G.

Maintenance and diagnosis of complex systems are common activities in the industrial world. Technological advances have led to a continuously increasing complexity of industrial systems. This complexity, which is due to an increasing number of components reduces in turn the reliability of plants. Therefore, fault diagnosis is becoming a growing field of interest. But fault diagnosis relies on sensors: efficient fault diagnosis procedures require a relevant sensor placement. This paper presents fundamental results for sensor placement based on diagnosability criteria. These results contribute to the design of sensor placement algorithms, which satisfies diagnosability specifications.

TuB24 324

Applications of Process Supervision and Fault Tolerant Control (Regular Session)

Chair: Ding, Steven X. — Univ. of Duisburg-Essen
Co-Chair: Gentil, Sylviane — INPG

14:00-14:20 TuB24.1

Detection of Oscillatory Control Loops in Irrigation Channels, pp. 5500-5505

Ooi, Su Ki — The Univ. of Melbourne
Weyer, Erik — Univ. of Melbourne

In this paper the algorithm for detection of oscillatory control loops developed in H&aumlgglund(1995) is applied to irrigation channels. The water levels in irrigation channels are controlled using mechanical gates. The controller configuration is a decentralized distant downstream scheme where a gate controls the water level upstream of the next downstream gate. The controller is a PI controller augmented with a low pass filter together with a feedforward term from the downstream gate. The algorithm is applied to real data from six consecutive reaches of an irrigation channel, and it detected the control loops that gave oscillatory response. Furthermore, due to the decentralized configuration, one is also able to localize the cause of the oscillation. Given that there can be many control loops in a channel network, the ability to localize the cause of an oscillation speeds up the trouble shooting process. However, care must be taken in choosing the thresholds in the algorithm in order to avoid frequent false alarm.

14:20-14:40 TuB24.2

Co-Design of a Safe Network Control Quadrotor, pp. 5506-5511

Berbra, Cedric — CNRS-INPG-UJF
Lesecq, Suzanne — INPG/UJF/CNRS
Gentil, Sylviane — INPG
Thiriet, Jean-Marc — CNRS-INPG-UJF

This paper deals with the co-design of a Network Control System (NCS) and its diagnosis. Residuals are shown to be affected by network packet losses. A new indicator, sensitive to packet losses is proposed and thus changes in the residuals due to faults or to packet losses can be differentiated. Results are exemplified through the simulation of a 4-rotor helicopter using the Matlab/Simulink standard. The network is simulated thanks to the TrueTime toolbox.

14:40-15:00 TuB24.3

Robust Fault Detection Using Consistency Techniques with Application to an Automotive Engine, pp. 5512-5517

Gelso, Esteban R. — Univ. of Girona
Frisk, Erik — Linkoping Univ.
Armengol Llobet, Joaquim — Univ. de Girona

Monitoring of the air intake system of an automotive engine is important to meet emission related legislative diagnosis requirements. In this paper, the problem of fault detection in the air intake system is stated as a constraint satisfaction problem over continuous domains with a big number of variables and constraints. This problem can be solved using Consistency Techniques. Consistency techniques are shown to be particularly efficient for checking the consistency of the Analytical Redundancy Relations (ARRs), dealing with uncertain measurements and parameters, and using experimental data.

15:00-15:20 TuB24.4

Optimal Guidance of Unmanned Aerial Vehicles for Emitter Location, pp. 5518-5522

Huang, Kun — Binghamton Univ.
Wu, Neng Eva — Binghamton Univ.
Fowler, Mark L. — Binghamton Univ.

This paper provides a solution to guidance of multiple unmanned aerial vehicles that carry sensors for locating a detected emitter of radio frequency signals. Guidance in this paper refers to updating the state of each vehicle to the most desirable position and velocity, reachable within a given time for the location purpose. The vehicles can then be guided to the updated sensor states for further target data acquisition and processing. This process continues until the target is located within a specified accuracy. Both the guidance criterion and the vehicle state update procedure take the probability of vehicle loss into consideration. Vehicle state update is formulated and solved as an optimization problem. The enhanced location performance under the optimized guidance, and the sensor system tolerance to vehicle loss are shown for a four-sensor system through simulations.

15:20-15:40 TuB24.5

A Note on Unknown Input Fault Detetection Filter Design, pp. 5523-5528

Ding, Steven X. — Univ. of Duisburg-Essen
Khan, Abdul Qayyum — Univ. of Duisburg-Essen
Wang, Yongqiang — Tsinghua Univ.
Abid, Muhammad — Univ. of Duisburg-Essen, Germany

This note addresses the problems related to the design of fault detection filters which are perfectly decoupled from unknown inputs. The major focuses are on the study of existence conditions, the design of reduced order and minimum order fault detection filters.

For the design purpose, different algorithms are provided. The achieved results are finally illustrated by an example.

15:40-16:00 TuB24.6

Classification of Voltage Sags Based on MPCA an CBR, pp. 5529-5534

Khosravi, Abbas — Amirkabir Uinversity
Melendez, Joaquim — Univ. de Girona
Zapateiro, Mauricio — Univ. of Girona
Colomer, Joan — Univ. de Girona

Impact of a bad power quality on customers has motivated the development of a classification strategies to identify sags (short duration voltage falls in the power system) and assist the location of its origin. The paper proposes a new method to classify voltage sags registered in distribution substations based on the combination of statistical and reasoning methods. The goal is to associate a sag waveform with its origin (Medium Voltage -MV- or High Voltage -HV-) in the network. Multiway Principal Component Analysis (MPCA) is used as dimension reduction strategy whereas Case Based Reasoning (CBR) is applied in this projection space to retrieve events previously registered and diagnosed. Capability of the proposed method has been demonstrated with data gathered in 25kV power substations.

TuB25 328

Process Modeling and Identification (Regular Session)

Chair: Hahn, Juergen — Texas A&M Univ.
Co-Chair: Fradkov, Alexander L. — Acad. of Sciences of Russia

14:00-14:20 TuB25.1

Multiple Switching Relay for Identification of Frequency Responses, pp. 5535-5538

Lee, Jietae — Kyungpook National Univ.
Je, Cheol Ho — Kyungpook National Univ.
Sung, Su Whan — Kyungpook National Univ.
Edgar, Thomas F. — Univ. of Texas at Austin

We discuss a new method for relay-auto tuning of a closed-loop control system. Sustained oscillations are obtained by putting relays in the feedback loop and they provide ultimate periods and gains of processes for tuning PID controllers. The ultimate periods obtained by the conventional relays have relative errors up to 5% for first order plus time delay processes. To improve the estimation of ultimate periods, modified relays such as a saturation relay and a relay with preload can be used. However, these modifications lose the binary (on-off) property of the conventional relay. Here relays with multiple switching which produce pulse-width-modulation (PWM) signals are proposed. They retain the binary property and show improved identification accuracies of ultimate data.

14:20-14:40 TuB25.2

A Time Delay Estimation Method for MIMO Systems, pp. 5539-5544

Ni, Boyi — Tsinghua Univ.
Shah, Sirish — Univ. of Alberta
Xiao, Deyun — Tsinghua Univ.

A time delay estimation(TDE) method for MIMO systems, using combined continuous wavelet transform(CWT) and cross correlation method, is proposed. By calculating and handling the cross correlation between the CWT coefficients of system input and output data,a series of time delays over scales (frequencies) are calculated and an unbiased estimation is deduced from them. The TDE method under closed loop case is also studied. The numerical examples with simulation as well as experimental data verify that the procedure works well.

14:40-15:00 TuB25.3

Selection of Parameter Sets and Design of Experiments for Estimation of Nonlinear Dynamic Systems, pp. 5545-5550

Chu, Yunfei — Texas A&M Univ.
Hahn, Juergen — Texas A&M Univ.

Models describing complex processes often contain a large number of parameter and may need to describe nonlinear behavior of the system. It is usually not possible in practice to identify all parameters due to the number and quality of measurement data as well as interactions among the parameters. A common approach is to select a set of parameters for estimation while other parameters are fixed at their nominal values. Such a parameter selection procedure is often based on sensitivity analysis; however, the determined sensitivity value depends on an assumed distribution of values of the parameters, initial states and known trajectories of the input signals. This work addresses some of the mentioned issues and presents a procedure which combines parameter selection for estimation with experimental design. Additionally, the effect that uncertainty in the parameter values has on the parameter set selection is also taken into account. An optimization problem is formulated whose solution is the optimal set of parameters to be estimated and the experimental conditions required for determining this set of parameters.

15:00-15:20 TuB25.4

Application of Speed-Gradient Variational Principle to Modeling Transient Processes in Thermodynamics, pp. 5551-5556

Fradkov, Alexander L. — Acad. of Sciences of Russia

The speed-gradient variational principle (SG-principle) is formulated and applied to thermodynamical systems. It is shown that Ziegler's Maximum Entropy Generation Principle as well as Prigogine's principle of minimum entropy production and Onsager's symmetry relations can be interpreted in terms of the SG-principle. For an SG thermodynamic system its negative entropy plays a role of the goal functional. The speed-gradient formulation of thermodynamic principles provides their extended versions, describing transient dynamics of nonstationary systems far from equilibrium. As an example an SG-model of transient(relaxation) dynamics for systems of a finite number of particles based on maximum entropy principle is derived. It has the form $dN(t)/dt = A\ln N(t)$, where $N(t)$ is the vector of the cell populations, A is a symmetric matrix with two zero eigenvalues corresponding to mass and energy conservation laws.

15:20-15:40 TuB25.5

Robust Fault Detection with Unknown-Input Interval Observers Using Zonotopes, pp. 5557-5562

Guerra, Pedro — Tech. Univ. of Catalonia (UPC)
Puig, Vicenc — Univ. Pol. de Catalunya
Witczak, Marcin — Univ. of Zielona Gora

This paper presents the problem of robust fault detection using unknown-input interval observers. These observers face the robustness problem using two complementary strategies. First, disturbances considered as unknown inputs are decoupled. Second, process/measurement noise and modeling uncertainty are considered unknown but bounded by intervals. Their effect is addressed using an interval state observation method based on zonotope representation of the set of possible states. Finally, an example based on a linearized model of a flight control system is proposed to show the effectiveness of the proposed approach.

15:40-16:00 TuB25.6

Cascade Process Modeling with Mechanism-Based Hierarchical Neural Networks, pp. 5563-5568

Cong, QiuMei — Northeastern Univ. center of automation
Chai, Tianyou — Northeastern Univ.
Yu, Wen — CINVESTAV-IPN

Cascade process, such as wastewater treatment plant, includes many nonlinear sub-systems and many variables. When the number of sub-systems is big, the input-output relation in the first block and the last block cannot represent the whole process. In this paper we use two techniques to overcome the above problem. First we propose a new neural model: hierarchical neural networks to identify the cascade process. Then we use serial structural mechanism model based on the physical equations to connect with neural model. A stable learning algorithm and theoretical analysis are given. Finally, this method is used to model a wastewater treatment plant. Real operational data of wastewater treatment plant is applied to illustrate the modeling approach.

TuB26 327

Modeling, Operation and Control of Power Systems II (Regular Session)

Chair: Horacek, Petr — Czech Tech. Univ. in Prague
Co-Chair: El-Metwally, K.A — Cairo Univ.

14:00-14:20 TuB26.1

Adaptive Nonlinear Control of Multiphase Synchronous Buck Power Converters, pp. 5569-5574

El Fadil, Hassan — Ec. Mohammadia d'Ingénieurs
Giri, Fouad — GREYC - Univ. de Caen
Guerrero, Josep.M — EUETIB, Univ. Pol. de Catalunya

(UPC)

The problem of controlling multiphase synchronous buck power converters is considered. The aim is to regulate the output voltage of the converter and to ensure an adequate current sharing between its different channels. The control law is designed from the large-signal bilinear model (of the whole multi-channels converter) using the backstepping technique. The obtained regulator is shown to meet its objectives namely an asymptotic stability of the closed-loop system, a tight output voltage regulation, an adequate current sharing and a good estimation of load resistor.

14:20-14:40 TuB26.2

Passive P-Control of a Grid-Connected Photovoltaic Inverter, pp. 5575-5580

Meza, Carlos	Tech. Univ. of Catalonia
Jeltsema, Dimitri	Delft Univ. of Tech.
Scherpen, Jacquelien M.A.	Univ. of Groningen
Biel, Domingo	Univ. Pol. de Catalunya

A passive P-controller for a single-phase single-stage grid-connected photovoltaic inverter is presented. Explicit dependance of the PV array parameters on external unpredictable variables such as temperature and solar irradiance is avoided by extending the control scheme with a reference estimator. A detailed simulation study shows the closed-loop behavior meets the desired control objectives.

14:40-15:00 TuB26.3

Application of Passivity-Based Control to Stabilization of the SMIB System with Controllable Series Devices, pp. 5581-5586

Manjarekar, Narayan	I.I.T. Bombay
Banavar, Ravi N.	Indian Inst. of Tech.
Ortega, Romeo	LSS-SUPELEC

A controllable series device (CSD) is used to damp the transient oscillations in a power system. The power system studied here is the single machine infinite bus (SMIB) and the CSD used is a controllable series capacitor (CSC). Interconnection and damping assignment passivity-based control (IDA PBC) is used for controller synthesis. The SMIB system is described with two different types of models - the second order swing equation model and the classical third order flux decay model. For the second order model the control objective of damping assignment as well as energy shaping is achieved. In case of the third order model the control objective is just damping injection.

15:00-15:20 TuB26.4

Individual Pitch Control of Wind Turbines Using Local Inflow Measurements, pp. 5587-5592

Thomsen, Sven Creutz	Tech. Univ. of Denmark
Niemann, Henrik	Tech. Univ. of Denmark
Poulsen, Niels K.	The Tech. Univ. of Denmark

This paper describes a model based control approach for individually adjusting the pitch of wind turbine blades and thereby attenuating the effect of asymmetric wind loads. It is assumed that measurements of local inflow along each blade are available. This effectively provides an estimate of the load distribution along the blades. The load estimates are used in a predictive setup where inflow measured by one blade is used as basis for calculating future loads for the other blades. Simulations with a full stochastic wind field illustrate the effectiveness of the individual pitch controller as compared to controlling the pitch collectively.

15:20-15:40 TuB26.5

Rate Bounded Linear Parameter Varying Control of a Wind Turbine in Full Load Operation, pp. 5593-5598

Řstergaard, Kasper Zinck	Vestas Wind Systems A/S
Stoustrup, Jakob	Aalborg Univ.
Brath, Per	Vestas Wind Systems A/S

This paper considers the control of wind turbines using an LPV design technique. The controller design is done by a combination of a method that uses elimination of controller variables and a method using a congruent transformation followed by a change of variables. An investigation is performed to understand the gap between zero rate of variation and arbitrary fast rate of variation for the selected scheduling variable. In particular it is analysed for which rate of variation, the local performance level starts to deteriorate from the performance level that can be obtained locally by LTI controllers. A rate of variation is selected which is expected only to be exceeded outside the normal wind turbine operating conditions. For this rate of variation a controller has been designed and simulations show a performance level over the operating region which is very similar to what can be obtained by LTI designs for the specific operating condition. The LPV controller, however, works for the whole operating range with reasonably fast changes within this.

15:40-16:00 TuB26.6

Multi-Objective VAr Planning with SVC Using Immune Algorithmand and Guaranteed Convergence Particle Swarm Optimization, pp. 5599-5604

Farsangi, Malihe Maghfoori	Electrical Engineering Department ofShahidBahonarUniversity, Ker
Nezamabadi-pour, Hossein	Electrical Engineering Department of ShahidBahonarUniversity, Ke
Lee, Kwang Y.	Baylor Univ.

In this paper, the ability of Immune Algorithm (IA) is investigated for VAr planning with the Static Var Compensator (SVC) in a large-scale power system. To enhance voltage stability, the planning problem is formulated as a multi-objective optimization problem for maximizing fuzzy performance indices. The multi-objective VAr planning problem is solved by the fuzzy IA and the results are compared with those obtained by the fuzzy Genetic Algorithm (GA) and fuzzy Guaranteed Convergence Particle Swarm Optimization (GCPSO).

TuB27 326

Fuzzy Systems and Control: Stability Analysis and Design
(Regular Session)

Chair: Guerra, Thierry Marie	Univ. of Valenciennes
Co-Chair: Shoureshi, Rahmat	Univ. of Denver

14:00-14:20 TuB27.1

Stability Analysis of Fuzzy Systems: Membership-Shape and Polynomial Approaches, pp. 5605-5610

Sala, Antonio	Univ. Pol. de Valencia
Guerra, Thierry Marie	Univ. of Valenciennes

This paper outlines two contributions to stability analysis of fuzzy systems: knowledge of the membership function shape (actually, constraints on the membership function values) and polynomial approaches. Both ideas reduce the conservativeness in the stability analysis of a nonlinear system when expressed as a fuzzy model by using membership shape information and by allowing a more general class of “fuzzy” systems than the widely-used Takagi-Sugeno one with linear consequents. In this way, the gap between fuzzy and nonlinear control gets smaller.

14:20-14:40 TuB27.2

A Membership-Function-Dependent Stability Analysis of Takagi-Sugeno Models, pp. 5611-5616

Bernal, Miguel	Univ. Valenciennes et Hainaut-Cambresis
Guerra, Thierry Marie	Univ. of Valenciennes
Kruszewski, Alexandre	Ec. Centrale de Lille

This paper presents a new approach for stability analysis of Takagi-Sugeno (TS) models. The analysis considers information derived from existing or induced order relations among the membership functions. Partitioning of the state-space and the use of piecewise Lyapunov functions (PWLF) arise naturally as a consequence of induced order relations. Conditions under the novel approach can be expressed as linear matrix inequalities (LMIs) so they can be efficiently solved. Examples are provided to show the advantages over the classical quadratic approach

14:40-15:00 TuB27.3

Robust Stability of Systems with Fuzzy Parametric Uncertainty, pp. 5617-5622

Husek, Petr	Czech Tech. Univ. in Prague

The paper deals with the problem of determining stability margin of a linear continuous-time systems with fuzzy parametric uncertainty. The coefficients of characteristic polynomial with linear affine dependency on system parameters are considered. The system parameters are described by fuzzy numbers with nonsymmetric triangular membership functions. An elegant solution, graphical in nature, based on generalization of Tsypkin-Polyak plot is presented.

15:00-15:20 TuB27.4

Robust Chaotic Cryptosystems Based on T-S Fuzzy Model, pp.

5623-5628

Yu, Gwo-Ruey — National Ilan Univ.

This paper presents the robust design for chaotic cryptosystems. The cryptosystem combines cryptograph with chaotic synchronization. The hyperchaotic signals are synchronized between the encrypter and the decrypter based on observer gains. The technique of linear matrix inequality (LMI) is applied to determine the observer gains. A theorem has been proposed to guarantee the robust stabilization for the chaotic synchronization system with external disturbance. Furthermore, the disturbance attenuation level is minimized such that the cryptosystems are optimally robust. Computer simulation demonstrates that the effectiveness of the robust design.

15:20-15:40 — TuB27.5

Fuzzy Partition Optimization for Approximate Fuzzy Q-Iteration, pp. 5629-5634

Busoniu, Lucian — Delft Univ. of Tech.
Ernst, Damien — Univ. of Ličge
De Schutter, Bart — Delft Univ. of Tech.
Babuska, Robert — Delft Univ. of Tech.

Reinforcement learning (RL) is a widely used learning paradigm for adaptive agents. Because exact RL can only be applied to very simple problems, approximate algorithms are usually necessary in practice. Many algorithms for approximate RL rely on basis-function representations of the value function (or of the Q-function). Designing a good set of basis functions without any prior knowledge of the value function (or of the Q-function) can be a difficult task. In this paper, we propose instead a technique to optimize the shape of a constant number of basis functions for the approximate, fuzzy Q-iteration algorithm. In contrast to other approaches to adapt basis functions for RL, our optimization criterion measures the actual performance of the computed policies in the task, using simulation from a representative set of initial states. A complete algorithm, using cross-entropy optimization of triangular membership functions, is given and applied to the car-on-the-hill example.

15:40-16:00 — TuB27.6

Robust AQM Controller Design for DiffServ Network Using Sliding Mode Control, pp. 5635-5639

Zhang, Nannan — Northeastern Univ.
Jing, Yuanwei — Northeastern Univ.
Yang, Muyi — Northeastern Univ.
Zhang, Siying — Northeastern Univ.

For DiffServ network, a AQM controller is designed based on the nonlinear fluid flow model and the Integrated Dynamic Congestion Control (IDCC) scheme. Due to modeling uncertainties, time varying parameter fluctuations and external disturbances, we adopt a robust controller based on sliding mode control. The controller is designed for premium traffic service and ordinary traffic service respectively. Especially for ordinary traffic, a sliding mode control algorithm is designed to compensate the input delay. Simulation results demonstrate that this method enables the queue length trace the reference value quickly. Consequently the proposed scheme gets good control effect.

TuB28 — 330A

Hybrid Vehicle II (Regular Session)

Chair: Rizzo, Gianfranco — Univ. of Salerno
Co-Chair: Manzie, Chris — The Univ. of Melbourne

14:00-14:20 — TuB28.1

Prediction of Power Demand for Hybrid Vehicles Operating in Fixed-Route Service, pp. 5640-5645

Bartholomaeus, Ralf — Fraunhofer
Klingner, Matthias — Fraunhofer
Lehnert, Martin — Fraunhofer

The efficiency of energy management strategies for hybrid electric vehicles depends significantly on the accuracy of the prediction of the load power which has to be provided by the hybrid drive. For vehicles in fixed-route service, measurements gained during vehicle operation can be used for the design of a predictor for the online calculation of the expected speed profile which is directly related to the load power profile. The paper describes, how the relevant information contained in measurements of the vehicle speed and position is processed and compressed in order to obtain a prediction algorithm that can cope with the limited memory space and computing power of a vehicle controller. The characteristics of the resulting algorithm are illustrated with real-life data.

14:20-14:40 — TuB28.2

Fuel Economy Benefits of Look-Ahead Capability in a Mild Hybrid Configuration, pp. 5646-5651

Kim, Tae Soo — The Univ. of Melbourne
Manzie, Chris — The Univ. of Melbourne
Watson, Harry — The Univ. of Melbourne

Mild hybrid electric vehicles (HEVs) take some benefits of full HEVs while having lower initial cost and weight, making them a more viable proposition for OEMs looking to enter the hybrid market. The popularization of mild hybrid electric vehicles (HEV) has exposed a new research potential in hybrid energy management. The optimal control of fuel economy in such a configuration is hard to achieve due to its multi-dimensional nature and the absence of future information. The blossoming telematics industry offers the potential to gather future information at relatively low cost through on-board sensing and vehicle-to-vehicle communication systems. In this paper, a novel approach to further fuel consumption minimization of a mild HEV is proposed. The approach is focused on adjusting the by-wire throttle in the vehicle in order to modify forward velocity, as well as controlling the power split between two sources. We show that on a realistic urban drive cycle, the telematic-enabled mild hybrid vehicle with preview of 150 meters can achieve up to 20% fuel saving compared to a comparable baseline conventional powertrain vehicle, and a further 1% fuel saving relative to previously published algorithms. The potential for further improvement in fuel economy through optimizing the use of the electric motor is also discussed.

14:40-15:00 — TuB28.3

Rule-Based Equivalent Fuel Consumption Minimization Strategies for Hybrid Vehicles, pp. 5652-5657

Hofman, Theo — Tech. Univ. Eindhoven

The highest control layer of a (hybrid) vehicular drive train is termed the Energy Management Strategy (EMS). In this paper an overview of different control methods is given and a new rule-based EMS is introduced based on the combination of Rule-Based and Equivalent Consumption Minimization Strategies (RB-ECMS). The RB-ECMS uses one main design parameter and requires no tuning of many threshold control values and parameters. This design parameter represents the maximum propulsion power of the secondary power source (i.e., electric machine/battery) during pure electric driving. The RB-ECMS is compared with the strategy based on Dynamic Programming (DP), which is inherently optimal for a given cycle. The RB-ECMS proposed in this paper requires significantly less computation time with the similar result as DP (within 1% accuracy).

15:00-15:20 — TuB28.4

Effects of Spark Ignition Timing and Fuel Injection Strategy for Combustion Stability on HEV Powertrain During Engine Restart and Deceleration Driving, pp. 5658-5663

Ohn, Hyungsuek — Seoul National Univ.
Yu, Seongeun — Seoul National Univ.
Min, Kyoung Doug — Seoul National Univ.

Stringent regulations of exhaust emission and fuel economy from vehicles have become major issues in the automotive industry. Hybrid Electric Vehicle (HEV) can be one of the crucial alternative plans over current conventional vehicle, but they have drawbacks such as the increase of engine out total hydrocarbon (THC) emission and the deterioration of combustion stability at frequent engine stop and restart. This study performs experimental investigation to obtain a better understanding of THC emission characteristic at engine restart and deceleration driving on a HEV powertrain of parallel motor/generator type. Using a Fast response Flame Ionization Detector (FFID) and specified tool for cycle by cycle, cylinder to cylinder combustion and engine control characteristic analysis during transient state of HEV powertrain. The experimental conditions cover variation of high voltage battery State of Charge (SoC), spark ignition timing and injected fuel mass. As an experimental result, the effect of the spark timing control is so little, but the reasonable injection duration for stable combustion is more than 7 (ms) at the first cycle shortly after engine start-up by motor although the injection rate is 2.7 ~ 3 (ms) at idle state. The reason why more fuel was injected was that the deposited fuel in the cylinder and intake port was reduced due to discharging and vaporization during deceleration step before idle stop.

15:20-15:40 — TuB28.5

Hardware in the Loop Simulation of Vehicle Stability Control Using Regenerative Braking and Electro Hydraulic Brake for Hybrid Electric Vehicle, pp. 5664-5669

Kim, Donghyun — Sungkyunkwan Univ.
Kim, Chulsoo — Hyundai Motor Company
Hwang, Sung-Ho — Sungkyunkwan Univ.
Kim, Hyunsoo — Sungkyunkwan Univ.

In this paper, hardware in the loop simulation(HILS) for a hybrid electric vehicle(HEV) braking performance is performed to investigate the vehicle stability control algorithm in the varying road surface condition. The vehicle stability control algorithm consists of the optimal braking torque distribution between the regenerative braking and the electro hydraulic braking. In addition to the optimal braking torque distribution, a sliding mode type wheel slip control algorithm is proposed to maintain the target slip ratio. The HILS system is composed of 4 wheel calipers and the electro hydraulic brake(EHB) module, and dynamic model of the HEV powertrain constructed by MATLAB Simulink is used as a software part. It is found from the HILS results that vehicle stability control algorithm using the regenerative braking, EHB and slip ratio control is able to provide the improved braking performance such as shorter braking distance, smaller error of the sideslip angle and yaw rate.

TuB29 — 330B

Vehicle Dynamics (Regular Session)

Chair: Gerdes, J. Christian — Stanford Univ.
Co-Chair: El Hajjaji, Ahmed — Univ. de Picardie-Jules Verne

14:00-14:20 — TuB29.1

An Output Feedback Controller Design for Lateral Vehicle Dynamic, pp. 5670-5675

Bosche, Jerome — Univ. of Amiens
El Hajjaji, Ahmed — Univ. de Picardie-Jules Verne

This paper deals with the robust lateral control to improve vehicle dynamic behavior. Bounded variations on longitudinal speed, front and rear tire stiffnesses are considered allowing the vehicle model to form a polytope of linear systems. In fact, the vehicle model depends affinely on the longitudinal speed and its inverse. Taking this dependence into account, the polytope is associated with a hyper-trapezoidal domain. This representation of the polytope is more judicious and finally less conservative than a classical hyper-rectangular one. An algorithm is proposed to compute a static output feedback controller with reduced gains. The controller guaranteed a certain level of performance for the vehicle system in terms of stability, settling time and also robustness under a given class of uncertainty. In order to highlight the performance of the proposed control algorithm, a numerical simulation is performed.

14:20-14:40 — TuB29.2

Steering Assist Torque Control Enhancing Vehicle Stabiliity, pp. 5676-5681

Lee, Ahn Na — MANDO Corp.
Jung, JiHyun — MANDO Corp.

The usage of electronically controlled systems is recently in the trend of increase. Electronically controlled systems for the vehicle are communicated through the network as CAN (Control Area Network) among individual electronic control systems. By sharing sensor and processing signals through the network among individual electronic control systems, Unified Chassis Control (UCC) which control individual electronic control systems at the same time can be possible. This paper presents Unified Chassis Control of Electronic Stability Control (ESC) and Electric Power Steering (EPS) for improving vehicle dynamic stability. Unified Chassis Control improves vehicle stability by steer intervention to assist driver's maneuverability. ESC detects vehicle-stability and driver-maneuvering through the sensor and processing signals and judges whether steer assist torque intervene for improving vehicle stability. If steer intervention is needed to control vehicle, a motor of EPS generates calculated steering assist torque for steer intervention which is transferred through the network. We demonstrated that Unified Chassis Control improves the vehicle stability by several vehicle tests such as braking or accelerating on Split – Ľ; roads and on under-steer or over-steer condition.

14:40-15:00 — TuB29.3

Unified Chassis Control for Vehicle Rollover Prevention, pp. 5682-5687

Yoon, Jangyeol — Seoul National Univ.
Cho, Wanki — Seoul National Univ. Korea
Yi, Kyongsu — Seoul National Univ.
Koo, Bongkyeong — MANDO Corp.

This paper describes an unified chassis control (UCC) strategy to prevent vehicle rollover and improve maneuverability. In order to detect a danger of rollover, rollover index (RI) which indicates an impending rollover is determined. The rollover index is calculated using estimated roll angle, roll rate and measured lateral acceleration. Lateral and vertical model-based roll state estimators are designed and combined to obtain the vehicle roll state induced by maneuvering and road disturbances. The vehicle mass is adapted to improve the robustness of the roll state estimator. The RI-based rollover mitigation controller (RMC) is designed by integrating the electronic stability control (ESC), active front steering (AFS) and continuous damping control (CDC). The RI/lateral stability-based RMC is also designed to ensure maneuverability. Computer simulation is conducted to evaluate the proposed UCC scheme by using validated vehicle simulation software. From the simulation results, it is shown that the proposed UCC can prevent vehicle rollover and load to improvements in vehicle stability.

15:00-15:20 — TuB29.4

Lateral Wind Force and Torque Estimation for a Driving Assistance, pp. 5688-5693

Glaser, Sébastien — INRETS-LCPC
Mammar, Said — LSC-CNRS-FRE2494
Dakhlallah, Jamil — INRETS-LCPC
Netto, Mariana — LIVIC - LCPC/INRETS

Main topics of driving assistances with respect to degraded driving situations, are low friction or low visibility. Thus, wind related problems are often less considered. However on high bridges or near sea shores, wind can generate car accident. In fact, wind shall have a huge impact on vehicle dynamic. For light vehicle, it could surprise the driver, resulting in a lateral movement. Looking at heavy truck, wind can be an additional factor that initiate a rollover. In this paper, an observer based method for the estimation of wind impact on vehicle dynamic is proposed. It develops the problem of numerical observability of the wind impact and propose an architecture to measure it. Next, it uses this knowledge in order to build a safe speed profile.

15:20-15:40 — TuB29.5

Detection of Critical Driving Situations Using Phase Plane Method for Vehicle Lateral Dynamics Control by Rear Wheel Steering, pp. 5694-5699

von Vietinghoff, Anne — Univ. Karlsruhe (TH)
Lu, Haiyan — Univ. Karlsruhe (TH)
Kiencke, Uwe — Univ. of Karlsruhe

A method for detecting laterally critical driving situations based on the vehicle body side slip angle (VBSSA) is investigated. Based on a nonlinear vehicle model, the vehicle stability is analyzed graphically on the phase plane. The stable area can be determined depending on the wheel turn angle, the velocity and the road friction coefficient. The detection of critical situations via the phase plane method is integrated into a gain scheduling control for the stabilization of the lateral vehicle dynamics. The control concept focuses on minimizing the VBSSA by means of rear wheel steering. Since the VBSSA cannot be measured in series production vehicles it is estimated using an Extended Kalman Filter that combines the lateral and longitudinal vehicle dynamics. The overall control concept including the EKF and the phase plane method are validated with the vehicle simulation software CarMaker. Besides open-loop maneuvers, additional close-loop maneuvers are conducted in order to investigate the driver's influence on the controller performance and it's reaction to the controller activity.

15:40-16:00 — TuB29.6

Vehicle Parameter Estimation and Stability Enhancement Using Sliding Modes Techniques, pp. 5700-5705

Shraim, Hassan — LSIS, Univ. AIX marseille III
Ouladsine, Mustapha — Univ. d'aix marseille III
Fridman, Leonid M. — Univ. of Mexico

In this paper, high order sliding mode observers are used to estimate tires longitudinal forces, vehicle side slip angle and velocities. Two types of high order sliding mode observers are used. A third order one is used to estimate the longitudinal forces, while for the estimation of the vehicle side slip and velocities, an observer based on the super twisting algorithm is proposed. Validations with

the simulator ve-dyna pointed out the good performance and the robustness of the proposed observers. Controller design for the braking is accomplished using a reduced state space model representing the movement of the vehicle center of gravity in the (X, Y) plane. Driver's reactions are taken into account. The performance of the closed loop system is carried out by means of simulation tests.

TuB30 330C
Guidance, Control & Navigation for Unmanned Air Vehicles
(Invited Session)

Chair: Tsourdos, Antonios — Cranfield Univ.
Co-Chair: Siguerdidjane, Houria — SUPELEC
Organizer: Tsourdos, Antonios — Cranfield Univ.

14:00-14:20 TuB30.1
Stability Analysis of an UAV Controller Using Singular Perturbation Theory (I), pp. 5706-5711

Bertrand, Sylvain — ONERA
Hamel, Tarek — Univ. de Nice Sophia Antipolis
Piet-Lahanier, Helene — ONERA

This paper presents the stability analysis of a hierarchical controller for an Unmanned Aerial Vehicle, using singular perturbation theory. Position and attitude control laws are successively designed by considering a time-scale separation between the translational dynamics and the orientation dynamics of a six degrees of freedom Vertical Take Off and Landing UAV model. In addition, for the design of the position controller, we consider the case where the linear velocity of the vehicle is not measured. A partial state feedback control law is proposed, based on the introduction of virtual states in the translational dynamics of the system.

14:20-14:40 TuB30.2
Cooperative Task Assignment Using Dynamic Ranking (I), pp. 5712-5717

Bracci, Andrea — Univ. of Pisa
Pollini, Lorenzo — Univ. of Pisa
Innocenti, Mario — Univ. of Pisa

The paper presents a novel approach to the decentralized task assignment for multiple cooperative unmanned air systems, in a multiple target-multiple task environment. The vehicles (or agents) may have complete or partial a priori information about the targets that populate the scenario. Each vehicle autonomously computes the cost for servicing each task available at each target using a path planning algorithm, taking into account obstacles, pop-up threats, and weights the total path cost including potential risk areas. Vehicles assign an initial ranking to each task, and then exchange their ranking information with the others. Each agent then updates the ranking of its tasks using a non linear dynamic programming algorithm that is proven to be stable and to converge to an equilibrium point. The ranking dynamics is initially formulated as a continuous time system, and then time-discretized depending on available data, and transmission rate among the network. Stability of the network and independence of steady state values from the data rate are proved analytically. Current studies are directed towards the effect of communication delays. The validity and performance of the proposed method are verifed via extensive numerical simulation, and compared with alternate techniques such as an optimal MILP based integrated task assignment and path planning solver.

14:40-15:00 TuB30.3
Dubins Path Planning of Multiple UAVs for Tracking Contaminant Cloud (I), pp. 5718-5723

Subchan, Subchan — Cranfield Univ.
White, Brian A. — Cranfield Univ.
Tsourdos, Antonios — Cranfield Univ.
Shanmugavel, Madhavan — Cranfield Univ.
Zbikowski, R — Cranfield Univ.

This paper presents cooperative path planning approach for multi UAVs to detect, model and track the shape of a contaminant cloud boundary. The objective of this research study is to manage the resources (airborne sensors) such as to determine the boundary of a cloud and track its motion with minimum information. The dispersing model of the contaminant cloud boundary is based on SCIPUFF. The UAVs are assumed to just have a sensor package which can sense nuclear, biological and chemical (NBC) contaminants. Therefore as a UAVs fly through a contaminant cloud the NBC sensors will recognise the entry and exit points of the UAVs from the contaminant cloud boundary and give these two points as measurements. Based on the measurements the splinegon approach uses to predict the contaminant cloud boundary and produces a segment for the next UAVs path

15:00-15:20 TuB30.4
UAV Optimal Cooperative Target Tracking and Collision Avoidance of Moving Objects (I), pp. 5724-5729

Prévost, Carole Gabrielle — Univ. Laval
Desbiens, Andre — Univ. Laval
Gagnon, Eric — Defence R&D Canada - Valcartier
Hodouin, Daniel — Laval Univ.

Effective target tracking and collision avoidance schemes are essential to the success of unmanned aerial vehicle (UAV) missions. In a dynamic environment, UAV path planning often relies on predicted obstacle and target motion. This paper presents an algorithm that predicts the trajectory of a moving object (target or obstacle) detected by a UAV. An extended Kalman filter is first employed to estimate the states of the object from its measured spatial position. The optimal object trajectory and its associated position prediction error are then calculated using the state equation defined for Kalman filtering. The proposed trajectory prediction scheme is afterward tested in a path planner which relies on decentralized cooperative predictive control to select optimal UAV trajectories as a function of the predicted target and obstacle trajectories. Simulation results are presented to demonstrate the effectiveness of the proposed approach.

15:20-15:40 TuB30.5
Robust Control and Visual Servoing of an Uav (I), pp. 5730-5735

Dib, Alaa — Supelec
Siguerdidjane, Houria — SUPELEC
Zaidi, Nedjma — Supélec

Abstract: The purpose of this paper is to show that a combination of a nonlinear controller for an UAV of quadrotor type and visual servoing for trajectories generation leads to better stability results in a perturbed environment. The quadrotor is an underactuated system and highly nonlinear, which induces some difficulties in the design of the controller and in particular the application of visual servoing. The dynamic model of the quadrotor has been established by taking into account the gyroscopic effects of the rotors. The state-space representation of the system has been chosen in such a way that it enables to derive a backstepping controller. To generate the trajectories, three types of visual servoing have been investigated, 2D, 3D and 2D1/2, in order to draw the advantages and the drawbacks of each approach. Numerical simulations have been performed and have confirmed the validity of the theoretical results, besides the backstepping controller has shown the ability to control the quadrotor in the presence of relatively high perturbation conditions.

15:40-16:00 TuB30.6
Multi-Rate Path-Following Control for Unmanned Air Vehicles, pp. 5736-5741

Antunes, Duarte — Inst. Superior Tecnico, Inst. forSystemsandRobotics
Silvestre, Carlos — Inst. Superior Tecnico
Cunha, Rita — Inst. Superior Técnico, Inst. for Systems and

A methodology is provided to tackle the path-following integrated guidance and control problem for unmanned air vehicles with measured outputs available at different rates. The path-following problem is addressed by defining a suitable non-linear path dependent error space to express the vehicle's nonlinear dynamics. The main novelty of the method is to explicitly take into account the different temporal characteristics of the onboard sensor suite in the controller design and implementation. The proposed controller solution relies on a linear parameter varying structure that naturally exploits these multi-rate characteristics of the system outputs to obtain the desired properties for the resulting integrated guidance and control system. Due to the periodic time-varying characteristics of the multi-rate mechanism, the controller synthesis is dealt with under the scope of linear periodic systems theory. The effectiveness of the path-following methodology is accessed in simulation for low altitude terrain-following manoeuvres of a small-scale helicopter using a full dynamic model of the vehicle.

TuBCC 401
Milestone Report by IFAC Coordinating Committee on Manufacturing and Logistics Systems (CC5) (Milestone Session)

Chair: Nof, Shimon Y. — Purdue Univ.

14:00-16:00 TuBCC.1

Advances in E-Manufacturing, E-Logistics, and E-Service Systems, pp. 5742-5750

Nof, Shimon Y. — Purdue Univ.
Filip, Florin Gheorghe — Romanian Acad.
Molina, Arturo — Tecnologico de Monterrey
Monostori, Laszlo — Computer and Automation Res. Inst. Hungarian
Pereira, Carlos Eduardo — Federal Univ. of Rio Grande do Sol

Abstract: Key problems in manufacturing plant control, modeling and information management, enterprise integration and interoperability, and large-scale complex systems are described. Recent major accomplishments in developing solution methods and tools are reviewed in e-Manufacturing, e-Service, and bio-inspired manufacturing and control; Real-time, cooperative/collaborative enterprises; autonomous, collaborative networked organizations; enterprise integration and processes models; and complex systems-of-systems. The article concludes with emerging trends, applications forecast, and future roles of engineers and managers in manufacturing, logistics and service systems.

TuC01 Atlantic Hall
Design Methods (Poster Session)

Chair: Bars, Ruth — Budapest Univ. of Tech. and Ec.
Co-Chair: Colaneri, Patrizio — Pol. di Milano

16:30-18:30 TuC01.1

Self-Tuning Continuous-Time Generalized Minimum Variance Control, pp. 5751-5755

Hoshino, Ryota — Tokyo Metropolitan Univ.
Mori, Yasuchika — Tokyo Metropolitan Univ.

There is Generalized Minimum Variance Control(GMVC) in one of the design methods of Self Tuning Control(STC). In general, STC is applied discrete-time design. According to selection of sampling period, discrete-time design has possibilities to generate unstable zero and odd time-delay, and fail to get a clear grasp of the controlled object at all times. Then, we propose continuous-time design of GMVC. For this reason it is called CGMVC. Because continuous-time design need not choose sampling period, CGMVC is easire design method than GMVC. In this paper, we confirm some advantage of CGMVC, and denote numerical example.

16:30-18:30 TuC01.2

Designing PI Controller Based on Iterative Learning Control Using Adaptive Technique, pp. 5756-5761

Gomma, H. W. — Univ. of Helwan
Thomas, Jean — Beni-Sueif Univ.

This paper presents a technique that can be used in designing an equivalent PI controller to different classes of the known Iterative Learning Control (ILC) namely P-type and high order ILCs. The equivalent PI controller can be explicitly represented in the z domain in contrast to the time domain based ILC, which gives another potential for stability analysis. Moreover, the derived PI controller combines the ease of tuning with the learning feature from past processes, which is the base of Iterative Learning Control (ILC). The results show that the ability of proposed approach to provide an equivalent PI controller that provides similar performances to the ILC when applied to various systems with no restrictions on the system order or type.

16:30-18:30 TuC01.3

Adaptive Control of Three – Tank – System Using Polynomial Methods, pp. 5762-5767

Kubalcik, Marek — Tomas Bata Univ.
Bobál, Vladimír — Tomas Bata Univ. in Zlin

Adaptive control of a three – tank - system laboratory model is presented. The objective laboratory model is a two input – two output (TITO) nonlinear system. It is based on experience with authentic industrial control applications. Two control algorithms utilizing polynomial theory and pole – placement were applied and compared. The first one is based on the traditional 1DOF (one – degree of freedom) configuration of the closed loop, the second one applies a decoupling method to suppress undesired cross – coupling. The algorithms implemented as self – tuning controllers are then used for control of the model. Results of real-time experiments are also included. Quality of control achieved by both methods is compared and discussed.

16:30-18:30 TuC01.4

A Virtual Prototyping Approach to the Design of Advanced Chiller Control Systems, pp. 5768-5769

Albieri, Michele — Rhoss S.p.A.
Beghi, Alessandro — Univ. di Padova
Bodo, Cristian — Univ. di Padova
Cecchinato, Luca — Univ. di Padova

In this paper we address the problem of designing advanced control systems for increasing the performances of one of the key elements of an HVAC system, the chiller unit. We describe the design of an adaptive controller for single scroll compressor, packaged air-cooled water chillers, that allows to substantially increase the energy performance of the system, as well as to achieve excellent regulation performances in process applications. In the design, extensive use has been made of a detailed simulation environment based on Matlab/Simulink that has been validated on a state-of-the-art experimental facility.

16:30-18:30 TuC01.5

Scheduling of a LQ Control Algorithm for Efficient FPGA Implementation, pp. 5770-5775

Sucha, Premysl — Czech Tech. Univ. in Prague
Hanzalek, Zdenek — Czech Tech. Univ. in Prague

This paper deals with the speed optimization of iterative algorithms with matrix operations or nested loops for hardware implementation in Field Programmable Gate Arrays (FPGA). The presented scheduling algorithm use Integer Linear Programming (ILP) while complex algorithm structure is modeled by system of linear inequalities. The method is demonstrated on a LQ control algorithm. An advantage of the presented scheduling method is its suitability for algorithms with longer iteration period.

16:30-18:30 TuC01.6

Eigenstructure Assignment for Helicopter Hover Control, pp. 5776-5781

Pomfret, Andrew James — Univ. of York
Griffin, Stuart J — Univ. of York
Clarke, Tim — Univ. of York

In this paper, recent Eigenstructure Assignment (EA) algorithms are implemented to provide dynamic control of a Lynx helicopter in the hover, using the ideal eigenstructure derived by Clarke et al. [2003b]. First, a state-feedback controller is presented to demonstrate that the target eigenstructure is consistent with the kinematics of a helicopter, and that the closed-loop system meets the UK Ministry of Defence Defence Standard 00-970 requirements for Level 1 handling qualities. The EA algorithm for semi-proper systems presented by Pomfret et al. [2005] is then employed to demonstrate its efficacy and to allow comparison with the state-feedback case. Finally, the gain suppression methods from Pomfret and Clarke [2005] are used to introduce structure to a controller without affecting its performance.

16:30-18:30 TuC01.7

Control System Design for a New Servo Press, pp. 5782-5787

Yeung, Wai Keung — The Chinese Univ. of Hong Kong
Li, Jian Ping — The Chinese Univ. of Hong Kong
He, Kai — The Chinese Univ. of Hong Kong
Luo, Yuanxin — Chinese Univ. of Hong Kong
Kong, Ching Tom — The Chinese Univ. of Hong Kong
Du, Ruxu — the Chinese Univ. of Hong Kong

A control system is developed for controlling a newly designed 300-ton servo press. The control goal is to drive the punch to track various desired trajectories, and to ensure the accurate repeatability of its bottom-dead-centre (BDC). Two major difficulties are encountered in designing the system. The first one is the nonlinear kinematics of the force-amplification mechanism. The second is the tight synchronization requirement of two servomotors. To cope with these problems, techniques such as kinematics buffers, cascaded feedback loops and cross-coupling method have been used. The control algorithms are implemented using six PID channels on a Turbo PMAC2 motion control card and are tested with experimental models. Satisfactory performance is obtained from the test results.

16:30-18:30 TuC01.8

Analysis of the Oil Film Effect in the Air Gap of an Electro-Hydraulic Compound Pump, pp. 5788-5795

Hsieh, Sheng-Ping — Feng Chia Univ.
Hwang, Thong-Shing — FENG CHIA Univ.
Hwang, Min-Tzung — Chung-Shan Inst. of Science and Tech.

The electro-hydraulic compound pump is a new integrated product, in which the pump and motor are combined as one unit replacing the traditional connection with a shaft coupling. A piston pump embedded in the motor rotor is capable of actuating the pump without a rotating shaft coupling. There are a great deal of advantages in this design, such as reduced noise, decreased power loss, and easy installation. The piston pump body is placed in the motor rotor because of the compound pump design. The air gap between the rotor and motor stator is filled with hydraulic oil. The rotor is directly rotated in the hydraulic oil. The control of the pressure and flow is achieved by means of the mechanical adjustment at the pressure valve. This paper adopts the Maxwell EM software matched with the corresponding mathematical theory to examine and simulate the oil film effect in the air gap on the electrical performance of an electro-hydraulic compound pump. The experimental results are given.

16:30-18:30 TuC01.9

Optimal State Space Control of DC Motor, pp. 5796-5801

Ruderman, Michael — Tech. Univ. Dortmund
Krettek, Johannes — Univ. of Dortmund
Hoffmann, Frank — Univ. of Dortmund
Bertram, Torsten — TU Dortmund

In comparison to classical cascade control architecture of DC motors, the state feedback control offers advantages in terms of design complexity, hardware realization and adaptivity. This paper presents a methodic approach to state space control of a DC motor. The state space model identified from experimental data provides the basis for a linear quadratic regulator (LQR) design. The state feedback linear control is augmented with a feedforward control for compensation of Coulomb friction. The controller is successfully applied and the closed loop behavior is evaluated on the experimental testbed under various reference signals.

16:30-18:30 TuC01.10

Calculating All Kp Admitting Stability of a PID Control Loop, pp. 5802-5807

Hohenbichler, Norbert — RWTH Aachen Univ.
Abel, Dirk — RWTH-Aachen Univ.

To answer the outstanding question of the set of all stabilising PID controller parameters for a linear delay free system, the interval of all stabilising proportional gains Kp must be known, which admit stabilisation of the closed loop in addition with certain Ki and Kd. This paper presents a new algorithm for the numerical calculation of the stabilising Kp-interval, which entirely avoids gridding Kp. The algorithm is based on a new approach in analysing the motion of the stability boundaries in the (Kd,Ki)-plane, when Kp varies. A software tool implementing the algorithm in Matlab is available for download.

16:30-18:30 TuC01.11

Robust Predictive PI Controller Based on First-Order Dead Time Model, pp. 5808-5813

Arousi, Fakhredin — Budapest Univ. of Tech. and Ec.
Schmitz, Ulrich — Shell Rhineland Refinery
Bars, Ruth — Budapest Univ. of Tech. and Ec.
Haber, Robert — Univ. of Applied Science Cologne

Predictive control algorithms give the control input minimizing a cost function considering expected future errors. PI control algorithms can be equipped with predictive properties. Simple predictive control algorithms are derived using approximation of an aperiodic process by a first-order model with dead time. Applying a noise model the robustness properties of the algorithm are enhanced considering plant-model mismatch. The noise filter is considered as a design parameter. Simulation examples demonstrate the behavior of the predictive PI algorithm and the robustifying effect of the noise filter.

16:30-18:30 TuC01.12

Constrained Control for Systems with Relative Degree One, pp. 5814-5819

Huba, Mikulas — Slovak Univ. of Tech.
Tapak, Peter — Faculty of Electrical Engineering andInformationTechnologyof Sl
Zakova, Katarina — Slovak Univ. of Tech.

The paper discusses the design of second and third order plants with two/three parallel first order channels i.e. second/third order system with one/two stable zeroes. The designed control respects input constraints and can be easily tuned by one parameter, the closed loop pole. When choosing proper closed loop poles one has to take into account parasitic time constants, measurement noise, plant uncertainty, etc. Nevertheless, in the nominal case the designed controller is able to give the dynamics ranging from the minimum time control to pure linear one - according to the chosen pole. The desired control signal has one interval at the saturation limit, then it converges to a steady value with the dynamics given by the closed loop pole.

16:30-18:30 TuC01.13

PI Controller Design for Actuator Preservation, pp. 5820-5824

Klan, Petr — Acad. of Sciences, Czech Republic
Gorez, R. — Univ. Catholique de Louvain

New explicit design relations for setting the controller parameters in PI control of industrial processes are proposed. The objective is to obtain proper transient responses with smooth control actions minimizing the variations of the controller output, hence preserving actuators from untimely attrition. The use of the proposed relations is illustrated by tests on real processes.

16:30-18:30 TuC01.14

A Design Method of Modified PID Controllers for Multiple-Input/multiple-Output Plants, pp. 5825-5830

Hagiwara, Takaaki — Graduate School of Engineering, Gunma Univ.
Yamada, Kou — Gunma Univ.

In this paper, we examine a design method of modified PID (Proportional-Integral-Derivative) controllers for multiple-input/multiple-output plants. PID controller structure is the most widely used one in industrial applications. Recently the parametrization of all stabilizing PID controller has been considered. Yamada and Hagiwara proposed a design method of modified PID controllers such that modified PID controllers make the closed-loop system for unstable plants stable and the admissible sets of P-parameter, I-parameter and D-parameter are independent from each other. However no method has been published to guarantee the stability of PID control system for multiple-input/multiple-output plants and the admissible sets of P-parameter, I-parameter and D-parameter to guarantee the stability of PID control system are independent from each other. In this paper, we propose a design method of modified PID controllers such that the modified PID controller make the closed-loop system for multiple-input/multiple-output plants stable and the admissible sets of P-parameter, I-parameter and D-parameter are independent from each other.

16:30-18:30 TuC01.15

Optimal LQI Synthesis for Speed Control of Synchronous Actuator under Load Inertia Variations, pp. 5831-5836

Fadel, Maurice — LAPLACE - INPT
Carriere, Sebastien — INPT
Caux, Stéphane — INPT

Direct drives applications are more and more common and rise up the control weakness to parameters variation. New method have been created but are most of time complex to tune and need powerful processor. In this paper, state feedback controllers optimized by Linear Quadratic principle are shown up. These methods achieve cost requirements due to constant gain coefficients. Methods tune criterion to let the closed loop stable and unsensitive to load variation. The first one uses an iterative algorithm on few tuned parameter. The last one blends poles placement and Linear Quadratic principle to achieve a fast synthesis method. Experimental results have been obtained taking into account internal current control and inverter limitation.

16:30-18:30 TuC01.16

Controller Design for Unstable FOPTD Plants Based on Sensitivty, pp. 5837-5841

Ali, Ahmad — Indian Inst. of Tech. Guwahati India
Majhi, Somanath — Indian Inst. of Tech. Guwahati

This paper presents a new method for designing PID controller for unstable first order plus time delay (FOPTD) plant models. The controller design problem is solved by pole zero cancellation and keeping the minimum distance of the Nyquist curve of the open loop transfer function from the critical point to a specified value. Analytical expressions correlating the controller parameters and the plant model parameters are also provided for ease of use. Simulation results are given to show the performance that can be achieved.

16:30-18:30 TuC01.17

Guaranteed Dominant Pole Placement with PID Controllers, pp. 5842-5845

Wang, Qing-Guo	National Univ. of Singapore
Zhang, Zhiping	National Univ. of Singapore
Astrom, Karl J.	Lund Inst. of Tech.
Zhang, Yu	GE Global Res. Center - Shanghai
Zhang, Yong	GE Global Res. Center

Pole placement is a well-established design method in linear control systems. Note however that with an output feedback controller of low-order such as PID one cannot achieve arbitrary pole placement for a high-order or delay system, and then partially or hopefully, dominant pole placement becomes the only choice. To the best of the authors' knowledge, no method is available in the literature to guarantee dominance of the assigned poles in the above case. This paper proposes two simple and easy methods which can guarantee the dominance of the assigned two poles for PID control systems. They are based on Root-Locus and Nyquist plot, respectively. If a solution exists, the parametrization of all the solutions is explicitly given. Examples are provided for illustration.

16:30-18:30 TuC01.18

On the Integral Sliding-Mode Control for Sample-Data Systems with State Time-Delay, pp. 5846-5849

Mu, Lijun	Ocean Univ. of China
Gao, Cunchen	Ocean Univ. of China
Li, Juan	Ocean Univ. of China

A discrete-time integral sliding mode control (DISMC) scheme is proposed for sample-data systems with state time-delay and disturbance. A steady-state error about the magnitude of O(T^{2}) is achieved for some delay systems. A variable replacement is applied to transform the original system to a new delay-free system; then a DISMC scheme is designed for the new system. Comparing with the existing methods dealing with time-delay systems, the new scheme is different and simple for some systems. The illustrative example demonstrates the validity of the proposed scheme.

16:30-18:30 TuC01.19

Delay-Dependent Decentralized Stabilization of Multi-Channel Singular Linear Continuous-Time Systems with Multiple Point Delays, pp. 5850-5855

Gui, Weihua	Central South Univ.
Jiang, Zhao-Hui	Central South Univ.
Yang, Chunhua	Central South Univ.
Xie, Yongfang	Central South Univ.

The delay-dependent decentralized stabilization problem of multi-channel singular time-delay time-invariant systems subject to multiple internal and external incommensurate constant point delays is discussed based on the descriptor integral-inequality approach. The descriptor integral-inequality Lemma is firstly established. Based on the new Lemma and the Lyapunov-Krasovskii functional approach, delaydependent decentralized stabilization sufficient conditions are obtained. An LMI based algorithm to design the decentralized state feedback controls that stabilize the multi-channel singular time delays systems is provided. Finally, some numerical examples are presented to illustrate the effectiveness and the availability for the design.

16:30-18:30 TuC01.20

Delay-Dependent H-Inf Control for 2-D State-Delayed Systems, pp. 5856-5861

Peng, Dan	Yanshan Univ.
Guan, Xinping	Yanshan Univ.
Long, Chengnian	Yanshan Univ.

Considering a class of two-dimensional (2-D) local state-space (LSS) Fornasini-Marchesini (FM) second model with delays in the states, this paper studies delay-dependent H_inf control problem. First, we propose delay-dependent bounded real lemma. Then a dynamic output feedback controller is developed, which assures that the closed-loop system is asymptotically stable and has H_inf performance gamma in terms of linear matrix inequalities' (LMIs') feasibility. Furthermore, the minimum H_inf performance gamma can be obtained by solving a linear convex optimization problem. A numerical example demonstrates the effectiveness of our results.

16:30-18:30 TuC01.21

Robust Stability of Polynomic Interval Polynomials, pp. 5862-5867

Husek, Petr	Czech Tech. Univ. in Prague

In this paper an algorithm for robust stability analysis of linear systems with parametric uncertainty is presented. The algorithm is based on multivariate interpolation-evaluation methods and fast Fourier transform used for computing determinant of a multivariate polynomial matrix. Positivity of a multivariate polynomial on a hyperrectangle is tested by Bernstein algorithm. The high efficiency of the proposed algorithm is demonstrated on automatic steering control of Daimler Benz city bus – an 8-th order closed-loop system with two uncertain parameters.

16:30-18:30 TuC01.22

On Positive Real Lemma for Non-Minimal Realization Systems, pp. 5868-5873

Kunimatsu, Sadaaki	Kumamoto Univ.
Kim, Sang-Hoon	SAMSUNG ELECTRONICS CO.,LTD
Fujii, Takao	Fukui Univ. of Tech.
Ishitobi, Mitsuaki	Kumamoto Univ.

In this paper, we state the positive real lemma and the strictly positive real lemma (KYP lemma) for non-minimal realization systems. First we show the positive real lemma for stabilizable and observable systems under only the constraint on the regularity of the systems, by using the generalized algebraic Riccati equation. Moreover we show that the solution of the Lyapunov equation in the positive real lemma is positive definite. Next we similarly derive the KYP lemma for stabilizable and observable systems with only the above constraint and show that the corresponding solution in the KYP Lemma is positive definite. Finally, as the duals of these problems, we show that the positive real and KYP lemmas for controllable and detectable systems have both positive definite solutions.

16:30-18:30 TuC01.23

Delay-Dependent Robust H_{infty} Control for Uncertain Singular Systems with Time-Varying Delay, pp. 5874-5879

Wang, Huijiao	Hangzhou Dianzi Univ.
Xue, Anke	Hangzhou Dianzi Univ.
Lu, Renquan	Zhejiang Univ.
Zhao, Xiaodong	Hangzhou Dianzi Univ.
Zhou, Xiao Hui	Hangzhou Dianzi Univ.

The problem of delay-dependent robust H_{infty} control for uncertain singular systems with time-varying delay is addressed in this paper. The uncertainty is assumed to be norm bounded. By establishing an integral inequality based on quadratic terms, a new delay-dependent bounded real lemma is derived and expressed in terms of linear matrix inequality(LMI). A suitable robust H_{infty} state feedback control law is presented, which guarantees that the resultant closed-loop system is regular, impulse-free and stable with disturbance attenuation level gamma for all admissible uncertainties. Two numerical examples are given to demonstrate the applicability of the proposed method.

16:30-18:30 TuC01.24

Observer-Based H_infinity Control for Stochastic Systems with Delays and Nonlinear Perturbations: LMI Approach, pp. 5880-5884

Xue, Anke	Hangzhou Dianzi Univ.
Chen, Yun	Hangzhou Dianzi Univ.
Zhang, Ke-Qin	Quanser Consulting Inc.
Zhao, Xiaodong	Hangzhou Dianzi Univ.
Wang, Jianzhong	Hangzhou Dianzi Univ.
Ge, Ming	Honeywell International

This paper considers the problem of observer-based H_infinity control for a class of It^o-type stochastic delay systems with nonlinear perturbations. An observer-based controller is constructed based on Lyapunov-Krasovskii approach, which guarantees the closed-loop system is robustly stochastically asymptotically stable in the mean square with prescribed H_infinity disturbance attenuation level for all admissible nonlinear perturbations. Suffcient condition for the existence of desired controller is presented in terms of a strict linear matrix inequality (LMI) if the control matrix B is full column rank. A numerical example is provided to demonstrate the effectiveness of the proposed method.

16:30-18:30 TuC01.25

Stabilizing Controllers, Lyapunov Functions, and the Inverse Problem of Optimal Control, pp. 5885-5890

Rapisarda, Paolo — Univ. of Southampton
Kojima, Chiaki — Univ. of Tokyo

We explore the connections of Margreta Kuijper's parametrization of stabilizing controllers, with some issues arising in inverse optimal control and in Lyapunov stability theory for higher-order linear time-invariant differential systems.

16:30-18:30 TuC01.26

Autonomous Linear Lossless Systems, pp. 5891-5896

Rao, Shodhan — Univ. of Southampton
Rapisarda, Paolo — Univ. of Southampton

We define a lossless autonomous system as one having a quadratic differential form associated with it called an energy function, which is positive and which is conserved. We define an oscillatory system as one which has all its trajectories bounded on the entire time axis. In this paper, we show that an autonomous system is lossless if and only if it is oscillatory. Next we discuss a few properties of energy functions of autonomous lossless systems and a suitable way of splitting a given energy function into its kinetic and potential energy components.

16:30-18:30 TuC01.27

Global Stabilization of Discrete-Time Chain of Integrators by Saturated Feedback, pp. 5897-5902

Zhou, Bin — Harbin Inst. of Tech.
Duan, Guang-Ren — Harbin Inst. of Tech.

The global stabilization problem for discrete-time n-th order integrators system with saturated input is considered. A new class of nested type nonlinear feedback law is proposed possessing new and useful characteristics. First, this approach allows the designer to pick some parameters that facilitate the placement of the closed-loop pole set consisting of some pairs of conjugate complex numbers having magnitude less than one when none of the saturation elements in the control laws is saturated. Only real numbers are allowed in the other existing results. Second, there are more free parameters in this class of nonlinear feedback laws that can be further used to improve performances of the closed-loop system. Third, this class of nonlinear feedback laws possesses very simple structure and is easy to implement in practice. Some simulative experiments confirm the good behavior in term of convergence performance of the closed-loop system comparing with some other existing techniques.

16:30-18:30 TuC01.28

Estimation of Attraction Domains in Wheeled Robot Control Using Absolute Stability Approach, pp. 5903-5908

Rapoport, Lev — Inst. for Control Sciences RAS; Javad GNSS
Morozov, Yuriy — Inst. of Control Sciences

Considered is the control synthesis problem for planar motion of a wheeled robot. The mathematical model of the robot is based on kinematic relationships between the velocity of a given point of a robot platform, referred to as the target point, orientation of the platform, and control. It is supposed that all four wheels move without a lateral slippage. The front wheels are responsible for steering. The control goal is to drive the target point to the prespecified trajectory and to stabilize the motion of the target point along the prespecified trajectory. The trajectory consists of line segments and circular arcs. The current curvature of the trajectory of the target point is taken as control; it is related to the steering angle of the front wheels by a simple algebraic expression. The control is subject to two-sided constraints due to limitations on the steering angle of the front wheels. For the control law proposed, the attraction domain in the space “distance to the trajectory - orientation” is analyzed. For the initial conditions from this domain, the system is guaranteed to hit a trajectory with given exponent of stability. The numerical method based on LMIs approach is proposed to approximate the attraction domain.

16:30-18:30 TuC01.29

Mixed H_2/H_infinity Control of Discrete-Time Markovian Jump Systems Via Static Output-Feedback Controllers, pp. 5909-5914

Shu, Zhan — The Univ. of Hong Kong
Lam, James — Univ. of Hong Kong
Xiong, Junlin — Univ. of Hong Kong

This paper investigates the static output-feedback mixed H_2/H_infinity control problem of discrete-time Markovian jump systems from a novel perspective. Unlike traditional methods, the closed-loop system is represented as an augmented form, in which input and gain-output matrices are decoupled. By virtue of the augmented representation, new characterizations on stochastic stability and H2/H1 performance of the closed-loop system are established in terms of matrix inequalities. Based on these, a sufficient condition with redundant matrices for the existence of the mode-dependent controller is proposed, and an iteration algorithm is given to solve the condition. An extension to the mode-independent case is provided as well.

16:30-18:30 TuC01.30

Composite Disturbance-Observer-Based Control and Terminal Sliding Mode Control for Uncertain Structural Systems, pp. 5915-5920

Wei, Xinjiang — Southeast Univ. Yantai Normal Univ.
Guo, Lei — UMIST

A new type of composite control scheme of disturbance-observer-based control and terminal sliding mode control is proposed for uncertain structural systems. The disturbance are supposed to include two parts. One is generated by an exogenous system, which can represent the harmonic signals with modeling perturbations in structural system. The other part is external excitation in H2-norm context. By combining the disturbance observer with terminal sliding mode control law, the disturbance with the exogenous system can be estimated and compensated, and external excitation can be attenuated in finite time which can be computed by our approach. Especially,the design of disturbance observer and controller can be obtained separately. Finally, simulations for a four-degree-of-freedom building model excited by 1940 El Centro earthquake excitation are given to demonstrate the effectiveness of the approach and compare the proposed results with the previous schemes in accuracy.

16:30-18:30 TuC01.31

High-Low Gain Redesign for a 4 DOF Spherical Inverted Pendulum, pp. 5921-5926

Liu, Guangyu — NICTA, The Univ. of Melbourne
Marconi, Lorenzo — Univ. di Bologna

We revisit a previous high-low gain control idea for a 4 DOF spherical inverted pendulum using a different approach, inspired by a nested saturation tool proposed by Marconi and Isidori, that provides explicit tuning rules to deal with certain bounded external disturbances. The update controller is a robust, decentralized and “global” controller.

16:30-18:30 TuC01.32

On PERIODICAL OSCILLATIONS of LURIE SYSTEMS with DISCONTINUOUS NONLINEARITY, pp. 5927-5932

Efimov, Denis — Liege Univ.

Sufficient conditions of global attracting limit cycle existence for Lurie system with sign nonlinearity are presented. It is assumed that the linear part of the system is output stabilizable, the nonlinearity has linear negative term plus positive one proportional to the output sign. Conditions of oscillatority in the sense of Yakubovich for this class of systems are also reestablished.

16:30-18:30 TuC01.33

Stability of Hybrid Impulsive Systems with Time Delay and Stochastic Effects, pp. 5933-5938

Yang, Zhichun — Chinese Acad. of Sciences
Hong, Yiguang — Chinese Acad. of Sciences

In this paper, a class of hybrid impulsive systems with time delays and stochastic effects are considered.We obtain some criteria on the global exponential stability in mean square for the impulsive stochastic delayed systems. To do this, differential inequalities and L-operator inequalities are developed. An example is given to illustrate the effectiveness of our results.

16:30-18:30 TuC01.34

Image-Based Camera-Robot Target-Tracking Satisfying Multicriteria Constraints, pp. 5939-5944

Lombardi, Warody C. — Federal Univ. of Santa Catarina
Martins, Nardęnio Almeida — UFSC - Univ. Federal de Santa Catarina
Bertol, Douglas Wildgrube — Federal Univ. of Santa Catarina
Pieri, Edson Roberto De — Federal Univ. of Santa Catarina
Castelan, Eugenio B. — Univ. Federal de Santa Catarina

This paper presents an image-based camera control, mounted on a nonholonomic mobile robot platform, traking a mobile target as reference, via task function approach. The system stability is guaranteed by the Lyapunov theory. Due to parametric uncertainties (target deepness), actuator (acceleration and velocity) and visual constraints, the gain is generated via LMIs (Linear Matrix Inequalities), to maximize the stability region associated to the closed loop. A convex optimization package was used to obtain the feedback gain, and simulations are presented to visualize the system behavior.

16:30-18:30 TuC01.35

A Novel Recursive Terminal Sliding Mode with Finite-Time Convergence, pp. 5945-5949

Yu, Shuanghe — Dalian Maritime Univ.
Du, Jialu — Dalian Maritime Univ.
Yu, Xinghuo — RMIT Univ.
Xu, He — Harbin Engineering Univ.

A novel recursive framework for designing terminal sliding mode (TSM) and fast terminal sliding mode (FTSM) with finite-time convergence is developed in this paper. The principle of finite-time convergence is investigated under these new formulations. The singularity problem around the origin with the previous TSM control can be resolved.

16:30-18:30 TuC01.36

Efficient Low-Cost Controllers for Constrained Manipulators with Uncertainties and Disturbances, pp. 5950-5955

Torres, Santiago — Univ. de La Laguna
Mendez, J. A. — Univ. de La Laguna
Acosta, L. — Univ. of La Laguna
Gonzalez, Evelio — Univ. de La Laguna
Toledo, Jonay — Univ. of La Laguna

This work presents an efficient control strategy for robot manipulators with constraints and affected by uncertainties and disturbances. The controller uses a combination of model predictive control (MPC) with an adaptive robust feedforward term. The predictive controller is based on interpolations between different simple solutions to guarantee the feasibility of the final solution applied to the manipulator. The proposed method improves the existing techniques in terms of robust capabilities. Feasibility is preserved with the MPC and applicability is also guaranteed as the computational load of the interpolation algorithm is low. The benefits of the strategy, compared with other existing controllers, are shown with simulation results obtained with a PUMA-560 manipulator.

16:30-18:30 TuC01.37

Constrained Controllability of Second Order Semilinear Systems, pp. 5956-5961

Klamka, Jerzy — Silesian Univ. of Tech. at Gliwice

In the paper finite-dimensional dynamical control systems described by second order semilinear stationary ordinary differential state equations are considered. Using a generalized open mapping theorem, sufficient conditions for constrained local controllability in a given time interval are formulated and proved. These conditions require verification of constrained global controllability of the associated linear first-order dynamical control system. It is generally assumed, that the values of admissible controls are in a convex and closed cone with vertex at zero. Moreover, several remarks and comments on the existing results for controllability of semilinear dynamical control systems are also presented. Finally, simple numerical example which illustrates theoretical considerations is also given. It should be pointed out, that the results given in the paper extend for the case of semilinear second-order dynamical systems constrained controllability conditions, which were previously known only for linear second-order systems.

16:30-18:30 TuC01.38

Neo Robust Control Theory -Beyond the Small-Gain and Passivity Paradigms, pp. 5962-5968

Liu, Kang-Zhi — Chiba Univ.

The celebrated small-gain approach to robust control only makes use of the gain information of uncertainty. This results in a limitation on the achievable control bandwidth in system design. On the other hand, the alternative passivity approach has only limited applications. To relax the limitations associated with small-gain and passivity approaches, we explore the possibility of utilizing both the gain and the phase information of uncertainty in robust control design. This paper discusses the modeling of uncertainty accounting for both gain and phase, robust stability conditions and their state space characterization.

16:30-18:30 TuC01.39

Stability of Zero Dynamics of Sampled-Data Nonlinear Systems, pp. 5969-5973

Ishitobi, Mitsuaki — Kumamoto Univ.
Nishi, Masatoshi — Kumamoto Univ.
Kunimatsu, Sadaaki — Kumamoto Univ.

One of the approaches to sampled-data controller design for nonlinear continuoustime systems consists of obtaining an appropriate model and then proceeding to design a controller for the model. Hence, it is important to derive a good approximate sampled-data model because the exact sampled-data model for nonlinear systems is often unavailable to the controller designers. Recently, Yuz and Goodwin have proposed an accurate approximate model which includes extra zero dynamics corresponding to the relative degree of the continuoustime nonlinear system. Such extra zero dynamics are called sampling zero dynamics. A more accurate sampled-data model is, however, required when the relative degree of a continuous-time nonlinear plant is two. The reason is that the closed-loop system becomes unstable when the more accurate sampled-data model has unstable sampling zero dynamics and a controller design method based on cancellation of the zero dynamics is applied. This paper derives the sampling zero dynamics of the more accurate sampled-data model and shows a condition which assures the stability of the sampling zero dynamics of the model. Further, it is shown that this extends a well-known result for the stability condition of linear systems to the nonlinear case.

16:30-18:30 TuC01.40

Design of Model Reference Adaptive Tracking Controllers for Mismatch Perturbed Nonlinear Systems with Input Nonlinearity, pp. 5974-5979

Cheng, Chih-Chiang — National Sun Yat-Sen Univ.
Chang, Chao-Chin — National Sun Yat-Sen Univ.
Su, Tai-Ming — National Sun Yat-Sen Univ.

A simple design methodology of model reference adaptive control (MRAC) scheme with perturbation estimation for solving robust tracking problems is proposed in this paper. The plant to be controlled belongs to a class of MIMO dynamic systems with input nonlinearity and mismatched time-varying state delay as well as model uncertainty. The control scheme contains three types of controllers. The first one is a linear feedback optimal controller, which is designed under the condition that no perturbation exists. The second one is an adaptive controller, it is used for adapting the unknown upper bound of perturbation estimation error. The third one is the perturbation estimation mechanism. The property of uniformly ultimately boundness is proved by using Lyapunov stability theorem, and the effects of design parameter on the dynamic performance are also analyzed. An example is demonstrated for showing the feasibility of the proposed control scheme.

16:30-18:30 TuC01.41

Robust Controller Design to Uncertain Nonlinear Tailless Aircraft, pp. 5980-5985

Li, Wenqiang — National Univ. of Defense Tech.
Ma, Jianjun — National Univ. of Defense Tech.
Zheng, Zhiqiang — National Univ. of Defense Tech.
Peng, Xuefeng — National Univ. of Defense Tech.

The vertical tail of an aircraft produces a large radar signature and the requirement for stealth in new military aircraft necessitates the design of tailless aircraft. Without the vertical tail results in lateral-directional response characteristics which are a great deal different from those of conventional aircraft. In this paper, a robust controller designed for the tailless aircraft is presented. The controller's basic structure consists of an inner-loop DI controller wrapped around an outer-loop robust mu-synthesis controller. The inner-loop controller equalizes the tailless aircraft dynamics across the flight envelope, and the outer-loop controller addresses the issues of stability, performance, and robustness to tailless aircraft uncertainties.

16:30-18:30 TuC01.42

Development and Application of a Sliding Mode Based Diagonal Recurrent Cerebellar Model Articulation Controller, pp. 5986-5991

Liu, Shan — Huazhong Univ. of Science and Tech.
Wang, Yongji — Hauzhong Univ. of Science And Tech.
Xu, Qi — Huazhong Univ. of Science and Tech.
Fang, Huijuan — Huazhong Univ. of Science and Tech.

This paper presents a sliding-mode-based diagonal recurrent cerebellar model articulation controller (SDRCMAC) for multiple-input-multiple-output (MIMO) uncertain nonlinear systems. Sliding mode technology is used to reduce the dimension of the control system. Two learning stages are adopted to train the SDRCMAC and to improve the stability of the control system. Lyapunov stability theorem and Barbalat’s lemma are adopted to guarantee the asymptotical stability of the system. Performance is illustrated on a two-link robotic control and motor control of the human arm in the sagittal plane.

16:30-18:30 TuC01.43

Fuzzy Guaranteed Cost Control for Nonlinear Systems with Input and State Time Delay, pp. 5992-5997

Yang, Xiaoguang — Northeastern Univ. Maritime Univ.
Zhang, Qingling — Northeastern Univ.
Jing, Xin — Northeastern Univ.
An, Yichun — Northeastern Univ.

Based on T-S fuzzy model, the guaranteed cost control problem of a class of uncertain nonlinear systems with input and state time delay is discussed. By constructing state-feedback controller, a sufficient condition that for the given performance index and control law, the closed-loop system is quadratic guaranteed cost stable is presented and expressed in terms of linear matrix inequality (LMI). A numerical example shows that the proposed design method is effective.

16:30-18:30 TuC01.44

On Singular Perturbations of Unstable Underactuated Mechanical Systems with Underactuation Degree >= 1, pp. 5998-6003

Acosta, José Ángel — Univ. de Sevilla
Lopez-Martinez, Manuel — Univ. de Sevilla

10 years ago, K.J. Ĺström proposed that the essence of the complex control problem originated by the joint of the pilot--&--aircraft can be captured on labs, by means of unstable underactuated mechanical systems. Thus, the unactuated part describes the autonomous aircraft dynamics and the actuated the piloted one. In this constructive approach we propose a nonlinear controller based on classical feedback linearization and singular perturbation theory, which has a compact and explicit expression, providing the designer a handle to address transient performance and robustness issues to dominate undesirable friction and/or drag effects, even in the unactuated coordinates. Further, partial differential equations need not to be solved. A multivariable example and successful experiments on the Furuta's pendulum are reported. To the best of authors' knowledge it has the largest attraction basin experimentally tested so far.

16:30-18:30 TuC01.45

Delay-Dependent Robust H Infinity Control for Uncertain Stochastic Systems, pp. 6004-6009

Li, Minghao — Donghua Univ.
Zhou, Wuneng — Donghua Univ.
Wang, Huijiao — Hangzhou Dianzi Univ.
Chen, Yun — Hangzhou Dianzi Univ.
Lu, Renquan — Zhejiang Univ.
Lu, Hongqian — Coll. of Information Science andTechnology,DonghuaUniversity,

This note deals with the problems of robust H_infty control for uncertain stochastic systems with a time-varying delay in the state. Based on the Lyapunov stability theory and the stochastic analysis tools, delay-dependent sufficient condition is established in terms of weak coupling linear matrix inequality (LMI) equations. The equations are derived by constructing a more efficient Lyapunov function candidate and combining LMI approach with free-weighting matrix technique. Properties of conservatism are only appeared with free-weighting matrices in a equation, which is coupled with another equation weakly. So the new criteria is low conservatism with large time-delay, large time-varying rate and small disturbance attenuation. Numerical examples are given to demonstrate the benefits of the proposed criteria.

16:30-18:30 TuC01.46

NONLINEAR mathcal{H}_{infty} SYNCHRONIZATION FOR LUR'E SYSTEMS USING TIME-DELAY FEEDBACK CONTROL, pp. 6010-6014

Zhong, Maiying — Shandong Univ.
Yuan, Shuai — Shandong Univ.
Liu, Yunxia — Shandong Univ.

This paper deals with the problem of nonlinear mathcal{H}_{infty} synchronization for Lur'e systems using time-delay feedback control. Making use of a vector field modulation in the master system by a filtered binary valued message signal, applying a static output feedback control with time-delay to the slave system, and taking into account mathcal{L}_{2}-norm bounded noise in the channel, the master-slave synchronization is formulated as to minimize the mathcal{L}_{2}-gain from the exogenous input to a tracking error. Then a delay-dependent synchronization criterion is derived to analyze the error system. Sufficient conditions for the mathcal{H}_{infty} synchronization and a feedback control with time-delay are obtained in terms of linear matrix inequality. Finally, the original message is recovered from the tracking error. Chua's circuit is given to illustrate the effectiveness of the proposed method.

16:30-18:30 TuC01.47

Simple Realization of Integral Fuzzy Control for Isolated AHPFC Converters, pp. 6015-6020

Lian, Kuang-Yow — National Taipei Univ. of Tech.
Hong, Chi-Wang — Chung-Yuan Christian Univ.

This paper proposes an integral Takagi-Sugeno (T-S) fuzzy control to achieve the output voltage regulation for AC-DC isolated active high power factor correction (AHPFC) converter. The converter can avoid high voltage stresses and decrease harmonic distortions under discontinuous conduction mode (DCM). The dynamics of converter are derived by AM-TTS-DS method. To ensure zero steady-state error, we add an extra integral error signal to the dynamics. Translating coordinate to the DC operating points, the converter's stabilization model can be determined. Both feedback gains and system stability are inferred simultaneously. The control gains can be obtained by solving linear matrix inequalities (LMIs) via Matlab's toolbox. A surprised property is that the obtained feedback gains are identical for every fuzzy control rule. This greatly simplifies the realization using analog circuits. The simulation and experimental results exhibit the satisfactory performance of the converter with integral T-S fuzzy regulator.

16:30-18:30 TuC01.48

Absolute Stability of Multivariable Lur'e-Type Descriptor Systems, pp. 6021-6026

Wada, Teruyo — Osaka Univ.
Ikeda, Masao — Osaka Univ.
Uezato, Eiho — Univ. of the Ryukyus

The purpose of this paper is to derive conditions for absolute stability as well as existence of solutions for multivariable Lur'e-type feedback systems whose linear part is expressed by a descriptor system. The nonlinearities are uncertain and satisfy multivariable sector conditions, or a part of the nonlinearities satisfies a norm bounded condition. Thus, the systems can be refered to as multivariable Lur'e-type descriptor systems. In the existing works on Lur'e-type descriptor systems, the nonlinearities were assumed to be smooth or given as a set of single-variable scalar functions, while in this paper, the smoothness assumption is relaxed and multivariable vector-valued nonlinearities are considered. The obtained stability conditions are described in terms of linear matrix inequalities, which are extensions of the authors' previous results on extended Popov criteria for multivariable Lur'e systems whose linear part is expressed by a state-space equation.

16:30-18:30 TuC01.49

Discontinuous Output Regulation of the Pendubot, pp. 6027-6032

Rivera, Jorge — Univ. de Guadalajara
Loukianov, Alexander G. — CINVESTAV IPN GDl
Castillo-Toledo, Bernardino — CINVESTAV-GDL, Mexico

In this work we address the problem of nonlinear output regulation of

an underactuated system by means of discontinuous control actions, in particular, the sliding mode output regulator problem in the case of error feedback is considered for the Pendubot system. The theory is revisited for nonlinear systems presented in the so-called Regular form. Simulations are carried out to verify the effectiveness of the discontinuous method.

16:30-18:30 TuC01.50

Time-Optimal Trajectory Generator under Jerk Constraints, pp. 6033-6038

Chen, Gan Nanzan Univ.
Hayashi, Hideki, Hideki Nanzan Univ.
Takami, Isao Nanzan Univ.

Step response is usually used as the performance index of controlled systems. Thus, the ideal system would be one that has an output which approaches to the step signal quickly without error or over-shoot. However, if the output of an actual plant converges to the reference signal in a very short period, it can be dangerous to the surrounding environment as well as the operators. Furthermore, the smooth trajectories are required in some cases like vehicle or elevator systems. It is known that some limitations on the jerk of the plant would be necessary in such situations which require ride quality.

In this paper, a non-linear feedforward filter for the step signal is proposed. The proposed filter, which has simple structure and requires less computational burden, produces time-optimal trajectories whose jerk guarantees the limitations that are given a priori. The effectiveness is substantiated with numerical examples.

16:30-18:30 TuC01.51

Moving Horizon Control and Estimation of Livestock Ventilation Systems and Indoor Climate, pp. 6039-6044

Wu, Zhuang Aalborg Univ.
Stoustrup, Jakob Aalborg Univ.
Jorgensen, John Bagterp Tech. Univ. of Denmark

In this paper, a new control strategy involves exploiting actuator redundancy in a multivariable system is developed for rejecting the covariance of the fast frequency disturbances and pursuing optimum energy solution. This strategy enhances the resilience of the control system to disturbances beyond its bandwidth and reduce energy consumption through on-line optimization computation. The moving horizon estimation and control (also called predictive control) technology is applied and simulated. The design is based on a coupled mathematical model which combines the hybrid ventilation system and the associated indoor climate for poultry in barns. The comparative simulation results illustrate the significant potential and advancement of the moving horizon methodologies in estimation and control for nonlinear Multiple Input and Multiple Output system with unknown noise covariance and actuator saturation.

16:30-18:30 TuC01.52

Global Exponential Stability of Delayed Parabolic Neural Networks, pp. 6045-6049

Sheng, Li Jiangnan Univ.
Yang, Huizhong Jiangnan Univ.

The globally exponentially stable conditions for delayed parabolic neural networks with variable coefficients are considered in this paper. We first derive the globally exponentially stable condition for delayed parabolic neural networks with variable coefficients based on delay differential inequality combining with Young inequality. Compared with the method of Lyapunov functionals as in most previous studies, our method is simpler and more effective for stability analysis.

16:30-18:30 TuC01.53

Boundary Control of Flexible Marine Risers, pp. 6050-6055

Do, Duc The Univ. of Western Australia
Pan, Jie The Univ. of Western Australia

A method to design a boundary controller for global stabilization of three-dimensional nonlinear dynamics of flexible marine risers is presented. Equations of motion of the risers are first developed in a vector form. The boundary controller at the top end of the risers is then designed based on Lyapunov's direct method. It is shown that when there are no environmental disturbances, the proposed boundary controller is able to force the riser to be globally exponentially stable at its equilibrium position. When there are environmental disturbances, the riser is stabilized in the neighborhood of its equilibrium position by the proposed boundary controller.

16:30-18:30 TuC01.54

On a Stabilization Problem of Nonlinear Programming Neural Networks, pp. 6056-6059

Huang, Yuan Can Beijing Inst. of Tech.
Yu, Chuang Shenyang Ligong Univ.
Zhu, Lingyun Beijing Inst. of Tech.

Intrinsically, Lagrange multipliers in Nonlinear Programming Theory play a regulating role in the process of searching the optima of constrained optimization problems. Hence, they may be regarded as control input variables as those in control systems. From this new perspective, it is showed that synthesizing nonlinear programming neural networks can be formulated to solve servomechanism problems. In this paper, under the second-order sufficient assumptions of nonlinear programming problems, a dynamic output feedback control law is proposed to stabilize the corresponding nonlinear programming neural networks. Moreover, their asymptotical stability is proved by the Lyapunov First Approximation Principle.

16:30-18:30 TuC01.55

Large-Scale Nonlinear Multivariable Systems (Decomposition, Modeling and Control Problems), pp. 6060-6065

Akhmetzyanov, Atlas Trapeznikov Inst. of Control Sciences,RussianAcademyofScien n

A class of multivariable systems is considered where modeling and control problems related to real physical processes can be solved only using approximate computational approach. The simulation processes are defined as solving mesh (finite-difference and finite-element) approximations of initial-boundary problems corresponding to original equations of mathematical physics for proper physical processes. The high dimensionality issues arising in the frame of such approach are overcome by means of decomposition and partitioning combined with multigrid spatial versions of approximating operator equations in function spaces. Multilevel computational methods for modeling and solving optimal control problems are oriented to using multiprocessor computer systems with parallel computing in message passing interface environment. The proposed results are actual both in theoretical and applied aspects. For instance, using the proposed approach to resolving problems of natural hydrocarbon deposit development simulation and optimal control opens wide capabilities for choosing efficient strategic decisions.

16:30-18:30 TuC01.56

A Tool for Converting FEM Models into Representations Suitable for Control Synthesis, pp. 6066-6071

Bokhari, Syed Fawad Raza Ali Hamburg Univ. of Tech.
Chughtai, Saulat Shuja Tech. Univ. of Hamburg-Harburg
Werner, Herbert Hamburg Univ. of Tech.

Finite Element Methods (FEM) play an important role in modelling of complex systems. Models generated from FEM are of very high dimension and are difficult to handle for control system design. In this paper, an algorithm is presented that converts a system generated from FEM into the state space model of an interconnected system, thus vastly reducing the complexity of synthesizing a distributed control strategy. A simple cantilever beam problem is used as an example to illustrate the proposed method. A state space representation of this system is obtained through FEM analysis. This model is converted from lumped state space form to interconnected form. A decentralized controller is then designed using a homotopy approach.

16:30-18:30 TuC01.57

Group Behaviour Control Based on Aggregation and Dilation, pp. 6072-6077

Xin, Bin Beijing Inst. of Tech.
Chen, Jie Beijing Inst. of Tech.
Dou, Li-Hua Beijing Inst. of Tech.
Peng, Zhi-hong Beijing Inst. of Tech.

The phenomenon of aggregation and dilation(A&D) widely exists in nature. The mechanism behind it is regarded as the effect of some kind of attraction and repulsion(A&R). A&R control becomes a popular and promising way of controlling the structure and distribution of a group composed of several and even numerous individuals. This paper presents the concepts of aggregation,

dilation and group evolution criticality based on group variance. We investigate the relationship between different levels of A&D as a foundation for the introduction of A&D analysis. The applications of A&D analysis and A&R control in several researches, including population-based optimization and group behavior control about multi-agent, are given in the form of simulation experiments.

16:30-18:30 TuC01.58

Improved-PSO-Based Optimal Scheduling for Rectifier Power System, pp. 6078-6083

Yang, Chunhua — Central South Univ.
Zhu, Hongqiu — Central South Univ.
Gui, Weihua — Central South Univ.

An optimization problem of series current scheduling for rectifier power system is presented in accordance with the policy of the time-of-use price. Aimed at the nonlinearity and the feature with equality and inequality constraints in this global optimization problem, an improved particle swarm optimization algorithm is proposed. In order to avoid premature convergence to local minimum, the improved particle swarm optimization algorithm adjusts its inertia weight according to the change of population’s fitness, and determines its mutation probability depending on the average distance of current population. The algorithm's performance is tested through three typical test function experiments. An optimal scheduling system based on the proposed methods is developed and has been put into use since Jan. 2006. Its industrial running results show its effectiveness, stability and reliability.

16:30-18:30 TuC01.59

Exponential Stabilization of Linear Systems with Time-Varying Sampling, pp. 6084-6087

Gao, Huijun — Harbin Inst. of Tech.
Wu, Junli — Harbin Inst. of Tech.
Lam, James — Univ. of Hong Kong
Chu, Danlei — Honeywell Process Solutions

This paper studies the problem of exponential stabilization of linear systems with time-varying sampling. The sampling rate varies form sample to sample with the given probability. By applying the input delay approach, the sampled-data system is transformed into a continuous time-delay system with stochastic parameter. A new exponential stability criterion is derived for the sampled-data system by using the Lyapunov functional approach. Based on this, the design procedure for stabilization controllers is presented by means of linear matrix inequalities (LMIs). An example shows the effectiveness of the proposed controller design methodology.

16:30-18:30 TuC01.60

Efficient Computation and Model Selection in Semi-Supervised Learning, pp. 6088-6093

Wang, Gang — Hong Kong Univ. of Science and Tech.
Qin, Shiyin — Beihang
Huang, Pipei — Beihang

Traditional learning algorithm uses only labeled data for training. However, labeled examples are often difficult or time consuming to obtain since they require substantial labeling efforts from humans. On the other hand, unlabeled data are often relatively easy to collect. Semi-supervised learning addresses this problem by using large quantities of unlabeled data with the labeled data to build better learning algorithms. In this paper, we propose a general approach augmenting traditional supervised learning into semi-supervised learning paradigm. A regularization framework which balances a tradeoff between loss and penalty is established. We investigate different implementations of loss function and suggest the methods which have the least computation expenses. The value of a hyperparameter, which determines the balance between loss and penalty, is crucial in model selection. Hence, we derive an algorithm that can fit the entire path of solutions for every value of hyperparameter. Its computational complexity is quadratic in the number of labeled examples only rather than the total number of labeled and unlabeled examples.

16:30-18:30 TuC01.61

Optimal Estimation by Using Fuzzy Systems, pp. 6094-6099

Amosov, Oleg S. — Amur State Univ. of Humanities and Pedagogy
Amosova, Lyudmila N. — Amur State Univ. of Humanities and Pedagogy

The paper compares the Bayesian algorithms for estimation of random vectors and the algorithms based on the fuzzy systems. It is shown that the traditional and fuzzy logic algorithms provide the estimates with the similar properties. The comparison results are discussed. The efficiency of applying the Takagi-Sugeno fuzzy systems to the nonlinear estimation problems is investigated by two examples.

16:30-18:30 TuC01.62

Dynamic Optimisation of Chemical Engineering Processes Using the Bees Algorithm, pp. 6100-6105

Pham, D T — Cardiff Univ.
Pham, Q.T. — Univ. of New South Wales
Ghanbarzdaeh, Afshin — Cardiff Univ.
Castellani, Marco — Cardiff Univ.

An improved version of the Bees Algorithm is proposed for solving dynamic optimisation problems. This new formulation of the Bees Algorithm includes new search operators, and a new selection procedure that enhances the survival probability of newly formed individuals. The proposed algorithm is tested on six benchmark dynamic optimisation problems. The benchmark problems include minimisation and maximisation tasks of different levels of complexity. For all the problems, the Bees Algorithm finds very satisfactory optima. The very small standard deviation of the results proves the high reliability of the proposed technique. Experimental tests show that the Bees Algorithm outperforms the state-of-the-art Ant Colony Optimisation algorithm. The Bees Algorithm improves also the best results published in the literature for the six benchmark problems.

16:30-18:30 TuC01.63

Application of Network Operator Method for Synthesis of Optimal Structure and Parameters of Automatic Control System, pp. 6106-6113

Diveyev, Askhat — Dorodnicyn Computing Centre of the RussianAcademyofSciences
Sofronova, Elena — Peoples' Frienfship Univ. of Russia

The problem of optimal control for nonlinear systems is considered. Genetic programming is used to obtain functional dependence of control vector from problem space vector. Network operator is proposed as one of possible solutions for effective calculations. The problem of structure-parametric synthesis of satellite angular movement stabilization system is described.

16:30-18:30 TuC01.64

Robust Fault Diagnosis of Energetic System with Parameter Uncertainties, pp. 6114-6119

Djeziri, Mohand Arab — Ec. Centrale de Lille
Ould bouamama, Belkacem — LAIL
Merzouki, Rochdi — Ec. Pol. de Lille

In this paper, a bond graph model based approach for robust FDI (Fault Detection and Isolation) in presence of parameter uncertainties is presented. Due to the energetic and multi physical properties of the Bond Graph, the whole of nonlinear model, structural analysis, residual with adaptive thresholds generations, and residual sensitivity analysis, can be synthesized using only one tool. This method is applied online for industrial steam generator. Experimental results are given to support the theoretical development.

16:30-18:30 TuC01.65

A New Objective Function for Controller Tuning, pp. 6120-6124

Ali, Ahmad — Indian Inst. of Tech. Guwahati India
Majhi, Somanath — Indian Inst. of Tech. Guwahati

In this paper, a new objective function to tune the PID/PI-PD controller is proposed by modifying the integral error squared (ISE) criterion. A new entrant to the family of evolutionary algorithms namely bacterial foraging is used to find the controller parameters by minimizing the objective function. The controller gives a smooth process output with almost zero percent overshoot as desired in the control industry. Robustness is also ensured as the value of the maximum sensitivity lies between 1.3 and 2. A comparative study of the achievable performances of the PID/PI-PD controller is also done and the proposed tuning method is tested on non-minimum, integrating and higher order plant models to illustrate the effectiveness of the new objective function.

16:30-18:30 TuC01.66

Parallel BMI Optimization Using Unimodal Normal Distribution Crossover GA with Reduced-Order Individual Expression, pp. 6125-6130

Kawanishi, Michihiro — Toyota Tech. Inst.

This paper deals with a global optimization of BMIEP (Bilinear Matrix Inequalities Eigenvalue Problem) based on parallel UNDX (Unimodal Normal Distribution Crossover) GA. The several efficient conventional techniques for real-coded GA are also incorporated. Considering the BMIEP characteristic properties, we introduce a reduced-order individual expression with alternating SDP evaluation. The alternating SDP evaluation needs much computational burden compared to conventional eigenvalue evaluation. In order to reduce the computational burden, we consider the parallelization of the algorithm. Numerical experiments are carried out to confirm the effectiveness of proposed algorithms.

16:30-18:30 TuC01.67

Frequency Domain Approach to Computing Loop Phase Margins of Multivariable Systems, pp. 6131-6135

Ye, Zhen — National Univ. of Singapore
Wang, Qing-Guo — National Univ. of Singapore
Hang, Chang Chieh — National Univ. of Singapore
Zhang, Yu — GE Global Res. Center - Shanghai
Zhang, Yong — GE Global Res. Center

The loop phase margins of multivariable control systems are defined as the allowable individual loop phase perturbations within which stability of the closed-loop system is guaranteed. This paper presents a frequency domain approach to accurately computing these phase margins for multivariable systems. With the help of unitary mapping between two complex vector space, the MIMO phase margin problem is converted using the Nyquist stability analysis to the problem of some simple constrained optimization, which is then solved numerically with the Lagrange multiplier and Newton-Raphson iteration algorithm. The proposed approach can provide exact margins and thus improves the LMI results reported before, which could be conservative.

16:30-18:30 TuC01.68

An H-Infinite Robust Tracker Controller for an UAV under Realistic Simulated Environmental Effects, pp. 6136-6141

López, Juan — Univ. Pol. de Madrid
Dormido, Raquel — UNED
Dormido, Sebastián — UNED
Gómez, José Patricio — Univ. Pol. de Madrid
Gómez, Ignacio — Univ. Pol. de Madrid

In this paper a robust multivariable H-infinite controller for an UAV to track all types of manoeuvres in the presence of noisy environment is addressed. The results demonstrate the ability of the proposed control scheme to maintain the desired trajectory despite the presence of noise and uncertainties. Tests with realistically large control inputs are used to validate the design.

16:30-18:30 TuC01.69

Decentralized Adaptive Robust Tracking Controllers of Uncertain Large Scale Systems with Time Delays, pp. 6142-6147

Wu, Hansheng — Prefectural Univ. of Hiroshima
Shigemaru, Shinji — Prefectural Univ. of Hiroshima

The problem of decentralized robust tracking and model following is considered for a class of uncertain large scale systems including delayed state perturbations in the interconnections. In this paper, it is assumed that the upper bounds of the delayed state perturbations, uncertainties, and external disturbances are unknown. A modified adaptation law with Ă;–modification is introduced to estimate such unknown bounds, and on the basis of the updated values of these unknown bounds, a class of decentralized local memoryless state feedback controllers is constructed for robust tracking of dynamical signals. The proposed decentralized adaptive robust tracking controllers can guarantee that the tracking errors between each time–delay subsystem and the corresponding local reference model without time–delay decrease uniformly asymptotically to zero.

16:30-18:30 TuC01.70

Active Queue Management Algorithm Based on Fuzzy Sliding Model Controller, pp. 6148-6153

Jing, Yuanwei — Northeastern Univ.
Yu, Na — Northeastern Uni.
Kong, Zhi — Northeastern Univ.
Dimirovski, Georgi Marko — Dogus Univ. of Istanbul

The active queue management (AQM) problem of networks is discussed. An AQM scheme is presented based on improved sliding model controller. The proposed controller combines the excellent characteristics of linear sliding model controller (LSMC) and the terminal sliding model controller (TSMC). The LSMC is used to speed up the error convergence when the error is greater than one, and the TSMC is adopted to guarantee the error convergence to zero in a finite time when the error is around the zero. The chattering in the conventional sliding model control systems is avoided with the employed continuous controller. The simulation results show that the proposed scheme has strong robust against the network modeling uncertainties and disturbances, as well as leads to the convergence of the output queue to the desired value quickly and precisely than employing either LSMC or TSMC alone.

16:30-18:30 TuC01.71

A QFT/EEAS Design of Multivariable Robust Adaptive Controllers, pp. 6154-6159

Namaki-Shoushtari, Omid — K. N. Toosi Univ. of Tech.
Khaki Sedigh, Ali — K.N. Toosi Univ. of Tech.
Araabi, Babak N. — Univ. of Tehran

This paper presents a robust adaptive control design methodology for multi-input multi-output (MIMO) plants based on Quantitative Feedback Theory (QFT) and Externally Excited Adaptive System (EEAS), both of which are the novel ideas of Horowitz. Self Oscillating Adaptive Systems (SOAS) are proposed to mainly overcome the problem of large gain variations, which is important in certain applications. To further improve the SOAS design, the idea of EEAS was developed. Finally, combined QFT and EEAS proposed a robust adaptive controller for SISO uncertain plants. However, due to the complex design nature of the proposed combined methodology and the difficulty of an optimal design, this line of Horowitz's research was not followed further. In this paper, to overcome the above mentioned problems the design procedure is reformulated as a set of cost functions and constraints. Genetic Algorithms are then used to solve the optimal design. Also, QFT/EEAS design is extended to multivariable uncertain plants. Sufficient conditions are derived to assure the achievement of given off-diagonal performance. Then, the given main channel performance could be achieved by using SISO QFT/EEAS method. Simulation studies indicate the effective performance of the proposed QFT/EEAS MIMO design methodology. It is shown that the proposed approach can handle large plant parameter uncertainties with lower loop bandwidths.

16:30-18:30 TuC01.72

Robust One-Step Model Predictive Control for Discrete Time-Delay Systems, pp. 6160-6165

Shi, Yujing — Northeastern Univ.
Chai, Tianyou — Northeastern Univ.
Yue, Heng — Northeastern Univ.

In this paper a robust one-step model predictive control (MPC)scheme is developed for discrete time-delay systems with polytopic-type uncertainty. The proposed MPC is obtained by minimizing a new cost function that includes multi-terminal weighting terms, subject to constraints on input. This MPC scheme allows the first move u(k|k) to be separated from the control moves governed by a state feedback law, which can reduce conservatism and improve feasibility and optimality. A linear matrix inequality (LMI) approach is applied to the controller synthesis. It can be shown that the proposed model predictive controller guarantees closed-loop stability. Simulation results are given to illustrate the performance of the proposed algorithm.

16:30-18:30 TuC01.73

Model Bridge Control-Multi-Degree of Freedom Design for High Robustness and High Performances, pp. 6166-6171

Watanabe, Keiji — Yamagata Univ.
Wang, Rui — Yamagata Univ.

This paper proposes a new concept of robust control – Model Bridge Control (MBC). The MBC is a multi-degree of freedom control based on the model bridge principle (MBP) that the gaps between objects and achievements are bridged by individual models. The key of MBC is the error compensation by the model which covers both gain and phase of the error. This breaks through the trade-off between the robust stability and performances, and yields high robustness and high performances simultaneously beyond the small gain theorem. A new robust stability criteria and systematic design method are presented.

16:30-18:30 TuC01.74

Stability of TCP/AQM Networks Based on a Switched Time-Delay System Modeling, pp. 6172-6177

Lu, Zongtao	Case Western Res. Univ.
Lin, Wei	Case Western Res. Univ.
Liberatore, Vincenzo	Case Western Res. Univ.
Sun, Yuanzhang	Tsinghua Univ.

We study the modeling and stability of TCP/AQM systems. The control-theoretic framework used in most of the previous work is linear system theory. Based on the linearization of nonlinear congestion control systems, classical linear techniques, such as the Nyquist or Bode criteria, are applied for the analysis of stability. The success of the linearization method depends on the assumption that the equilibrium is far away from the zero queue length point so that the linearization is well-deŻned. In this paper, the nonlinearity of the queue part is taken into consideration and TCP/AQM systems with proportional control are modeled as a class of switched time-delay systems. For such systems, we employ a Lyapunov approach and establish stability results. Simulations are presented to demonstrate the effectiveness of the stability analysis.

TuC02 304A

Asymptotic Stabilization of Nonlinear Systems (Regular Session)

Chair: Johansson, Rolf	Lund Univ.
Co-Chair: Tsuzuki, Takayuki	Shimane Univ.

16:30-16:50 TuC02.1

Global Asymptotic Stabilization for a Nonlinear System on a Manifold Via a Dynamic Compensator, pp. 6178-6183

Tsuzuki, Takayuki	Shimane Univ.
Yamashita, Yuh	Hokkaido Univ.

The purpose of this paper is to solve a global asymptotic stabilization problem for a nonlinear control system on a Riemannian manifold. As well known, a system on a noncontractible manifold is not globally asymptotically stabilizable via a C1 feedback law. This problem results from the existence of multiple singular points of such a controlled system. It is shown that if all the singular points can be assigned to a subset of the extended state space using a dynamic compensator and a C0 feedback, then the original system becomes globally asymptotically stable. Moreover, a method for stabilization is developed using a dynamic compensator and a global control Lyapunov function for an input-affine system. Finally, we propose a method for constructing the control Lyapunov function for a controllable system.

16:50-17:10 TuC02.2

Dynamically Scaled Generalized Inversion for Asymptotic Stabilization of Underactuated Spacecraft Dynamics, pp. 6184-6189

Bajodah, Abdulrahman H.	King Abdulaziz Univ.

Novel concept of feedback linearization is introduced for smooth asymptotic stabilization of underactuated spacecraft equipped with one and two degrees of actuation. The concept is based on generalized inversion, and is aimed at asymptotically realizing a perturbation from the unrealizable feedback linearizing transformation. A desired stable second-order linear dynamics in a norm measure of the angular velocity components about the unactuated axes is prescribed. Evaluation of this dynamics along the vector field defined by the underactuated Euler's dynamical equations of angular motion results in a relation that is linear in the control variables. This relation is used to assess realizability of the desired unactuated dynamics, resulting in necessary and sufficient conditions for asymptotic stabilizability of underactuated spacecraft. Generalized inversion of the relation produces a control law that is composed of particular and auxiliary parts. The generalized inverse in the particular part is scaled by a dynamic factor that depends on the spacecraft angular velocity components about the spacecraft actuated axes, such that the generalized inverse converges uniformly to the standard Moore-Penrose generalized inverse as the transient response decays, resulting in asymptotic realization of the desired unactuated stable linear dynamics. The null-control vector in the auxiliary part of the control law is chosen for asymptotic stable perturbed feedback linearization of the actuated subsystem.

17:10-17:30 TuC02.3

Stabilization of Nonlinear Systems Using Weak-Control-Lyapunov Functions, pp. 6190-6195

Nishida, Gou	RIKEN
Tsuzuki, Takayuki	Shimane Univ.
Nakamura, Hisakazu	Nara Inst. of Science &Tech.
Yamashita, Yuh	Hokkaido Univ.

This paper proposes a recursive method of constructing weak-control-Lyapunov functions for nonlinear systems. Lyapunov function is one of effective tools to study stability and stabilization in nonlinear system control design. However, a general way of finding Lyapunov functions has not been known yet. Our method is introduced by an explicit topological-geometric assumption for a state space manifold, called a Morse-Smale. The assumption indicates that there exists a sequence of inclusions of the manifold and its singular structures, called a weak-Lyapunov filtration. From this structure, we can construct a finite number of iterations to define weak-control-Lyapunov functions. As a result, the existence of the weak-control-Lyapunov functions can be specified by the investigation of property of manifolds.

17:30-17:50 TuC02.4

Separation Principle for a Class of Nonlinear Feedback Systems Augmented with Observers, pp. 6196-6201

Shiriaev, Anton	Umea Univ.
Johansson, Rolf	Lund Univ.
Robertsson, Anders	LTH, Lund Univ.
Freidovich, Leonid	UmeÍ Univ.

The paper suggests conditions for presence of quadratic Lyapunov functions for nonlinear observer based feedback systems with an 'input nonlinearity' in the feedback path. Provided that the system using state feedback satisfies the circle criterion (i.e., when all states can be measured), we show that stability of the extended system with output feedback control from a (full state) Luenberger-type observer may be concluded using the circle criterion. As another result, we state a separation principle for a class of feedback systems with an input nonlinearity. When only local stability results can be stated, our method provides an estimate of the region of attraction.

17:50-18:10 TuC02.5

A Class of Nonlinear RLC Circuits Globally Stabilizable by Proportional Plus Integral Controllers, pp. 6202-6207

Castańos, Fernando	Lab. des Signaux et Systčmes
Jayawardhana, Bayu	Univ. of Manchester
Ortega, Romeo	LSS-SUPELEC
Garcia-Canseco, Eloisa	Univ. of Groningen

In this note we identify graph-theoretic conditions which allow to write an RLC circuit as port-Hamiltonian with constant input matrices. We show that under additional monotonicity conditions of the network's components, the circuit enjoys the property of relative passivity, an extended notion of classical passivity. The property of relative passivity is then used to build simple, yet robust and globally stable, Proportional plus Integral controllers.

18:10-18:30 TuC02.6

Componentwise Stabilization of Interval Systems, pp. 6208-6213

Pastravanu, Octavian C.	Tech. Univ.
Matcovschi, Mihaela-Hanako	Tech. Univ. Gh. Asachi of Iasi

The componentwise stability of a linear system is a special type of asymptotic stability induced by the existence of exponentially decreasing rectangular sets that are invariant with respect to the free response. An interval system x'(t) =Ax(t) +Bu(t) , A_;[A_;,A+], B_;[B_;,B+], is componentwise stabilizable if there exists a constant feedback u(t) = Fx(t) that ensures the componentwise stability of the whole family of linear systems defined by x'(t) = (A+BF)x(t) . The paper formulates computable necessary and sufficient conditions for the componentwise stabilizability of interval systems. It is shown that the componentwise stabilizing feedback matrices define the solution set of two equivalent linear inequalities These results are further exploited to construct a linear programming problem for which (i) the absence of a feasible solution means the componentwise stabilization is not possible, (ii) a feasible solution provides a componentwise stabilizing feedback matrix. The applicability of the theoretical development is illustrated by a numerical example.

TuC03 304B

Applications of Higher Order Sliding Mode Control (Invited Session)

Chair: Boiko, Igor — IMB Controls
Co-Chair: Shtessel, Yuri B. — Univ. of Alabama at Huntsville
Organizer: Boiko, Igor — IMB Controls
Organizer: Shtessel, Yuri B. — Univ. of Alabama at Huntsville
Organizer: Pisano, Alessandro — Univ. di Cagliari

16:30-16:50 TuC03.1

Non-Parametric Tuning of PID Controllers Via Modified Second-Order Sliding Mode Algorithms (I), pp. 6214-6219

Boiko, Igor — IMB Controls

An application of the modified second-order sliding mode (SOSM) algorithms to a PID controller tuning is presented. The proposed method utilizes the opportunity of exciting test oscillations in the controller-process loop at the frequency corresponding to a desired phase lag of the process. This allows for this frequency to become the phase crossover frequency in the closed-loop system with a PID controller if the tuning rules are formulated as non-parametric rules in terms of the “ultimate frequency” and “ultimate gain”. The use of those properties results in designing a simple tuning method that provides the desired stability of the system. A simple test that involves measurements of the amplitude and of the frequency of the self-excited oscillations and non-parametric tuning rules that provide desired gain margins exactly are presented.

16:50-17:10 TuC03.2

Second Order Sliding Mode (SOSM) Approach to Orbital Stabilization of Friction Pendulum Via Position Feedback (I), pp. 6220-6225

Orlov, Yury — CICESE
Raul Santiesteban Cos, Raul Santiesteban Cos — CICESE
Aguilar, Luis T. — CITEDI-IPN
Acho, Leonardo — EUETIB-Univ. Pol. of Catalunya

A second order sliding mode (SOSM) approach is proposed for orbital stabilization of a friction pendulum, operating under uncertain conditions. Only position measurements are assumed to be available. A SOSM velocity observer is developed and included into the closed-loop system, driven by the quasihomogeneous controller that provides orbital stabilization of the pendulum. Performance issues of the observer-based position feedback synthesis are illustrated in a simulation study.

17:10-17:30 TuC03.3

Integrated Autopilot and Guidance for Dual Control Missiles Using Higher Order Sliding Mode Control and Observers (I), pp. 6226-6231

Tournes, Christian — Davidson Tech.
Shtessel, Yuri B. — Univ. of Alabama at Huntsville

An integrated Autopilot-and Guidance Algorithm is developed using Higher Order Sliding Mode Control, for interceptors steered by combination of aerodynamic lift, sustainer thrust and center of gravity divert thrusters. A smooth HOSM guidance generates flight path trajectory angular rates and attitude rate commands. The attitude rate maneuvers are aimed at producing desired aerodynamic lift and / or orienting sustainer thrust. The lateral acceleration created by the attitude maneuver is treated as a “cooperative” disturbance and accounted for by the trajectory control. SOSM autopilot design is based on nonlinear dynamic sliding manifold. Proposed algorithm also includes seeker tracker, bore sight stabilization and estimation of target lateral acceleration. The algorithm is tested using computer simulations against a ballistic maneuvering target.

17:30-17:50 TuC03.4

High Order Sliding Mode Control of a Sensorless Induction Motor (I), pp. 6232-6237

Traoré, Dramane — Ec. Centrale De Nantes-CNRS
Plestan, Franck — Ec. Centrale De Nantes-CNRS
Glumineau, Alain — Ec. Centrale Nantes
De Leon, Jesus — Univ. Autonoma de Nuevo Leon

A new High Order Sliding Mode (HOSM) controller and an adaptive observer for sensorless induction motors (IM) drive are designed. The adaptive interconnected observer estimates the fluxes, the angular velocity, the load torque, and the stator resistance. The speedflux control law is an original HOSM one: a sliding manifold is designed in order to ensure finite-time convergence of sliding variable and its high order time derivatives. The Lyapunov theory is used to prove the stability of the observer then the stability of the "observer-controller". To test the feasbility of the proposed solutions, a significant low frequency benchmark is used by considering the sensorless control problem of IM. Robustness with respect to parameters variations is proved and experimentally verified.

17:50-18:10 TuC03.5

Compressor Surge Suppression by Second-Order Sliding Mode Control Technique (I), pp. 6238-6244

Pisano, Alessandro — Univ. di Cagliari
Bartolini, Giorgio — Univ. of Cagliari
Muntoni, Aldo — Univ. of Cagliari
Usai, Elio — Univ. degli Studi di Cagliari

Surge is one of the two main dynamic instabilities that can occur in compressor systems (the other is the rotating stall) preventing their satisfactory operation and being potential cause of serious damages.

In this paper we consider a Close Coupled Valve (CCV) as actuator, and we suggest the use of a second-order sliding-mode (2-SM) technique for the active control of the surge phenomenon. We refer to the Moore-Greitzer model with cubic compressor characteristics, and we show that the proposed technique can drive the system towards a stable operating point by rejecting a significant class of persistent pressure and flow disturbances acting on the system. Furthermore, the perfect knowledge of the compressor and load characteristics is not required to design the controller.

18:10-18:30 TuC03.6

Higher Order SM Control of Nonlinear Systems with Unmodeled Actuators (I), pp. 6245-6250

Loukianov, Alexander G. — CINVESTAV IPN GDI
Fridman, Leonid M. — Univ. of Mexico
Canedo, Jose M. — CINVESTAV
Soto-Cota, Adolfo — Ph.d. Student
Sanchez, Edgar N. — CINVESTAV

In this paper, a control strategy is proposed for robust stabilization of nonlinear perturbed plants in the presence of actuator unmodeled dynamics. The block control technique is applied to design a nonlinear SM manifold for achieving the error tracking, and High Order Sliding Mode (HOSM) algorithm is implemented to ensure finite time convergence of the state vector to the designed SM manifold. A robust exact differentiator is designed to obtain the estimates of the sliding variable and its derivatives. The proposed method is applied to design robust controllers for a power electric system in the presence of the exciter system unmodeled dynamics.

TuC04 308

Applications of Nonlinear Control V (Regular Session)

Chair: Marconi, Lorenzo — Univ. di Bologna
Co-Chair: Tyukin, Ivan — Univ. of Leicester

16:30-16:50 TuC04.1

Attenuation of Slugging in Unstable Oil Wells by Nonlinear Control, pp. 6251-6256

Kaasa, Glenn-Ole — Hydro Res. Centre
Alstad, Vidar — Norsk Hydro ASA
Zhou, Jing — Norwegian Univ. of Science and Tech.
Aamo, Ole Morten — NTNU

This paper illustrates the potential of nonlinear model-based control applied for stabilization of unstable flow in oil wells. A simple empirical model is developed that describes the qualitative behavior of the downhole pressure during severe riser slugging. A nonlinear controller is designed by an integrator backstepping approach, and stabilization for open-loop unstable pressure setpoints is demonstrated. The proposed backstepping controller is shown in simulations to perform better than PI and PD controllers for low pressure setpoints, and is in addition easier to tune. Operation at a low pressure setpoint is desirable since it corresponds to a high production flow rate.

16:50-17:10 TuC04.2

A Simple Feedback-Loop for a Frequency Lock on a Narrow Atomic Transition, pp. 6257-6262

Bonnabel, Silvere — Univ. de Ličge
Dubois, Guilhem — Ec. Normale Supérieure -

UPMC-Paris 6 - CNRS
Rouchon, Pierre ENSMP

In this paper we consider an atomic system with a narrow transition probed with a user-controlled electromagnetic radiation, the basis of atomic clocks. We propose a simple feedback-loop in order to lock automatically the probe frequency on the atomic transition, allowing continuous clock operation without any preparation steps. The proof of the convergence of the feedback-loop is based on averaging arguments, with approximations compatible with realistic physical parameters. Numerical simulations illustrate the robustness of the proposed feedback-loop versus measurement noise and bias.

17:10-17:30 TuC04.3

Predator-Prey Dynamics Subject to a Threshold Policy with Hysteresis, pp. 6263-6268

Mendoza Meza, Magno Enrique — Federal Univ. of Rio de Janeiro
Bhaya, Amit — Federal Univ. of Rio De Janeiro
Kaszkurewicz, Eugenius — Univ. Federal de Rio de Janeiro-Brazil

This paper introduces a threshold policy with hysteresis (TPH) for the control of one-predator one-prey models. The models studied are the Lotka-Volterra (LV) and Rosenzweig-MacArthur (RM) two species density-dependent predator-prey models. The proposed policy (TPH) changes the dynamics of the system in such a way that a bounded oscillation is achieved. The policy can be designed by a suitable choice of so called virtual equilibrium points in a simple and intuitive manner.

17:30-17:50 TuC04.4

Non-Uniform Small-Gain Theorems for Systems with Critical and Slow Relaxations, pp. 6269-6276

Tyukin, Ivan — Univ. of Leicester
Nijmeijer, Hendrik — Eindhoven Univ. of Tech.
Van Leeuwen, Cees — Riken Brain Science Inst.

We consider the problem of small-gain analysis of asymptotic behavior in interconnected nonlinear dynamic systems. Mathematical models of these systems are allowed to be uncertain and time-varying. In contrast to standard small-gain theorems that require global asymptotic stability of each interacting component in the absence of inputs, we consider interconnections of systems that can be critically stable and have infinite input-output L_infty gains. For this class of systems we derive small-gain conditions specifying state boundedness of the interconnection. The estimates of the domain in which the system's state remains are also provided. Conditions that follow from the main results of our paper are non-uniform in space. That is they hold generally only for a set of initial conditions in the system's state space. We show that under some mild continuity restrictions this set has a non-zero volume, hence such bounded yet potentially globally unstable motions are realizable with a non-zero probability. Proposed results can be used for the design and analysis of intermittent, itinerant and meta-stable dynamics which is the case in the domains of control of chemical kinetics, biological and complex physical systems, and non-linear optimization. The main results are illustrated with simple examples, and relation of our results with the standard small-gain conditions is discussed.

17:50-18:10 TuC04.5

Linear Robust Control for a Nonlinear Active Suspension Model Considering Variable Payload, pp. 6277-6282

Herrnberger, Michael — Tech. Univ. München
Maeder, Dominik — Tech. Univ. of Munich, Germany
Lohmann, Boris — Tech. Univ. Munich

The control of active suspension systems is described in many publications over the last decades. However, often only idealized linear models are used for control design and simulations, what can lead to wrong conclusions regarding controller performance and energy costs. Therefore, this paper presents a nonlinear passive suspension model of a quarter car test-rig currently built up at the Institute of Automatic Control which can be extended with models of active elements. Furthermore it is lined out, how a robust controller can be synthesized for this system. For this purpose the nonlinear model is linearized around the equilibrium point and parametric model uncertainties are introduced together with performance weighting functions. In order to include the influence of the variable chassis payload into the design process, a trim point uncertainty is added which completes the structured uncertainty model. With this a modern robust control design approach using the structured singular value can be presented, considering different chassis masses and their influence on the linearization point. Finally it is demonstrated, how robust performance or robust stability can be analyzed if a linear controller already exists.

18:10-18:30 TuC04.6

Integral Sliding Mode Control for Improved Robustness and Accuracy of Induction Motors, pp. 6283-6288

Mohamed, Haider Abbas F. — Univ. of Malaya
Yang, Soo Siang — Univ. of Malaya
Moghavvemi, Mahmoud — Univ. of Malaya

This paper proposes the use of sliding mode control to improve the performance of field-oriented speed controllers of induction motors. The integral sliding mode control provides means to obtain an accurate estimate for disturbances and plant parameter perturbations. This estimator is to be used as an auxiliary control loop to reject these disturbances and parameter perturbations while avoiding chattering in the main control loop. The result is a controller with high degree of robustness and accuracy. Stability is achieved by using a design procedure based on a Lyapunov function. The feasibility of implementing such controllers is verified on a highly nonlinear system, an induction motor. Whether loaded or unloaded, the proposed integral sliding mode controller has proved to achieve high performance.

TuC05 307

Analytic Design of Control Systems (Regular Session)

Chair: Varga, A. — DLR Oberpfaffenhofen
Co-Chair: Lin, Zongli — Univ. of Virginia

16:30-16:50 TuC05.1

A Parametric Lyapunov Equation Approach to Low Gain Feedback Design for Discrete-Time Systems, pp. 6289-6294

Zhou, Bin — Harbin Inst. of Tech.
Lin, Zongli — Univ. of Virginia
Duan, Guang-Ren — Harbin Inst. of Tech.

Low gain feedback, a parameterized family of stabilizing state feedback gains whose magnitudes approach zero as the parameter decreases to zero, has found several applications in constrained control systems, robust control and nonlinear control. In the continuous-time setting, there are currently three ways of constructing low gain feedback laws: the eigenstructure assignment approach, the parametric ARE based approach and the parametric Lyapunov equation based approach. The eigenstructure assignment approach leads to feedback gains explicitly parameterized in the low gain parameter. The parametric ARE based approach results in a Lyapunov function along with the feedback gain, but requires the solution of an ARE for each value of the parameter. The parametric Lyapunov equation based approach possesses the advantages of the first two approaches and results both an explicitly parameterized feedback gains and a Lyapunov function. The first two approaches have been extended to discrete-time setting. This paper develops the parametric Lyapunov equation based approach to low gain feedback design for discrete-time systems.

16:50-17:10 TuC05.2

On Computing Nullspace Bases - a Fault Detection Perspective, pp. 6295-6300

Varga, A. — DLR Oberpfaffenhofen

We discuss computationally efficient and numerically reliable algorithms to compute minimal proper nullspace bases of a rational or polynomial matrix. The underlying main computational tool is the orthogonal reduction to a Kronecker-like form of the system matrix of an equivalent descriptor system realization. A new algorithm is proposed to compute a simple minimal proper nullspace basis, starting from a non-simple one. Minimal dynamic cover based computational techniques are used for this purpose. The discussed methods allow a high flexibility in addressing in a numerically sound way several applications in fault detection.

17:10-17:30 TuC05.3

Boundary Predictive Control of Second-Order Linear Modulus-Constant Distributed Parameter Systems Based on Wavelets Transformation, pp. 6301-6306

Ding, Douzhang — East China Univ. of Science and Tech.
Gu, Xingsheng — East China Univ. of Science and

Tech.

Control system design of distributed parameter system is the difficulty of control theory. A new idea to control of distributed parameter system is to induct the boundary control idea into predictive control of distributed parameter system based on wavelets transformation. Discrete-time boundary predictive control algorithm of second-order linear modulus-constant distributed parameter system based on orthogonal wavelets transformation is proposed in this paper. Second-order linear modulus-constant distributed parameter system in boundary control is approximated in Haar wavelets transformation. So the predictive control proposition of distributed parameter system has been transformed into the predictive control issue of lumped parameter system. The boundary predictive controller is designed for the input returning to the boundary predictive control rule of the original system. Simulation studies of the proposed algorithm, as well as the system robustness under uncertainty such as the parameters perturbations, and a disturb occurring to the system output are showed. The results have verified the control effectiveness of the proposed algorithm.

17:30-17:50 TuC05.4

A Multi-Parametric Optimization Strategy for Multilevel Hierarchical Control Problems., pp. 6307-6312

Faisca, Nuno	Imperial Coll. London
Kouramas, Konstantinos	Imperial Coll. London
Pistikopoulos, Efstratios N.	Imperial Coll.

In this work the three–level hierarchical control problem and the decentralised control problem are investigated and a general optimisation strategy is developed for solving these problems based on recent developments on multi–parametric programming. The main idea is to recast each optimisation subproblem in the multilevel hierarchy as a multi–parametric programming problem and then transform the multilevel problem into a single-level optimisation problem. This allows for the control policies (decisions) at each level of the multilevel optimisation problem to be obtained as explicit functions of the state of the dynamic systems involved in each level and the control policies of the higher levels. A three person dynamic optimisation problem is presented to illustrate the mathematical developments.

17:50-18:10 TuC05.5

Propagation of Mean Anisotropy of Signals in Filter Connections, pp. 6313-6318

Kurdyukov, A.P.	Russian Acad. of Sciences
Vladimirov, Igor	The Univ. of Queensland

The anisotropy-based approach to robust control in stochastic systems occupies a unifying intermediate position between the H_2 and H_inf-optimal control theories. Initiated at the interface of Information Theory and Robust Control about fourteen years ago, the approach employs the a-anisotropic norm of a linear system as its worst-case sensitivity to input random disturbances whose mean anisotropy is bounded by a nonnegative parameter a. The latter quantities the temporal "colouredness" and spatial "non-roundness" of the signal by its minimal relative entropy production rate with respect to Gaussian white noises with scalar covariance matrices. Revisiting the underlying definitions, the paper emphasizes the role of feedback in the construct of mean anisotropy of signals and discusses propagation of the latter through various filter connections. The results can be used to support physical and engineering intuition for a "rational" choice of the mean anisotropy level a in the design of anisotropy-based robust controllers.

18:10-18:30 TuC05.6

Non-Parametric H_infty Control Synthesis with Suboptimal Controller Sets., pp. 6319-6324

Den Hamer, A.J.	Eindhoven Univ. of Tech.
Steinbuch, Maarten	Eindhoven Univ. of Tech.
Weiland, Siep	Eindhoven Univ. of Tech.
Angelis, Georgo	Philips Applied Tech.

The effectiveness of norm-based control methodologies heavily relies on the quality of the model that describes the dynamic behavior of the plant. In practical applications, the requirement to accurately describe the system at hand often results in high-order plant-models. On the other hand, low-order models are desired to end-up with low-order controllers that reduce implementational costs. The resulting trade-off between dynamical order and closed-loop performance can not be handled in a straightforward manner since the closed-loop behavior is unknown at the moment of plant-parametrization.

This paper proposes a method to overcome this trade-off via non-parametric H_infty control-synthesis, i.e. omitting parametrization of the plant. As a result, no data-reduction or data-interpolation is performed before synthesis. The resulting controller is represented as Frequency Response Sets for a given frequency grid. This data can be used as input for controller parametrization with explicit trade-off between closed-loop performance and controller order.

This is achieved by considering the mixed-sensitivity problem as a model-matching problem based on Youla-parametrization. Via a specific conceptual choice of the coprime-factorization for the Youla parametrization, it is proved that the SISO H_infty control synthesis problem can be solved in a non-parametric way based on the plant zeros and frequency response coefficients of the system solely. A simulation study is performed on a fourth-order system to illustrate the main steps in the approach.

TuC06 310A

Delays in Interconnected Systems (Invited Session)

Chair: Niculescu, Silviu-Iulian	Lab. of Signals and Systems (L2S), UMR CNRS8506,CNRS-SUPELEC
Co-Chair: Dugard, Luc	CNRS-INPG-UJF
Organizer: Dugard, Luc	CNRS-INPG-UJF
Organizer: Niculescu, Silviu-Iulian	Lab. of Signals and Systems (L2S), UMR CNRS 8506,CNRS-SUPELEC

16:30-16:50 TuC06.1

A Convolution Approach for Delay Systems Identification (I), pp. 6325-6329

Belkoura, Lotfi	Univ. de Lille 1
Richard, Jean-Pierre	Ec. Centrale de Lille
Fliess, Michel	Ec. Pol.

This paper deals with on-line identification of delay systems. Based on non-asymptotic techniques, the estimation approach reduces to solving polynomials or eigenvalue problems. Numerical simulations with noisy data but also with slowly time varying parameters and delay are provided.

16:50-17:10 TuC06.2

Supply Network Dynamics and Delays; Performance, Synchronization, Stability (I), pp. 6330-6335

Sipahi, Rifat	Northeastern Univ.
Delice, Ismail Ilker	Northeastern Univ.

Recent research results in operations research specifically emphasize the critical role of delays in the functionality of supply networks. Delays arise due to the time needed for material deliveries, information flow and human perception towards adjusting to new decisions. Delays contaminate decision-making and lead to poor performance, synchronization problems and fluctuations in inventory levels resulting in major economical losses. This paper surveys continuous time deterministic mathematical models developed at system-level for supply network dynamics along with standard delay models pertaining to material deliveries, information flows and human perception. Next, the analogy between such delay models arising in supply networks and other real-life applications is pointed out. It is foreseen that complexity of the problem requires multi-disciplinary research bridging operations research, business, systems and control engineering, and mathematics. The paper concludes with an illustrative example and discussions of specific challenges anticipated in future research.

17:10-17:30 TuC06.3

Control of a Remote System Over Network Including Delays and Packet Dropout (I), pp. 6336-6341

Seuret, Alexandre	Royal Inst. of Tech.
Richard, Jean-Pierre	Ec. Centrale de Lille

This work concerns the observer-based control of a remote, Master-Slave system through the Internet network. This communication link introduces variable, asymmetric and unpredictable delays, as well as packet loss. The data-sampling effects are also taken into account, even in the aperiodic case. Whereas the existing strategies require additional butters, allowing the delay to become constant, the present result uses the information as soon as received. The proposed

Lyapunov-Krasovskii functionals and LMI algorithms provide controller and observer gains which ensure the asymptotic stability of the global closed loop. The maximum admissible number of successive packets dropouts is also computed. The last part of the paper provides a simulation, where the Slave is a second-order system.

17:30-17:50 TuC06.4

On Strongly Stabilizing Controller Synthesis for Time Delay Systems (I), pp. 6342-6346

Ozbay, Hitay — Bilkent Univ.

In this paper, a strongly stabilizing controller design method, proposed earlier for finite dimensional systems, is extended to a class of time delay systems. A special factorization of the plant is done first. Then, an infinite dimensional one-block H-infinity control problem is solved using existing techniques. The solution of this H-infinity control problem, together with the stable coprime factors of the plant give the stable controller stabilizing the feedback system. The method is illustrated with a numerical example. The example also shows the effects of internal and input/output time delays on the solvability of the strong stabilization problem using this approach.

17:50-18:10 TuC06.5

Robust Motion Synchronization Control for Interconnected Systems with Human Interaction (I), pp. 6347-6352

Cheong, Joono — Korea Univ.

Niculescu, Silviu-Iulian — Lab. of Signals and Systems (L2S)

This paper addresses synchronization control and the associated practical issues for the class of interconnected systems with time delay. We consider uncertainty in the plant model as a disturbance, and to cope with it, a disturbance compensation scheme -- the so-called disturbance observer -- is presented. We examine the performance of the compensation scheme and its effect to overall stability. For applications with human interaction, the effect of additional dynamics from human operator is also investigated. To validate our claims on these issues, numerical simulations are presented.

18:10-18:30 TuC06.6

Modeling Approaches and Robust Stability Conditions for Networked Controlled Systems with Uncertain Delays, pp. 6353-6358

Dritsas, Leonidas — Univ. of Patras

Tzes, Anthony — Univ. of Patras

In this article two modeling approaches for Networked Controlled Systems (NCS) with different types of uncertainly varying bounded transmission delays and static discrete–time control laws are presented. Different models are offered for each case, all linked to the objective of designing robust discrete-time controllers. It is analytically shown how the careful mixing of asynchronous (event–driven) and synchronized (clocked) signals can lead to discrete time uncertain (possibly switched) systems, where results form robust control analysis and synthesis can be applied. After showing the implications of these modelling results for control synthesis purposes, sufficient conditions for the robust stability are given for each approach and a comparison of the conservatism of results is discussed.

TuC07 310B

Robustness Analysis (Regular Session)

Chair: Petersen, Ian Richard — Univ. of New South Wales - ADFA

Co-Chair: Hagiwara, Tomomichi — Kyoto Univ.

16:30-16:50 TuC07.1

Frequency-Dependent Scaling Induced by Noncausal Linear Periodically Time-Varying Scaling for Discrete-Time Systems, pp. 6359-6364

Hagiwara, Tomomichi — Kyoto Univ.

Ohara, Yasuhiro — Kyoto Univ.

A novel technique called noncausal linear periodically time-varying (LPTV) scaling was introduced recently, and it was shown that even static noncausal LPTV scaling has an ability of inducing frequency-dependent scaling if it is interpreted in the context of the conventional scaling approach. Motivated by this preceding study of ours, this paper studies to exploit this attractive property and demonstrates with numerical examples that it leads to quite effective robust stability analysis. The idea of noncausal LPTV scaling is then applied to the robust stability analysis of continuous-time systems via the Tustin transformation, and the effectiveness of such an approach is again demonstrated with a numerical example.

16:50-17:10 TuC07.2

The Real DFM Radius and Minimum Norm Plant Perturbation for General Control Information Flow Constraints, pp. 6365-6370

Lam, Simon — Univ. of Toronto

Davison, Edward J. — Univ. of Toronto

The real decentralized fixed mode radius measures how ``near'' a decentralized LTI system is from having a decentralized fixed mode (DFM) present. In this paper, some properties of the real DFM radius are discussed, a procedure for computing the actual system parametric perturbations that achieves the real DFM radius is presented, and the real DFM radius is extended to deal with structured perturbations and general information flow constraints. A study of applying the radius to determine how to pair system inputs and outputs to obtain a robust decentralized control system structure with respect to parametric perturbations is also presented.

17:10-17:30 TuC07.3

The Transmission Zero at S Radius and the Minimum Phase Radius of LTI Systems, pp. 6371-6376

Lam, Simon — Univ. of Toronto

Davison, Edward J. — Univ. of Toronto

In this paper, the transmission zero at s radius and the minimum phase radius of a linear time-invariant (LTI) system are introduced.The former radius gives a measure of how ``near'' a LTI system is from having a transmission zero at a specified point s in the complex plane, and the latter radius measures how ``near'' a minimum phase system is to a nonminimum phase system. Formulas for computing both radii are presented, along with the procedures for constructing the minimum norm perturbations that achieve the respective radius. Some properties of the two radii and numerical examples are also given.

17:30-17:50 TuC07.4

Invariant Approximations of the Maximal Invariant Set or ``Encircling the Square'', pp. 6377-6382

Rakovic, Sasa V. — ETH Zurich

Fiacchini, Mirko — Univ. de Sevilla

This paper offers a method for the computation of invariant approximations of the maximal invariant set for constrained linear discrete time systems subject to bounded, additive, disturbances. The main advantage of the method is that it generates invariant sets at any step of the underlying set iteration. Conditions under which the sequence of generated invariant sets is monotonically non--decreasing and converges to the maximal invariant set are provided. Explicit formulae for the estimates of the Hausdorff distance between the underlying iterates and the maximal invariant set are derived.

17:50-18:10 TuC07.5

Stability Analysis of Discrete LPV Systems Subject to Rate-Bounded Parameters, pp. 6383-6388

Wei, Chia-Po — National Sun Yat-Sen Univ.

Lee, Li — National Sun Yat-Sen Univ.

This paper considers the stability analysis of the feedback connection of a discrete LTI system and time-varying parameters whose variation intervals and bounds of variation rates are assumed known. To tackle the problem, the robust D-admissibility of uncertain descriptor systems is first analyzed. Based on this result, we derive a necessary and sufficient LMI condition for the existence of a parameter dependent Lyapunov function to ensure the robust stability of the considered LPV system. In view of the infinitely many LMIs involved due to the uncertainty description, three sufficient conditions in finite number of LMIs are derived by means of the vertex separator, the D-G scaling, and the SOS relaxation techniques. Finally, a simple example is used to illustrate the effectiveness of the proposed method.

18:10-18:30 TuC07.6

A Kalman Decomposition for Possibly Controllable Uncertain Linear Systems, pp. 6389-6395

Petersen, Ian Richard — Univ. of New South Wales - ADFA

This paper considers the structure of uncertain linear systems building on concepts of robust unobservability and possible controllability which were introduced in previous papers. The paper presents a new characterization of the possibly controllable states for the case in which a certain system transfer function is non-zero. This result complements the result of a previous paper which presented a characterization of the possibly controllable states for the case in which the transfer function is zero. When combined with previous geometric results on robust unobservability and possible controllability, the results of this paper lead to a general Kalman type decomposition for uncertain linear systems.

TuC08 310C

Robust Control Applications (Regular Session)

Chair: Hong, Boe-Shong (George) — National Chung Cheng Univ.

Co-Chair: Schuster, Eugenio — Lehigh Univ.

16:30-16:50 TuC08.1

Linear Quadratic Energy-Motion Regulators of Electric Motorcycles, pp. 6396-6401

Hong, Boe-Shong (George) — National Chung Cheng Univ.
Huang, Chun-Chia — National Chung Cheng Univ.
Chiu, Ching-Huang — National Formosa Univ.

With the application of H_infinity-control theory to dynamics of electric motorcycles, we obtain a feedback regulator served for keeping the balance between energy consumption and motion responses. This regulator parameterises an ad hoc vehicular personality: the trade-off between economy in energy and quickness in motion. Computer simulations and road tests are provided to verify the practicability of such a parameterisation. In performing experiments, we develop the technology of making industrial controllers, inclusively of robust DSP programs for implementing feedback dynamics into PIC microcontrollers.

16:50-17:10 TuC08.2

Robust Control of Resistive Wall Modes in Tokamak Plasmas Using Mu-Synthesis, pp. 6402-6409

Dalessio, Joseph — Lehigh Univ.
Schuster, Eugenio — Lehigh Univ.
Humphreys, D.A. — General Atomics
Walker, Michael — General Atomics
In, Yongkyoon — FAR-Tech. Inc
Kim, Jin-Soo — FAR-Tech. Inc.

In this work, L';-synthesis is employed to stabilize a model of the resistive wall mode (RWM) instability in the DIII-D tokamak. The GA/Far-Tech DIII-D RWM model is used to derive a linear state space representation of the mode dynamics. The key term in the model characterizing the magnitude of the instability is the time-varying uncertain parameter cpp, which is related to the RWM growth rate ł;. Taking advantage of the structure of the state matrices, the model is reformulated into a robust control framework, with the growth rate of the RWM modeled as an uncertain parameter. A robust controller that stabilizes the system for a range of practical growth rates is proposed and tested through simulations.

17:10-17:30 TuC08.3

Loop Filter Design for Phase-Locked Loops with Guaranteed Lock-In Range, pp. 6410-6415

Chou, Yung-Shan — Tamkang Univ.
Chen, Yu-Cheng — National Taiwan Univ.
Chang, Fan Ren — National Taiwan Univ.

Lock-in range is one of the key parameters which govern the dynamic performance of a phase-locked loop (PLL). For low-order PLLs, coarse formulas can be derived under certain assumptions and approximation for designing loop filters to achieve the performance requirement. However, it is difficult, if not impossible, to establish such relations for high-order PLLs. In this paper, we propose a new loop filter design which, in addition to satisfying the prescribed lock-in range specification, achieves several other performance requirements as well, such as small noise bandwidth and good transient response (small settling time, small overshoot). The proposed method is applicable to PLLs of any order.

17:30-17:50 TuC08.4

A Software Tool for Robust PID Design, pp. 6416-6421

Garpinger, Olof — Lund Univ.
Hagglund, Tore — Professor

This paper presents a fast, interactive and easily modifiable software tool for robust PID design. The Matlab based program is supposed to give people with moderate knowledge on PID control a possibility to learn more and also be a future part of an autotuner. The PID design is made by minimizing the integrated absolute error value during a load disturbance on the process input. The optimization is performed with H_; constraints on the sensitivity and complementary sensitivity function, providing a robust closed loop system. Nelder Mead optimization is used with the AMIGO method providing an initial controller. The proposed method works well, and is very efficient, on a large batch of systems common in process industry. The design tool is also shown to work on a highly oscillatory process model.

17:50-18:10 TuC08.5

Robust Real-Time Control of a Two-Rotor Aerodynamic System, pp. 6422-6427

Petkov, P.Hr. — Tech. Univ. of Sofia
Christov, Nicolai D. — Tech. Univ. of Sofia
Konstantinov, Mihail M. — Univ. of Architecture & Civil Engineering

This paper presents the design and experimental evaluation of a two-degree-of-freedom discrete-time mu-controller for a laboratory two-rotor aerodynamic system with ten uncertain parameters. The controller implemented is of 24th order and ensures robust stability and robust performance of the closed-loop sampled-data system. This controller is realized on a PC by using the Real Time Workshop of MATLAB with a sampling frequency of 100 Hz. The experimental results are close to the results predicted by using the linearized model of the system and highlight many of the difficulties associated with the practical implementation of robust control laws.

18:10-18:30 TuC08.6

Robust Torque Tracking Control for E-IVT Hybrid Powertrain, pp. 6428-6433

Reyss, Olivier — SUPELEC
Duc, Gilles — SUPELEC
Pognant-Gros, Philippe — RENAULT SA
Sandou, Guillaume — SUPELEC

This study deals with the control of a hybrid vehicle powertrain, composed of three actuators (one engine, two electric machines). This powertrain belongs to the Electric-Infinitely Variable Transmission (E-IVT) class. In order to achieve low fuel consumption, drivability and electric power management, controllers have to achieve imultaneously three specifications, namely engine speed, wheel-torque and battery power references. Decoupled controlled-output behaviors and optimal performances are also required. In order to imitate a classical powertrain, the control structure is split in two parts. The interest is to decouple transmission speed ratio control and wheel torque control. A model-based design approach is proposed, that directly deals with robustness and decoupling, in a full multivariable and frequency-dependent framework (Hinfinity synthesis). Closed-loop simulations are presented. Stability and performances subject to disturbances and non-linearities are also evaluated, using the theory of linear parameter varying (LPV) systems.

TuC09 311C

Nonlinear System Identification IV (Regular Session)

Chair: Coluccio, Loredana — Univ. della Calabria

Co-Chair: Sun, Lianming — The Univ. of Kitakyushu

16:30-16:50 TuC09.1

A Decoupling Derivative-Based Approach for Hammerstein System Identification, pp. 6434-6439

Fedele, Giuseppe — Univ. della Calabria
Coluccio, Loredana — Univ. della Calabria

This paper proposes a non iterative algorithm for the identification of Hammerstein model, using the sampled output data obtained from the step response, giving a continuoustime model for the linear part and a point-wise estimation of the nonlinear one. Key in the derivation of the results is the algebraic derivative method in the frequency domain yielding exact formula in terms of multiple integrals of the output signal, when placed in the time domain. By investigating the connection between such integrals and parameters to be estimated, a set of three linear regression equations is proposed. The first equation is used to estimate the structure of poles in the linear part, the second to estimate a point of the nonlinearity, the third to estimate the structure of zeros in the linear part. No a priori knowledge of the structure of the nonlinearity is required. The proposed algorithm is numerically robust, since it is based only on least squares estimation. Simulation results validate the proposed algorithm.

16:50-17:10 TuC09.2

Identification of Hammerstein and Wiener Models Using Spectral Magnitude Matching, pp. 6440-6445

Abd-Elrady, Emad — Graz Univ. of Tech.
Gan, Li — Graz Univ. of Tech.

The problem of the identification of Hammerstein and Wiener models is considered in this paper. The suggested approach in this paper utilizes the spectral magnitude matching method that minimizes the sum squared error between the spectral magnitudes - evaluated for a number of short-time frames - of the measured output signal of the nonlinear system and the output signal of the nonlinear model. The coefficients of Hammerstein and Wiener models are estimated using the generalized Newton iterative algorithm. Simulation results show that the suggested approach gives very good results especially for moderate and high signal to noise ratios.

17:10-17:30 TuC09.3

Modeling and Identification of Electrohydraulic System and Its Application, pp. 6446-6451

Xing, Zongyi — Nanjing Univ. of Science and Tech.
Gao, Qiang — nanjing Univ. of science and Tech.
Wu, Yingying — nanjing Univ. of science and Tech. ins

In general, the first and the most important step in system analysis, prediction and control is the proper model of the system. In order to design the controller of nonlinear electrohydraulic system, several modeling techniques are proposed: the transfer function of the electrohydraulic system is identified using first-principle method, and the intelligent models are built by fuzzy modeling and neural networks. First, the automatic depth control electrohydraulic system (ADCES) of a certain type of weapon is introduced, and how to obtain the input-output data is proposed. Then, three modeling algorithms are detailed, including transfer function, fuzzy system and neural networks. Finally, five models are identified based on the ADCES; and the analysis of the obtained models lays the foundation of the controller design.

17:30-17:50 TuC09.4

Rational Approximation and Identification of Distributed Parameter Systems, pp. 6452-6457

Gubarev, Vyacheslav — National Acad. of Science of Ukraine, NationalSpaceAgencyof U
Zhukov, Oleksii — NationalAcademyofScienceofUkraine,NationalSpaceAgencyofUkraine

The unified infinite dimensional model structure which assumes on its base to develop the method and algorithms of systems rational approximation and identification is proposed for distributed parameter systems with discrete inputs and outputs. The considered truncated realization converges to infinite-dimensional non-rational model of system for nuclear type operators. Approximation is represented by series expansion on independent basis functions which are fundamental solutions of ordinary differential equations. The using of Jordan realization have succeeded in creation of iterative identification algorithm admitting sequential model reconstruction by separate parts consisting of one or several modes.

17:50-18:10 TuC09.5

Identification of Hammerstein Systems with Set-Valued Observations, pp. 6458-6465

Zhao, Yanlong — Chinese Acad. of Sciences

This work is concerned with identification of Hammerstein systems whose outputs are measured by set-valued sensors. The system consists of a memoryless nonlinearity which is polynomial and possibly non-invertible, followed by a linear subsystem. The parameters of linear and nonlinear parts are unknown but have known orders. Input design, identification algorithms, and their essential properties are presented under the assumptions that the distribution function of the noise is known and the threshold values of set-valued sensors are known. The concept of strongly scaled full rank signals is introduced to capture the essential conditions under which the Hammerstein system can be identified with set-valued observations. Under strongly scaled full rank conditions, a strongly convergent algorithm is constructed. The unbias and efficient properties of the algorithm are investigated.

18:10-18:30 TuC09.6

Polytopic Quasi-LPV Model Based on Neural State-Space Models and Application to Air Charge Control of a SI Engine, pp. 6466-6471

Abbas, Hossam — Hamburg Univ. of Tech.
Werner, Herbert — Hamburg Univ. of Tech.

This paper is one of two joint papers, each presenting a different representation of a feedforward neural network. Here a discrete-time polytopic quasi linear parameter varying (LPV) model of a nonlinear system based on a neural state-space model is proposed, whereas in the joint paper (Abbas andWerner [2008]) a neural state-space model is transformed into a linear fractional transformation (LFT) representation to obtain a discrete-time quasi-LPV model of the nonlinear system. As a practical application, air charge control of a spark-ignition (SI) engine is used in both papers to illustrate two different synthesis methods for fixed structure low-order discrete-time LPV controllers. In the present paper, the synthesis of a fixed-structure low-order self-scheduled H_inf controller is based on linear matrix inequality (LMIs) and evolutionary search. A controller is designed for the nonlinear system and its performance is compared with that achieved when a standard self-scheduled H_inf controller is used.

TuC10 311B

Particle Filtering and Monte-Carlo Methods (Regular Session)

Chair: Fu, Li-Chen — National Taiwan Univ.
Co-Chair: Shah, Sirish — Univ. of Alberta

16:30-16:50 TuC10.1

Constrained State Estimation Using Particle Filters, pp. 6472-6477

Prakash, Jagadeesan — Madras Inst. of Tech.
Shah, Sirish — Univ. of Alberta
Patwardhan, Sachin — IIT Bombay

Recursive estimation of constrained nonlinear dynamical systems has attracted the attention of many researchers in recent years. For nonlinear/non-Gaussian state estimation problems, particle filters have been widely used. As pointed by Daum (2005), particle filters require a proposal distribution and the choice of proposal distribution is the key design issue. In this paper, a novel approach for generating the proposal distribution based on a Constrained Unscented Kalman filter is proposed. The efficacy of the proposed constrained state estimation algorithm using a particle filter (CUPF) is illustrated via a successful implementation on a simulated gas-phase reactor.

16:50-17:10 TuC10.2

Identification of Nonlinear Processes with Known Model Structure under Missing Observations, pp. 6478-6483

Gopaluni, Ratna Bhushan — Univ. of British Columbia

A novel maximum likelihood solution to the problem of identifying parameters of a nonlinear model under missing observations is presented. An expectation maximization (EM) algorithm, which uses the expected value of the complete log-likelihood function including the missing observations, is developed. The expected value of the complete log-likelihood (E-step) in the EM algorithm is approximated using particle filters and smoothers. New expressions for particle filters and smoothers under missing observations are derived. The maximization step (M-step) in the EM algorithm is performed using standard optimization routines. The above nonlinear identification approach is illustrated through numerical examples.

17:10-17:30 TuC10.3

Adaptive Particle Filter with Fixed Empirical Density Quality, pp. 6484-6489

Straka, Ondrej — Univ. of West Bohemia
Simandl, Miroslav — Univ. of West Bohemia

The paper deals with the particle filter in state estimation of a discrete-time nonlinear non-Gaussian system. The goal of the paper is to design a sample size adaptation technique to guarantee the quality of an empirical probability density function (pdf) which approximates a target filtering pdf. The quality is measured by inaccuracy (cross-information) between the empirical pdf and the filtering pdf. It is shown that for increasing sample size the inaccuracy converges to the Shannon differential entropy (SDE) of the filtering pdf. The proposed technique adapts the sample size to keep a difference between the inaccuracy and the SDE within pre-specified bounds with a pre-specified probability. The particle filter with the proposed sample size adaptation technique is illustrated in a numerical example.

17:30-17:50 TuC10.4

Estimating Volatility and Model Parameters of Stochastic Volatility Models with Jumps Using Particle Filter, pp. 6490-6495

Aihara, Shin Ichi — Tokyo Univ. of Science, Suwa
Bagchi, Arunabha — Univ. of Twente
Saha, Saikat — Univ. of Twente

Despite the success of particle filter, there are two factors which cause difficulties in its implementation. The first one is the choice of importance functions commonly used in the literature which are far from being optimal. The second one is the combined state and parameter estimation problem. In a widely used Heston model on stochastic volatility in financial literature, we are able to circumvent both these problems. To reflect the most realistic situation, we also include jump in the stochastic volatility model.Numerical results show the effectiveness of the algorithms.

17:50-18:10 TuC10.5

Human Tracking by Importance Sampling Particle Filtering on Omnidirectional Camera Platform, pp. 6496-6501

Song, Chao-Jung — National Taiwan Univ.
Huang, Cheng-Ming — NATIONAL TAIWAN Univ.
Fu, Li-Chen — National Taiwan Univ.

This paper proposes a sequential importance sampling (SIS) particle filtering framework to track the human with overcoming the warping and low resolution. We utilize a foreground-based importance sampling mechanism for efficiently converge to the target distribution. We construct a tracking system with the fusion image likelihood, even the human raises the head. Furthermore, the two-space integration to evaluate the likelihood measurement is proposed to robustly track human for overcome the warping effect. The overall performance has been validated in the experiments.

18:10-18:30 TuC10.6

A Fix-Up for the EKF Parameter Estimator, pp. 6502-6507

Wiberg, Don — UCSC
Oh, Sewon — AJOU Univ.
Youn, Jung Su — samsung-thales company
Johnson, Luke — Univ. of California, Santa Cruz
Hong, Suk Kyo — Ajou Univ.

Abstract: We have reduced recursive parameter estimation to Kalman filtering, with a few added fixes. By incorporating projections in the parameter gain updates and parameter variance estimates, the recursive maximum likelihood method asymptotically becomes a reformulation and fix-up of the extended Kalman filter used as a parameter estimator (EKFPE), except that an additional nxn linear symmetric matrix must also be updated for each parameter estimate. Estimates for both the process and measurement noise variances, as well as for structural parameters, have been proven globally convergent to a local maximum of the likelihood function. This obviates the usual guesswork in finding noise variances when fitting data using the EKFPE, and assures the existence of the innovations representation for the recursive maximum likelihood method. Slightly non-linear and also slightly unstable linear, as well as drastically time-varying stable linear, system parameters can be estimated even in severe noise environments. On average, the rate of convergence of parameter estimates appears to be faster than other methods if no projection limit is hit.

TuC11 311A

Adaptive Control by Neural Networks (Regular Session)

Chair: Stefanovic, Margareta — Univ. of Wyoming
Co-Chair: Benallegue, Abdelaziz — Univ. of Versailles St Quentin

16:30-16:50 TuC11.1

Direct Adaptive NN Control of MIMO Nonlinear Discrete-Time Systems Using Discrete Nussbaum Gain, pp. 6508-6512

Zhai, Lianfei — Northeatern Univ.
Yang, Chenguang — National Univ. of Singapore
Ge, Shuzhi Sam — National Univ. of Singapore
Chai, Tianyou — Northeastern Univ.
Lee, Tong Heng — National Univ. of Singapore

In this paper, direct adaptive neural network (NN) control is developed for a class of multi-input and multi-output (MIMO) nonlinear systems in discrete-time. To solve the difficulty of nonaffine appearance of control, implicit function theorem is exploited to assert the existence of an ideal desired feedback control (IDFC). Then, high-order-neural-network (HONN) is employed to approximate the IDFC. Under the assumption that the inverse control gain matrix has an either positive definite or negative definite symmetric part, the obstacle in NN weights tuning for the MIMO systems is transformed to as similar as unknown control direction problem for SISO system. Then, the difficulty in NN weights tuning is overcame by exploiting the discrete Nussbaum gain, which is combined with deadzone method to treat with external disturbance with unknown upper bound. All signals in the closed-loop system are guaranteed to be semi-globally-uniformly-ultimately-bounded (SGUUB). The effectiveness of the proposed control is demonstrated in the simulation.

16:50-17:10 TuC11.2

Adaptive Control Via Backstepping Technique and Neural Networks of a Quadrotor Helicopter, pp. 6513-6518

Madani, Tarek — Univ. of Versailles St Quentin en Yvelines
Benallegue, Abdelaziz — Univ. of Versailles St Quentin

A nonlinear adaptive controller for the quadrotor helicopter is proposed using backstepping technique mixed with neural networks. The backstepping strategy is used to achieve good tracking of desired translation positions and yaw angle while maintaining the stability of pitch and roll angles simultaneously. The knowledge of all physical parameters and the exact model of the quadrotor are not required for the controller, only some properties of the model are needed. In fact, online adaptation of neural networks and some parameters is used to compensate some unmodeled dynamics including aerodynamic effects. Under certain relaxed assumptions, the proposed control scheme can guarantee that all the signals in the closed-loop system are Uniformly Ultimately Bounded (UUB). The design methodology is based on Lyapunov stability. One salient feature of the proposed approach is that the controller can be applied to any type of quadrotor helicopter of different masses and lengths within the same class. The feasibility of the control scheme is demonstrated through simulation results.

17:10-17:30 TuC11.3

A Fuzzy Neural Network Direct Adaptive Iterative Learning Controller for Robot Manipulators, pp. 6519-6524

Wang, Ying-Chung — Acad. Sinica
Chien, Chiang-Ju — Huafan Univ.
Lee, Der- Tsai — Acad. Sinica

This paper studies the iterative learning control of robotic systems with repetitive tasks. A fuzzy neural network is applied to design a direct adaptive iterative learning controller. The fuzzy neural network is introduced for compensation of the unknown certainty equivalent controller. A new adaptive law using mixed time-domain and iteration-domain adaptation is developed. It is shown that the finiteness of control parameters and control input can be guaranteed for all the time interval during each iteration without using parameter projection.

17:30-17:50 TuC11.4

Neuro Robust Adaptive Descending Control of Space Vehicles, pp. 6525-6529

Zhang, Ran — North Carolina A&T State Univ.
Weng, Liguo — North Carolina A&T State Univ. & National Inst. of
Cai, Wenchuan — North Carolina A&T State Univ.
Zhang, Mingjin — North Carolina A&T State Univ.
Song, Yong D. — North Carolina A&T State Univ.

Accurate descending control is crucial to ensure safe operation of space exploration vehicles. This work investigates automatic trajectory tracking control of space vehicles during landing phase. A set of algorithms for adjusting vehicle heading angle, heading speed and altitude are derived using adaptive robust and neural network control techniques. It is shown that with the proposed control algorithms, external disturbances and coupled dynamics inherent in the system are effectively compensated. Simulations on various flight conditions also confirm the effectiveness of the proposed methods.

17:50-18:10 TuC11.5

Reinforcement Hybrid Evolutionary Learning for TSK-Type Neuro-Fuzzy Controller Design, pp. 6530-6535

Hsu, Yung-Chi — National Chiao-Tung Univ.
Lin, Sheng-Fuu — National Chiao-Tung Univ.

This paper proposes a recurrent TSK-type neuro-fuzzy controller (TNFC) with reinforcement hybrid evolutionary learning algorithm (R-HELA). The proposed R-HELA combines the compact genetic algorithm (CGA) and the modified variable-length genetic algorithm (MVGA) to perform the structure/parameter learning for constructing the TNFC dynamically. The evolution of a population consists of three major operations: group reproduction using the compact genetic algorithm, variable two-part crossover, and variable two-part mutation. Illustrative example is conducted to show the performance and applicability of the proposed R-HELA method.

18:10-18:30 TuC11.6

Performance Improvement in Unfalsified Control Using Neural Networks, pp. 6536-6541

Cao, Jinhua — Univ. of wyoming
Stefanovic, Margareta — Univ. of Wyoming

In this paper, a novel combination of unfalsified control and intelligent control is proposed to improve the dynamic performance of an uncertain system. A PID controller, whose parameters are adaptively tuned by switching among members of a given candidate set using observed plant data, is presented and compared with multi-model adaptive control. Two different cost functions are compared for their capability in selecting the ``best'' controller. The principle of Radial Basis Function Neural Networks (RBFNN) is used to update the parameters of the selected PID controller to further improve the performance. Simulation results demonstrate that the proposed control switching strategy compares favorably to the alternatives.

TuC12 313

Dependable Control of Discrete Event Systems III (Invited Session)

Chair: Frey, Georg — Univ. of Kaiserslautern
Co-Chair: Niel, Eric — INSA de Lyon
Organizer: Faure, Jean-Marc — ENS Cachan
Organizer: Lesage, Jean-Jacques — ENS de Cachan
Organizer: Frey, Georg — Univ. of Kaiserslautern
Organizer: Papadopoulos, Yiannis Ioannis — Univ. of Hull

16:30-16:50 TuC12.1

A Fault Tolerant Architecture for Supervisory Control of Discrete Event Systems (I), pp. 6542-6547

Paoli, Andrea — Univ. of Bologna
Sartini, Matteo — Univ.
Lafortune, Stephane — Univ. of Michigan

In this paper the problem of Fault Tolerant Control (FTC) in the framework of Discrete Event Systems (DES) modeled as automata is considered. The approach we follow is the so-called active approach in which the supervisor actively reacts to the detection of a malfunctioning component in order to eventually meet degraded control specifications. Starting from an appropriate model of the system, we recall the notion of safe diagnosability as a necessary step in order to achieve fault tolerant supervision of DES. We then introduce two new notions: (i) “safe controllability”, which represents the capability, after the occurrence of a fault, of steering the system away from forbidden zones and (ii) “active fault tolerant system”, which is the property of safely continuing operation after faults. We show how it is possible to define a general control architecture to deal with the FTC problem by introducing a special kind of automaton, called a “diagnosing-controller”.

16:50-17:10 TuC12.2

On-Line Fault Inference for Large-Scale Event-Driven Systems Based on Bayesian Network and Timed Markov Model (I), pp. 6548-6553

Inagaki, Shinkichi — Nagoya Univ.
Ogawa, Hideyuki — Nagoya Univ.
Suzuki, Tatsuya — Nagoya Univ.

This paper presents an on-line fault inference, diagnosis ,and detection strategy for large-scale event-driven controlled systems. First of all, the controlled plant is decomposed into some subsystems, and the global diagnosis is formulated using the Bayesian Network (BN), which represents the causal relationship between the fault and observation in subsystems. The graph structure of the BN is constructed based on the control law adopted in the system. Second, the local diagnoser is developed using the conventional Timed Markov Model, and the local diagnosis results are used to specify the conditional probability assigned to each arc in the BN. By exploiting this decentralized architecture, the computational burden for the diagnosis can be distributed in the subsystems. As the result, the diagnosis for large scale practical system can be realized on-line. Finally, the usefulness of the proposed strategy is verified through some experimental results of an automatic transfer line.

17:10-17:30 TuC12.3

Fault Detection of Discrete Event Systems Using Petri Nets and Integer Linear Programming (I), pp. 6554-6559

Fanti, Maria Pia — Pol. of Bari
Dotoli, Mariagrazia — Pol. di Bari
Mangini, Agostino Marcello — Pol. di Bari

The paper addresses the fault detection problem for discrete event systems on the basis of a Petri Net (PN) model. Assuming that the structure of the PN and the initial marking are known, faults are modelled by unobservable transitions. Moreover, we assume that there may be additional unobservable transitions that are associated with the system legal behaviour and that the marking reached after the firing of a transition is unknown. We propose a diagnoser that works on-line: it waits for the firing of an observable transition and employs an algorithm based on the definition of some integer linear programming problems to decide whether the system behaviour is normal or exhibits some possible faults.

17:30-17:50 TuC12.4

Towards a Fault Tolerant Manufacturing Control System (I), pp. 6560-6565

Andreasson, Sven-Arne — Chalmers Univ. of Tech.

The CHAMP (Chalmers Architecture and Methodology for Flexible Production) system isa general control system for manufacturing that can be configured for arbitrary production.

The system consists of producers that can perform operations on products and movers that can move products between producers. Each product is described by a number of operations that are mapped to global operations in the database. A producer can perform any global operation for which it has a program. The mappings of global operations, programs and producers are also present in the database.

Since a global operation can be performed by more than one producer there is an inherent possibility for fault tolerance. In the product description variations can be described which also increases the fault tolerance.

The system can be run offline where the production is simulated. Thus the control system that is tested by simulation is the real control system.

17:50-18:10 TuC12.5

A Contribution to the Validation to of Operating Mode Switching: Application to Satellite (I), pp. 6566-6571

Gonzalez Berlanga, Saul Israel — INSA de Lyon
Niel, Eric — INSA de Lyon
Zouari, Belhassen — FST Tunis
Blanquart, Jean-Paul — EADS Astrium

We propose a methodology for modeling systems with different operating modes using Nested Petri Nets (NPNs) based on Valk’s approach, where each token can be also considered as one Petri Net. NPNs provide a powerful tool for concurrent modeling and introduce interesting properties such as synchronization at a hierarchical level. In order to manage operating modes of critical and complex systems these properties are used to define and link component behaviors to the global system, through synchronized transitions. In order to formally verify these properties, CTL formulae will be used, translated from a logical table of technical specifications. The formulae allow a formal validation of the model and an examination of its coherency when the system switches to a new operating mode, under the influence of exceptional events. This verification is possible namely by using logic programming tools for the simulation and model checking. It is illustrated through a case study concerning a satellite's control unit.

18:10-18:30 TuC12.6

A Component Based Architecture for the Reconfiguration of Hybrid Systems Using Control Description (I), pp. 6572-6577

Guadri, Ahmed	Ec. Centrale de Lille
Dangoumau, Nathalie	Lab. d'Automatique, Génie InformatiqueetSignal(LAGIS), Ec.
Craye, Etienne	Ec. Centrale de Lille

Control systems are required to satisfy increasingly severe safety and performance criteria (reliability, security· · ·) mainly in the case of large scale systems. Such systems have to be described with a multiple abstraction levels paradigms such as hybrid systems (implementing both discrete and continuous dynamics). We present and formalize a new strategy for the reconfiguration of a hybrid system that relies on the specification of a region-based component oriented model which is updated whenever the system dynamics are modified. The standard controller is modified when a fault is detected and identified by use of an objectives automaton : Failing standard controls are replaced by a new sequence of controls chosen from an input space. Finally, we illustrate this method in the case of a system of communicating tanks.

TuC13 314

Recent Trends in Multiagents Formation Control (Invited Session)

Chair: Anderson, Brian D.O.	Australian National Univ.
Co-Chair: Yu, Changbin	National ICT Australia
Organizer: Anderson, Brian D.O.	Australian National Univ.
Organizer: Yu, Changbin	National ICT Australia

16:30-16:50 TuC13.1

Reduction of Self-Localization Errors in Multi-Agent Autonomous Formations (I), pp. 6578-6583

Shames, Iman	Australian National Univ.
Fidan, Baris	National ICT Australia
Anderson, Brian D.O.	Australian National Univ.

This paper considers the problem of reduction of self-localization errors in multi-agent autonomous formations when only distance measurement is available to the agents in a globally rigid formation. It is shown that there is a relationship between the singular values of a matrix called reduced rigidity matrix and the error induced by measurement error on localization solution. This fact is exploited to introduce an optimal selection of anchors, agents with exactly known positions, which results in a small induced error by measurement errors on localization solution. In the end, some simulation results are presented to demonstrate this optimal anchor selection in globally rigid formations.

16:50-17:10 TuC13.2

Agent and Link Redundancy for Autonomous Formations (I), pp. 6584-6589

Yu, Changbin	National ICT Australia
Anderson, Brian D.O.	Australian National Univ.

More and more often the multiagent formations found in high-risk military and civilian missions are designed to sustain the loss of some agents or control/communication links. In a military context, the agent loss could be a result of enemy attack and/or mechanical breakdown, while the link loss is usually due to enemy jamming, reduced transmission power, obstacles and/or hardware failure. If the agents are tasked to tightly maintain their inter-agent distances in order to maintain a desirable shape of the formation, loss of certain agents or links could lead to catastrophic consequences. This preliminary work proposes to address this potential problem by enforcing redundancy in the formation design, by addition of extra agents and/or links beyond the minimum necessary. Following an existing graphical model of the formations, we extend the notions and definitions for simple rigidity to ones including the redundancy concept. We remark that this engineered redundancy naturally reflects a level of operational robustness/health of the formation. We differentiate the measure into a deterministic metric and a statistical metric, and provide some general results on redundant rigidity.

17:10-17:30 TuC13.3

Generalized Controller for Directed Triangle Formations (I), pp. 6590-6595

Cao, Ming	Princeton Univ.
Yu, Changbin	National ICT Australia
Morse, A. Stephen	Yale Univ.
Anderson, Brian D.O.	Australian National Univ.
Dasgupta, Soura	Univ. of Iowa

This paper proposes and analyzes a distributed control law which generalizes three different previously considered control laws for maintaining a triangular formation in the plane consisting of three point-modeled, mobile autonomous agents. It is shown that the control law under consideration can cause any initially non-collinear, positively-oriented (resp. negatively-oriented) triangular formation to converge exponentially fast to a desired positively-oriented (resp. negatively-oriented) triangular formation. These findings clarify and extend earlier results.

17:30-17:50 TuC13.4

Formation Control of Heterogeneous Multi-Robot Systems (I), pp. 6596-6601

Wang, Qining	Peking Univ.
Wu, Ming	the second artillery engineering Coll.
Huang, Yan	Peking Univ.
Wang, Long	Peking Univ.

In this paper, a new position feedback based formation control method for heterogeneous multi-robot teams is presented and evaluated. The formation behaviors are integrated with dynamic reference object based collaborative navigation and efficient obstacle avoidance to maintain and change formation real-time. This method is computationally efficient and easy to coordinate in heterogeneous systems. The time to formalize and switch specified formation patterns can be controlled by adjusting the position feedback parameter. Satisfactory experimental results are obtained in simulation and real heterogeneous multi-robot system which consists of autonomous vehicles and legged robots.

17:50-18:10 TuC13.5

Distributed Formation Control for Target-Enclosing Operations Based on a Cyclic Pursuit Strategy (I), pp. 6602-6607

Hara, Shinji	The Univ. of Tokyo
Kim, Tae-Hyoung	Japan Science and Tech. Agency
Hori, Yutaka	The Univ. of Tokyo

This paper studies a design methodology of a distributed cooperative controller for target-enclosing operations by multiple dynamic agents. To this end, we first present an on-line path generator design method based on a cyclic pursuit scheme. Then, we provide the stability condition which the developed path generator should satisfy. This condition is derived based on a simple stability analysis method for large-scale linear systems with generalized frequency variable. The formation control scheme combined with a cyclic pursuit based distributed on-line path generator satisfying the derived stability condition guarantees the required global convergence property with theoretical rigor. Simulation examples illustrate its distinctive features and the achievement of a desired pursuit pattern.

18:10-18:30 TuC13.6

Fault Tolerant, Scalable Multi-Agent Control under Medium Access Constraints (I), pp. 6608-6613

Vemulapalli, Manish	Univ. of Iowa
Dasgupta, Soura	Univ. of Iowa
Kuhl, Jon	Univ. of Iowa

This paper extends our earlier work presented at the last IFAC World Congress that concerned the fault tolerant, distributed, scalable control of a group of agents that must move in a formation specified by relative positions between agents and a constant formation velocity. The control law we had proposed naturally accommodated various levels of fault tolerance and scalability and required an amount of inter-agent communication that was commensurate with a designated level of fault tolerance. The control law assumed, however, that this exchange of information occurred simultaneously. In practice communications must occur under Medium Access Control (MAC) constraints. Thus no agent can transmit and receive at the same time, and cannot transmit to another agent who is receiving information from yet another. We modify our earlier control algorithm so that such MAC constraints are respected, and provide a stability analysis of this modified control law.

TuC14 318

Control Over Networks III (Regular Session)

Chair: Basar, Tamer — Univ. of Illinois at Urbana-Champaign
Co-Chair: Qiu, Li — Hong Kong Univ. of Sci. & Tech.

16:30-16:50 TuC14.1

A Descriptor Systems Approach to Robust Exponential Stability of Networked Control Systems, pp. 6614-6619

Zhang, Qingling — Northeastern Univ.
Zheng, Meng — Northeastern Univ.
Song, Min — Northeastern Univ.
Li, Chunji — Northeastern Univ.
Duan, Xiao-dong — Dalian Nationalities Univ.
An, Yichun — Northeastern Univ.

In this paper, we consider a class of networked control systems (NCSs) with normbounded uncertainties. Using the continuous modelling method, the NCSs can be described as delayed differential equations (DDEs), which can be viewed as a general form of the NCSs model, where the effect of the network-introduced delay and data packet dropout are simultaneously considered. Robust exponentially asymptotical stability criterion are derived based on a delaydependent method. Robust output feedback controller can also be determined by solving a set of linear matrix inequalities.

16:50-17:10 TuC14.2

Tracking Performance Limitations in a Linear Feedback System with Remote Sensors, pp. 6620-6625

Su, Weizhou — South China Univ. of Tech.
Petersen, Ian R. — UNSW at Australian Def. Force Acad.
Qiu, Li — Hong Kong Univ. of Sci. & Tech.

This paper studies tracking performance limitations for a networked feedback control system. In the system, the plant is a linear time invariant (LTI) SISO system and the measurement signal is received from a remote site through a network. The reference signal in the tracking problem is a step signal. The tracking performance is measured by an integral square error between the output of the plant and the reference signal. To transmit the measurement signal through a network, this signal is quantized and then certain information which the original signal possesses could be lost. The major issue which we study in this paper is: How does a logarithmic quantization law constrain the best attainable tracking performance of the feedback system? Here the quantization error is modeled as a product of the original signal and a bounded nonlinear function. An upper bound of the best attainable tracking performance of the system is presented in terms of the quantization error model and the characteristics of the plant. It is also found that, if the nonlinear function in the quantization error model is an H_{infty} norm-bounded uncertainty, this upper bound is the tracking performance limit of the feedback system under the worst uncertainty. In the case where the quantizer and network are not used in the system, the upper is equal to the tracking performance limit of the LTI system.

17:10-17:30 TuC14.3

State Feedback Controller Design of Networked Control Systems with Time Delay and Packet Dropout, pp. 6626-6631

Li, HongBo — Tsinghua Univ.
Sun, Zengqi — Tsinghua Univ.
Chow, Mo-Yuen — North Carolina State Univ.
Chen, Badong — Tsinghua Univ.

In this paper, the stability analysis and synthesis problems for networked control systems (NCSs) are investigated. By introducing the lifting technique into NCSs, a novel discrete-time switch model is proposed with the consideration of time delay and packet dropout during the transmission of packets. It describes NCSs as a switch system, and therefore enables us to apply the theory from switch systems to study NCSs in discrete-time domain. In terms of the given model, we give su±cient conditions for the existence of state feedback controller such that the closed-loop NCSs are asymptotically stable. Based on the obtained stability conditions, a homotopy-based iterative LMI algorithm is developed to get the state feedback gain. Simulation results are given to demonstrate the e®ectiveness of the proposed approaches.

17:30-17:50 TuC14.4

Optimal Estimation Over Channels with Limits on Usage, pp. 6632-6637

Basar, Tamer — Univ. of Illinois at Urbana-Champaign
Bommannavar, Praveen — Univ. of Illinois at Urbana-Champaign

We consider several cases of a sequential estimation problem in which two decision making agents work together but with limited communication (between them) to minimize a performance criterion. One agent makes sequential observations about the state of an underlying, possibly vector valued, stochastic process for a fixed period of time. The observer agent upon observing the process decides whether or not to disclose some information about the process to the other agent, the estimator, and if yes, when and how. The constraint is that the observer may act only a limited, pre-specified number of times. For such problems, we develop the optimal observer-estimator policies first for the case when the source process is n-th order Gauss-Markov, and then for the case when the source is a vector process.

17:50-18:10 TuC14.5

Stability and Passivity of Complex Spatio-Temporal Switching Networks with Coupling Delays, pp. 6638-6641

Yao, Jing — Tongji Univ.
Wang, Hua O. — Boston Univ.
Guan, Zhi-Hong — Huazhong Univ. of Science & Tech.
Xu, Weisheng — Tongji Univ.

In this paper, a new model of complex dynamical network is established. It is called a complex spatio-temporal switching network. That is, the subsystem of each node at different time interval corresponds to different switching mode. Based on passivity property, the stability and passivity of this kind of network with time-delay interconnections are addressed. An example and simulation results are included.

18:10-18:30 TuC14.6

Design of Multiple Actuator-Link Control Systems with Packet Dropouts, pp. 6642-6647

Quevedo, Daniel E. — The Univ. of Newcastle
Silva, Eduardo I — The Univ. of Newcastle
Nesic, Dragan — Univ. of Melbourne

This paper presents a novel design strategy for networked control systems, where a centralized controller needs to divide its attention between various actuators. Communication is via an unreliable network affected by data-dropouts and which allows access to only one actuator node at a time. To achieve good performance, control and network protocol are co-designed and signal predictions are sent to buffered actuator nodes. By using methods from predictive control theory, we show how closed loop stability in the presence of data-dropouts can be ensured.

TuC15 317

Image-Based Biological and Medical Systems Modeling (Invited Session)

Chair: Feng, David Dagan — Hong Kong Pol. Univ.
Co-Chair: Huang, Sung-Cheng — UCLA David Geffen School of Medicine
Organizer: Feng, David Dagan — Hong Kong Pol. Univ.

16:30-16:50 TuC15.1

Adaptive Bolus Chasing Computed Tomography Angiography (I), pp. 6648-6653

Bai, Er-Wei — Univ. of Iowa
Cai, Zhijun — Univ. of Iowa
Wang, Ge — Univ. of Iowa

Synchronization of the contrast bolus peak and CT imaging aperture is a crucial issue for CTA. It effects the CTA imaging quality and the necessary amount of contrast dose. In this paper, we propose an optimal adaptive bolus chasing controller. The controller estimates and predicts the unknown two dimensional bolus density on line and then determines the optimal control actions. Tracking errors are mathematically quantified in terms of estimation errors. Simulation results on the actual patient data exhibit its superior performance to the current constant-speed method. Also, the preliminary experiments demonstrate the clinical feasibility.

16:50-17:10 TuC15.2

Detection of Measurement Outliers in Tracer Kinetics (I), pp. 6654-6657

Huang, Sung-Cheng — UCLA David Geffen School of Medicine

In tracer kinetic studies for extracting biological information, measurement noise and error in the kinetics could affect the reliability of the estimated biological parameters. While the effect of statistical noise has been studied extensively before, the effect of outliers has not been addressed as much. In this study, we described an algorithm for detecting and removing outliers.Computer simulation was used to generate kinetic data sets corresponding to those of the FDG tracer used in PET studies to evaluate the effect of outliers and the performance of the outlier detection algorithm. Results show that outlier could increase drastically the variability of the estimated rate constants of FDG transport and phosphorylation. The outlier detection algorithm imbedded in a regular model fitting procedure was found to have a low probability of missing outliers in the kinetics. The probability of falsely identifying non-outliers as outliers was high, but these false positive detections did not affect the reliability of the biological estimates. With the outlier detection, the variability of the parameter estimates in the simulated FDG kinetics with outliers could be reduced by a factor of more than 5. The present study demonstrated the importance of outlier detection in interpreting tracer kinetics. Some areas for future studies are also discussed.

17:10-17:30 — TuC15.3

Model-Based Prediction of the Individual N-Repetition Maximum with Application to Physical Rehabilitation (I), pp. 6658-6663

Schrempf, Andreas — Univ. of Applied Sciences, Upper Austria
Habelsberger, Winfried — Gebeitskrankenkasse Upper Austria

The individual adjustment of the training intensity during physical training of the lower back muscles plays a cruical role in strength rehabilitation of chronic low back pain patients. Since an one-repetition maximum test may increase injury risk and a common N-repetition maximum test with several trials is stressful for the patient and in many cases inaccurate, in this paper a model-based approach is proposed for predicting the N-repetition maximum. The individual N-repetition maximum is predicted by means of a biomechanical model together with fatique parameters obtained from an isometric maximum voluntary muscle contraction measurement and allows for a proper adjustment of the training intensity.

17:30-17:50 — TuC15.4

A Whole Body Model of FDG Metabolism Based on VHP Datasets (I), pp. 6664-6668

Bai, Jing — Tsinghua Univ.
Qiao, Huiting — Tsinghua Univ.

Using 2-[^{18}F]fluoro-2-deoxy-D-glucose (FDG) and positron emission tomography (PET), the kinetic models for FDG metabolism were established in tissue of myocardium, lung, stomach, spleen, pancreas, marrow, liver and kidneys. All submodels were connected by the circulation system, forming the whole body model. The model can be visualized on the base of Visible Human Project (VHP), to simulate the dynamic metabolic process of FDG in human body. The simulated FDG distribution images were in 2D and 3D formats, and presented higher resolution than original PET image. The result of this study can be used not only for education and related research, but also by PET operators to design their PET experiment program.

17:50-18:10 — TuC15.5

Reliable Model and Cluster Aided Formation of Parametric Images in Functional Imaging (I), pp. 6669-6674

Wen, Lingfeng — Univ. of Sydney
Eberl, Stefan — Royal Prince Alfred Hospital
Feng, David Dagan — Hong Kong Pol. Univ.

Parameter estimation in functional imaging provides unique quantitative measures in clinical diagnosis, and in the evaluation of treatment response and new drugs. Voxel-by-voxel parameter estimations can construct parametric images which visualize the spatial distribution of functional parameters. The low signal-to-noise ratio in single photon emission computed tomography (SPECT) may cause physiologically meaningless estimates using the general linear least square method (GLLS). A proof-of-principle framework is proposed in this study for constructing simultaneously multiple parametric images using a model-aided GLLS method and fuzzy clustering for dynamic SPECT. Computer simulations were performed to evaluate the accuracy and reliability of estimates for the studied methods. The results show that the model-aided GLLS with fuzzy clustering did enhance reliability for voxel-by-voxel parameter estimation with a slight overestimation of the volume of distribution. The method employing normalization of TTAC was superior to the method without normalization.

18:10-18:30 — TuC15.6

Macrostructural Biofilm Characterization Via Textural Image Analysis by SGLDM and GLRLM (I), pp. 6675-6680

Pons, Marie-Noelle — ENSIC
Milferstedt, Kim — Univ. of Illinois at Urbana-Champaign
Morgenroth, Eberhard — Univ. of Illinois at Urbana-Champaign

The macrostructure development of biofilms grown in an annular reactor and in a rotating biological contactor has been monitored using the Spatial Gray-level Dependence Method (SGLDM) and the Gray-Level Run Length Method (GLRLM). Due to the large number of descriptors, Principal Components Analysis was used to sort the results. Both methods look promising for biofilm monitoring.

TuC16 — 316

Automation for Improving International Stability (Invited Session)

Chair: Kopacek, Peter — Vienna Univ. of Tech.
Co-Chair: Han, Man-Wook — Vienna Univ. of Tech.
Organizer: Kopacek, Peter — Vienna Univ. of Tech.

16:30-16:50 — TuC16.1

Choices for Global Social Stability (I), pp. 6681-6685

Kile, Frederick — Microtrend
Dimirovski, Georgi Marko — Dogus Univ. of Istanbul

Abstract: Scientists and societal leaders increasingly agree that human activity is irretrievably changing the environment in which human life and other life forms co-exist. Action to reduce human impact on the environment is an imperative prerequisite to achieving social stability. Accelerating migration patterns due to environmental stress and population pressure have been associated with emerging conflicts. Population movement from rural areas to megacities may weaken social structures and create social chaos. Traditional dogmas, whether ethnic, religious or political, must be re-thought in this changing context if global society is to avoid collapse in a weakening ecosystem. Copyright © 2008 IFAC

16:50-17:10 — TuC16.2

Models for International Stability (I), pp. 6686-6690

Erbe, Heinz — Tech. Univ. Berlin
Kopacek, Peter — Vienna Univ. of Tech.

Conflict resolution was dominated by more or less verbal approaches some years ago. Nowadays system engineering methods, based on well known principles of control engineering, mathematics, statistics are applied to such problems. One of the main problems arising is the description of the static and dynamic behaviour of conflict partners or systems in form of mathematical methods. Such models are determined either in a theoretical or experimental way. Theoretical model building yields to complicated models difficult to handle. Therefore simple models are mostly used determined in a heuristic way. In the paper methods for model building are presented and as an example a simple linear time invariant model is used to describe gas or oil supply and consumption of several countries.

17:10-17:30 — TuC16.3

Systems Security Problems and Cultural Meanings in Control and Automation Systems: Empirical Evidence for Value Conflicts in Systems Engineering (I), pp. 6691-6696

Freeman, Amanda — Waterford Inst. of Tech.
Stapleton, Larry — School of Science, Waterford Inst. of Tech.

Automation and control systems such as integrated enterprise information technologies and distributed telemedical system architectures require highly secure information processing environments to ensure that costly (and even fatal) errors do not occur. However, research into systems development methodologies shows significant gaps in the treatment of systems security. Many methodologies do not specifically include security and privacy considerations within their frame of reference. As a consequence, recent studies of information control and management systems have shown that, in a global context, many organisations are at a significant security risk.In this paper we examine five of the most common system engineering methodologies cited in the literature, and we examine to what extent each of these methodologies incorporates security and privacy as part of the systems development process. This paper also presents empirical evidence to support the proposition that, as regards system security, high technology engineering education is at odds with the core values of students of systems engineering. This has major implications for the development of secure systems in a globalised economic context. The evidence shows how students from a wide variety of cultural backgrounds come into degree programmes valuing security highly, but the education programmes do not address systems security in very much depth.

17:30-17:50 TuC16.4

Progressive Adaptive Mechanisms for the International Cooperation, pp. 6697-6702

Tsyganov, Vladimir — Inst. of Control Sciences Russian Acad. of Sciences

Abstract: On the modern stage of globalization there are no adequate international institutions to control forthcoming global instability. As a way to establishing their scientific background, progressive adaptive mechanisms for the international cooperation are proposed. They included both international and states mechanisms intended to coordinate multinational corporation activity to prevent expansion of dangerous weapon, capital drain to offshore and so on. Both adaptive mechanisms for international solidarity and adaptive international regimes are considered. The sufficient conditions of their progressiveness are found. Obtained results had been implemented in the international regime of intangible technologies export control.

17:50-18:10 TuC16.5

Power Industry Computer Control System Design and Implementation Problems: A Case Study of Poland (I), pp. 6703-6708

Lewoc, Jozef Bohdan — Design, Res. and Translation
Han, Man-Wook — Vienna Univ. of Tech.

The design and implementation team of computer automation systems for the Polish power industry faced many difficult problems connected with the lack of experience in this domain in the country. Another kind of problems was implied by different levels of information and communication technology in that country and in well developed ones. The differences were generated by both internal (importation limitations) and external (various embargos) reasons. But perhaps the most severe problems were the political ones, implied by the omnipotent communist system, that could spoil and often spoiled even many-year work of design and implementation teams. The paper tries to answer how, in such adverse conditions, it was possible to design and develop very successful power industry computer automation systems.

18:10-18:30 TuC16.6

Technological Development and the Human System (I), pp. 6709-6714

Genser, Robert — IFAC-Beirat Austria

The reasons for flaws of technological development at present are pointed out. Examples from complex projects like in telecommunication, transportation, or Electronic Data Interchange for Administration, Commerce and Transport (EDIFACT) are giving insight. The change of actors of the past intensifies tremendously the difficulties given by globalization and complexity of new systems for developing applicable human solutions. New technology in fields like medicine demands new requirements and paradigms. Stable human solutions are a prerequisite for economy and efficiency. This demands a holistic approach, which considers also history, psychology as well as organizational aspects itself together with educational and creativity environment. Goal systems, adequate decision-making, importance of experience gained in the field of complex software development, and the limits of metrics or strong preference for mathematical solutions are pointed out.

TuC17 320A

Measurement (Highlight Session)

Chair: Oh, KiJang — POSCO
Co-Chair: Choi, Seho — POSCOLAB, POSCO

16:30-16:50 TuC17.1

On-Line Red-Scale Measurement System for Wire Rod Coil (I), pp. 6715-6716

Choi, Seho — POSCOLAB, POSCO
Bae, Homoon — POSCO

This article deals with a red-scale measurement system which can be applied to Wire Rod Production Line in POSCO (Pohang Iron and Steel Company). A red-scale is a type of oxidized Fe coated on the surface of wire rod and as the name means it has red color. The main cause of red-scale is an improper control of cooling process after final milling stage. To control the cooling process we need to measure the amount of red-scale on the surface of wire rod and to feedback the information of red-scale to control unit. We developed a red-scale measurement system in which we used a color camera to get the information of the amount of red-scale on the whole of wire rod surface instead very limited spot information when we employ commercial colorimeter. This paper will explain the details of the structure of red-scale measurement system and its red-scale estimation algorithm Copyright © 2008 IFAC

16:50-17:10 TuC17.2

On-Line Overlap Measurement System for the Joining Part of Endless Rolling (I), pp. 6717-6718

Kang, Myoungkoo — posco
Kim, Yongsoo — posco

The on-line Overlap Measurement System is developed for measuring the length of overlap just before joining in the Endless Rolling Mill in POSCO (Pohang Iron and Steel Company). Because the joining mechanism of POSCO is different from the other ones, overlap measurement system is necessary to check if joining is possible. If overlap length is not in the appropriate range, joining process would not be done successfully. For the successful joining process, proper overlap must be prepared before joining and the overlap length is to be known before joining. First overlap measurement system had been realized at laboratory, and then was installed at the Joining Machine to show its good performance and reliability.

17:10-17:30 TuC17.3

Development of Numerical Model & Temperature Monitoring System for Inductive Heater Oven (I), pp. 6719-6720

Jung, Wonchul — POSTECH
You, Jongwoo — POSCO
Won, Sangchul — Pohang Univ. of Science & Tech.

This paper describes numerical model for inductive heating oven and temperature monitoring system for Continuous Coating Line. For induction heating, the heat generation is concentrated within skin depth so exponentially decaying heat distribution was assumed. To calculate and to monitor the oven exit temperature, measurement system was installed on the inductive heater oven including pyrometer and several thermocouples. The experimental result showed the effectiveness of the developed mathematical model.

17:30-17:50 TuC17.4

Development of Surface Inspection System for Wire Rod (I), pp. 6721-6722

Park, Chang Hyun — POSTECH
Choi, Seho — POSCOLAB, POSCO
Bae, Homoon — POSCO
Hwang, Hwawon — POSCO
Kang, Dongyeop — POSTECH
Won, Sangchul — Pohang Univ. of Science & Tech.

This paper introduce the surface inspection system for wire rod in steel-making industry. The inspection system is base on vision technology. We have developed illumination system with blue LED lighting sources to get best quality of surface image. And we have implemented defect detection algorithms based on block sigma transform which can recognize wire rod objects and segments defect candidates from images in robust and efficient manner. We have installed the inspection system in production line and have good detection rates.

17:50-18:10 TuC17.5

The 3D Position Recognition of Multiple Coils Using Ellipse Fitting with Probabilistic Edge Detection with Stereo Cameras (I), pp. 6723-6728

Lee, Dongwook — POSTECH
Kim, Sehoon — POSTECH
Kim, Dowan — POSTECH
Won, Sangchul — Pohang Univ. of Science & Tech.

The development of unmanned crane is an important issue of Factory Automation in steel industry. This paper focus on unmanned crane for picking up coils on a trailer although positions and diameters of coils is not fixed. In order to pick up those coils, unmanned crane should know exact 3D coil position. Therefore, in order to find out exact 3D coil's centers, this paper propose the system that recognize 3D position of coil center based on ellipse detection and 3D reconstruction method using stereo vision system. In details, the probabilistic ellipse oriented edge detection method and ellipse fitting method using RANSAC algorithm are proposed. Then, resolving correspondence problem using epipolar geometry and 3D reconstruction using calibrated stereo vision method are used to complete our work. Experiments show the effectiveness of the proposed method.

18:10-18:30 TuC17.6

On-Line Punchless Detection of Laser Welding Part of Cold-Rolling Steel Strip (I), pp. 6729-6730

Lim, ChoongSoo — POSCO
Oh, KiJang — POSCO
Huh, HyeongJun — POSCO
Park, HyunChul — POSCO

The punchless welding point detection system using laser diagnostics for continuous strip production line has been developed. At the entrance of the steel strip production line, the preceding and following coils are welded for continuous processing. The welding point detection and tracking of the position is essential for the setup change of various important processing facilities according to the specifications of the coil under processing. Conventionally the hole is punched for on-line detection of the welding point by transmission and detection of light. But the punched hole causes several disadvantages such as decrease of productivity, generation of flaws, breaking of high steel strip. There are mainly three types of welding of coils; flash butt, laser and mesh seam welding. The punchless welding point detection system for laser welding has been developed and tested in real production line. The welding point is detected by measuring the change of reflected light distribution due to welding part and high speed temporal analysis of the measured reflectance signal.

TuC18 320B

Robotics for LCD & Semiconductor Industry (Highlight Session)

Chair: Kim, Dong-Il — Samsung Electronics
Co-Chair: Kanitani, Kiyoshi — Nachi-Fujikoshi Corp.
Organizer: Song, Ji Oh — Samsung Electronics

16:30-16:50 TuC18.1

Advanced Control Techniques for Semiconductor and Flat Panel Display Substrate Handling Robots, pp. 6731-6738

Hosek, Martin — Brooks Automation, Inc.
Moura, Jairo Terra — Brooks Automation, Inc.

Substrate-handling robots for semiconductor and flat-panel-display manufacturing applications possess undesirable structural flexibilities and frictional effects which erode closed-loop stability and deteriorate tracking performance. In this study, advanced control and identification techniques are applied to cope with these control challenges. The techniques include sensorless modal stabilization, observer-corrector control strategy, iterative learning control approach and neural-network-based perturbation estimation. The fundamentals of the techniques are reviewed and the resulting performance improvements are demonstrated experimentally.

16:50-17:10 TuC18.2

Flexible Manufacturing by Application of RFID and Sensors in Robot Cell Manufacturing Systems, pp. 6739-6744

Matsuoka, Makoto — Omron Corp.
Watanabe, Tohru — Ritsumeikan Univ.

Cell production in which only a few human operators manufacture products by themselves is popular in Japan due to its flexibility. However, the decrease in the number of young persons in developed countries will make it difficult to do in the near future. Therefore, cell production using robots is going to be needed. A cell production system using a robot and automatic machines having special functions is developed. The robot transfers parts and tools for the automatic machines. A RFID is attached to each part, and the quick change in the functions of the automatic machines is executed as the kinds of products change. Adaptive tool setup scheduling for the change in operation times of the special function machines is executed and the improvement of product efficiency is analyzed. Many vision sensors are used for the adjustment of the position and orientation of the robot hand and parts, and distributed image processing for the hand and parts make rapid motion adjustment possible.

17:10-17:30 TuC18.3

Reliability of Large Sized FPD Panel Handling Robot (I), pp. 6745-6746

Kanitani, Kiyoshi — Nachi-Fujikoshi Corp.

For large sized glass handling robot, reliability improving activity increases the importance. The activity is divided into two phases of design phase and line usage phase. At the design phase, accurate simulation for keeping the limitation of material or gear strength and accurate torque control are the key. At the line usage phase, supporting tool for preventive maintenance activity is the key. As the maintenance work itself is a hard work for large sized robot, a preventive maintenance is useful.

17:30-17:50 TuC18.4

Fatigue Life Prediction of the LCD Transfer Robot Frame (I), pp. 6747-6748

Park, Joong Kyung — SAMSUNG Electronics Co., LTD.
Yim, Hong Jae — Kookmin Univ.
Seo, Jong Hwi — SAMSUNG Electronics Co., LTD.
Seo, Soong Young — SAMSUNG Electronics Co., LTD.
Hwang, Jae Chul — Samsung Electronics Co.,Ltd.
Choi, Yong Won — Samsung Electronics Co.,Ltd.

In this paper, an integrated fatigue life prediction methodology is presented for design validation of the LCD transfer robot. For accurate fatigue life analysis, S-N curves are generated with the materials used in the robot by rotating bending fatigue tests. Static stress analysis is carried out with the FE model of the frame component. Strain gage test results are compared with FE stress analysis results to validate the analysis model. Dynamic load history can be obtained through flexible multi-body dynamic simulations. Then fatigue life of the structural component can be predicted with the dynamic stress history and the S-N data. To validate the proposed methodology, fatigue tests are performed with the sub assembly component.

17:50-18:10 TuC18.5

Error Compensation of a Large Scale LCD Glass Transfer Robot (I), pp. 6749-6750

Hwang, Jae Chul — Samsung Electronics Co.,Ltd.
Seo, Jong Hwi — SAMSUNG Electronics Co., LTD.
Choi, Yong Won — Samsung Electronics Co.,Ltd.
Yim, Hong Jae — Kookmin Univ.

A new generation LCD (liquid crystal display) technology requires the bigger size of raw glass in order to supply the demand for a large size TV. Samsung Electronics Company has built the world first 7th generation LCD plant and also recently 8th generation LCD plant. In order to handle bigger and heavier glass, a large scale LCD glass transfer robot is necessary. This robot requires precise path accuracy in order to improve stack efficiency of glass cassette which affects the productivity of LCD plant. But it is difficult to meet the requirement of accuracy because the deflection and deformation of structural components to bear the large dynamic loads deteriorate the accuracy of the robot. This paper presents a method of improving the vertical path accuracy by kinematic compensation for the deflection without any increase of structural stiffness. Firstly, the LCD transfer robot and its requirements are introduced. Next, flexible multi-body dynamic model to simulate the deflection and deformation under dynamic loads is established. Then the idea of improving the path accuracy is presented. Finally its optimization problem is solved using DOE (design of experiment) method.

TuC19 320C

Robot Manipulators III (Regular Session)

Chair: D'Ippolito, Filippo — Univ. di Palermo
Co-Chair: Melchiorri, Claudio — Univ. of Bologna

16:30-16:50 TuC19.1

Force Tracking Impedance Control with Variable Target Stiffness,

pp. 6751-6756
Lee, Kwang-Kyu TUM

In this paper, a novel force tracking impedance control strategy is presented in which target stiffness is varied on-line to regulate the desired contact force without any knowledge of the environment. Humans can control contact force by adjusting their arm stiffness. The contact force can be either increased by making one's arm stiffer or decreased by reducing the arm stiffness. Furthermore, humans can keep the force tracking error within a certain range without any knowledge of environmental parameters as long as how much force they exert on the object is known to them. Analogously, the proposed control scheme achieves a contact force regulation control by adjusting the target stiffness of the impedance control. The new force tracking impedance control scheme does not require estimating environment stiffness or locations since the controller is adapted only based on the previous force tracking error between the desired and real contact force. Stability of the proposed scheme is discussed with a quadratic Lyapunov function. Extensive simulation studies with a 7 degree of freedom (DoF) robot manipulator using full arm dynamics are conducted to demonstrate the validity of the proposed scheme.

16:50-17:10 TuC19.2
Adaptive Control of Multi-Fingered Robot Hand Using Quaternion, pp. 6757-6762
Ueki, Satoshi Gifu Univ.
Kawasaki, Haruhisa Gifu Univ.
Mouri, Tetsuya Gifu Univ.

This paper presents an adaptive control for multi-fingered robot hand with rolling contact to a grasped rigid object. In the proposed controller, the dynamic parameters of both object and multi-fingered robot hand are estimated adaptively. The orientation error of the object is described around relative rotational axis using quaternion. The asymptotic convergence of object motion and contact force has been proved by the Lyapunov-like Lemma. Experiment of the object grasping by human-type robot hand using three fingers is shown.

17:10-17:30 TuC19.3
Robot Force and Impact Control with Feedforward Switching, pp. 6763-6768
Zotovic, Ranko Univ. Pol. de Valencia
Valera, Angel Univ. Pol. de Valencia

This paper proposes the use of a proportional force controller with feedforward and active damping. It is demonstrated that with the adequate selection of the parameters both velocity control in free motion and force tracking in constrained motion can be achieved. Nevertheless, the most important contribution of the article is the switching of the feedforward term in function of the state variables in order to smooth the impact. Optimal switching criteria from the point of view of energy dissipation have been deduced and verified by simulations.

17:30-17:50 TuC19.4
Generalized Proportional Integral Control for a Robot with Flexible Finger Gripper, pp. 6769-6775
Becedas, Jonathan Univ. de Castilla-La Mancha
Payo, Ismael Univ. of Castilla-La Mancha
Feliu, Vicente Univ. of Castilla-La Mancha
Sira-Ramirez, Hebertt J. CINVESTAV-IPN

In this paper a Generalized Proportional Integral output feedback control scheme is proposed for grasping tasks. We have designed a flexible finger gripper mounted at the tip of a rigid arm which can grasp and move objects from a place to other so that a bending force control of the flexible gripper is combined with a position control of the rigid arm. Experiments are presented to verify the goodness of the proposed control law.

17:50-18:10 TuC19.5
Planning Setpoints for Contact Force Transitions in Regrasp Tasks of 3D Objects, pp. 6776-6781
Grosch, Patrick Tech. Univ. of Catalonia
Suarez, Raul Univ. Pol. de Catalunya
Carloni, Raffaella Univ. of Bologna
Melchiorri, Claudio Univ. of Bologna

This paper presents a simple and fast solution to the problem of finding the time variation of n contact forces that keep an object under equilibrium while one of the n contact forces is removed/added from/to the grasp. The object is under a constant perturbation force, like for instance its own weight. It is assumed no acceleration of the object during the regrasp operation, as well as the knowledge of the starting and ending grasp configurations. The procedure returns the set points of the n contact forces for a feed-forward control system of a manipulator device in a regrasping action. The procedure was implemented and an illustrative numerical example is included in the paper.

18:10-18:30 TuC19.6
Adaptive Interaction Robot Control with Estimation of Contact Force, pp. 6782-6785
D'Ippolito, Filippo Univ. di Palermo
Alonge, Francesco Univ. of Palermo
Bruno, Antonino Univ. of Palermo

This paper deals with a new adaptive force-position control of a robotic manipulator based on force estimation. First, an adaptive position controller is derived with contact force component as estimated parameters. Second, a supervisory external loop is added in order to regulate the contact force to the desired value. Extensive simulations with 2-DOF manipulator illustrate the followed approach.

TuC20 321C
Mobile Robot Control III (Regular Session)
Chair: van den Boom, Ton J. J. Delft Univ. of Tech.
Co-Chair: Khorrami, Farshad Pol. Univ.

16:30-16:50 TuC20.1
Minimum-Time Control of a Two-Wheeled Differentially Driven Vehicle in the Presence of Slip, pp. 6786-6791
Piccagli, Stefano Univ. degli Studi di Brescia
van den Boom, Ton J. J. Delft Univ. of Tech.
Visioli, Antonio Univ. of Brescia

In this paper we propose a solution for the minimum-time control of a two-wheeled differentially driven mobile robot in the presence of slip between the wheels and the ground. Starting from the Lagrangian equations of the system a Newton-Eulerian model of the robot is obtained by adding longitudinal and lateral forces between the tyres and the ground, expressed by means of the Pacejka equation. The travelling time of the robot from an initial point to an end point has to be minimised subject to actuator constraints. A Chebyshev series approach is used for the optimisation of the trajectory. Because this optimisation procedure requires a significant computational effort, several trajectories are calculated off line and then they are sampled and used for the training of a neural network controller. This controller is then employed on line in order to make the mobile robot follow the desired path.

16:50-17:10 TuC20.2
Obstacle Avoidance for Wheeled Robots in Unknown Environments Using Model Predictive Control, pp. 6792-6797
Yoon, Yongsoon Seoul National Univ.
Choe, Tokson agency for defense development
Park, Yongwoon agency for defense development
Kim, H. Jin Seoul National Univ.

This paper presents a model predictive approach for obstacle avoidance of car-like unmanned ground vehicles (UGVs). An optimal tracking problem while avoiding obstacles in unknown environments is formulated in terms of cost minimization under constraints. Information on obstacles can be incorporated online in the nonlinear model predictive framework and kinematic constraints are treated by Karush-Kuhn-Tucker (KKT) condition. The overall problem is solved real-time with nonlinear programming. This approach is applied to car-like robots including tire models while explicitly considering the dimension of the UGV rather than treating it as a dimensionless cart model. Two kinds of potential-like terms are employed in the cost function for obstacles avoidance. The first term is to consider the distance between the UGV and the obstacle, and the second one is to consider the parallax information of the UGV about the obstacles. Simulation results show that both two approaches can make safe steering in a simple environment, but in a complex environment such as an urban area, the approach based on the modified parallax (MP) was more successful in the view of the computation time and safe steering.

17:10-17:30 TuC20.3
Obstacle Avoidance for Unmanned Sea Surface Vehicles: A Hierarchical Approach, pp. 6798-6803

Krishnamurthy, Prashanth — Pol. Univ.
Khorrami, Farshad — Pol. Univ.
Ng, Tzer Leei — Pol. Univ.

In this paper, we describe a hierarchical system for path planning and obstacle avoidance for totally autonomous Unmanned Sea Surface Vehicles (USSVs). The proposed system is comprised of three major components: a wide-area planner based on the A* graph-search algorithm, a local-area planner based on our low-resource path-planning and obstacle avoidance algorithm GODZILA, and an inner-loop nonlinear tracking control law. The performance of the proposed system is demonstrated through simulations using our high-accuracy real-time Six Degree-of-Freedom (DOF) Hardware-In-The-Loop (HITL) simulation platform whose design and implementation have been documented in our recent papers. The HITL platform is capable of simultaneously simulating multiple USSVs and passive obstacles and incorporates a nonlinear dynamic model of the USSV including detailed characterizations of hydrodynamic effects, emulation of sensors and instrumentation onboard the USSV, and the actual hardware and software components used for USSV control in the experimental testbed. The performance of the inner-loop controller has been validated through experimental tests which are described briefly in this paper and the experimental validation of the complete obstacle avoidance system is currently underway.

17:30-17:50 — TuC20.4

Reactive Navigation of a Mobile Robot in Unknown Environments, pp. 6804-6809

Luh, Guan-Chun — Tatung Univ.
Liu, Wei-Wen — Tatung Univ.
Lin, Huang-Kai — Tatung Univ.

In this paper, a Reactive Immune Network (RIN) is proposed and employed for mobile robot navigation in unknown environments. Rather than building a detailed mathematical model of artificial immune systems, this study tries to explore the principle in an immune network focusing on its self-organization, adaptive learning capability, and immune feedback. In addition, an adaptive virtual target method is integrated to solve the local minima problem in navigation. Several trapping situations are adopted to evaluate the performance of the proposed architecture. Experimental results show that the mobile robot is capable of avoiding obstacles, escaping traps, and reaching the goal efficiently and effectively.

17:50-18:10 — TuC20.5

A Hybrid Systems Approach to Closed-Loop Navigation of Electromagnetically Actuated Satellite Formations Using Potential Functions, pp. 6810-6814

Ahsun, Umair — Air Univ.
Miller, David W. — Massachusetts Inst. of Tech.
Ahmed, Shakil — CESAT, NESCOM

Potential function method has been used extensively to navigate robotic vehicles in the form of a closed-loop control law. One problem associated with the potential function method is the presence of local minima in the navigation space. This paper presents a novel approach of using switching in order to avoid the local minima and hence achieving global convergence to the desired configuration. This method is applied to electromagnetically actuated satellites formations having nonlinear dynamics and shown to achieve collision-free reconfiguration with a low computational burden.

18:10-18:30 — TuC20.6

Decentralized Formation Control of Multi Vehicles Systems with Non-Holonomic Constraints Using Artificial Potential Field, pp. 6815-6820

Sisli, Ufuk Yetis — Istanbul Tech. Univ.
Temeltas, Hakan — Istanbul Tech. Univ.

In this work, decentralized formation control of a multi vehicle system is investigated. Each vehicle model considers kinematic constraints of differential drives which is a principal approach for various application for mobile robotics in 2D space. A virtual leader is assigned to navigate the whole cluster in a certain formation via predefined paths. Each vehicle produces its own control signal via communication with other vehicles and interactions with virtual leader and the obstacles around. These interactions and communications are modeled with artificial potential fields. Also formation shape is given as global minimums of artificial potentials between vehicles. The proposed system can successfully form any shape and navigate even in the presence of unknown obstacles. Simulations of flocking and formation navigation with kinematics constraints are presented.

TuC21 — 321B

Low-Cost Safe Embedded Control System (Invited Session)

Chair: Bayart, Mireille — Univ. de Lille1, LAGIS
Co-Chair: Wang, Wei — Dalian Univ. of Tech.
Organizer: Bayart, Mireille — Univ. de Lille1, LAGIS

16:30-16:50 — TuC21.1

Embedded Implementation of Mobile Robots Control (I), pp. 6821-6826

Valera, Angel — Univ. Pol. de Valencia
Valles, Marina — Assistant Professor
Albertos, Pedro — Univ. Pol. de Valencia
Simarro, Raul — Univ. Pol. de Valencia.
Benítez Sánchez, Ignacio — Pol. Univ. of Valencia

In some embedded applications, the global control objective can be split in different control objectives from simpler to more complex ones. In this sense, simple controllers can achieve the basic control problems and controllers with more computational resources can be in charge of more complicated decisions. In these situations, a control architecture for coordinating all the components is needed.

This work will present a distributed network-based control of mobile robots, each of them having embedded control system based on a microcontroller. In the control architecture proposed, in addition to the mobile robots, there is a PC working as a server and a set of PCs to control the mobile robots. A wide range of different control tasks can be done because all the computers are networked connected. The paper will also show some control examples like mobile robot control, automatic path generation free of collisions, control algorithms based on agents, etc.

16:50-17:10 — TuC21.2

Distribution Diagnosis of Networked Embedded System (I), pp. 6827-6832

Bayart, Mireille — Univ. de Lille1, LAGIS

The progress in microelectronics allows to integrate, in embedded systems, both digital computation and communication network capabilities. During the last years, smart sensors and actuators, then embedded systems and network sensors have appeared. They lead to development of networked embedded system. These systems have to comply with safety requirements but they are constantly under cost pressure. In introduction to the session on "Low-Cost Safe Embedded Control System", the paper is interested to these news architectures and poses the problem of the fault detection and isolation. It gives different points of view which are considered in the literature for studying the origin of the failure : some works concern only sensors, actuators and physical process, some works focus on monitoring of the network, others sum up the networks in estimated delay, then some problems that are not yet treated are given.

17:10-17:30 — TuC21.3

Framework for Reliability Evaluation of Networked Control Systems (I), pp. 6833-6838

Ghostine, Rony — CRAN
Thiriet, Jean-Marc — CNRS-INPG-UJF
Aubry, Jean-François — INPL
Robert, Michel — Univ. Henri Poincaré Nancy 1

This paper presents a framework to enable the analysis of the influence of the transmission faults on the reliability of a networked control system (NCS). The approach is composed of two parts: a modelling part in which all the basic components of a networked control system are modelled and a simulation part in which simulation is done on the models to evaluate the reliability. Due to external perturbations transmission faults may occur on the medium decreasing network quality of service and system performance. These aspects are difficult to assess with traditional dependability method like fault trees and reliability blocks. Our approach is applied to a case study example. The results show that our framework is an effective way for the reliability evaluation of networked control.

17:30-17:50 — TuC21.4

Reliability Increasing through Networked Cascade Control Structure – Consideration of Quasi-Redundant Subsystems (I), pp. 6839-6844

Galdun, Jan — Tech. Univ. of Košice
Ligus, Jan — Tech. Univ. of Košice
Thiriet, Jean-Marc — CNRS-INPG-UJF
Sarnovsky, Jan — Tech. Univ. of Košice

The paper presents common cascade control architecture where specific kind of redundancy could be considered. There are different approaches how to increase the reliability of networked control systems. Common approach uses redundant components in control system i.e. passive or active redundancy. We deal with quasi-redundant subsystems (shared redundancy) which could be very useful when critical failure appears. This type of redundancy offers several important advantages such as minimizing the number of components as well as reliability increasing. The example of a four-rotor mini-helicopter is presented where a cascade control architecture is considered. The main contribution of this paper is that it helps to determine the applications where quasi-redundant subsystems are a good solution to remain in a significant reliability level even if critical failure appears.

17:50-18:10 — TuC21.5

A Low Cost Embedded Control System of Step Motor and Its Application (I), pp. 6845-6849

Wang, Yong — Dalian Univ. of Tech.
Liu, Quanli — Dalian Univ. of Tech.
Wang, Wei — Dalian Univ. of Tech.
Zhan, Zili — Dalian Seasky Automation Co., Ltd

The step motor is a kind of electric actuator that transfers electrical pulses to angular displacement. How to fulfill the control task of step motor by embedded control system is a practical problem since the common computer control system has a higher cost and more redundant than the customized embedded control system. A dual-ARM7 microcontroller embedded structure is developed in this paper to keep the real-time performance, reliability and low cost. One of the ARM controllers is responsible for human-computer interaction, and the other one is dedicated to motion control. Based on this low cost platform an industrial stationary length controller is developed. The two kinds of new velocity profiles are designed and implemented. The application result shows that the embedded control system developed in this paper improves the step motor system performance and achieves low cost purpose.

TuC22 — 321A

Fuzzy Logic Control Systems (Regular Session)

Chair: Anthierens, Cedric — Inst. des Sciences du Mouvement UMR6233
Co-Chair: Behera, Laxmidhar — Indian Inst. of Tech. Kanpur

16:30-16:50 — TuC22.1

Fuzzy Model-Based Model Following Control for a Class of Nonlinear Systems, pp. 6850-6854

Ohtake, Hiroshi — Univ. of Electro-communications
Tanaka, Kazuo — Univ. of Electro-Communications
Wang, Hua O. — Boston Univ.

This paper presents nonlinear model following control for a class of nonlinear systems using the fuzzy model-based control approach. We propose the construction method of augmented fuzzy control system for continuous-time nonlinear systems by differentiating the original nonlinear system. Moreover, we introduce the dynamic fuzzy controller which can make outputs of the nonlinear system converge to outputs of the reference nonlinear system, and derive the controller design conditions in terms of LMIs. A design example illustrates the utility of this approach.

16:50-17:10 — TuC22.2

Network Inversion Based Controller Design for Discrete T-S Model, pp. 6855-6860

Kar, Indrani — Indian Inst. of Tech. Kanpur
P., Premkumar — Indian Inst. of Tech. Kanpur
Behera, Laxmidhar — Indian Inst. of Tech. Kanpur

This paper presents an elegant method for controlling nonlinear systems by modeling them in terms of a Takagi-Sugeno(T-S) fuzzy model. The concept of network inversion is used to design the controller for such a system. The proposed controller is shown to make the closed loop system stable in the sense of Lyapunov. The existing controller design techniques for T-S fuzzy model, like LMI techniques, robust control techniques are based on a sufficient or prerequisite condition for closed loop stability whereas in the present scheme no such sufficient condition is necessary. Moreover the present approach greatly simplifies the process of controller design compared to the earlier techniques. Simulation results on three nonlinear systems show the efficacy of the proposed control scheme. The proposed controller has also been implemented on the cart pole system in real time and the results are provided with a qualitative comparison with the well established LQR control.

17:10-17:30 — TuC22.3

A Sum of Squares Approach to Guaranteed Cost Control of Polynomial Discrete Fuzzy Systems, pp. 6861-6866

Tanaka, Kazuo — Univ. of Electro-Communications
Ohtake, Hiroshi — Univ. of Electro-communications
Wang, Hua O. — Boston Univ.

This paper presents a sum of squares (SOS) approach to guaranteed cost control of polynomial discrete fuzzy systems. First, we present a polynomial discrete fuzzy model that is more general representation of the well-known discrete Takagi-Sugeno (T-S) fuzzy model. Secondly, we derive a design condition based on polynomial Lyapunov functions that contain quadratic Lyapunov functions as a special case. Hence, the design approach discussed in this paper is more general than that based on the existing LMI approaches to discrete T-S fuzzy control system designs. The design condition realizes guaranteed cost control by minimizing the upper bound of a given performance function. In addition, the design condition can be represented in terms of SOS and is numerically (partially symbolically) solved via the recent developed SOSTOOLS. A design example is provided to illustrate the validity of the design approach.

17:30-17:50 — TuC22.4

The T-S Fuzzy Design and Implementation for Nonlinear Motion Systems with Control Redundancy, pp. 6867-6872

Shing, Chong-Cheng — National Chiao-Tung Univ.
Lin, Yee-Chang — National Chiao-Tung Univ.
Hsu, Pau-Lo — National Chiao Tung Univ.

The linear matrix inequality (LMI) method is generally adopted to obtain the Takagi-Sugeno (T-S) fuzzy control design with guaranteed system stability only. However, in real implementations, control specifications, like the damping ratio, the natural frequency or the bandwidth, are crucial to system design. In this paper, a feasible T-S fuzzy control design approach is proposed for the nonlinear motion systems with control redundancy, like in robots and satellites with input freedom to obtain the desirable position and orientation. In this paper, by applying the T-S fuzzy modeling and the inverse of the input matrix, a feasible T-S fuzzy controller is obtained to directly meet both system stability and design specifications. The proposed controller design method has been successfully applied to an omindirectional mobile robot (ODMR) system. Both simulation and experimental results indicate that the obtained system performance and stability directly meet the control design specifications. Results also indicate that the effect of the Coriolis force is effectively suppressed by the proposed approach and it leads to improved accuracy in both tracking and contouring precision especially in high-speed motions.

17:50-18:10 — TuC22.5

Design of a Visual Comfort Sensor for Daylighting Devices, pp. 6873-6878

Leclercq, Maximilien — Sherpa Engineering
Anthierens, Cedric — Inst. des Sciences du Mouvement UMR6233
Bideaux, Eric — INSA of Lyon
Flambard, Luc — Sherpa Engineering

This paper reports one task of a global investigation based on a whole daylighting system designed to equip refurbished and new buildings. This study forms part of the research conducted by a French group that works on green energy. The authors aim to provide occupants with daylight for everyday tasks, hence reducing electricity consumption and increasing comfort level as well. This paper presents the conception and design of a new virtual sensor based on a fisheye video camera dedicated to the assessment of optic comfort. This device includes a fuzzy logic kernel to deal with the subjective aspect of the human perception related to sight.

18:10-18:30 — TuC22.6

Enhancing the Flight Simulator Feeling by Minimising Backlash-Effects, pp. 6879-6884

Amara, Zied — ENSICA

Berard, Caroline SUPAERO
Bordeneuve-Guibé, Joel ENSICA

In this paper we addressed the problem of improving the control of AC motors used for the specific application of 3 degrees of freedom moving base flight simulator. Indeed the presence of backlash in DC motors gearboxes induces shocks and naturally limits the flight feeling. A comparison is hence set up between two techniques aiming to deal with this problem: Adaptive Fuzzy Controller and Neural Controller. Dynamic inversion with Fuzzy Logic is used to design an adaptive backlash compensator. The classification property of fuzzy logic techniques makes them a natural candidate for the rejection of errors induced by the backlash. A tuning algorithm is given for the fuzzy logic parameters, so that the output backlash compensation scheme becomes adaptive. The compensator uses the Neural Networks techniques demonstrate that artificial neural networks can be used to compensate hysteresis caused by gear backlash in precision position-controlled mechanisms. A major contribution of this research is that physical analysis of the system nonlinearities and optimal control are used to design the neural network structure.

TuC23 323
Industrial Applications of Distributed Real-Time Object-Computing (Invited Session)

Chair: Pereira, Carlos Eduardo — Federal Univ. of Rio Grande do Sol
Co-Chair: Sanz, Ricardo — Univ. Pol. de Madrid
Organizer: Pereira, Carlos Eduardo — Federal Univ. of Rio Grande do Sol
Organizer: Wehrmeister, Marco Aurelio — UFRGS
Organizer: Sanz, Ricardo — Univ. Pol. de Madrid

16:30-16:50 TuC23.1
Evaluating Aspect and Object-Oriented Concepts to Model Distributed Embedded Real-Time Systems Using RT-UML (I), pp. 6885-6890

Wehrmeister, Marco Aurelio UFRGS
Freitas, Edison Pignaton UFRGS
Orfanus, Dalimir Univ. of Paderborn
Pereira, Carlos Eduardo Federal Univ. of Rio Grande do Sol
Rammig, Franz Univ. of Paderborn HNI

The growing design complexity of today's embedded real-time systems requires new techniques aiming the raising of the abstraction level since earlier stages of design in order to deal with such complexity in a suitable way. This paper reports a case study, which provides an assessment of two well-know high-level paradigms, namely Aspect- (AO) and Object-Oriented (OO) Paradigms. Concepts of both paradigms were applied at modeling phase of a Distributed Embedded Real-Time System (DERTS). The handling of DERTS' functional and non-functional requirements (at modeling level) using AO and OO concepts is discussed. Both paradigms are compared using of a set of software engineering metrics, which were adapted to be applied at modeling level. The presented results show the suitability of each paradigm for DERTS specification in terms of reusability quality of model elements.

16:50-17:10 TuC23.2
Automated Configuration of Component-Based Distributed Real-Time and Embedded Systems from Feature Models (I), pp. 6891-6896

White, Jules Vanderbilt Univ.
Schmidt, Douglas C. Vanderbilt Univ.

Component-based distributed real-time and embedded (DRE) systems facilitate the reuse of software artifacts across applications. To achieve a high-level of reuse, component-based DRE systems leverage late binding to allow dynamic system assembly at deployment time (e.g., via configuration scripts) rather than statically at compile-time. The complexity of deriving a correct manual configuration of an arbitrary set of components, however, is a key source of system failures, downtime, and missed deadlines.

This paper presents a model-driven engineering tool called Fresh that uses (1) feature models to codify the configuration rules of components, (2) a constraint solver to derive a correct application configuration, and (3) an XML annotation engine to inject configuration decisions from the constraint solver directly into an application configuration.We use an avionics mission computing case study based on the Lightweight CORBA Component Model (CCM) to (1) demonstrate the complexities of configuring components in/out of a component-based application and (2) motivate the reduction in the configuration complexity when Fresh is used.The results show that Fresh achieves 80-90% reduction in manual configuration effort, while also ensuring that the derived configuration is correct with respect to application configuration constraints and QoS requirements.

17:10-17:30 TuC23.3
Embedded Component Technology for Complex Control Systems (I), pp. 6897-6902

Sanz, Ricardo Univ. Pol. de Madrid
Rodriguez, Manuel Univ. Pol. de Madrid
Martínez, Carlos Univ. Pol. de Madrid
Hernando, Adolfo Univ. Pol. de Madrid

The question of finding the best technology for software-based controller deployment is still open. One of the main problems is that computing infrastructures for controllers are composed by heterogeneous hardware and software platforms scattered over a set of heterogeneous networking infrastructures. The standardised object-oriented efforts done around the the OMG specifications try to overcome some of the difficulties raised by this heterogeneity. Inside the Distributed Object Computing (DOC) landscape, CORBA is a well known framework for the construction of modularised, object oriented, distributed applications. The CORBA object model, however, is not enough when confronting the problems related to deployment, configuration and evolutionary maintenance of systems. This paper describes the ECF component technology specifically built for the construction of component-based, distributed embedded systems.

17:30-17:50 TuC23.4
Distributed Object-Based Architecture for Controlling Autonomous Vehicles (I), pp. 6903-6908

Silva, Ronaldo Aparecido UFSC
Kelber, Christian UNISINOS
Rico, Julio Normey Escuela Superior de Ingenieros de Sevill
Becker, Leandro Federal Univ. of Santa Catarina

In autonomous vehicles control, there is a need to interconnect several distributed electronic components in a proper manner to allow the embedded computational system to perform its control task in an efficient and reliable way. Therefore, this paper presents an object-based communication architecture that provides an infrastructure to design such systems. The proposed architecture relies in the publisher/subscriber protocol, which is characterized by the uncoupling between its components, anonymous communication with content-based messages, and many-to-many communications. Our architecture is based in the concept of sentient-objects, which are reactive entities distributed across the network that normally represent elements from the problem-domain. The paper presents the architecture, as well as an application used for controlling an autonomous vehicle.

17:50-18:10 TuC23.5
The UML – MARTE Standardized Profile (I), pp. 6909-6913

Gerard, Sebastien CEA LIST
Selic, Bran IBM

The UML Profile for Modeling and Analysis of Real-Time and Embedded Systems (also called the UML profile for MARTE, or simply, MARTE) adds capabilities to UML for model-driven development of real-time and embedded systems (RTES). It provides support for specification, design, and verification/validation stages. This new profile replaces the existing UML Profile for Schedulability, Performance and Time (formal/03-09-01), which was based on an earlier version of UML (UML 1.x). MARTE defines the foundations for model-based description and analysis of real time and embedded systems. At its core is a set of fundamental concepts which are further refined for modeling and a variety of quantitative analyses. The modeling capabilities range from support for system specification through to detailed design of real-time and embedded systems. For the analysis portion, the intent is not to define new techniques for analyzing real-time and embedded systems, but to support the ones that currently exist as well as potential new ones. Hence, it provides facilities to annotate models with information required to perform specific types of analyses. In particular, MARTE focuses on performance and schedulability analysis. But, it also defines a general analysis framework which can be specialized for other kinds of analysis.

TuC24 324
Reliability & Safety Analysis: Fault Diagnosis by Discrete Event Systems (Regular Session)

Chair: Zhao, Qing — Univ. of Alberta
Co-Chair: Demmou, Hamid — LAAS -CNRS - Univ. of Toulouse

16:30-16:50 TuC24.1

Fault Diagnosis Using a Timed Discrete Event Approach Based on Interval Observers, pp. 6914-6919

Meseguer, Jordi — Univ. Pol. de Catalunya (UPC)
Puig, Vicenc — Univ. Pol. de Catalunya
Escobet, Teresa — Univ. Pol. de Catalunya

This paper proposes a fault diagnosis method using a timed discrete-event approach based on interval observers which improves the integration of fault detection and isolation tasks. The interface between fault detection and fault isolation considers the degree of fault signal activation and the occurrence time of the diagnostic signals using a combination of several theoretical fault signature matrices which store the knowledge of the relationship between diagnostic signals and faults. As a novelty, this paper proposes to implement the fault isolation module using a timed discrete event approach in spite of using an analytical fault detection model. In this way, the diagnosis result will be enhanced since the occurrence of a fault generates a unique sequence of observable events (fault signals) that will be recognized by the isolation module implemented as a timed discrete event system. The states and transitions that characterize such a system can be inferred directly from the relation between fault signals and faults. The proposed fault diagnosis approach is applied to detect and isolate faults of the Barcelona’s urban sewer system limnimeters (level meter sensors).

16:50-17:10 TuC24.2

Reliability Monitoring of Fault Tolerant Control Systems, pp. 6920-6925

Li, Hongbin — Univ. of Alberta
Zhao, Qing — Univ. of Alberta
Yang, Zhenyu — Aalborg Univ. Esbjerg

This paper proposes a reliability monitoring scheme for active fault tolerant control systems using a stochastic modeling method. The reliability index is defined based on system dynamical responses and a safety region; the plant and controller are assumed to have a multiple regime model structure; and a semi-Markov model is built for reliability evaluation based on safety behavior of each regime model estimated by using Monte Carlo simulation. Moreover, the history data of fault detection & isolation decisions is used to update its transition characteristics and reliability model.

17:10-17:30 TuC24.3

Pertinent Scenarios in Temporal Petri Nets for Critical System Analysis, pp. 6926-6931

Sadou, Nabil — LAAS - CNRS, Univ. of Toulouse
Demmou, Hamid — LAAS -CNRS - Univ. of Toulouse

This paper deals with dynamic reliability of embedded systems. It is addressed by generating critical scenarios (scenarios leading to feared states). The aim of this paper is to propose the definition of two concepts related to the notions of scenario, minimality and completeness. These two notions guarantee the pertinence of scenarios. In Petri net model, a scenario is defined as a partial order between events (transition firings in Petri net) leading from one partial state (here partial marking) to another one. In this paper, we use linear logic as a new representation of Petri net model. The definition of minimality and completeness is based on this new representation.

17:30-17:50 TuC24.4

A Barrier Certificate Approach to the Verification of the Safe Operation of a Chemical Reactor, pp. 6932-6937

Shah, Gaurang — Tech. Univ. Dortmund
Volker, Marten — Chair of Process Control
Sonntag, Christian — Univ. Dortmund
Engell, Sebastian — Univ. of Dortmund

In industrial practice, extensive simulations are performed in order to analyse the safety and the correct operation of controlled chemical processes. One aspect of verifying the safe operation is to prove that the states of the system stay within a safe region for a certain set of inputs or disturbances which is the main theme of this paper. Recently, a rigorous method for this type of verification problem has been proposed which makes use of Barrier Certificates for verifying whether an undesired set of states can be reached. If the system dynamics can be described in polynomial form, the safety of the system can be proven algorithmically. The determination of a barrier certificate is a sum-of-squares (SOS) problem which can further be transformed into a non-convex Bilinear Matrix Inequality (BMI) problem. This paper deals with proving the safety of a Continuously Stirred Tank Reactor (CSTR), a non-linear system, using barrier certificates. Uncertainties are represented by a bounded disturbance acting on the system. Safety is explicitly proven for a convex set of initial conditions and a non-convex unbounded unsafe set. Two situations are considered, the uncontrolled plant and the closed-loop system with a state-feedback controller. For the solution of the BMI problem, three different numerical approaches are compared. It turned out that solving the non-convex BMI problem directly is more efficient than solving it using the convex iterative approach.

17:50-18:10 TuC24.5

A Safety Barriers-Based Approach for the Risk Analysis of Socio-Technical Systems, pp. 6938-6943

Leger, Aurélie — Nancy Univ. Res. Center for Automatic Control,CNRS, UM
Farret, Régis — INERIS
Duval, Carole — Company
Levrat, Eric — Univ.
Weber, Philippe — Nancy Univ. CNRS, (CRAN UMR 7039)
Iung, Benoît — Nancy Univ.

Usually, an efficient interaction between different resources of an industrial system (technical, human and organizational) leads to an efficient operation of this system. If this interaction is too weak due to missing or failing resources, the system can evolve to inoperative or risky situations, which can be hazardous for critical systems (as nuclear power plants and chemical processes). Thus methodologies are needed to support risk analysis by integrating together these system dimensions. Nevertheless few existing methodologies are able to perform this task and are mainly dedicated to partial or specific application domains. To face this gap, the paper presents a new methodology based on a system knowledge unification and its structuring in order to quantitatively estimate risks. Then the proposed approach integrates explicitly safety barriers, considered as key parts for risks prevention, and modeled by means of Bayesian networks. Finally a barrier example is depicted in the paper to highlight the feasibility of the methodology.

18:10-18:30 TuC24.6

Diagnostics of Industrial Processes in Decentralised Structures with Application of Fuzzy Logic, pp. 6944-6949

Koscielny, Jan — Warsaw Univ. of Tech.
Bartys, Michal, Zbigniew — Warsaw Univ. of Tech.
Syfert, MichaB; — Warsaw Univ. of Tech.

In the paper the problem of decomposition of the diagnostic system has been described. Principles of diagnostics in the decentralised hierarchic structure with the application of fuzzy logic have been given. The features and advantages of diagnostics of industrial processes in decentralised structures have been discussed. An industrial example of diagnostic reasoning in the decomposed structure has been presented.

TuC25 328
Model Predictive and Optimization-Based Control (Regular Session)

Chair: Rossiter, J. Anthony — Univ. of Sheffield
Co-Chair: Skogestad, Sigurd — Norwegian Univ. of Science and Tech.

16:30-16:50 TuC25.1

Stable IHMPC for Unstable Systems, pp. 6950-6955

Gonzalez, Alejandro, Hernan — Univ. of São Paulo
Sotomayor, Oscar — Pol. School of the Univ. of Sao Paulo
Odloak, Darci — Univ. of São Paulo - Brazil

An alternative method to formulate the stable Model Predictive Control (MPC) optimization problem, which allows controlling unstable systems with a large domain of attraction, is presented in

this work. Usually, stability is guaranteed by means of an appropriate selection of a terminal cost, a terminal constraint, and a local unconstrained controller for predictions beyond the control horizon. This is the case, for instance, of the infinite horizon MPC (IHMPC) with a null local controller, and the dual MPC with a local Linear Quadratic Regulator (LQR). In the last case, the MPC formulation also allows a local optimality. However, its domain of attraction is limited (small, in most of the cases) and depends on the size of the terminal set and the length of the control horizon. Here we propose the inclusion of an appropriate set of slacked terminal constraints into the optimization problem as a way to enlarge the domain of attraction of the MPC that uses the null local controller. In addition, this slack allows a simple offset-free operation in the proximities of the input saturation. Despite the proposed controller does not achieve local optimality, simulations show that its performance is similar to the one obtained with the dual MPC that uses a LQR local controller.

16:50-17:10 TuC25.2

Explicit MPC with Output Feedback Using Self-Optimizing Control, pp. 6956-6961

Manum, Henrik — Norwegian Univ. of Science and Tech.
Narasimhan, Sridharakumar — Norwegian Univ. of Science and Tech. (NTNU)
Skogestad, Sigurd — Norwegian Univ. of Science and Tech.

Model predictive control (MPC) is a favored method for handling constrained linear control problems. Normally, the MPC optimization problem is solved on-line, but in ‘explicit MPC’ an explicit precomputed feedback law is used for each region of active constraints (Bemporad et al., 2002). In this paper we make a link between this and the ‘self-optimizing control’ idea of finding simple policies for implementing optimal operation. The ‘nullspace’ method (Alstad and Skogestad, 2007) generates optimal variable combinations, c = u _; Kx, which for the case with perfect state measurements are equivalent to the explicit MPC feedback laws, where K is the optimal state feedback matrix in a given region. More importantly, this link makes it possible to derive explicit feedback laws for cases with (1) state measurement error included and (2) measurement (rather than state) feedback. We further show how to generate optimal low-order controllers for unconstrained optimal control, also in the presence of noise.

17:10-17:30 TuC25.3

Development and Application of an Integrated MPC Technology, pp. 6962-6967

Zhu, Yucai — Eindhoven Univ. of Tech.
Xu, Zuhua — Zhajiang Univ.
Zhao, Jun — Zhejiang Univ.
Han, Kai — Zhejiang Univ.
Qian, Jixin — Zhejiang Univ.
Li, Weixin — Sinopec Yangtze Petrochemical Company

This work introduces an integrated MPC controller. The integrated MPC consists of three modules: an MPC control module, an online identification module and a control monitor module. The three modules work together coherently in real-time; it can perform automatic controller commissioning and automatic controller maintenance. In MPC commissioning, the online identification module and the MPC control module work together and perform various steps in MPC implementation automatically. When the MPC controller is online, the control monitor module continuously monitors the MPC performance and model quality. When control performance degradation and considerable model error are detected, monitor module will start the maintenance by activating the online identification module. The identification module will re-identify the model and replace the old model. A prototype of the integrated MPC controller has applied successfully to two PTA units and the result will be reported.

17:30-17:50 TuC25.4

Conditions for Which MPC Fails to Converge to the Correct Target, pp. 6968-6973

Shead, Leo Roger Edward — Univ. of Sheffield
Muske, Kenneth R. — Villanova Univ.
Rossiter, J. Anthony — Univ. of Sheffield

This paper considers the efficacy of disturbance models for ensuring offset free tracking and optimum steady-state target selection within linear model predictive control (MPC). Previously published methods for steady-state target determination can address model error, disturbances, and output target changes when the desired steady state is unconstrained, but may fail when there are active constraints. This paper focuses on scenarios where the most desirable target is unreachable, thus some constraints are active in steady state. Examples are given showing that the resulting ’feasible steady-state target’ can converge to a point which is not as close as possible to the true target. These failures have not been widely discussed in the literature. From the closed-loop behavior, hypotheses are put forward as necessary conditions for offset-free control. These hypotheses are then investigated through the use of Karush-Kuhn- Tucker (KKT) conditions of optimality.

17:50-18:10 TuC25.5

Fast Model Predictive Control Using Online Optimization, pp. 6974-6979

Wang, Yang — Stanford Univ.
Boyd, Stephen P. — Stanford Univ.

A widely recognized shortcoming of model predictive control (MPC) is that it can usually only be used in applications with slow dynamics, where the sample time is measured in seconds or minutes. A well known technique for implementing fast MPC is to compute the entire control law offline, in which case the online controller can be implemented as a lookup table. This method works well for systems with small state and input dimensions (say, no more than 5), and short time horizons. In this paper we describe a collection of methods for improving the speed of MPC, using online optimization. These custom methods, which exploit the particular structure of the MPC problem, can compute the control action on the order of 100 times faster than a method that uses a generic optimizer. As an example, our method computes the control actions for a problem with 12 states, 3 controls, and horizon of 30 time steps (which entails solving a quadratic program with 450 variables and 1260 constraints) in around 5msec, allowing MPC to be carried out at 200Hz.

18:10-18:30 TuC25.6

Multiobjective Optimization for Automatic Tuning of Robust Model Based Predictive Controllers, pp. 6980-6985

Vega, Pastora — Univ. of Salamanca
Francisco, Mario — Univ. of Salamanca
Tadeo, Fernando — Univ. of Valladolid Q4718001C

In this paper a general procedure for tuning multivariable model predictive controllers (MPC) with constraints is presented. It has been applied to tune the control system of an activated sludge process control in a wastewater treatment plant. Control system parameters are obtained by solving a mixed sensitivity optimization problem, defined in terms of the H infinity norms of different weighted closed loop transfer functions matrices of the system, and a set of constraints, some of them expressed using the l1 norm. The use of multiple linearized models for the control allows for the specification of many robust performance criteria. The mathematical optimization for tuning all controller parameters is tackled in two iterative steps due to the existence of integer and real numbers. First, integer parameters are obtained using a special type of random search, and secondly a sequential programming method is used to tune the real parameters.

TuC26 327

Modeling, Operation and Control of Power Systems III (Regular Session)

Chair: Lee, Kwang Y. — Baylor Univ.
Co-Chair: Sawodny, Oliver — Univ. of Stuttgart

16:30-16:50 TuC26.1

Introducing Model Predictive Control for Improving Power Plant Portfolio Performance, pp. 6986-6991

Edlund, Kristian — Dong Energy
Bendtsen, Jan Dimon — Aalborg Univ.
Břrresen, Simon — DONG Energy
Mřlbak, Tommy — DONG Energy

This paper introduces a model predictive control (MPC) approach for construction of a controller for balancing the power generation against consumption in a power system. The objective of the controller is to coordinate a portfolio consisting of multiple power plant units in the effort to perform reference tracking and disturbance rejection in an economically optimal way. The performance function is chosen as a mixture of the L_1-norm and a linear weighting to model the economics of the system. Simulations show a significant improvement of the performance of the MPC compared to the current implementation consisting of a distributed PI controller structure, both in terms of minimising the overall cost but also in terms of the ability to minimise deviation, which is the classical objective.

16:50-17:10 TuC26.2

An Optimal Adaptive Control Approach for Power Systems, pp. 6992-6997

Geng, Bo — Tsinghua Univ.
Luo, Guiming — Tsinghua Univ.
Kwon, Wook Hyun — Seoul National Univ.

An optimal adaptive control method for power systems is concerned in this paper. The control approach adopts a weighted controller and a type of extended recursive identification algorithm, of which the unbiased estimation deduction is also presented. Furthermore, the proposed control approach is applied to power system stabilizer (PSS) and some simulation experiments are carried out to test its control effect. The results prove conclusively that the optimal adaptive control approach can effectively impact the stability of the power system operation under disturbance.

17:10-17:30 TuC26.3

Criteria for Evaluation of Power Balance Control Performance in UCTE Transmission Grid, pp. 6998-7003

Havel, Petr — Czech Tech. Univ.
Horacek, Petr — Czech Tech. Univ. in Prague
Janecek, Eduard — Univ. of West Bohemia
Fantik, Josef — CEPS a.s.

In this paper two criteria for evaluation of power balance control performance in control areas of the UCTE interconnection are proposed: the mean value of Area Control Error (ACE) and the standard deviation of ACE. A methodology for assigning fair values of the two criteria to individual control areas is presented. This methodology ensures that the UCTE grid is operated in a safe manner and no area performs control at the expense of other areas. Since the fair values of the ACE standard deviation depend on a chosen model of ACEs coincidence, two cases were investigated: a model with no coincidence (optimistic one) and a model with full coincidence (pessimistic one).

17:30-17:50 TuC26.4

Dynamic Investigation of Network Restoration by the Pumped-Storage Plant Markersbach in Germany, pp. 7004-7009

Krüger, Manfred — Univ. of Rostock
Weber, Harald — Univ. of Rostock

To restore a transmission network after blackout without predetermined voltage by neighbouring transmission systems, the restoration has to proceed from power-station units within the own network area. In small separate networks connecting electrical equipment and consumers can result in unstable operating conditions. Possibly tripped protective measures can cause the breakdown of the restored transmission system in the end. To investigate network restoration, a realistic dynamic model of the extra-high voltage system is needed on a simulation platform. In this way different scenarios of restoration can be analysed from technical points of view. Creating a complete dynamic network model, the dynamic models of the most significant supplying power plants are necessary. The paper presents the results of modelling the black-start capable pumped-storage plant (PSP) Markersbach that is located in eastern part of Germany. Basing on measurements in the PSP Markersbach a dynamic power-station model was developed and its parameters were identified. With the model of the power plant several restoration scenarios proceeding from PSP Markersbach can be investigated regarding their feasibility. This project is a part of cooperation between Vattenfall Europe Transmission GmbH (VE-T) and University of Rostock. The determined possibilities of a successful network restoration are going to be involved in a conception concerning the restoration of VE-T transmission system. This conception will also be used as instruction manual for employee training.

17:50-18:10 TuC26.5

Passivity Based Control of Power Plants, pp. 7010-7015

Wen, Chengtao — Carnegie Mellon Univ.
Ydstie, B. Erik — Carnegie Mellon

In this paper,we show that the state space spanned by the intensive variables such as temperature and pressure is isomorphic to that spanned by extensive variables such as the mass and energy inventories for a single component process system. Then we propose a state space model for power plants, which uses the mass and energy inventories as state variables, and has an a±ne structure in the control variables. In addition, a passivity based inventory controllers are developed. Numerical simulations suggest the performance and e±ciency of the inventory controllers in power plant systems

18:10-18:30 TuC26.6

Modelling, Simulation, Identification, and Model-Based Control of Integrated Fuel-Cell-Based Power Plants, pp. 7016-7021

Weickgenannt, Martin — Univ. of Stuttgart
Kharitonov, Alexander — Univ. of Stuttgart
Gepert, Vanessa — Univ. of Stuttgart
Sawodny, Oliver — Univ. of Stuttgart

In this contribution, a fuel cell-based power plant which uses water and methane to produce electrical power is considered. While earlier publications deal with the fuel cell only, this contribution takes the whole plant into account. The distributed modelling of the hydrogen producing reformer unit is presented. Methods are developed which allow for a fast and efficient simulation of the model equations. As the other parts of the power plant are of similar dynamical structure, the simulation methods are easily transferable. The identification of parameters for the power plant is performed on the basis of measurements and dynamic simulation. Sophisticated control concepts for the optimal operation of the power plant are proposed. They consider the whole plant and couplings between the various elements to maximise the plant's efficiency.

TuC27 326

Modeling and Identification with Fuzzy and Neural Techniques
(Regular Session)

Chair: Sreenatha, Anavatti G. — Australian Defence Force Acad.
Co-Chair: Herreros, Alberto — Univ. of Valladolid

16:30-16:50 TuC27.1

Structure Adaptation of Multi-Layer Perceptron Network for On-Line System Identification, pp. 7022-7027

Hering, Pavel — Univ. of West Bohemia
Simandl, Miroslav — Univ. of West Bohemia

Identification of nonlinear systems by a neural network is treated. The paper deals with a design of a suitable neural network structure to approximate a nonlinear function of the identified system. Contrary to the recent algorithms, the proposed structure adaptation algorithm can be applied on-line during the identification process. The designed algorithm consist of a statistical test for making decision about suitability of an a priori chosen network and then either a growing or a pruning according to the size of the network is applied. The acceptance or rejection of the model is realized by application of the statistical cumulative sum test from the decision making field. The growing part of the algorithm repeatedly utilizes principle of the learning methodology for detecting faults in nonlinear dynamical systems for adding neurons to the hidden layer. Finally, the pruning algorithm is based on a measure of sensitivity of the model output error to the removing of the network connections. The properties of the proposed structure adaptation algorithm are illustrated in a numerical example.

16:50-17:10 TuC27.2

Improved Training of an Optimal Sparse Least Squares Support Vector Machine, pp. 7028-7033

Xia, Xiao Lei — Queen's Univ. Belfast
Li, Kang — Queen's Univ. Belfast
Irwin, George W. — Queen's Univ. of Belfast

The optimal separating hyperplane of a typical Least Squares Support Vector Machine (LS-SVM) is constructed using most of the training samples. A consequent disadvantage is the slowdown of the LS-SVM classification process on the test samples. Previous methods address this issue by simplifying the decision rule established after training, which risks a loss in generalization ability and imposes extra computation cost. This paper presents a novel optimal sparse LS-SVM whose decision rule is parameterized by the optimal set of training examples, in addition to having an optimal generalization capability. For a large number of classification problems, the new LS-SVM requires a significantly reduced number of training samples, a property referred to as the sparseness of the

solution. The training of the LS-SVM method is implemented using a modified two-stage regression algorithm. Experiments on two-spiral data confirms the advantages described. Simulation results on checkerboard data further illustrate that the proposed LS-SVM can effectively produce an optimal hyperplane which is sparse in training examples.

17:10-17:30 TuC27.3

Interpretability-Accuracy Improvement in a Neuro-Fuzzy ART Based Model of a DC Motor, pp. 7034-7039

Galende, Marta — Fundación CARTIF
Sainz, Gregorio — Univ. de Valladolid
De La Fuente, Maria Jesus — Univ. De Valladolid. Q4718001C
Herreros, Alberto — Univ. of Valladolid

The aim of this paper is to propose a general methodology applicable to any rule based fuzzy model generated by any precise or linguistic fuzzy algorithm to improve the linguistic-accuracy trade-off. Here, the neuro-fuzzy system FasArt (Fuzzy Adaptive System ART based) is used for its proven model capabilities, as shown in previous papers and works. If does, however, have the usual drawbacks, from the linguistic point of view, of most fuzzy modeling methods found in the scientific literature. A fuzzy model of a DC motor is generated by FasArt, whose performance is a good estimation of the motor's behavior, then this performance is improved by a better interpretability of the knowledge attained and stored by this fuzzy model. The main idea behind this approach is to find a fuzzy model with enough accuracy and an adequate capacity of explanation or interpretability of its data acquired knowledge. The modeling process can thus be seen as knowledge extraction in human or linguistic terms: from a numeric level (data) to a symbolic one (linguistic fuzzy rules).

17:30-17:50 TuC27.4

Fuzzy Mechanism Model with Neural Compensation for Estimation of Shaft Furnace's Product Quality, pp. 7040-7045

Wu, Fenghua — Northeastern Univ.
Chai, Tianyou — Northeastern Univ.
Yu, Wen — CINVESTAV-IPN

Usually grey-box modeling has better accuracy than black-box identification. The grey-box can be regarded as combination of mechanistic modelling and intelligent identification. But in many cases, mechanistic models are not available, for example the production quality of the shaft furnace which will be discussed in this paper, we can use fuzzy technique to obtain the mechanistic models that can be checked by the physical meanings. In this paper, we propose a novel modeling approach for complex nonlinear systems, it has a fuzzy mechanistic model and a neural compensator. For the training of the neural network, we propose a new fast and stable algorithm. Finally, the above method is successfully applied on estimation of the production quality of the shaft furnace.

17:50-18:10 TuC27.5

Stable Learning Algorithm Approaches for ANFIS As an Identifier, pp. 7046-7051

Aliyari Shoorehdeli, Mahdi — Science & Res. Branch Islamic Azad Univ.
Teshnehlab, Mohammad — k. n. toosi Univ. of Tech.
Khaki Sedigh, Ali — K.N. Toosi Univ. of Tech.

This study suggests new learning laws for Adaptive Network based Fuzzy Inference System that is structured on the basis of TSK type III as a system identifier. Stable learning algorithms for consequence parts of TSK type III rules are proposed on the basis of the Lyapunov stability theory and some constraints are obtained. Simulation results are given to validate the results. It is shown that instability will not occur for learning rates in the presence of constraints. The learning rate can be calculated online from the input–output data, and an adaptive learning for the Adaptive Network based Fuzzy Inference System structure can be provided.

18:10-18:30 TuC27.6

Modelling, Control and Optimization of a Continuous Distillation Tower through Fuzzy Techniques, pp. 7052-7057

Santafé-Moros, Asunción — Univ. Pol. de Valencia
Díez, José Luis — Univ. Pol. de Valencia
Barceló-Rico, Fátima — Univ. Pol. de Valencia
Gozalvez-Zafrilla, Jose M. — Univ. Pol. de Valencia

This paper presents a methodology for the design of a fuzzy controller applicable to continuous processes based on local fuzzy models and velocity linearizations. It has been applied to the implementation of a fuzzy controller for a continuous distillation tower. Continuous distillation towers can be subjected to variations in feed characteristics that cause loss of product quality or excessive energy consumption. Therefore, the use of a fuzzy controller is interesting to control process performance. A dynamic model for continuous distillation was implemented and used to obtain data to develop the fuzzy controller at different operating points. The fuzzy controller was built by integration of linear controllers obtained for each linearization of the system. Simulation of the model with controller was used to validate the controller effectiveness under different scenarios. The results showed that the fuzzy controller was able to keep the target output in the desired range for different inputs disturbances, changing smoothly from a predefined target output to another. The developed techniques are applicable to more complex distillation systems including more operating variables.

TuC28 330A

New Trends in Powertrain Control (Regular Session)

Chair: Soliman, Ahmed — OSU
Co-Chair: Alamir, Mazen — Gipsa-Lab. (CNRS-Univ. of Grenoble)

16:30-16:50 TuC28.1

Optimization of Heavy Truck's Driveline Performance Via Model Predictive Control Rated by a Comfort Evaluation Algortihm, pp. 7058-7063

Webersinke, Lena — Univ. Karlsruhe
Feth, Daniela — Univ. Karlsruhe
Hertweck, Mario — Daimler AG
von Vietinghoff, Anne — Univ. Karlsruhe (TH)
Kiencke, Uwe — Univ. of Karlsruhe

Finding the best compromise between comfort and dynamic during Tipin/out operations in heavy trucks is the aim of this project. Therefore, in this paper a new control concept is introduced based on model predictive control. The main parts of this concept are a fusion of the two different control targets comfort and dynamic to one resulting control variable and the design of a model predictive controller. This controller provides an optimal tracking of the predicted control target.

Due to the subjective perception of the driver, evaluating the comfort of a driving situation is not as easy as to describe the dynamic. Therefore, an online comfort evaluation algorithm based on objective measurement data is developed.

The very good performance of the developed control concept can be confirmed by this evaluation algorithm.

16:50-17:10 TuC28.2

Statistical Engine Knock Control, pp. 7064-7065

Stotsky, Alexander A. — Volvo Car Corp.

A new statistical concept of the knock control of a spark ignition automotive engine is proposed. The control aim is associated with the statistical hypothesis test which compares the threshold value to the average value of the maximal amplitude of the knock sensor signal at a given frequency. Control algorithm which is used for minimization of the regulation error realizes a simple count-up-count-down logic. A new adaptation algorithm for the knock detection threshold is also developed. Confidence interval method is used as the basis for adaptation. A simple statistical model which includes generation of the amplitude signals, a threshold value determination and a knock sound model is developed for evaluation of the control concept.

17:10-17:30 TuC28.3

Leakage Detection in a Fuel Evaporative System, pp. 7066-7071

Frisk, Erik — Linkoping Univ.
Krysander, Mattias — Linköping Univ.

On-Board Diagnostics (OBD) regulations require that the fuel system in personal vehicles must be supervised for leakages. Legislative requirement on the smallest leakage size that has to be detected is decreasing and at the same time the requirement on number of leakage checks are increasing. A consequence is that detection must be performed under more and more diverse operating conditions. This paper describes a vacuum-decay based approach for evaporative leak detection. The approach requires no additional hardware such as pumps or pressure regulators, it only utilizes the pressure sensor that is mounted in the fuel tank. A

detection algorithm is proposed that detects small leakages under different operating conditions. The method is based on a first principles physical model of the pressure in the fuel tank. Careful statistical analysis of the model and measurement data together with statistical maximum-likelihood estimation methods, results in a systematic design procedure that is easily tuned with few and intuitive parameters. The approach has been successfully evaluated on real data measured in a research laboratory.

17:30-17:50 TuC28.4

Model-Based Fault Diagnosis of a NOx Aftertreatment System, pp. 7072-7078

Pisu, Pierluigi — Clemson Univ.
Canova, Marcello — The Ohio State Univ.
Soliman, Ahmed — OSU

The Lean NOx Trap (LNT) is an aftertreatment device used to attain a reduction in nitrogen oxide emissions for Diesel and lean burn engines. The LNT is typically used as a storage device, capturing NOx during lean engine operation. The trap can be regenerated by controlling the exhaust air-fuel ratio to create a rich gas mixture. Under rich conditions, the stored NOx is released and catalytically converted. This way, tailpipe emissions can be significantly reduced by properly modulating the lean (storage) and rich (regeneration) periods. To maintain the LNT operate with high conversion efficiency, an optimized control of the regeneration scheduling is required. In addition, LNT systems require fault diagnostic schemes to detect and isolate faults, typically related to sulfur and thermal damages. This paper deals with the design and validation through simulation of a model-based fault diagnosis scheme for a LNT system. The mathematical model of the subsystem, based on the physics of the processes involved, consist of time-varying nonlinear ODEs. The proposed diagnostic approach is based on the generation of residuals using system models and through comparison of the predicted and measured value of selected variables, including the AFR, catalyst output temperature and the NOx concentration at the output of the LNT. The paper focuses on detection and isolation of controller faults and LNT parametric faults related to sulfur and thermal damage. The model utilized in the diagnostic scheme, which includes sulfur poisoning and thermal deactivation processes, has been experimentally validated from data collected on a Diesel LNT system and integrated with a quasi-steady engine and vehicle simulator to estimate tailpipe emissions during standard driving cycles.

17:50-18:10 TuC28.5

Unified MPC Strategy for Idle-Speed Control, Vehicle Start-Up and Gearing Applied to an Automated Manual Transmission, pp. 7079-7085

Amari, Rachid — IFP
Alamir, Mazen — Gipsa-Lab. (CNRS-Univ. of Grenoble)
Tona, Paolino — IFP

A real-time Model Predictive Control (MPC) is proposed for controlling the behavior of an Automated Manual Transmission (AMT). The underlying formulation shows a unified approach that handles different modes: idle-speed control, vehicle start-up, gearing up and down.

Sub-optimal solutions are computed on-line using an adaptive reduced dimensional parametrization that is directly linked to the accelerator pedal position.

Transmission stability constraints are explicitly handled as well as saturations on the control inputs. The proposed control is tested both in simulation and on line in a city car demonstrator equipped with a natural gas engine.

18:10-18:30 TuC28.6

Semi-Physical Neural Network Model in Detecting Engine Transient Faults Using the Local Approach, pp. 7086-7090

Wang, Xun — Queen's Univ. Belfast
McDowell, Neil — Queen's Univ. Belfast
Kruger, Uwe — The Petroleum Inst.
McCullough, Geoffrey — Internal Combustion Engines Res. Group
Irwin, George W. — Queen's Univ. of Belfast

This paper investigates detection of an air leak fault in the intake manifold subsystem of an automotive engine during transient operation. Previously, it was shown that integrating the local approach with an auto-associative neural network model of the engine, significantly increased the sensitivity of fault detection. However, the drawback then is that the computational load is naturally dependent on the network complexity. This paper proposes the use of the available physical models to pre-process the original signals prior to model building for fault detection. This not only extracts existing relationships among the variables, but also helps in reducing the number of variables to be modelled and the related model complexity. The benefits of this improvement are demonstrated by practical application to a modern spark ignition 1.8 litre Nissan petrol engine.

TuC29 330B

Sensors, Virtual Sensors and Observers (Regular Session)

Chair: Basset, Michel — Univ. de Haute-Alsace
Co-Chair: El Hajjaji, Ahmed — Univ. de Picardie-Jules Verne

16:30-16:50 TuC29.1

Vehicle Roll and Road Bank Angles Estimation, pp. 7091-7097

Sebsadji, Yazid — INRETS-LCPC
Glaser, Sébastien — INRETS-LCPC
Mammar, Saďd — CNRS
Netto, Mariana — LIVIC - LCPC/INRETS

Driving safety can be enhanced by better understanding of risk situation, which can be achieved by the knowledge of vehicle dynamic states as well as the road geometry. Among the parameters of the road that have an influence on vehicle dynamics, one can find the bank angle, which can not however be measured by low cost onboard sensors. In this paper, a new method of road bank angle and vehicle roll estimation using an unknown input proportional integral (PI) observer is proposed. To reach this goal, first a bicycle vehicle model is chosen. This model is quite simple but well appropriate for the considered application. Thereafter, an Extended Kalman Filter (EKF) is developed in order to estimate the sideslip angle which is also difficult to measure with low cost sensors. This estimate is then used as an input of the PI observer in order to estimate vehicle roll angle and the road bank angle (road attribute). Testing on measurements obtained with a prototype vehicle shows the good behavior the proposed estimation scheme.

16:50-17:10 TuC29.2

Non-Fragile Observer-Based Control of Vehicle Dynamics Using T-S Fuzzy Approach, pp. 7098-7103

El Messoussi, Wissam — Univ. of Picardie Jules Verne
Bosche, Jerome — Univ. of Amiens
Pages, Olivier — Univ. of Picardie Jules Verne
El Hajjaji, Ahmed — Univ. de Picardie-Jules Verne

This paper deals with the problem of non-fragile observer-based vehicle control. Vehicle dynamics are described by a 10-DOF (Degree Of Freedom) model which include lateral, longitudinal, yaw and roll dynamics. Plant dynamics uncertainties as well as the vehicle longitudinal velocity variation are taken into account in the controller synthesis. The controller to be designed is assumed to be subject to gain variations, due to additive unknown noise and environmental influence. The nonlinear vehicle model is approximated by a Takagi-Sugeno fuzzy model with structured parametric uncertainties. Combined pole placement and Hinf algorithm is used to satisfy performance specifications. Closed-loop stability conditions are given in the form of LMI (Linear Matrix Inequalities).

17:10-17:30 TuC29.3

A Novel Approach to Real Time Tire-Road Grip and Slip Monitoring, pp. 7104-7109

Andrieux, Arnaud — Renault SAS
Lengellé, Régis — Univ. of Tech. of Troyes
Beauseroy, Pierre — Univ. de Tech. de Troyes
Chabanon, Christian — Renault SAS

It is a very challenging task to measure longitudinal slip of a tire on road surface in normal driving conditions, because of the very small value of the slip (a few 1/1000). This paper presents an industrially deployable method for Tire-Road Friction (TRF) monitoring applied to passenger vehicle. This method estimates the longitudinal wheel slip and the normalized friction coefficient, for low grip requirement driving conditions, in real time. It uses wheels velocity and forces applied on wheels bearings. Due to the imperfections in the wheel speed sensors used, signal to noise ratio from speed measurement is very low. A correction, taking into account the measured deterministic component of the speed measurement noise (called sensor signature), allows for a correction of wheels speed signals and, accordingly, a better estimation of slip. The obtained results demonstrate the ability of our method to distinguish between wet and dry roads during a longitudinal stabilized drive. This method finds applications in Adaptive Cruise Control systems, Driving Assistance systems and Intelligent Highways.

17:30-17:50 TuC29.4

An Estimation Process for Vehicle Wheel-Ground Contact Normal Forces, pp. 7110-7115

Doumiati, Moustapha — Univ. de Tech. de compičgne
Victorino, Alessandro — Univ. de Tech. de Compičgne
Charara, Ali — Univ. de Tech. de Compičgne
Baffet, Guillaume — Univ. de Tech. de Compičgne
Lechner, Daniel — INRETS-MA Lab. Departement of accident mechanismanalysis

This paper presents a new methodology for estimating wheel-ground contact normal forces, commonly known as vertical forces. The proposed method uses measurements from currently available standard sensors (accelerometers and relative suspension sensors). The aim of this study is to improve vehicle safety, especially to prevent rollover problems. One particular feature of the method is the separation of the estimation process into three blocks. The first block serves to identify the vehicle's weight, the second block contains a linear observer whose main role is to estimate the one-side lateral transfer load, while the third block calculates the four wheel vertical forces using a nonlinear observer. The different observers are based on the Kalman filter. The estimation process is applied and compared to real experimental data obtained in real conditions. Experimental results validate and prove the feasibility of this approach.

17:50-18:10 TuC29.5

Vison-Based Determination of Wheel Camber Angle and Tire Deflection, pp. 7116-7121

Lamy, Christophe — Univ. de Haute Alsace
Basset, Michel — Univ. de Haute-Alsace

Accurate determination of vehicle's lateral behavior is necessary in the domain of vehicle dynamics and more particularly in the context of improvement of vehicle safety. Thus, a cutting-edge knowledge of its interaction with the road surface is primordial. In consequence, the integration of a force model, representing the tire/ground interface, into the global vehicle model is needed. The validity of such a model directly depends on its nature and more particularly on the determination accuracy of its inputs and outputs. This paper focalizes on an input: the wheel/road camber angle. Studies in collaboration with a carmaker have shown a required measurement accuracy lower than ±0.1ć; in order to identify the tire model parameters from real data with a high precision. Different existing solutions were studied and their accuracy was estimated. In parallel, a new method for direct camber determination was developed in the laboratory. Its vision-based principle's major purpose is to give an accurate measurement: its precision is robust to the road unevenness and the vehicle's velocity. The tire deflection is estimated in the same time. The method feasibility and its measurement precision were studied from real tests with the laboratory test car.

18:10-18:30 TuC29.6

A Single Chip Packaged MEMS G Sensor for Industrial Applications, pp. 7122-7123

Yoo, Kwangho — SML Electronics, Inc.
Ahn, Taedong — SML Electronics Inc.
Lee, Seungcheol — Mando Corp.
Lim, Jungtaek — Mando Corp.
Kim, Seongsoo — Mando Corp.
Kim, Daehoon — LG Innotek
Cho, Dong-il Dan — Seoul National Univ.

Development of a single chip packaged MEMS G sensor for industrial applications is discussed. The developed G sensor is composed of a MEMS sensing element and a signal processing ASIC. The MEMS sensing element is fabricated by using the unique sacrificial/bulk micromachining (SBM) process for better mechanical properties. And the signal processing ASIC is fabricated in 0.5um CMOS process technology and operated with +5Vdc single power supply. The ASIC also has features of over/reverse voltage protection, ESD protection, self-test, and temperature sensor. To ensure high reliability in industrial environment, Low Temperature Co-fired Ceramic (LTCC) packaging is performed. The packaged chip is Land Grid Array (LGA) type which has 18 I/O pads, and the outline dimensions are 9.7mm x 8mm x 1.9mm. The developed G sensor offers analog voltage output with ±2g dynamic range, 0.962mG bias instability, and 76dB SNR.

TuC30 330C

Navigation (Regular Session)

Chair: Verriest, Erik I. — Georgia Inst. of Tech.
Co-Chair: Shim, Duk Sun — Chung-Ang Univ.

16:30-16:50 TuC30.1

Interception of a Moving Object in a FIFO Graph, pp. 7124-7129

Hizem, Mohamed Mejdi — Ec. Lille
Castelain, Emmanuel — Ec. Lille
Toguyeni, Armand — Ec. Lille

This paper solves the problem of intercepting a moving object in FIFO graphs. In the graph, a first mobile (the target) is moving with a known fixed itinerary. The second mobile (the pursuer) aims to reach the first one with the minimum delay. So, our goal is to find the shortest path for the interception taking into account the dynamic nature of the graph. This interception problem can be applied to the case of an urban transport company that needs to send a rescue team to one of their buses that is still in movement. First, we propose a model to set the basic problem. Then we present an interception algorithm based on Dijkstra algorithm for shortest path computation in a graph. After, we prove that the result of the algorithm is optimal. Finally, we compute the complexity of the algorithm and we prove its efficiency.

16:50-17:10 TuC30.2

Road Navigation System Monitoring Using a Pseudorange Snapshot Test, pp. 7130-7135

Fouque, Clément — Univ. de Tech. de Compičgne
Bonnifait, Philippe Pascal Patrick — Univ. of Tech. of Compiegne

Global Navigation Satellite Systems (GNSS) are often used to localize a receiver with respect to a given map. This association problem, also known as map-matching, is usually addressed using estimated positions computed by the GNSS receiver. This paper focus on the use of GNSS raw data (L1 pseudo-measurements) and cartographic data provided by a digital road network. Using the positioning residuals of map-aided GNSS, a new method for tackling the underlying problem of the road selection is proposed. This paper show that this approach is also well adapted to integrity problem of map-matching, since a consistency test is derived. Experimental results illustrate the performance of this method with different maps.

17:10-17:30 TuC30.3

A Variant to Naismith's Problem with Application to Path Planning, pp. 7136-7141

Verriest, Erik I. — Georgia Inst. of Tech.

Naismith obtained a set of empirical rules for the time required to move through a terrain. In this paper we solve the problem of minimization the transit time between two points on a given terrain. We give an interpretation of Naismith's rule which leads to a very elegant geometric construction of the optimal solution. Indeed, there is some ambiguity in the interpretation of Naismith's rule. We first solve the problem for a conical mountain, then generalize for a terrain with arbitrary topography. We conclude with a discussion of the relative merit of our variant with respect to the known solution. In particular, we show that the difference of these interpretations amounts to less than 10% in the worst case, thus justifying the use of this simple solution. This problem is a paradigm for navigation of autonomous vehicles in heterogenous terrain. It may prove useful for path planning for robotic rovers as used for instance on the surface of Mars.

Keywords: Optimal control, path planning, autonomous vehicles

17:30-17:50 TuC30.4

Accommodation Rule of Double Faults for Seven Inertial Sensors, pp. 7142-7147

Yang, Cheol-Kwan — Chung-Ang Univ.
Shim, Duk Sun — Chung-Ang Univ.

This paper considers a fault accommodation problem for inertial navigation systems (INS) which have 7 inertial sensors such as gyroscopes and accelerometers. When it is decided that double faults occur in the inertial sensors due to the fault detection and

isolation (FDI), it is necessary to decide whether the faulty sensors should be excluded or not. An accommodation rule of double faults for 7 sensors is obtained based on the error covariance of triad-solution of redundant inertial sensors, which is related to the navigation accuracy of INS. Monte Carlo simulation is performed for coplanar configuration and the obtained accommodation rule is drawn in the decision space of two-dimensional Cartesian coordinate system.

17:50-18:10 TuC30.5

An Intersection Model Based on the Gsom Model, pp. 7148-7153

Haj-Salem, Habib — INRETS
Lebacque, Jean-Patrick — INRETS
Mammar, Salim — SETRA

In the field of the traffic modelling, among the many problems to be solved, the intersection modelling problem constitutes one of the most difficult. In particular, network modelling requires an intersection model which must be both simple and realistic in order to describe the behaviour of the flow or vehicles. In this paper, the intersection model based on the GSOM model class (generic second order macroscopic model) is presented and discussed. Based on several simulation runs, simulation results are described. According to the fixed boundary conditions, acceptable results are obtained and demonstrate the right information propagation in/out the node.

18:10-18:30 TuC30.6

Urban Traffic Control Problem: A Game Theory Approach, pp. 7154-7159

Alvarez, Israel — CINVESTAV-IPN
Poznyak, Alexander S. — CINVESTAV-IPN
Malo, Alejandro — CINVESTAV-IPN

Traffic congestion is an issue in every major city.Many approaches have been tried. In this paper, we propose to model signalized intersections as finite controlled Markov chains. The intersection represents a noncooperative game where each player try to minimize its queue, so epsilon_;Nash's equilibrium is the solution. This paper is focused on the traffic light control problem for urban traffic, using Game Theory and Extraproximal Method for its realization. The examples show the effectiveness of the suggested approach.

TuCCC 401

Milestone Report by IFAC Coordinating Committee on Power and Process Systems (CC6) (Milestone Session)

Chair: Dochain, Denis — Univ. Catholique de Louvain

16:30-18:30 TuCCC.1

Monitoring and Control of Process and Power Systems : Adapting to Environmental Challenges, Increasing Competitivity and Changing Customer and Consumer Demands, pp. 7160-7171

Dochain, Denis — Univ. Catholique de Louvain
Marquardt, Wolfgang — RWTH Aachen Univ.
Won, Sangchul — Pohang Univ. of Science & Tech.
Malik, O.P. — The Univ. of Calgary
Kinnaert, Michel — Univ. Libre de Bruxelles
Lunze, Jan — Ruhr-Univ. Bochum

This paper is supposed to be the milestone report of CC6 and will be connected to a milestone session.

Process and power plant control, along with fault detection/isolation are being addressed by significant on-going research with many theoretical developments focused on improvements for all of these major industrial applications. This report provides an overview of the current key problems, recent accomplishments and trends, as well as a forecast of anticipated developments within this very important field of industrial applications.

WePL1 Auditorium (301)

Perspectives on System Identification by Lennart Ljung (Plenary Session)

Chair: Hara, Shinji — The Univ. of Tokyo

08:00-09:00 WePL1.1

Perspectives on System Identification, pp. 7172-7184

Ljung, Lennart — Linköping Univ.

System identification is the art and science of building mathematical models of dynamic systems from observed input-output data. It can be seen as the interface between the real world of applications and the mathematical world of control theory and model abstractions. As such it is an ubiquitous necessity for successful applications. System identification is a very large topic, with different techniques that depend on the character of the models to be estimated, linear, non-linear, hybrid, nonparametric etc. At the same time, the area can be characterized by a small number of leading principles, e.g. to look for sustainable descriptions by proper trade offs in the triangle of model complexity, information contents in the data, and effective validation. The area has many facets and there are many approaches and methods. A tutorial or a survey in a few pages is not quite possible. Instead this presentation aims at giving an overview of the "science" side, i.e. basic principles and results and at pointing to open problem areas in the practical, "art", side of how to approach and solve a real problem.

WePL2 Auditorium (301)

Automation and Control Systems Technology in Korean Shipbuilding Industry: The State of the Art and the Future Perspectives by Keh-Sik Min (Plenary Session)

Chair: Fleming, P.J. — Univ. of Sheffield

09:00-10:00 WePL2.1

Automation and Control Systems Technology in Korean Shipbuilding Industry: The State of the Art and the Future Perspectives, pp. 7185-7190

Min, Keh-Sik — Hyundai Heavy Industries Co., Ltd.

Today's shipbuilding industry has been gradually transformed into technology driven industry from labor intensive one due to the growing needs to meet environmental regulations on ship operations, increased technological requirements of the clients, and extremely enlarged size of vessels. On the other hand, the global market becomes severely competitive due to latecomers armed with cheaper labor cost and expanded production facilities. Under these circumstances, Korean shipbuilding companies are seeking effective ways to strengthen their competitiveness in quality, cost, and delivery, and ultimately to benefit the customers. To this end, not only researches on high value-added ships but also much R&D efforts on production automation and optimization of logistics are being conducted. Through these efforts they try to construct high quality ships and to reduce the term of production with increased productivity and reliability in ship-manufacturing processes. In order to accelerate technological discrimination over foreign competitors, Korean shipbuilders are endeavouring to develop automation technologies which derive high level functionality, improved performance, reduced cost, and easy maintenance in ship operation. As an integrated manufacturing industry, from cutting steel plates to building up ship operating software, shipbuilding industry has close connections with diverse technological fields. Automation technology is one of the key fields of them. This talk covers the current trends and future directions of shipbuilding automation and control systems technologies in Korean shipbuilding industry.

WeA01 Atlantic Hall

Systems and Signals II (Poster Session)

Chair: Campi, Marco — Univ. of Brescia
Co-Chair: Park, Youngjin — KAIST

10:30-12:30 WeA01.1

An Improved Algorithm for the Design of Testable Subsystems, pp. 7191-7196

Ploix, Stephane — Inst. National Pol. de Grenoble
Yassine, Abed Alrahim — Inst. National Pol. de Grenoble
Flaus, Jean-Marie — E.N.S.I.E.G.

In complex industrial plants, there are usually many sensors and the modeling of plants leads to lots of mathematical relations. Before using classical tools for fault detection, the first problem to solve is: what sensors and mathematical relations should be selected for the design of a detection test such as a state observer or a parity space based detection algorithms. This paper presents a general method for finding all the possible testable subsystems i.e. sets of relations, than can lead to detection tests, taking into account actuator and sensor locations. This method, which is based on a structural analysis, provides the constraints that have to be used for the design of each detection test and manages situations where constraints contain non deductible variables. Thanks to these results, it becomes possible to select the most interesting testable subsystems regarding detectability and diagnosability criteria.

10:30-12:30 WeA01.2

Testing the Covariance Matrix of the Innovation Sequence in Application to Aircraft Sensor Fault Detection, pp. 7197-7202

Hajiyev, Chingiz — Istanbul Tech. Univ.

Operative methods of testing the covariance matrix of the innovation sequence of the Kalman filter are proposed. The quadratic form of the random Wishart matrix is used in this process as monitoring statistic, and the testing problem is reduced to the classical problem of minimization of a quadratic form on the unit sphere. As a result, two algorithms for testing the covariance matrix of the innovation sequence are proposed. In the first algorithm, the sum of all the elements of the matrix is used for the scalar measure of the Wishart matrix being tested, while in the second algorithm the maximal eigenvalue of this matrix is used. In the simulations, the longitudinal and lateral dynamics of the F-16 aircraft model is considered, and detection of pitch rate gyro failures, which affect the covariance matrix of the innovation sequence, are examined. Some recommendations for the fastest detection of failure are given.

10:30-12:30 WeA01.3

Design Method of Fault Detector for Injection Unit, pp. 7203-7208

Ochi, Kiyoshi — The Japan Steel Works,LTD.
Saeki, Masami — Hiroshima Univ.

An injection unit is considered as a speed control system utilizing a reaction-force sensor. Our purpose is to design a fault detector that detects and isolates actuator and sensor faults given that the system is disturbed by a reaction force. First described is the fault detector's general structure. In this system, a disturbance observer that estimates the reaction force is designed for the speed control system in order to obtain the residual signals, and then post-filters that separate the specific frequency elements from the residual signals are applied in order to generate the decision signals. Next, we describe a fault detector designed specifically for a model injection unit. It is shown that the disturbance imposed on the decision variables can be made significantly small by appropriate adjustments to the observer bandwidth, and that most of the sensor faults and actuator faults can be detected and some of them can be isolated in the frequency domain by setting the frequency characteristics of the post-filters appropriately. Our result is verified by experiments for an actual injection unit.

10:30-12:30 WeA01.4

Fault Detection of Distributed Networked Control Systems with Access Constraints, pp. 7209-7214

Zong, Qun — Tianjin Univ.
Liu, Wenjing — Tianjin Univ.
Dou, Liqian — Tianjin Univ.
Sun, Liankun — Tianjin Univ.

This paper considers the fault detection problem of distributed networked control systems (DNCS) with limited data transmission rate. In order to deal with the limited bandwidth of the network, two steps are taken. The first one is the periodic communication sequence which is introduced to the two-level DNCS to ensure that only some specified subsystems rather than all of them are connected to the central fault diagnosis unit at a certain time; the second one is that the signals which are transmitted to the central unit from each subsystem are not the inputs and outputs but the residuals which are smaller. Because periodic communication sequence's introduction changes the observability of the system, a theorem is provided to discuss the observability of DNCS as well as to give a new system model under observable condition. On the basis of residuals transmitted from subsystems to the central unit, some steps are taken to get the inputs and outputs which are necessary for fault detection. Then, according to the new system model and obtained inputs and outputs, the central fault diagnosis unit based on the periodic system theory is designed under this communication pattern. Finally, a numerical example is provided to illustrate the effectiveness of the proposed method.

10:30-12:30 WeA01.5

Disturbance Decoupled Fault Reconstruction Using Sliding Mode Observers, pp. 7215-7220

Ng, Kok Yew — Monash Univ.
Tan, Chee Pin — Monash Univ.
Akmeliawati, Rini — Monash Univ. Sunway Campus Malaysia,
Edwards, Christopher — Univ. of Leicester

The objective of a robust fault reconstruction scheme is to generate an accurate reconstruction of the fault that is una_ected by disturbances. A typical method for robust fault reconstruction is to reconstruct the faults and disturbances, which is conservative and requires stringent conditions. This paper investigates and presents conditions that guarantee a fault reconstruction that rejects the e_ects of disturbances, which are less stringent than those of previous work. A VTOL aircraft model is used to validate the work of this paper.

10:30-12:30 WeA01.6

SDG-Based Fault Isolation for Large-Scale Complex Systems Solved by Rough Set Theory, pp. 7221-7226

Yang, Fan — Tsinghua Univ.
Xiao, Deyun — Tsinghua Univ.

Signed directed graph (SDG) is an important qualitative model that is used to describe large-scale complex systems and the cause-effect relationships among variables. It has been successfully applied in fault diagnosis, hazard assessment and other areas. In the fault isolation problem, the task is to find the fault origin that causes the abnormal phenomenon. However, as the basis of analysis, the inference method based on SDG, is simply a traversal search or a rule-based expert system. Because of the redundant or disordered information, the efficiency of these algorithms is quite low. Rough set theory provides an idea of handling vague information and can be used to data reduction, thus it can be introduced to the fault isolation problem (a kind of decision problems) to optimize the decision rules. The decision algorithm is proposed in this paper, in which the generation and reduction methods of the rules are related to the structure of the SDG model. We combine the algebraic and logical expression ways to achieve the purpose. Moreover, due to the convenience of expressing granularity, the decision algorithm is still applicable when the types of the faults we concerned are changed or reformed. Finally, an example of a 65t/h boiler system is carried out to illustrate and validate the proposed method, and some future trends of this method are also discussed.

10:30-12:30 WeA01.7

Active Fault Detection and Dual Control in Multiple Model Framework, pp. 7227-7232

Puncochar, Ivo — Univ. of West Bohemia
Simandl, Miroslav — Univ. of West Bohemia

The paper deals with active fault detection and dual control in the multiple model framework. A monitored and controlled system is described by a discrete-time linear stochastic model at each step of a finite time horizon. The model belongs to an a priori given set of models, and known transient probabilities describe switching between the models. The goal is to design an active detector and controller that processes all available information and generates decisions and inputs. The decisions inform whether a fault has occurred in the system, and the inputs should simultaneously control and excite the system. As the control is in conflict with the excitation, the dual control problem arises. It is shown that both active fault detection and dual control can be solved using Bellman's principle of optimality, and a corresponding backward recursive equation is derived. The approximative solution of the backward recursive equation is discussed, and an algorithm based on an application of rolling horizon and nonlinear filtering techniques is presented. The presented approach is illustrated in a simple numerical example.

10:30-12:30 WeA01.8

Identification and Abnormal Condition Detection of a Cement Rotary Kiln, pp. 7233-7238

Makaremi, Iman — Univ. of Windsor
Fatehi, Alireza — K.N. Toosi Univ. of Tech.
Araabi, Babak N. — Univ. of Tehran
Azizi, Morteza — Saveh Cement Co.
Cheloian, Ahmad — Saveh Cement Company

In this paper, we use system identification methods for abnormal condition detection of a cement rotary kiln. After selecting proper inputs and output, an input-output model is identified for the plant. A novel approach is used in order to estimate the delays of the input channel of the kiln. By means of that, the identification task gets easier and the results are more accurate. To identify the kiln, Locally Linear Neuro-Fuzzy (LLNF) model is used. This model is trained by LOLIMOT algorithm which is an incremental tree-structure

algorithm. Finally, a model for the healthy mode of the kiln is obtained through which it is possible to detect abnormal conditions in the process. We distinguished two common abnormal conditions in kiln and another one which was not characteristically known for cement experts as well.

10:30-12:30 WeA01.9

Fault Diagnosis of AC Servo Motor with Current Signals Based on Wavelet Decomposition and Template Matching Methods, pp. 7239-7244

Kim, Yountae	Pusan National Univ.
Bae, Hyeon	Pusan National Univ.
Kim, Sungshin	Pusan National Univ.
Vachtsevanos, George J.	Georgia Inst. of Tech.

This paper presents a diagnosis technique to detect and identify faults in AC servo motors. The first phase of stator currents among three phases is digitized and stored in the time domain. Wavelet transform is employed to convert the signals onto time-frequency domain because the time domain based approach is not suitable for detecting state features of the current signals. Pre-processing algorithms that includes a kind of mean-filtering, synchronization with Hilbert transform and difference are consecutively performed to the raw signal to determinate features. Wavelet decomposition is applied to the difference values by the optimally selected mother wavelet and the features are calculated from the transformed signals. The extracted features are compared with the motor fault templates for the template matching method. The results based on real data show that the proposed approach is very useful to extract features of the signals for fault diagnosis.

10:30-12:30 WeA01.10

Reduced Bank of Kalman Filters, pp. 7245-7250

Pachner, Daniel	Honeywell
Kroupa, Stepan	Czech Tech. Univ.

A reduction of the computational complexity of bank of Kalman filters is proposed. The algorithm is focused in fault detection and isolation problems. It is shown that the orders of individual filters in the bank can be lower than the respective filtered process model order. The original model state variables are not estimated. Linear functions of noise samples are the newly estimated variables.

10:30-12:30 WeA01.11

A Nonlinear Hybrid Fault Detection, Isolation and Estimation Using Bank of Neural Parameter Estimators, pp. 7251-7258

Sobhani-Tehrani, Ehsan	Concordia Univ.
Talebi, H.A.	Amirkabir Univ. of Tech.
Khorasani, Khashayar	Concordia Univ.

This paper presents two novel hybrid schemes for component fault diagnosis in a general nonlinear system. Unlike most fault diagnosis techniques, the proposed solution detects, isolates, and identifies the severity of faults in the system within a single integrated framework. The proposed technique is based on a bank of adaptive neural parameter estimators (NPE) and a set of parameterized fault models. At each instant of time, the NPEs provide estimates of the unknown fault parameters (FP) that are used for fault diagnosis. Two structures of NPE, namely series-parallel and parallel, are proposed with their respective fault isolation policies. While the series-parallel structure possesses fast convergence, the parallel scheme is extremely robust to measurement noise. Although, it has a more complex isolation policy, the parallel structure exhibits a more robust fault isolation capability. The parameter estimation for both architectures is based on an on-line minimization of instantaneous output estimation error. Simple network architecture and straightforward weight adaptation laws make our proposed technique appropriate for real-time implementation. Simulation results presented in this paper for detection, isolation, and identification of faults in nonlinear reaction wheel actuators of a 3-axis stabilized satellite in the presence of disturbances and noise demonstrate the effectiveness of our proposed fault diagnosis schemes.

10:30-12:30 WeA01.12

Formulating and Solving Robust Fault Diagnosis Problems Based on a H_; Setting, pp. 7259-7264

Chen, Jie	Brunel Univ.

This paper studies the robust fault detection problem using the standard H_infty filtering formulation. With this formulation, the minimization of the disturbance effect on the residual is formulated as a standard H_infty filtering problem and the design can be solved using standard H_infty techniques. To facilitate the enhancement of the residual sensitivity to the fault, the difference between the residual and the fault (or filtered fault) is minimized against the disturbance and the fault. The residual generated in this way is a faithful replicate of the fault and the reliable detection can be achieved. The paper also incorporates the modelling error into the robust residual design using the standard H_infty filtering formulation.

10:30-12:30 WeA01.13

Hybrid Systems Diagnosis by Coupling Continuous and Discrete Event Techniques, pp. 7265-7270

Bayoudh, Mehdi	LAAS-CNRS, Toulouse Univ.
Trave-Massuyes, Louise	CNRS
Olive, Xavier	Thales Alenia Space

This paper deals with the problem of diagnosing systems that exhibit both continuous and discrete event dynamics. The proposed approach combines techniques from both continuous and discrete event diagnosis fields. On the on hand, an extension of the parity space approach is used to associate signatures to every operational mode of the system. On the other hand, signature switches arising from the transition from one mode to another are abstracted in the form of a set of events that capture the continuous dynamics. These events are merged into the original discrete dynamic model of the system, allowing us to apply the well-known discrete-event-systems diagnoser approach. This is illustrated on an example that shows the diagnosabilityimprovement of the hybrid approach.

10:30-12:30 WeA01.14

Fault Diagnosis in a Wireless Network, pp. 7271-7275

D'Innocenzo, Alessandro	Univ. degli Studi dell'Aquila
Di Benedetto, M. Domenica	Univ. of L'Aquila
Di Gennaro, Stefano	Univ. di L'Aquila

Given a wireless network and a graph modelling the node connection topology, we address the problem of fault diagnosis of nodes. When the external point of access to network information is at a lower layer of the ISO/OSI protocol stack, the problem is trivial. However, as often occurs, a user is able to access the network at the application layer: this implies that the available observation of the network status is considerably restricted, and solving the diagnosis problem is not trivial. In this paper, we state necessary and sufficient conditions for being able to detect which node is faulty, and propose a diagnosis algorithm on the basis of diagnosability definitions and theoretical studies developed for timed and hybrid automata in the computer science community.

10:30-12:30 WeA01.15

Actuator Fault-Tolerant Control Based on Invariant Set Separation, pp. 7276-7281

Ocampo-Martinez, Carlos	The Univ. of Newcastle
De Dona, Jose Adrian	The Univ. of Newcastle
Seron, Maria	The Univ. of Newcastle

In this paper an actuator fault-tolerant control (FTC) strategy based on invariant set computation is presented. The proposed scheme is based on a bank of observers which match different fault situations that can occur in the plant. Each of these observers produces an estimation error with a distinctive behavior when the observer matches the current fault situation in the plant. With the information of the estimation errors from each of the considered observers, a fault diagnosis and isolation (FDI) module is able to reconfigure the control loop by selecting the appropriate stabilising controller from a bank of precomputed control laws, each of them related to one of the considered fault models. The decision criteria of the FDI is based on the computation of invariant sets of the estimation errors for each fault scenario and for each control configuration. Conditions for the design of the FDI module and for fault-tolerant closed-loop stability are given, and the effectiveness of the approach is illustrated with an example.

10:30-12:30 WeA01.16

A MPC for Start-Up Phase Tension and Looper Control in Hot Strip Finishing Mills Using Continuation Approach (I), pp. 7282-7287

Masuda, Shiro	Tokyo Metropolitan Univ.
Asano, Kazuya	JFE R&D Corp.
Imai, Kizuku	Tokyo Metropolitan Univ.

This paper gives a design method for a model predictive control (MPC) approach based on a unified performance index throughout the start-up phase tension and looper control which consists of the non-contact and contact modes in order to suppress the deviation of the strip tension while the looper contacts with the strip as quickly as possible. We will formulate the control problem by using a MPC for a piecewise affine (PWA) system with the terminal condition and an unknown terminal time. However, in order to realize the feedback control using a receding horizon strategy, we have to solve nonlinear equations in an online manner as precisely as possible. Therefore, the paper gives a method using a continuation method for solving the nonlinear equations efficiently. The efficiency of the proposed method is shown through numerical simulations.

10:30-12:30 WeA01.17

A Robust Auto-Tuning On-Line Trend Extraction Method, pp. 7288-7293

Charbonnier, Sylvie INPG/UJF
Damour, Cedric INPG/UJF

On-line trend extraction is the first step to be achieved by a pattern-matching diagnostic system. Indeed, most pattern-matching diagnostic methods are based on the classification of qualitative or semi-qualitative trends extracted from one or several signals. The relevance of the trend extracted is a key point for the diagnostic system accuracy. This paper presents a trend extraction method which is robust to the presence of artefacts and step-like variations and does not require a priori tuning of the parameters of the method. The parameters are tuned on line by the algorithm itself (auto-tuning method), using a robust estimate of the signal variability. Results obtained on both simulated data and real data show the efficiency of the method.

10:30-12:30 WeA01.18

Fault Detection and Isolation for a Kind of NCSs with Markov Delays, pp. 7294-7299

Cheng, Yue Tsinghua Univ.
Ye, Hao Tsinghua Univ.
Wang, Yongqiang Tsinghua Univ.
Wang, Guizeng Tsinghua Univ.
Ge, Chuanhu Tsinghua Univ.

A new approach for fault detection and isolation (FDI) of Networked Control Systems (NCSs)is proposed in this paper. The paper first regards NCSs with unknown network-induced delay as a Jump Markov linear system (JMLS) with unknown input, then gives a Bayesian estimation of the JMLS based on Unknown Input Kalman filter (UIKF), and finally uses the estimation results to detect and isolate faults based on Log-likelihood ratio (LLR) approach. Simulation example shows that the method is robust to random networked induced-delay and unknown input.

10:30-12:30 WeA01.19

Fault Diagnosis Strategies for a Simulated Nonlinear Aircraft Model, pp. 7300-7307

Benini, Matteo Univ. of Ferrara
Bonfe, Marcello Univ. di Ferrara
Castaldi, Paolo Univ. of Bologna - Aerospace Engineering Faculty
Geri, Walter Univ. of Bologna
Simani, Silvio Univ. of Ferrara

In this work, different procedures for sensor Fault Detection and Isolation (FDI) applied to a simulated model of a commercial aircraft are presented. The main point of the paper regards the design of two FDI schemes based on a linear Polynomial Method (PM) and the NonLinear Geometric Approach (NLGA). The obtained results highlight a good trade–off between solution complexity and achieved performances. The FDI schemes are applied to the aircraft model, characterised by tight–coupled longitudinal and lateral dynamics. The properties of the residual generators are experimentally investigated and verified by simulating a general aircraft reference trajectory. The overall performance of the developed FDI schemes are analysed in the presence of turbulence, measurement and model errors. Comparisons with other FDI methods based on Neural Networks (NN) and Unknown Input Kalman Filter (UIKF) are finally reported.

10:30-12:30 WeA01.20

Principal Components Structured Models for Fault Isolation, pp. 7308-7313

Verde, Cristina Inst. de Ingenieria, UNAM
Mina, Jesús Engineering Inst. UNAM

This work proposes a method for fault isolation by means of the structured model characterization with isolation capability, and the residual generation through dynamic principal component analysis. Specifically, the characterization is obtained using graph theory tools, and is expressed in terms of known variables and subsets of constraints. Thus, in the absence of analytical explicit models, the fault isolation task can be solved if the structured models satisfy isolability conditions and a set of nominal historical data from the process is available to carry out the dynamic principal component analysis based monitoring with adaptive standardization. Simulation results for the three tanks system show the efectiveness of the solution for fault isolation tasks.

10:30-12:30 WeA01.21

Fault Diagnosis Based on the Enclosure of Parameters Estimated with an Adaptive Observer, pp. 7314-7319

Combastel, Christophe ENSEA
Zhang, Qinghua INRIA
Lalami, Abdelhalim ENSEA

The proposed fault diagnosis approach associates an adaptive observer for residual generation with set-membership computations based on zonotopes for residual evaluation. The main advantage of this approach is its rigorous propagation of pre-specified modeling uncertainty bounds to the computed residuals. Within the assumed modeling uncertainty bounds, fault detection is guaranteed to be free of false alarm, while the efforts made with set-membership computation minimize the conservativeness of fault detection decisions. The novelty compared to earlier works mainly resides in a guaranteed robustness to bounded parameter variations and in a method for dealing with occasional lack of input excitation.

10:30-12:30 WeA01.22

Paper Path Detection in Ink Jet Printers by Using Speed Perturbation Observer, pp. 7320-7325

Lu, Ping-Chou KINPO Electronics, Inc.
Yeh, Syh-Shiuh National Taipei Univ. of Tech.

As the speed of paper feeding processes in an ink jet printer is increased, the paper feeding mechanisms are usually prone to induce some paper transport problems such as paper jamming and slipping, and some mechanical problems such as gear cracking and chattering. Therefore, for ensuring printing qualities and for preventing destructive damages, the paper path detection in ink jet printers is required. In this paper, we explore the feasibility of using speed perturbation observer to detect paper path situations in an ink jet printer. Moreover, in comparing with the existing approaches, this paper presents an approach without additional sensors. The speed perturbation observer composed of a nominal plant, a low-pass filter, and an identification unit is developed to detect paper path situations during paper feeding processes. The design concept is based on the fact that external disturbances usually significantly affect the speed performances of an axial motion system. Since the paper feeding processes in ink jet printers are equivalent to that the interaction among paper and paper feeding mechanisms exerts external disturbances on the driven motor, it is interesting to detect paper path situations by estimating speed perturbations induced by different paper feeding actions. The proposed approach is implemented on an ink jet printer and two usual paper path situations are tested. The experimental results demonstrate that the proposed approach can accurately respond to the different paper path situations caused by different paper feeding actions.

10:30-12:30 WeA01.23

Fault Detection and Isolation of Retarded Time-Delay Systems Using a Geometric Approach, pp. 7326-7331

Meskin, Nader Concordia Univ.
Khorasani, Khashayar Concordia Univ.

This paper investigates development of Fault Detection and Isolation (FDI) filters for retarded time-delay systems. A bank of residual generators is designed based on the linear geometric approach so that each residual is affected by one fault and is decoupled from the others while the H_infty norm of the transfer function between the disturbance and the residual signals are less that a prespecified value. Simulation results presented in the paper show and demonstrate the effectiveness of our proposed FDI algorithm.

10:30-12:30 WeA01.24

New Residual Generation Design for Fault Detection, pp. 7332-7337

Larroque, Benoît LGP-ENIT
Noureddine, Farid LGP-ENIT
Rotella, Frederic ENIT

A new design procedure of a reduced order unknown input observer (UIO) is proposed to generate residuals for fault detection isolation (FDI). The originality of this work consists in the adopted approach for the procedure implementation. Indeed the kernel of the actuator fault distribution matrix is generated thanks to generalized inverses. The Kronecker product is used to solve a Sylvester equation which appears in the equations of an UIO. Residuals generated by bank of observers allow on the one hand the detection isolation of every actuator fault and on the other hand the isolation between actuator faults and sensor faults.

10:30-12:30 WeA01.25

Fault Detection Based on Uncertain Models with Bounded Parameters and Bounded Parameter Variations, pp. 7338-7343

Adrot, Olivier INPG - UJF - CNRS

Flaus, Jean-Marie E.N.S.I.E.G.

This paper deals with a fault detection method taking into account model uncertainties described by bounded variables. A parity space approach is used for generating testable redundancy relations in which each uncertain parameter is defined by an interval containing all its feasible values. Consistency tests consist in evaluating these set-membership relations and lead to convex sets containing the feasible free-fault behaviours of the supervised system. The objective is to improve fault detection performance by taking into account constraints on variations of uncertain parameters, which do not randomly vary.

10:30-12:30 WeA01.26

Fault Detection Based on Orthotopic Set Membership Identification for Robot Manipulators, pp. 7344-7349

Reppa, Vasso Univ. OF PATRAS

Tzes, Anthony Univ. of Patras

In this article a fault detection algorithm for capturing structural and/or sensor failures in robot manipulators is presented. The robot dynamics is linearizable with respect to a certain parameter. Using this linearizable representation, common faults in robot arms, such as failures of actuators or faulty sensor measurements, can be identified as variations encountered in the parameter vector. The proposed algorithm uses an Orthotopic Set Membership Identifier that defines the feasible parameter set and the parameters' bounds, within which the Weighted Recursive Least Square parameter estimate resides. An Output Uncertainty Predictor that generates the future region of faultless system operation. A fault is detected, when one of the following criteria below is validated: a) the WRLS parameter estimate resides out of the parameters's bounds, b) there is a sudden increase in the volume of the feasible set and c) the system's output is not within the predicted interval. Simulation studies are offered to test this fault detection methodology, customized to a two-link robot arm.

10:30-12:30 WeA01.27

Fault Diagnosis with the Use of the Knowledge about Symptoms Delay Intervals, pp. 7350-7355

Koscielny, Jan Warsaw Univ. of Tech.

Syfert, MichaB; Warsaw Univ. of Tech.

Dziembowski, BolesB;aw Warsaw Univ. of Tech.

The paper refers the issue of utilisation of knowledge about symptoms delays in fault isolation. Firstly, formal conditions for fault isolability in the case of reasoning based on binary diagnostics matrix and the intervals of the symptoms delays are formulated and its influence of fault isolability is discussed. Finally, the new isolation algorithm utilising such knowledge is proposed. The presented approach is illustrated with the example of fault isolability analysis for three tank system.

10:30-12:30 WeA01.28

Statistical Properties and Design Criterions for AI-Based Fault Isolation, pp. 7356-7362

Nyberg, Mattias Linkoping Univ.

Krysander, Mattias Linköping Univ.

Fault diagnosis in the presence of noise and model errors is of fundamental importance. In the paper, the meaning of fault isolation performance is formalized by using the established notion of coverage and false coverage from the field of statistics. Then formal relations describing the relationship between fault isolation performance and the residual related design parameters are derived. For small faults, the measures coverage and false coverage are not applicable so therefore, a different performance criteria, called sub-coverage, is proposed. The performance of different AI-based fault isolation schemes is evaluated and it is shown that the well known principle of minimal cardinality diagnosis gives a very bad performance. Finally, some general design guidelines that guarantee and maximize the fault isolation performance are proposed.

10:30-12:30 WeA01.29

GIMC-Based Fault Detection and Its Application to Magnetic Suspension System, pp. 7363-7368

Nakaso, Yujiro Kanazawa Univ.

Namerikawa, Toru Kanazawa Univ.

This paper deals with a fault detection for a magnetic suspension system by using Generalized Internal Model Control (GIMC) structure. To design robust fault detection filters, two fault detection design problems are formulated as multiple objective optimization problems by minimizing the effects of disturbances and maximizing the fault sensitivity involving an LTI system with disturbance and fault signals. The fault detection filters designed by solving each optimization problems are implemented with the magnetic suspension system to verify its validity. A filter designed via the problem 1 has good transient performance, but the output signal of the filter is affected by the disturbance signals. Another filter which is designed via the problem 2, however, has good robustness for disturbance signals. Moreover, experimental results show that both filters have enough fault detection properties compared with a conventional detection filter.

10:30-12:30 WeA01.30

A Diagnostic Model for Identifying Parametric Faults, pp. 7369-7374

Doraiswami, Rajamani Univ. of New Brunswick

Diduch, C.P. Univ. of New Brunswick

Tang, Jiong Univ. of New Brunswick

This paper considers a new approach to fault detection and isolation (FDI) for systems modeled as an interconnection of subsystems that are each subject to parametric faults. The paper develops i) the concept of a diagnostic model that parameterizes all possible subsystem faults, ii) an off-line scheme for identification of the diagnostic model, iii) a parity equation that results in a residual that is a linear function of the change in the diagnostic parameters and iv) a fault isolation scheme that does not require a recursive least squares type identifier.

10:30-12:30 WeA01.31

Fault Detection System Design for Networked Control System with Stochastically Varying Transmission Delays, pp. 7375-7380

Al-Salami, Ibrahim Univ. of Duisburg-Essen

Ding, Steven X. Univ. of Duisburg-Essen

Zhang, Ping Univ. of Duisburg-Essen

This paper studies the observer based fault detection problem in networked control systems. It is assumed that the transmission delays caused by the communication network are varying and their probability distribution is unknown but knowledge about its stochastic characteristics is known a priori . First the dynamic modelling of a proposed networked control system under different sampling frequencies using the packet-oriented data transmission method is derived. Based on this developed system model, an approach for fault detection system is presented. Main attention is paid to the residual evaluation task in order to reduce false alarm rate caused by the uncertainties due to the effect of the communication network. A study based on simulation platform to verify the results is given.

10:30-12:30 WeA01.32

Bayesian Based Fault Diagnosis: Application to an Electrical Motor, pp. 7381-7386

Mechraoui, Amine Lab. grenoblois de l'image, de la parole, du signal et de

Medjaher, Kamal FEMTO-ST Inst. UMR CNRS 6174 - UFC / ENSMM / UTBM

Zerhouni, Noureddine FEMTO-ST Inst. UMR CNRS 6174 - UFC / ENSMM / UTBM

In the literature, several fault diagnosis methods, qualitative as well as quantitative, are proposed. The main objective of these methods is in one hand, to allow detection, isolation and identification of faults; and in the other hand to insure safety, reliability and availability of systems. This paper presents a diagnosis method based on the use of a new and suitable mathematical tool: bayesian networks. Their learning and inference capabilities allow to model complex processes by taking into account the uncertainty and the incompleteness of the provided knowledge. Furthermore, the graphical representation of causal relations existing between variables, events or physical phenomena makes bayesian networks easy to use and leads to models which can be understandable by even a non specialist of the modeled domain.

10:30-12:30 WeA01.33

A Fault-Tolerant Control Strategy for Takagi-Sugeno Fuzzy Systems, pp. 7387-7392

Witczak, Marcin — Univ. of Zielona Gora
Dziekan, Lukasz — Univ. of Zielona Gora
Puig, Vicenc — Univ. Pol. de Catalunya
Korbicz, Jozef — Univ. of Zielona Gora

In this paper, a new active FTC strategy is proposed. First, it is developed in the context of linear systems and then it is extended to Takagi-Sugeno fuzzy systems. The key contribution of the proposed approach is an integrated FTC design procedure of the fault identification and fault-tolerant control schemes. Fault identification is based on the use of an observer. While, the FTC controller is implemented as a state feedback controller. This controller is designed such that it can stabilize the faulty plant using Lyapunov theory and LMIs.

10:30-12:30 WeA01.34

An Algebraic Approach for Behavioral Model Decomposition, pp. 7393-7398

Berdjag, Denis — Univ. of Science and Tech. of Lille
Cocquempot, Vincent — LAGIS - LILLE 1 Univ.
Christophe, Cyrille — Univ. des Sciences et Tech. de Lille

This paper presents a constrained decomposition methodology for discrete-event models. Partial models are obtained and used for model-based fault detection and isolation. The constraints of the decomposition ensures that the resulting partial model is decoupled from a given subset of inputs. The constrained decomposition method is formulated using pair algebra concepts as an iterative algorithm for easy implementation.

10:30-12:30 WeA01.35

A System for Automated Final Quality Assessment in the Manufacturing of Vacuum Cleaner Motors, pp. 7399-7404

Benko, Uros — Jozef Stefan Inst.
Petrovcic, Janko — Jozef Stefan Inst.
Musizza, Bojan — Jozef Stefan Inst.
Juricic, Dani — Jozef Stefan Inst.

In this paper we present a system for fault detection and isolation of electrical motors for vacuum cleaners, which serves for on-line quality assessment at the end of the production line. The main focus of the paper is on detection of incipient mechanical faults by means of sound analysis. A detailed description of the procedures for detection and isolation of faults with mechanical origin is given. One of the contributions concerns innovative implementation of the feature extraction algorithm in a way that spectral procedures used in system analysis are substituted by much simpler and computationally more effective algorithms. Herewith the system is able to accurately isolate three different types of mechanical faults. Additional contribution regards diagnostic system integration which generates highest product end quality and traceability. In order to fully utilize a huge amount of diagnostic data, possibilities for the upgrade of the present diagnostic system with advanced production line supervision support are indicated.

10:30-12:30 WeA01.36

Online Statistical Monitoring and Fault Classification of the Tennessee Eastman Challenge Process Based on Dynamic Independent Component Analysis and Support Vector Machine, pp. 7405-7412

Salahshoor, Karim — petroleum Univ. of Tech.
Kiasi, Fariborz — petroleum Univ. of Tech.

This paper presents a new online statistical monitoring based on dynamic independent component analysis (DICA) to detect the Tennessee Eastman challenge process faults. The proposed method employs dynamic feature extraction approach to capture most of the inherent dynamic fault information. This leads to an efficient fault detection with superior performance compared to independent component analysis (ICA) approach in both detection rate and number of false alarms. A new statistic measure has been introduced to enhance the monitoring capabilities of ICA and DICA. An approach based on cumulative percent variance (CPV) has been incorporated to mechanize the selection of required number of independent components in both ICA and DICA online monitoring methods. To choose the best time-lag order for each fault dynamic model in the DICA augmented data matrix, a multivariate auto regressive exogenous (ARX) model structure has been adopted by validating the minimum Akaike's information criterion (AIC) index. An online procedure based on a multi-class support vector machine (SVM) with Gaussian kernel function, being set by sub-optimal width parameters, is employed to classify and isolate each fault. The SVM uses one against all (OAA) algorithm for fault classification and sequential minimization optimization (SMO) to solve the classification problem. Performances of the developed process monitoring methods (ICA-SVM, DICA-SVM) are evaluated on the Tennessee Eastman challenge process (TE).

10:30-12:30 WeA01.37

On-Line Process Monitoring Based on Wavelet-ICA Methodology, pp. 7413-7420

Salahshoor, Karim — petroleum Univ. of Tech.
Kiasi, Fariborz — petroleum Univ. of Tech.

In this paper, a new process monitoring methodology is presented to detect fault occurrence. The proposed methodology incorporates a wavelet de-noising approach based on the fast wavelet transform (FWT) to extract the embodied fault dynamics from the noisy measured data. A level dependent soft thresholding technique using Daubechies 3 with three levels of decomposition is utilized. An appropriate sliding window scheme is presented to enable on-line implementation of wavelet de-noising filtering. An ICA statistical monitoring technique is employed to detect fault. To enhance ICA monitoring capability, a new statistic measure is developed to cater for monitoring the excluded part which has not been captured by the main dominant part. An approach based on cumulative percent variance (CPV) is presented to mechanize the selection of dominant independent components in the presented monitoring methodology. The effectiveness of the proposed wavelet-ICA approach will be demonstrated by applying on the Tennessee Eastman challenge process plant.

10:30-12:30 WeA01.38

Neural Network Based System Identification for Autonomous Flight of an Eagle Helicopter, pp. 7421-7426

Samal, Mahendra — UNSW@ADFA
Sreenatha, Anavatti G. — Australian Defence Force Acad.
Garratt, Matthew — UNSW@ADFA

Neural Network Identification (NNID) for modeling the dynamics of a miniature Eagle helicopter is presented in this paper. Off-line and on-line identification is carried out for both coupled and decoupled dynamics of the helicopter from the flight test data. For both the cases, identification results and the error statistics are provided. The off-line identification performs better due to sufficient training time and data. Results indicate neural network based black-box method is suitable for modeling the nonlinear dynamics of the helicopter. This can be further applied for the design of Automatic Flight Control System (AFCS).

10:30-12:30 WeA01.39

LPV Design of Charge Control for an SI Engine Based on LFT Neural State-Space Models, pp. 7427-7432

Abbas, Hossam — Hamburg Univ. of Tech.
Werner, Herbert — Hamburg Univ. of Tech.

This paper is one of two joint papers, each presenting and utilizing a different representation of a feedforward neural network for controller design. Here a neural state-space model is transformed into a linear fractional transformation (LFT) representation to obtain a discrete-time quasi-linear parameter-varying (LPV) model of a nonlinear plant, whereas in the joint paper (Abbas and Werner [2008]) a method is proposed to transform the neural state-space into a discrete-time polytopic quasi-LPV model. As a practical application, air charge control of a Spark-Ignition (SI) engine is used in both papers as example to illustrate two different synthesis methods for fixed structure low-order discrete-time LPV controllers. In this paper, a method that combines modelling using a multilayer perceptron network and controller synthesis using linear matrix inequalities (LMIs) and evolutionary search is proposed. In the first step a neural state-space model is transformed into a linear fractional transformation (LFT) representation to obtain a discrete-time quasi-LPV model of a nonlinear plant from input-output data only. Then a hybrid approach using LMI solvers

and genetic algorithm, which is based on the concept of quadratic separators, is used to synthesize a discrete-time LPV controller.

10:30-12:30 WeA01.40

Biosocial Culture Inspired Hierarchical Algorithm for MISO Block Oriented Nonlinear System Identification - Application to Ozone Modeling, pp. 7433-7438

Naitali, Abdessamad	emi, Univ. Mohammed V de Rabat-Agdal
Giri, Fouad	GREYC - Univ. de Caen
Elayan, Elamari	Univ. of Caen
Mohamed, Haloua	Ec. Mohammadia d'Ingénieurs, Univ. Mohammed V Agdal

A new solution to nonlinear systems identification of MISO Hammerstein and/or Wiener models is developed using tools from Evolutionary Computation based optimization. A hybrid genetic and swarming intelligence based Hierarchical Cultural Algorithm is used to adapt the structure of the bad less suited model and to estimate the parameters of its dynamics and nonlinearities representation. Performances of such solution, illustrated through a real life application show how this class of tools can be very helpful to solve complex nonlinear problems such as the ozone phenomenon identification.

10:30-12:30 WeA01.41

Nonlinear System Identification in a Noisy Environment Using Wavelet Based SDP Models, pp. 7439-7444

Truong, Nguyen-Vu	RMIT Univ.
Wang, Liuping	RMIT Univ.

This paper presents an approach to the identification of nonlinear system in noisy environment using a wavelet based State Dependent Parameter (SDP) model to chacterize the system's nonlinear dynamics. The obtained model is in the form of a set of linear regressive output/input terms (state) multiplied by the respective SDPs, which are compactly parameterized by wavelet basis functions. In this approach,a modified Instrumental Variable (IV) algorithm is used to solve to the inconsistency problem of linear least squares parameter's estimation in the presence of noise. A simulation example is provided to illustrate the proposed approach.

10:30-12:30 WeA01.42

A New Cluster Validity Criterion for Fuzzy C-Regression Models Clustering and Its Application to Fuzzy Model Identification, pp. 7445-7450

Kung, Chung-Chun	Tatung Univ.
Su, Jui-Yiao	Tatung Univ.

In this paper, a new cluster validity criterion for fuzzy c-regression models (FCRM) clustering algorithm with affine linear functional cluster representatives is proposed. The proposed cluster validity criterion calculates the overall compactness and separateness of the FCRM partition and then determines the appropriate number of clusters. Besides, its application to fuzzy model identification is discussed. A T-S fuzzy model identification algorithm is proposed to extract compact number of IF-THEN rules from data. Two simulation examples are provided to demonstrate the potential of the proposed cluster validity criterion and the accuracy of the constructed T-S fuzzy model.

10:30-12:30 WeA01.43

Least Squares Method Applied to Rail Vehicle Contact Condition Monitoring, pp. 7451-7456

Charles, Guy	Loughborough Univ.
Dixon, Roger	Loughborough Univ.
Goodall, R.M.	Loughborough Univ.

The dynamics of a railway vehicle are driven by the geometry and conditions at the wheel-rail contact. Typically the condition and shape of the wheel and rail are monitored separately and off line. The work presented here is part of ongoing research into on-line model-based estimation of parameters in the wheel-rail contact dynamics. This paper outlines a practical approach to estimating a nonlinear function within a dynamic system by using a piecewise cubic functions. The parameters for the cubic functions are estimated with a least squared approach applied to the dynamic measurements taken from the system. A simplified plan-view wheelset and suspended mass model is introduced to use as an application of this technique. A contact geometry term, conicity, which is a nonlinear function of the relative lateral wheel-rail position, is included in the rail vehicle model. The conicity is successfully estimated using the least-squares method outlined in the paper.

10:30-12:30 WeA01.44

Non-Linear Identification and Analysis of a HEUI System, pp. 7457-7462

Liu, Jui-Jung	Kainan Univ.
Lee, Ya-Wei	Ordnance Readiness and Development Center
Cheng, Chiz-Chung	Lee-Ming Inst. of Tech.

This study presents the estimation of a nonlinear autoregressive moving average with exogenous inputs (NARMAX) model of a novel hydraulically actuated electronic unit injection (HEUI) system. The injection pressure-fuel rate relationship is detected to understand the HEUI system and its effects on engine performance. The dynamics of causation is first investigated in the time domain to estimate the non-linear models. Further validation is then done using model predicted output, correlation tests and cross-validation tests.

10:30-12:30 WeA01.45

Feedback Analysis of Radial Basis Functions Neural Networks Via Small Gain Theorem, pp. 7463-7467

Ali, S. Saad Azhar	Air Univ.
Shafiq, Muhammad	GIKI
Ba-Khashwain, Jamil M.	King Fahd Univ. of Petroleum & Minerals
Al-Sunni, Fouad M.	King Fahd Univ. of Pet. & Min.

Radial basis function neural networks are used in a variety of applications such as pattern recognition, nonlinear identi_cation, control, time series prediction, etc. In this paper, feedback analysis of the learning algorithm of radial basis function neural networks is presented. It studies the robustness of the learning algorithm in the presence of uncertainties that might be due to noisy perturbations at the input or to modeling mismatch. The learning scheme is _rst associated with a feedback structure and then the stability of that feedback structure is analyzed via small gain theorem. The analysis suggests bounds on the learning rate in order to guarantee that the learning algorithm will behave as robust nonlinear _lters and optimal choices for faster convergence speeds.

10:30-12:30 WeA01.46

Lipschitz Numbers: A Medium for Delay Estimation, pp. 7468-7473

Makaremi, Iman	Univ. of Windsor
Fatehi, Alireza	K.N. Toosi Univ. of Tech.
Araabi, Babak N.	Univ. of Tehran

The paper deals with problem of estimating input channel delay in nonlinear system with a model-free approach. The proposed method is based on Lipschitz theory. It is an extension to the Lipschitz method which was proposed for determining the order of a model. Our algorithm consists of two parts which in the first one estimation is made on the proper number of dynamics on the input and in the second part the pure delay of the input is obtained. The method is applied for estimation of the delay of two different models and the estimation was as accurate as possible.

10:30-12:30 WeA01.47

A Novel RSMI Based on Regression and Natural Power Method, pp. 7474-7479

Wu, Ping	Zhejiang Univ.
Yang, ChunJie	Zhejiang Univ.
Song, Zhi-Huan	Zhejiang Univ.

In this paper, we propose a new recursive subspace model identification (RSMI) based on regression and natural power method (NP) which is an array signal processing algorithm with excellent convergence properties. We call this new algorithm as `R-NP'. The basic idea of the algorithm is to utilize an unstructured least squares linear regression approach at the updating observation vector step and the close relationship between RSMI with NP. This algorithm has simpler procedures than other RSMI algorithms. A numerical example illustrates that R-NP method is efficient and have a better performance in terms of transient behavior with respect to EIVPAST. In this paper, we consider the case where the order of system to be identified is a priori known.

10:30-12:30 WeA01.48

Nonlinear System Identification and Control Using an Input-Output Recurrent Neurofuzzy Network, pp. 7480-7485

Gonzalez-Olvera, Marcos A.	National Autonomous Univ. of Mexico (UNAM)

Tang, Yu National Univ. of Mexico

In this work we develop an input-output recurrent neurofuzzy network in discrete-time for identification and control of nonlinear systems. The structure is linear in the consequent parameters and nonlinear in the antecedent ones. The training of the antecedent parameters is achieved by linearizing them around a suboptimal value, assuming that the only known data are input-output signals obtained directly from measurements of the system, as well as some information about its structure (local stability and time delays). The training algorithm is based on a Kalman filter, stable under certain assumptions. It is also presented a theorem to check the stability of the resulting network in the Lyapunov sense, and a predictive control design. The performance of the network is shown by the identification and control of a nonlinear benchmark system.

10:30-12:30 WeA01.49

Operatorial Parametrizing of Controlled Dynamic Systems - Application to the Fed-Batch Bioreactor Control Problem, pp. 7486-7490

Montseny, Emmanuel Univ. of Toulouse
Doncescu, Andrei Lab. of Architecture and Analysis of Systems CNRS

Dynamic models most of time involve differential equations, which are "time-local". Such models can also be considered "globally", that is in the sense of "trajectories" in the state "space-time". Up to adapted concepts, such a different interpretation reveals itself more flexible, namely because it allows to use various operatorial transformations whose time-local equivalent in general cannot exist and from which can result some remarkable properties. Namely, we introduce a principle of parametrizing for dynamic equations by means of such transformations. We then consider an example of bioreactor model for which we highlight how suitable timenonlocal transformations can sometimes be used to efficiently solve some nonlinear control problems.

10:30-12:30 WeA01.50

An Innovative Method for Identification of Dynamic Systems Based on LoLiMoT, pp. 7491-7497

Ahmad Sharbafi, Maziar Univ. of Tehran
Mohammadi Nejad, Aida Khaje Nasir Toosi Univ. of Tech.

There are many methods in identification developing every day. But identification of dynamic systems has still remained a complex open problem. One of the new effective methods of identification in nonlinear problems is identification with Neurofuzzy approach. Compared with classic neural network and wavelet network this method is faster and more accurate, demonstrated with an example in this paper. The main aim of this paper is developing a Locally Linear Model Tree based algorithm which can be used in structure identification. Our method inspired from the concepts utilized in definition of this Neurofuzzy network and its quality was shown by a bench mark structure identification problem.

10:30-12:30 WeA01.51

Fuzzy Model Based Indirect Adaptive Control Design for Nonlinear Systems with a Dead-Zone, pp. 7498-7503

Chen, Her-Sheng TATUNG Univ.
Yu, Wen-Shyong Tatung Univ.

In this paper, we present a fuzzy model based indirect adaptive control scheme for a class of nonlinear systems with a dead-zone. The Takagi-Sugeno (T-S) fuzzy model is used for representing a nonlinear system, where the parameters of the fuzzy model are updated online according to Lyapunov stability theorem. An inverse functions are cascaded with the plant to cancel the effects of dead-zone, and the dead-zone slopes in both positive and negative sides are assumed to be the same. In addition, the proposed adaptive fuzzy controller ensures the stability of the closed-loop system with dead-zone and the output is forced to follow the desired reference input. An inverted pendulum system is used to illustrate the effectiveness of the proposed method. The simulation can demonstrate the validity of the proposed scheme and achieve satisfy simulation results.

10:30-12:30 WeA01.52

New Hybrid Model and Switched PI Observer for Dry Friction Systems, pp. 7504-7509

Nouailletas, Rémy LCIS, ESISAR
Le, Hoang Bao LCIS-ESISAR-INPG
Mendes, Eduardo LCIS-ESISAR-INPG
Koenig, D. Inpg - Esisar

In this paper, a polytopic approach is used to derive a new hybrid model of systems submitted to dry friction. The principal characteristics of the proposed approach are that it is easily comprehensible, has few parameters, allows the adjustment of the model complexity to the treated case, models the stick-slip phenomena, and has low simulation time. The proposed new dry friction model is applied to the modeling of a real experimental mechanical system. The model parameters are obtained using an adequate position control which is based on a controller with very low bandwidth. To estimate the states of such system, a polytopic PI observer is proposed using a H_{infty} formulation. Its performance and robustness against model uncertainty are shown in simulation.

10:30-12:30 WeA01.53

Recursive Identification Algorithms Based on Minimizing Estimation Error, pp. 7510-7515

Luo, Guiming Tsinghua Univ.
Kimura, Hidenori The Inst. of Physical and Chemical Res. (RIKEN)
Kwon, Wook Hyun Seoul National Univ.

Parameter selection for the criterion weighting matrix is concerned based on the information of both modifying the past estimation residuals and renewing the present estimation residual error . After minimizing the system estimation error, an optimal recursive algorithm is given. In this method the system data record can be used efficiently. The consistency of the new recursive algorithm is analyzed. Finally, some simulation examples are included to demonstrate the new method's reliability.

10:30-12:30 WeA01.54

Optimal Spectral Expansion for Discrete Control, pp. 7516-7521

Vykhovanets, Valery Intitute of Control Science

Consideration was given to identification of discrete processes, which is reducible to the functional decomposition of discrete functions, where by the decomposition is meant the representation of a function by a formula in the basis of binary operations. A procedure of optimal formula design was based on a novel approach of spectral expansion. Both exact and asymptotic complexity estimate of the designed formulas were given.

10:30-12:30 WeA01.55

Dynamical Effects of Vision-Based Position Measurement, pp. 7522-7527

Laroche, Edouard LSIIT
Delavigne, Julien Strasbourg Univ. 1

In vision-based control schemes, a position measurement is computed from image processing. This kind of sensor sensibly differs from the classical physical sensors for which the data can be filtered before being sampled. This paper is dedicated to the analysis of the dynamical effects of this measurement system. A model is derived allowing to emphasize the behavior in the high frequencies, with better accuracy than the models available. When the camera is used as a sensor for a mechanical system with a continuous-time model, we show that a discrete-time model can be derived that accounts accurately for the camera effect. When considering identification of the continuous-time model of the system, it is shown that accurate results can be obtained with output measurement provided by camera by considering the input data as provided by a first-order hold instead of a zero-order hold. It is also shown that accurate results can be obtained even if the eigen modes are close to the Shannon frequency and when neglecting modes at higher frequency than the Shannon frequency.

10:30-12:30 WeA01.56

An Improved MILP Method for Data Rectifications with Gross Error Candidates, pp. 7528-7533

Li, Jianlie Zhejiang Univ.
Rong, Gang Zhejiang Univ.
Wang, Xu Zhejiang Univ.
Feng, YiPing ZheJiang Univ.

MILP (Mixed Integer Linear Programming) method for simultaneous gross error detection and data reconciliation has been proved to be an efficient way to adjust process data with material and other balance constraints. But the efficiency will decrease significantly when the MILP method is applied in a large-scale data rectification problem because there are too many binary variables to be considered. In this paper, a strategy is proposed to generate a list of gross error candidates with reliability factors. The list of candidates are combined into the MILP objective function to improve the efficiency and accuracy through reducing the number of binary variables and giving accurate weights for suspected gross errors. Industrial examples are provided to show the efficiency of the algorithm.

10:30-12:30 WeA01.57

Identification and Distance Detection for Ultrasonic Sensor by Correlation Method, pp. 7534-7538

Jang, Jin S. Pukyong National Univ.
Joo, Moon G. Pukyong National Univ.
Lee, Won Chang Pukyong National Univ.
Jung, Dong Won Rist
Lim, Zhong Soo Rist

This paper presents a method for identification and distance detection for ultrasonic sensors of indoor mobile robot by using correlation scheme. The transmitted signal is identified by correlation between known model patterns and the patterned signal from transmitters and this scheme is useful when multiple sensors are involved. Distance detection by correlation is shown to be more accurate than conventional threshold method.

10:30-12:30 WeA01.58

Systematic Evaluation of Relaxation Circumstances Based on Bio-Neurological Signals (I), pp. 7539-7543

Chen, Lanlan Saga Univ.
Sugi, Takenao Saga Univ.
Shirakawa, Shuichiro National Center of Neurology and Psychiatry, Tokyo, Japan
Zou, Junzhong East China Univ. of Science and Tech.
Nakamura, Masatoshi Graduate School of Science and Engineering, Saga Univ.

The widespread use of relaxation technique amongst medicine community and sustained work environments makes a more complete understanding of its physiological effects. This research proposes a systematic evaluation for relaxation circumstances, which consists of subjective evidence and objective evidence. Innovative feature of this evaluation system is adding bio-neurological signals to support previous findings about relaxation circumstances. A work-rest schedule containing mental calculation and music relaxation is specially designed to reflect effect of prolonged cognitive work and relaxation in mental work environments. The results indicate that short period of music relaxation in sustained mental work is effective to counteract the accumulation of mental fatigue and improve work efficiency. This systematic evaluation method can be widely applicable, in medical fields, working environments and daily life for the purpose of prediction, detection and evaluation of human states.

10:30-12:30 WeA01.59

Higher Order Digital Delta-Sigma Modulator with Small Fluctuation: Sliding Mode Operation Approach, pp. 7544-7549

Yoneya, Akihiko Nagoya Inst. of Tech.

A new design approach of a digital delta-sigma modulator with small output fluctuation is proposed. The digital delta-sigma modulators are used in the digital-analog converters, the fractional-N phase lock loop, etc. and its output fluctuation is one of the important performances although a higher order modulator often produces large fluctuations. In this work, the noise shaping filter of the modulator is operated so that the operating point may maintain close to a sliding plane by selecting the output value to reduce the fluctuation of the output signal. By employing the sliding plane, the degrees of the freedom of the output signal is enhanced.

10:30-12:30 WeA01.60

Adaptive Active Noise Control Schemes for Headset Applications, pp. 7550-7555

Dandasi, Veeravasantarao Indian Inst. of Tech. Kanpur
S, Ajay National Inst. of Tech. Karnataka, Surathkal
P., Premkumar Indian Inst. of Tech. Kanpur
Behera, Laxmidhar Indian Inst. of Tech. Kanpur

Abstract: This paper presents the design and implementation of adaptive feedback active noise control system (ANC) for head phone applications. Active Noise Control is a technique of acoustic noise reduction using a secondary source of sound which produces "antinoise" to cancel the primary noise. In this paper, narrow band single channel feedback ANC for headsets application is focused upon. The filter weights are updated by using the feedback form of Filtered-X LMS (FXLMS) algorithm. Performances for the IIR-based filter, FIR-based filter are compared with those of the algorithm by using ADALINE. The real time implementation of the system is performed using TMS320C6713 DSP Starter Kit (DSK) and the performance is analyzed for two tone sinusoidal noise.

10:30-12:30 WeA01.61

A Continuous-Time Fixed-Lag Smoother Converging in Finite Time, pp. 7556-7559

Kwon, Bo Kyu Seoul National Univ.
Kwon, Wook Hyun Seoul National Univ.

In this paper, we propose a new fixed-lag smoother that estimates the fixed-delayed state for a continuous-time stochastic system. The estimation error variance of the proposed smoother is minimized under the constraint that the estimated state converges to the real state exactly in finite time after noises or uncertainties disappear. For numerical computing, the proposed smoother is represented in a differential form. In order to achieve the convergence in finite time, any additional processes such as batch processing and sampling data through discrete-time techniques are not required. A numerical example is presented to illustrate the finite time convergence of the proposed smoother in comparison with the asymptotic convergence of the conventional Kalman smoothers.

10:30-12:30 WeA01.62

An Optimal Sequential Decentralized Filter of Discrete-Time Systems with Cross-Correlated Noises, pp. 7560-7565

Wen, Chenglin Hangzhou Dianzi Univ.
Wen, Chuanbo Shanghai Dianji Univ.
Y.Li, Yuan Li Yuan

In this paper, a new sequential decentralized computational structure is developed for optimal state estimation in discrete time-varying linear stochastic control system with multiple sensors and cross-correlated noises. We uses a hierarchical structure to perform successive orthogonualizations of the measurement noises, and the Kalman filters sequentially runs based on the new constructed measurement sequency. The the estimator also can process the system with measurements delay as well as data fault because the update step is just according to the coming order of sensors in a recursive form. The precision relation between the new algorithm and the centralized multisensor fusion method is strictly proved and simulation result shows that new filter is better than other similar filters in performance.

10:30-12:30 WeA01.63

Nonlinear ANC Using a Third-Order Volterra Filter with an LDLT-FAP Algorithm, pp. 7566-7569

Seo, J.B. Hanyang Univ.
Kim, K.J. Hanyang Univ.
Nam, Sang Won Hanyang Univ.

Active noise control (ANC) systems employing the conventional fast affine projection (FAP) algorithms may lead to low ANC performance when the non-unity step size is chosen. To solve the problem, an LDLT- fast affine projection algorithm was proposed recently for the linear ANC. In this paper, the LDLT-FAP algorithm is further utilized, along with a third-order Volterra filter, for nonlinear ANC. Simulation results show that the proposed approach yields the good nonlinear ANC performance even in wide range of step sizes.

10:30-12:30 WeA01.64

Velocity and Acceleration Estimation for Optical Incremental Encoders, pp. 7570-7575

Merry, Roel Eindhoven Univ. of Tech.
Molengraft, René van de Eindhoven Univ. of Tech.
Steinbuch, Maarten Eindhoven Univ. of Tech.

Optical incremental encoders are extensively used for position measurements in motion systems. The position measurements suffer from quantization errors. Velocity and acceleration estimations obtained by numerical differentiation largely amplify the quantization errors. In this paper, the time stamping concept is used to obtain more accurate position, velocity and acceleration estimations. Time stamping makes use of stored events, consisting of the encoder counts and their time instants, captured at a high resolution clock. Encoder imperfections and the limited resolution of the capturing rate of the encoder events result in errors in the estimations. In this paper, we propose a method to extend the observation interval of the stored encoder events using a skip operation. Experiments on a motion system show that the velocity estimation is improved by 54% and the acceleration estimation by 92%.

10:30-12:30 WeA01.65

Sampling of Noisy Signals: Spectral vs Anti-Aliasing Filters, pp. 7576-7581

Blachuta, Marian — Silesian Tech. Univ.
Grygiel, Rafal — Silesian Tech. Univ.

In the paper we study the properties of sampling stochastic signals corrupted by a wideband stochastic noise where samples are taken either directly from resulting signal, or as the output from a continuous-time filter. We consider two types of filters: anti-aliasing filters whose characteristics depend solely on sampling period, and Kalman filters, whose characteristics depend on spectra of signals of interest.We also study possible improvement attained by discretetime Kalman filtering applied to the sampled signal. We compare the results of two competitive methods: classical point-wise sampling followed by discrete-time filtering, and continuous-time filtering prior to sampling possibly followed by digital filtering. The study is performed for a wide range of sampling periods and noise-to-signal ratios and leads to important practical conclusions.

10:30-12:30 WeA01.66

Approximations for State Estimation in a Plane Using Two Two-Axis Accelerometers, pp. 7582-7587

Boje, Edward — Univ. of KwaZulu Natal

This paper examines the estimation of the state of an object moving in the horizontal plane using two, two-axis accelerometers and no rate gyro. Second order approximations are developed for estimating the state noise covariance in the inertial reference frame from the known measurement covariance of the sensors. These approximations can be integrated with position and heading measurements into an extended Kalman filter.

10:30-12:30 WeA01.67

A Self-Evolving Interval Type-2 Fuzzy Neural Network for Nonlinear Systems Identification, pp. 7588-7593

Juang, Chia-Feng — National Chung Hsing Univ.
Lu, Chun-Feng — Chung-Chou Inst. of Tech.
Tsao, Yu-Wei — National Chung-Hsing Univ.

This paper proposes a Self-Evolving Interval Type-2 Fuzzy Neural Network (SEIT2FNN) for nonlinear systems identification. The SEIT2FNN has both on-line structure and parameter learning abilities. The antecedent parts in each fuzzy rule of the SEIT2FNN are interval type-2 fuzzy sets and the fuzzy rules are of the Takagi-Sugeno-Kang (TSK) type. An on-line clustering method is proposed to generate fuzzy rules which flexibly partition the input space. For parameter learning, the consequent part parameters are tuned by a rule-ordered Kalman filter algorithm for high accuracy learning performance. The antecedent part parameters are learned by gradient descent algorithms. Comparisons with identification using other type-1 and type-2 fuzzy systems verify the performance of the SEIT2FNN.

10:30-12:30 WeA01.68

Recursive Motion Recovery Based on Dynamic Vision, pp. 7594-7599

Chen, Xinkai — Shibaura Inst. of Tech.

The motion recovery for a class of movements in the space by using stereo vision is considered by observing at least three points in this paper. The considered motion equation can cover a wide class of practical movements in the space. The observability of this class of movement is clarified. The estimations of the motion parameters which are all time-varying are developed in the proposed algorithm based on the second method of Lyapunov. The assumptions about the perspective system are reasonable, and the convergence conditions are intuitive and have apparently physical interpretations. The proposed recursive algorithm requires minor a priori knowledge about the system and can alleviate the noises in the image data. Furthermore, the proposed algorithm is modified to deal with the occlusion phenomenon. Simulation results show the proposed algorithm is effective even in the presence of measurement noises.

WeA02 304A

Nonlinear Observers I (Regular Session)

Chair: Guay, Martin — Queen's Univ.
Co-Chair: Hammouri, Hassan — Univ. Claude Bernard

10:30-10:50 WeA02.1

Approximate Observer Error Linearization for Nonlinear Systems with Input, pp. 7600-7605

Bäuml, Markus — Univ. Erlangen-Nürnberg
Deutscher, Joachim — Univ. Erlangen-Nürnberg

This paper presents an approach to the design of nonlinear observers by approximate error linearization. It extends previous results of the authors to systems with input applying Lyapunov's Auxiliary Theorem. By using a Galerkin approach on the basis of multivariable Legendre polynomials the L_2-norm of the remaining nonlinearity in the resulting error dynamics can be made small on a specified multivariable interval in the state space. Linear matrix equations are derived for determining the corresponding change of coordinates and output injections. Consequently, the proposed design procedure can easily be implemented in a numerical software package. A dc motor with a boost converter as actuator demonstrates the properties of the proposed numerical observer design.

10:50-11:10 WeA02.2

High-Gain Observers in the Presence of Measurement Noise: A Switched-Gain Approach, pp. 7606-7611

Ahrens, Jeffrey — Corning Inc.
Khalil, Hassan K. — Michigan State Univ.

This paper considers output feedback control using high-gain observers in the presence of measurement noise for a class of nonlinear systems. We study stability in the presence of measurement noise and illustrate the tradeoff when selecting the observer gain between state reconstruction speed and robustness to model uncertainty on the one hand versus amplification of noise on the other. Based on this tradeoff we propose a high-gain observer that switches between two gain values. This scheme is able to quickly recover the system states during large estimation error and reduce the effect of measurement noise in a neighborhood of the origin of the estimation error. We argue boundedness and ultimate boundedness of the closed-loop system under switched-gain output feedback.

11:10-11:30 WeA02.3

Qubit Hamiltonian Identification: A Symmetry-Preserving Observer-Based Approach, pp. 7612-7617

Bonnabel, Silvere — Univ. de Ličge
Mirrahimi, Mazyar — INRIA Rocquencourt
Rouchon, Pierre — ENSMP

We consider a pure two-state quantum system illuminated by two lasers. A photo-detector captures the fluorescence of the system. We build an invariant observer which yields a (local) estimation of the wave function (or density matrix) and the two key parameters (laser de-tuning and the atom-laser coupling strength) of the hamiltonian. The design exploits the symmetries of the system and can be interpreted geometrically. The convergence proof is based on averaging arguments. Simulation with noise illustrates the robustness of the obtained estimation algorithm.

11:30-11:50 WeA02.4

An Approach to Unknown Input Observation for Non-Input-Affine Nonlinear MIMO Systems, pp. 7618-7623

Stegmann, Nadine — Univ. of Kaiserslautern
Liu, Steven — Univ. of Kaiserslautern

This paper presents the application of a linear state and input observation approach to a non-input-affine nonlinear MIMO system. To detect and identify disturbances on the system's input, the system is transformed into an input-affine form by dynamic compensation and then linearized. The linearization carried out is not exact due to the unknown disturbance. It is shown that the linearization error can be represented as an equivalent input disturbance to the exact linear system representation and the linear observation approach therefore holds. The usefulness of the proposed method is demonstrated by a practical example. The system under consideration is a car-like mobile platform subject to steering angle errors. A control approach to compensate for the input disturbance based on the observation results is presented.

11:50-12:10 WeA02.5

On the Numerical Investigation of a Luenberger Type Observer for Infinite-Dimensional Vibrating Systems, pp. 7624-7629

Li, Xiao-Dong — Univ. Claude Bernard Lyon 1

Xu, Chengzhong	Univ. Claude Bernard - Lyon1
Peng, Yue-Jun	Univ. Blaise Pascal Clermont-Ferrand II
Tucsnak, M.	Univ. of Nancy

In this paper we present an infinite-dimensional Luenberger type observer for a class of vibrating systems. We undertake numerical investigations of the observer based on the Euler-Bernoulli model of elastic beam. The finite element method is adopted. The spatial interval is subdivided into a finite number N of smaller intervals. On each small interval we use hermitian shape functions of degree 3 to approximate the unknown function which is the solution of the system under study. Numerical simulations are carried out to illustrate the convergence of the designed observer.

12:10-12:30 WeA02.6

Observer Design for a Class of Uniformly Observable MIMO Nonlinear Systems with Coupled Structure, pp. 7630-7635

Liu, Feng-Long	Univ. de Caen, ENSICAEN
Farza, Mondher	Univ. DE CAEN, ENSICAEN
M'Saad, Mohammed	GREYC CNRS UMR 6072
Hammouri, Hassan	Univ. Claude Bernard

A high gain observer is synthesized from a canonical form that characterizes the class of uniformly observable systems. Two main contributions are to be emphasized: the first is related to the considered structure of the canonical form which does not assume a complete triangular structure. That is, each block may contain nonlinearities which depend on the whole state. The second main contribution lies in the simplicity of the observer gain synthesis since the expression of this gain is given and its calibration is reduced to the choice of a single design parameter. Moreover, this involves a design function that has to satisfy a mild condition which is given. Different expressions of such a function are proposed. Of particular interest, it is shown that high gain observers and sliding mode like observers can be derived by considering particular expressions of the design function. An example with simulation results is given for illustration purposes.

WeA03 304B

Control of Switched Systems (Regular Session)

Chair: Celikovsky, Sergej	Inst. of Information Theory and Automation, Acad. of Science of the Czech Republic; Faculty of EE, Czech Tech. Univ.
Co-Chair: van den Boom, Ton J. J.	Delft Univ. of Tech.

10:30-10:50 WeA03.1

Reliable Adaptive Control for Switched Fuzzy Systems, pp. 7636-7641

Zhang, Le	Northeastern Univ. of shenyang
Andreeski, Cvetko	Faculty of Tourism and Hospitality
Dimirovski, Georgi Marko	Dogus Univ. of Istanbul
Jing, Yuanwei	Northeastern Univ.

A model of a kind of uncertain switched fuzzy systems is presented first, in which each subsystem is an uncertain fuzzy system. Then the robust stabilization problem to the system is studied and a solution proposed. When the upper bounds of the disturbances are unknown, and the actuator is serious failure and the residual part of actuator can not make original system stable, a reliable robust adaptive controller is constructed to guarantee the closed-loop system is uniformly ultimately bounded via using switching technique and multiple Lyapunov function approach. The switching strategy achieving system uniformly ultimately bounded of the uncertain switched fuzzy system is given. An illustrative example is given that demonstrates the feasibility and the effectiveness of the proposed method.

10:50-11:10 WeA03.2

Average Dwell-Time Method to Stabilization and L2-Gain Analysis for Uncertain Switched Nonlinear Systems, pp. 7642-7647

Wang, Min	Key Lab. of Integrated Automation ofProcessIndustry,Minist
Dimirovski, Georgi Marko	Dogus Univ. of Istanbul
Zhao, Jun	The Australian National Univ.

This paper is concerned with the problem of stabilization and L2-gain analysis for a class of switched nonlinear systems with norm-bounded time-varying uncertainties. A system in this class is composed of two parts: a uncertain linear switched part and a nonlinear part, which are also switched systems. When all the subsystem are stabilizable and have a L2-gain, the switched feedback control law and the switching law are designed respectively using average dwell-time method such that the corresponding closed-loop switched system is exponentially stable and achieves a weighted L2-gain. We construct the Piecewise Lyapunov functions and design the switching law based on the structural characteristics of the switched system.

11:10-11:30 WeA03.3

Robust Stabilizability of Switched Linear Time-Delay Systems with Polytopic Uncertainties, pp. 7648-7653

Yao, Zhenxian	Tianjin Univ.
Wang, Yijing	Tianjin Univ.
Zuo, Zhiqiang	Tianjin Univ.
Zhao, Huimin	Tianjin Univ.
Zhang, Guoshan	Tianjin Univ.

This paper is devoted to robust stability analysis via state feedback of linear systems with state delay that are composed of polytopic uncertain subsystems. By state feedback, we mean that the switchings among subsystems are dependent on system states. For continuous-time switched linear systems, we show that if there exists a common positive definite matrix for stability of all convex combinations of the extreme points which belong to different subsystem matrices, then the switched system is robustly stabilizable via state feedback. The stability conditions of both delay-independent and delay-dependent are analyzed using Lyapunov- Razumikhin functional approach. Furthermore, we propose the switching rules by using the obtained common positive definite matrix.

11:30-11:50 WeA03.4

A Hamiltonian Approach for the Optimal Control of the Switching Signal for a DC-DC Converter, pp. 7654-7659

Corona, Daniele	TU Delft
Buisson, Jean	Supélec
De Schutter, Bart	Delft Univ. of Tech.

The optimal control problem of a switching DC-DC converter is considered in this paper. An LQ (Linear Quadratic) type performance index of the error between the current state variables and the target working point is defined. The feedback control on the decision variable of the duty cycle frequency is then formulated as a minimization of an appropriate Hamiltonian function of which suboptimal solutions are proposed. These are based on a detailed study of the average model of the system, obtained from the desired steady state solution. This paper focuses on a particular converter (the Buck-Boost converter), but the results are easily extensible to all single switch-cell converters.

11:50-12:10 WeA03.5

Model Predictive Control for Switching Max-Plus-Linear Systems with Random and Deterministic Switching, pp. 7660-7665

van den Boom, Ton J. J.	Delft Univ. of Tech.
De Schutter, Bart	Delft Univ. of Tech.

Switching max-plus-linear (SMPL) systems are discrete event systems that can switch between different modes of operation. In each mode the system is described by a max-plus-linear state equation and a max-plus-linear output equation, with different system matrices for each mode. The switching may depend on input and state, or it may be a stochastic process. We derive a stabilizing model predictive controller for SMPL systems with both deterministic and stochastic switching. In general, the optimization in the MPC algorithm boils down to a nonlinear optimization problem, where the cost criterion is piecewise polynomial on polyhedral sets and the inequality constraints are linear.

12:10-12:30 WeA03.6

Model Reduction for Switched Linear Discrete-Time Systems with Polytopic Uncertainties and Arbitrary Switching, pp. 7666-7671

Zhang, Lixian	Ec. Pol. de Montreal
Shi, Peng	Faculty of Advanced Tech.
Basin, Michael V.	Autonomous Univ. of Nuevo Leon

In this paper, the problem of H-infinity model reduction for switched linear discrete- time systems with polytopic uncertainties is investigated. A reduced-order switched model is constructed for a given robustly stable switched system, which has the same structural polytopic uncertainties as the original system such that the resulting error system is robustly asymptotically stable and an H1 error performance is guaranteed. A sufficient condition for the existence of the desired reduced-order model is derived and formulated in terms of a set of linear matrix inequalities. By solving the corresponding convex optimization problem in such existence condition, the vertex system of reduced-order model can be obtained, which also provides a suboptimal H-infinity gain for the error system between the original system and the reduced-order model. A numerical example is given to show the effectiveness and the potential of the proposed techniques.

WeA04 308
Nonlinear Pendulum Control (Regular Session)

Chair: Xin, Xin — Okayama Prefectural Univ.
Co-Chair: Gordillo, Francisco — Univ. de Sevilla

10:30-10:50 WeA04.1
Swing-Up Control Based on Virtually Composite Links for an N-Link Underactuated Robot with Passive First Joint, pp. 7672-7677

Xin, Xin — Okayama Prefectural Univ.
Kaneda, Masahiro — Okayama Prefectural Univ.
Yamasaki, Taiga — Okayama Prefectural Univ.
She, Jin-Hua — Tokyo Univ. of Tech.

This paper concerns a swing-up control problem for an n-link revolute robot in a vertical plane with its first joint being passive and the rest being active. The objectives of this paper are: 1) to design a controller under which the robot can be brought into any arbitrarily small neighborhood of the upright equilibrium point, where all links of the robot remain in their upright positions; 2) to attain a global analysis of the motion of the robot under the controller. To achieve the above challenging objectives, first, this paper addresses how to devise iteratively a series of virtually composite links for designing a coordinate transformation on the angles of all active joints. Second, this paper constructs a novel Lyapunov function based on the transformation, and proposes an energy based swing-up controller. Third, this paper carries out a global analysis of the motion of the robot under the controller, and establishes some conditions on control parameters for achieving the swing-up control objective. This paper provides insight into the energy or passivity based control to underactuated multi-degree-of-freedom systems.

10:50-11:10 WeA04.2
Passivity-Based Control of an Overhead Travelling Crane, pp. 7678-7683

Aschemann, Harald — Univ. of Rostock

In this paper, a passivity-based control scheme is proposed for the two main translational axes of an overhead crane to provide an active damping of crane load oscillations. The decentralised control structure consists of independent axis controllers, which are adapted to the varying rope length using gain-scheduling techniques. The tracking capabilities concerning desired trajectories for the crane load in the xy-plane can be improved by introducing feedforward control based on an inverse system model. Furthermore, a reduced-order disturbance observer is utilised for the compensation of nonlinear friction forces. The achieved control performance is shown by selected experimental results obtained from an implementation on a 5 t-overhead travelling crane.

11:10-11:30 WeA04.3
Backstepping Control of a High-Speed Linear Axis Driven by Pneumatic Muscles, pp. 7684-7689

Schindele, Dominik — Univ. of Rostock
Aschemann, Harald — Univ. of Rostock

This paper presents a backstepping control scheme for a new linear axis. Its guided carriage is driven by a nonlinear mechanism consisting of a rocker with a pair of pneumatic muscle actuators arranged at both sides. This innovative drive concept allows for an increased workspace as well as higher carriage velocities as compared to a direct actuation. Modelling leads to a system of nonlinear differential equations including polynomial approximations of the volume characteristic as well as the force characteristic of the pneumatic muscles. The proposed control has a cascade structure: The internal pressure of each pneumatic muscle is controlled by a fast underlying control loop, whereas in an outer control loop the carriage position and the mean internal pressure of the muscles are controlled. Remaining model uncertainties as well as nonlinear friction can be counteracted either by an observer-based disturbance compensation or an adaptive control strategy. Experimental results from an implementation on a test rig show a high control performance.

11:30-11:50 WeA04.4
Control of Mechanical Systems with Constraints: Two Pendulums Case Study, pp. 7690-7694

Ananyevskiy, Mikhail — Saint-Petersburg State Univ.
Fradkov, Alexander L. — Acad. of Sciences of Russia
Nijmeijer, Hendrik — Eindhoven Univ. of Tech.

A method for control of mechanical systems under phase constraints, applicable to energy control of Hamiltonian systems is proposed. The constrained energy control problem for two pendulums by a single control action is studied both analytically and numerically. It is shown that for a proper choice of penalty parameter of the algorithm any energy level for the one pendulum under any specified constraint on the energy of the other pendulum can be achieved. Simulation results confirm fast convergence rate of the algorithm.

11:50-12:10 WeA04.5
A Controller for Swinging-Up and Stabilizing the Inverted Pendulum, pp. 7695-7699

Aracil, Javier — Univ. de Sevilla
Acosta, José Ángel — Univ. de Sevilla
Gordillo, Francisco — Univ. de Sevilla

The hybrid solution to the pendulum swinging-up and stabilizing problem introduced by Ĺström and Furuta is based in two steps: an energy injection and a linear stabilization around the desired inverted position. However the energy injection stage only considers the pendulum, and not the motion of the pivot. Furthermore, for the stabilization stage linear law, only a very small basin of attraction can be guaranteed. In this paper the energy controller is enlarged to cope with the pivot dynamics and a nonlinear controller is introduced for the stabilization stage with a larger basin of attraction. The approach proposed allows to cope both with the pendulum on a cart and the Furuta one. Experiments with a laboratory Furuta pendulum are included.

12:10-12:30 WeA04.6
Interconnection and Damping Assignment Passivity--Based Control of the Pendubot, pp. 7700-7704

Sandoval, Jesus — Inst. Tecnologico de La Paz
Ortega, Romeo — LSS-SUPELEC
Kelly, Rafael — CICESE

In this paper, we apply the interconnection and damping assignment passivity--based control design technique to the underactuated mechanical system called pendubot. The proposed control system drives a class of pendubot systems to the upward configuration, starting from a neighborhood of this configuration. Simulation results show the performance of the proposed control system.

WeA05 307
Controller Constraints and Structure I (Regular Session)

Chair: Balemi, Silvano — SUPSI (Scuola Univ. Professionale della SvizzeraItaliana)
Co-Chair: Herrmann, Guido — Univ. of Bristol

10:30-10:50 WeA05.1
Wind Evaluation Breadboard Control Architecture, Dynamic Model and Performance, pp. 7705-7710

Viera Curbelo, Teodora Aleida — Inst. de Astrofisica de Canarias
Zuluaga, Pablo — Inst. de Astrofisica de Canarias
Reyes, Marcos — Inst. de Astrofisica de Canarias
Núńez, Miguel — Inst. de Astrofísica de Canarias
Castro Lopez-Tarruella, Fco. Javier — Gran Telescopio de Canarias

The WEB (Wind Evaluation Breadborad) for the European ELT (Extremely Large Telescope) Design Study is a primary mirror and telescope simulator formed by seven segments, including position sensors, electromechanical support systems and support structures. The purpose of the WEB is to study the effects of wind on the control of the positions of the segments. This paper describes the Control Architecture, the dynamic model generated based on the Finite Element Model and the performances achieved in simulations

10:50-11:10 WeA05.2
Complexity Reduction in Explicit MPC through Model Reduction, pp. 7711-7716

Hovland, Svein — Norwegian Univ. of Sci & Tech.

Gravdahl, Jan Tommy — Norwegian Univ. of Science & Tech.

In this paper we propose to use model reduction techniques to make explicit model predictive control possible and more attractive for a larger number of applications and for longer control horizons. The main drawback of explicit model predictive control is the large increase in controller complexity as the problem size increases. For this reason, the procedure is limited to applications with low-order models, a small number of constraints and/or short control horizons. The proposed use of model reduction techniques is demonstrated for several applications, among others for control of fuel cell breathing. In all applications, a significant reduction in controller complexity is achieved.

11:10-11:30 — WeA05.3

Coordinating Fuzzy Control of the Sintering Process, pp. 7717-7722

Xiang, Jie — Central South Univ.
Wu, Min — Central South Univ.
Duan, Ping — Central South Univ.
Cao, Weihua — Central South Univ.
He, Yong — Central South Univ.

The sintering process is an important step in the iron and steel making process and features strong complexity, nonlinearity and large time-delay. This paper presents a coordinating control method that two fuzzy controllers are designed to control the burning through point (BTP) and the bunker-level. First, the BTP control is the main control task with the sinter strand speed as the control variable, and a predictive fuzzy control scheme is developed where an intermediate process model is used to perform on-line controller design to meet a closed-loop performance specification that is associated with desired process output. Then, a fuzzy controller is designed to control the charging bunker-level via adjusting the strand speed. The two fuzzy controllers are proposed for these two closed-loops and it is shown that the satisfactory response of the closed-loop system can be achieved by handling the strand speed. Results of simulation and actual running illustrate the performance of the proposed method.

11:30-11:50 — WeA05.4

Partial-Order Reduction of Observers for Linear Systems, pp. 7723-7728

Balemi, Silvano — SUPSI (Scuola Univ. Professionale della Svizzera Italian

Full-state observers for linear systems use available measurements for the estimation of the entire state of a system. Reduced-order observers instead deliver an estimate only in the unmeasured state subspace while the state values in the measured subspace are taken directly from the measurements. This paper presents a combination of both types of observers which directly uses only part of the measured subspace and estimates/filters the rest of the state space. The order of this new observer is freely selectable between that of the full-state observer and of the reduced-order observer. A practical example demonstrates the validity of the new observer form. The results show that the performance of a state-feedback controller with the new observer is similar to that with the full-state observer.

11:50-12:10 — WeA05.5

Improving Sector-Based Results for Systems with Deadzone Nonlinearities, pp. 7729-7734

Turner, Matthew C. — Univ. of Leicester
Herrmann, Guido — Univ. of Bristol
Postlethwaite, Ian — the Univ. of Leicester

The conservatism of sector-based results for systems consisting of an interconnection of a linear-time-invariant (LTI) system and a static, sector-bounded nonlinearity is well known. Despite this, they are widely used in control system analysis and synthesis. This paper shows how, when the sector-bounded nonlinearity is a deadzone, standard sector based results can be modified to allow the synthesis of a nonlinear controller which can deliver improved performance over standard results. The appealing feature of the method is that, as the main part of the design is done using standard sector results, the computation associated with the improved controller is essentially the same as with the standard controller. An override control example is used to illustrate the potential of the results.

12:10-12:30 — WeA05.6

Damping Angular Oscillations of a Pendulum under State Constraints, pp. 7735-7742

Okanouchi, Satoru — Oshima National Coll. of Maritime Tech.
Yoshida, Kazunobu — Shimane Univ.
Matsumoto, Itaru — Yonago National Coll. of Tech.
Kawabe, Hisashi — Hiroshima Inst. of Tech.

This paper considers the problem of damping the oscillation of a plane pendulum by moving the pivot in the vertical plane and the weight along the rod of the pendulum, with limited amplitudes. Conditions for stability of the motion of the pendulum are derived using energy-based methods, and based on them energy-based controls satisfying the amplitude constraints are developed, which move the pivot and weight sinusoidally and achieve an excellent control performance by controlling the variables with constant amplitudes. When the oscillation of the pendulum becomes sufficiently small, each of the energy-based controls is taken over by a linear or saturating control, which also satisfies the amplitude constraint, to regulate the entire state of the system to the nominal point. The saturating control is used to move the pivot horizontally, which also effectively damps the residual oscillation of the pendulum. Numerical and experimental results are given to demonstrate the effectiveness of the proposed control laws.

WeA06 — 310A

Infinite Dimensional Systems: Distributed Parameter Systems

(Regular Session)

Chair: Werner, Herbert — Hamburg Univ. of Tech.
Co-Chair: Chen, YangQuan — Utah State Univ.

10:30-10:50 — WeA06.1

On the Accessibility of Distributed Parameter Systems, pp. 7743-7748

Rieger, Karl — Johannes Kepler Univ. of Linz
Schlacher, Kurt — Johannes Kepler Univ. of Linz
Schöberl, Markus — Johannes Kepler Univ. of Linz

This contribution is devoted to the accessibility analysis of distributed parameter systems. A formal system theoretical approach is proposed by means of differential geometry, which allows an intrinsic representation for the class of infinite dimensional systems. Beginning with the introduction of a convenient representation form, in particular, the accessibility along a trajectory is discussed generally. In addition, the derivation of (local) (non-)accessibility criteria via utilizing transformation groups is shown. In order to illustrate the developed theory the proposed method is applied to an example.

10:50-11:10 — WeA06.2

Sampled-Data Output Feedback Control of Distributed Parameter Systems Via Semi-Discretization in Space, pp. 7749-7754

Tan, Ying — The Univ. of Melbourne
Nesic, Dragan — Univ. of Melbourne

This paper provides sufficient conditions to stabilize a sampled-data linear distributed parameter system with finite-dimensional input and output via a family of finite-dimensional continuous-time approximations that are obtained from numerical schemes. This family of continuous-time finite-dimensional approximations can be exponentially stabilized by a family of output feedback controllers when the space discretization parameter h is sufficiently small. Sufficient conditions presented in this paper guarantee that the same family of output feedback controllers can exponentially stabilize the exact sampled-data linear distributed parameter system for a sufficiently small sampling period. Since the output feedback controller design is based on the family of finite-dimensional approximations which only require a standard finite-dimensional control theory, this result can simplify the design of controller for sampled-data infinite-dimensional systems when the sampling period is fast enough and those sufficient conditions are satisfied.

11:10-11:30 — WeA06.3

Controller Implementation for a Class of Spatially-Varying Distributed Parameter Systems, pp. 7755-7760

Candogan, Utku Ozan — MIT
Ozbay, Hitay — Bilkent Univ.
Ozaktas, Haldun M. — Bilkent Univ.

In this paper we discuss fast implementation of the model based centralized controllers using fractional Fourier transform for large scale plant models coming from spatial discretization of a certain type of linear spatially-varying distributed parameter systems. This fast implementation reduces the computational time delay significantly when the dimension of the system is higher than 512. Compared to direct implementation, the proposed method allows faster sampling. If the control design objectives are demanding fast closed loop modes, then slower sampling required by direct implementation leads to instability. The results are illustrated by an example.

11:30-11:50 WeA06.4

Distributed Control for a Class of Spatially Interconnected Discrete-Time Systems, pp. 7761-7766

Chughtai, Saulat Shuja — Tech. Univ. of Hamburg-Harburg
Werner, Herbert — Hamburg Univ. of Tech.

This paper considers the analysis and synthesis of a spatially distributed controller for discrete-time spatially interconnected parameter-varying system. The system under consideration has both discrete time and space dynamics. The concept of quadratic separators (Iwasaki and Shibata, 2001), (Chughtai and Werner, 2007) has been extended to compute a measure of worst-case performance for such systems by solving an LMI problem. The use of quadratic separator allows a systematic search for a parameter dependent Lyapunov function, thus resulting in less conservative controllers. The problem of synthesizing controllers leads to a nonlinear matrix inequality, and a hybrid evolutionary-LMI approach to solving this problem, based on LMI solvers and genetic algorithms, is proposed in this paper. A design example illustrates the efficiency of the proposed method.

11:50-12:10 WeA06.5

New Dilated LMIs to Synthesize Controllers for a Class of Spatially Interconnected Systems, pp. 7767-7771

Chughtai, Saulat Shuja — Tech. Univ. of Hamburg-Harburg
Werner, Herbert — Hamburg Univ. of Tech.

This paper presents sufficient conditions based on dilated LMIs to analyze and synthesize controllers that minimize the L_2-norm of the the closed-loop system for spatially varying interconnected polytopic systems. The approach presented here searches for a parameter dependent Lyapunov function (PDLF) by dilating the original LMIs. This dilation not only helps in the search for a PDLF but also introduces extra degrees of freedom which may result in further reduction of conservatism. Approaches to synthesize full-order polytopic controllers and reduced-order, reduced-structure controllers are also presented here.

12:10-12:30 WeA06.6

Resource-Constrained Sensor Routing for Parameter Estimation of Distributed Systems, pp. 7772-7777

Patan, Maciej — Univ. of Zielona Gora
Tricaud, Christophe — Utah State Univ.
Chen, YangQuan — Utah State Univ.

We consider a setting where mobile nodes with sensing capacity form a network whose mission is to collect measurements for parameter estimation of a distributed parameter system (DPS). Two techniques to optimize node motions are presented which constitute a trade- off between the achievable accuracy of parameter estimates and limited motion resources of sensor network nodes. The framework is based on the use of the D-optimality criterion defined on the Fisher information matrix associated with the estimated parameters as a measure of the information content in the measurements. Restrictions on maximal distances traveled by sensor nodes are imposed so as to guarantee realizable solutions. The approach is to convert the problem to a canonical optimal control one in Mayer form, in which both the control forces of the sensors and the initial sensor positions are optimized. Numerical solutions are then obtained using the Matlab PDE toolbox and the RIOTS_95 optimal control toolbox which handles various constraints imposed on the node motions. Illustrative numerical experiments with the proposed techniques are presented.

WeA07 310B

Optimal Control Theory I (Regular Session)

Chair: Colaneri, Patrizio — Pol. di Milano
Co-Chair: Logist, Filip — Katholieke Univ. Leuven

10:30-10:50 WeA07.1

Mitigation of Curse of Dimensionality in Dynamic Programming, pp. 7778-7783

Li, Duan — Chinese Univ. of Hong Kong
Wang, Qing — Chinese Univ. of Hong Kong
Wang, Jun — Qingdao Univ.
Yao, Yirong — Shanghai Univ.

Dynamic programming, one of the most powerful solution methodologies to achieve optimality for separable optimization problems, suffers heavily from the notorious ``curse of dimensionality'', which prevents its direct applications when the dimension of the state space is high. By aggregating multiple constraints into a single surrogate constraint, the surrogate constraint formulation offers an ideal platform for powerful utilization of dynamic programming, although often with a price of a presence of duality gap. In this paper, we propose a novel convergent dynamic programming algorithm by integrating a domain cut scheme with the surrogate constraint formulation, thus enabling elimination of the duality gap gradually in the solution process.

10:50-11:10 WeA07.2

Conjugation of Hamiltonian Systems in Optimal Control Problems, pp. 7784-7789

Krasovskii, Andrey — Inst. of Mathematics and Mechanics of Ural Branch ofRAS
Tarasyev, Alexander — Inst. of Mathematics and Mechanics of Ural Branch ofRAS

The optimal control problem with a functional given by an improper integral is considered for models of economic growth. Properties of concavity of the maximized Hamiltonian are examined and analysis of Hamiltonian systems in the Pontryagin maximum principle is implemented including estimation of steady states and conjugation of domains with different Hamiltonian dynamics. On the basis of this analysis an algorithm is proposed for construction of optimal trajectories by sewing dynamics of Hamiltonian systems. The proposed algorithm is illustrated by computer simulations of optimal trajectories in models of economic growth for real macroeconomic data.

11:10-11:30 WeA07.3

A Switched MPC Approach to Hierarchical Control, pp. 7790-7795

Scattolini, Riccardo — Pol. di Milano
Colaneri, Patrizio — Pol. di Milano
De Vito, Daniele — Pol. di Milano

This paper deals with the problem of designing stable hierarchical control schemes within a Model Predictive Control (MPC) framework. Specifically, the considered control structure is composed by two layers. At the upper level, a switched robust MPC regulator is designed to define, in a slow time scale, the subset of actuators to be activated in the next sampling interval as well as to compute the required control actions they must provide. At the lower level, the selected actuators are controlled through an MPC strategy in order to account for hard control and state constraints. The discrepancy between the control actions required by the system at the upper level and those effectively provided by the systems at the lower level is tolerated in view of the robustness properties guaranteed by the MPC law adopted at the upper level.

11:30-11:50 WeA07.4

Possibilities of the Cross-Entropy Method Usage in the Control Theory, pp. 7796-7801

Tahirovic, Adnan — Univ. of Sarajevo, Pol. di Milano
Lacevic, Bakir — Univ. of Sarajevo

This paper deals with the Cross-Entropy method application in the control theory. The method is a the combinatorial optimization technique that is mostly used in the networks theory and could be used in deterministic optimization problems as well. The paper shows the possibiliy of the Cross-Entropy usage in the control parameter tuning. Similar to genetics algorithms, this method minimizes a given performance function in order to find optimal parameters. The appropirate conclusions about relability and the convergence rate of the method were experimentaly supported. The first two experiments used PI controller with different performance functions, where the optimal controller values have been obtained through the simulation. The third experiment used LQR controller to control a complex system. The tunining of four parameters of a LQR control matrix and obtained values were compared with the ones generated by LQR algorithm.

11:50-12:10 WeA07.5

Efficiently Solving Multiple Objective Optimal Control Problems, pp. 7802-7807

Logist, Filip — Katholieke Univ. Leuven

Van Erdeghem, Peter M.M. — KU Leuven
Smets, Ilse — Biotec - Bioprocess Tech. And Control
Van Impe, Jan F.M. — Katholieke Univ. Leuven

This paper discusses an improved method for solving multiple objective optimal control (MOOC) problems, and efficiently obtaining the set of Pareto optimal solutions. A general MOOC procedure has been introduced in Logist et al. (2007b}, to derive optimal generic temperature profiles for a steady-state tubular plug flow reactor. This procedure is based on a weighted sum of the different costs, and combines analytical and numerical optimal control techniques. By varying the weights, the exact Pareto set has been obtained. However, it is known for the weighted sum approach that a uniform variation of the weights, not necessarily leads to an even spread on the Pareto front (and thus an accurate representation). In addition, the analytical derivations in the proposed procedure become intractable for large-scale systems. Therefore, this paper introduces two modifications: the use of (i) the normal constraint method (Messac and Mattson, 2004) instead of the weighted sum, and (ii) piecewise linear approximations instead of the analytical relations. Two examples, i.e., (i) a classic minimum time, minimum control effort problem, and (ii) a more real-life determination of optimal temperature profiles for tubular reactors, illustrate the enhanced performance and the general applicability of the procedure.

F. Logist, P. Van Erdeghem, I.Y. Smets, and J.F. Van Impe. Multiple-objective optimisation of a jacketed tubular reactor. In Procs of the European Control Conference, pages 963-970, 2007b.

A. Messac and C.A. Mattson. Normal constraint method with garantee of even representation of complete Pareto frontier. AIAA Journal, 42(10): 2101-2111, 2004.

12:10-12:30 — WeA07.6

Optimal Control of Switched Systems: A Polynomial Approach, pp. 7808-7813

Mojica Nava, Eduardo — Ec. des Mines de Nantes
Meziat, Rene — Univ. of Los Andes
Quijano, Nicanor — The Ohio State Univ.
Gauthier, Alain — Univ. de los Andes
Rakoto-Ravalontsalama, Naly — Ec. des Mines de Nantes

A polynomial approach to solve the optimal control problem of switched systems is presented. It is shown that the representation of the original switched problem into a continuous polynomial systems allow us to use the method of moments. With this method and from a theoretical point of view, we provide necessary and sufficient conditions for the existence of minimizer by using particular features of the minimizer of its relaxed, convex formulation. Even in the absence of classical minimizers of the switched system, the solution of its relaxed formulation provide minimizers.

WeA08 — 310C

Optimization Based Controller Synthesis I (Regular Session)

Chair: Sugie, Toshiharu — Kyoto Univ.
Co-Chair: Dumur, Didier — Ec. Superieure d'Electricite

10:30-10:50 — WeA08.1

Systematic Design of Optimal Performance Weight and Controller in Mixed-Ľ; Synthesis., pp. 7814-7819

Pettazzi, Lorenzo — Univ. of Bremen
Lanzon, Alexander — Univ. of Manchester

In this paper we investigate the problem of synthesizing a controller that maximizes the level of robust performance for a plant subject to both complex and real uncertainties. The technique here developed uses the mixed-Ľ; synthesis approach but, unlike the classical D,G-K iteration, it maximizes the size of the performance weights that in the H-infinity framework capture desired closed loop performance. This optimization is restricted by the constraint that there exists an internally stabilizing controller that achieves robust performance with respect to the maximized weights. Thus, performance weights and a controller that achieves an optimized level of robust performance are synthesized together in a systematic way. The designer is only required to specify the plant uncertain set and some frequency dependent functions, dubbed optimization directionalities, that reflect, in a qualitative way, the desired performance requirements. It is pointed out that choosing this directionality function is much easier than choosing the performance weights directly so that the design of good performance weights is greatly simplified.

10:50-11:10 — WeA08.2

Nonsmooth Frequency Shaping Control Design with an Application, pp. 7820-7825

Simőes, Alberto — ONERA-CERT
Apkarian, Pierre — UPS
Noll, Dominikus — UPS

Performance criteria of great practical interest in classical controller design are often expressed as constraints on specific frequency bands. This leads to a difficult design problem due to its inherent nonsmoothness and nonconvexity. In this paper, we present a rigorous approach based on constrained mathematical programming. The efficiency of our design technique is demonstrated with the practically difficult control of an uncertain flexible structure.

11:10-11:30 — WeA08.3

Robust Pole Placement Via Reflection Axes Polytopes, pp. 7826-7831

Nurges, Ulo — Tallinn Univ. of Tech.
Rustern, Ennu — Head of The Inst.

A robust version of the output controller design for discrete-time systems is introduced. Instead of a single stable point a stable polytope is preselected in the closed loop characteristic polynomial coefficient space. A constructive procedure for generating stable polytopes is given starting from the unit hypercube of reflection coefficients of monic polynomials. This procedure is quite straightforward because for a special family of polynomials the linear cover of so-called reflection vectors is stable. The roots placement of reflection vectors is studied. A stability measure in a polytope is introduced in order to solve the problem by quadratic programming approach.

11:30-11:50 — WeA08.4

Off-Line Robustification of Model Predictive Control for Uncertain Multivariable Systems, pp. 7832-7837

Stoica, Cristina Nicoleta — Supelec
Rodriguez-Ayerbe, Pedro — Supelec
Dumur, Didier — Ec. Superieure d'Electricite

This paper proposes an off-line state-space control methodology for enhancing the robustness of multivariable Model Predictive Control (MPC) through the convex optimization of the Youla parameter. The Youla parameter-based optimization strategy allows convex specifications in closed-loop representation, focusing on the robustification of an initial controller using LMIs (Linear Matrix Inequalities) techniques. It is well established that such kind of robustification improves among others robustness towards unstructured uncertainties, however modifying the robustness of the initial controller towards system polytopic uncertainties. On the other hand, these polytopic uncertainties are not straightforward to deal with, imposing non-convex specifications in the Youla parameter. To overcome these difficulties, a novel structure is presented, including an additional convex condition on the Youla parameter to preserve robustness of the initial controller towards system polytopic uncertainties while managing the compromise with robust stability under unstructured uncertainties for the nominal controlled system. The potential of the developed robustified multivariable MPC controller is further illustrated in simulation on a stirred tank reactor.

11:50-12:10 — WeA08.5

A Gradient Method for the Static Output Feedback Mixed H2/H-Infinity Control, pp. 7838-7842

Kami, Yasushi — Akashi National Coll. of Tech.
Nobuyama, Eitaku — Kyushu Inst. of Tech.

This paper is concerned with the mixed H2/H-infinity control problem via static output feedback control. The main purpose of this paper is to give an iterative method for finding a sub-optimal static output-feedback controller

for the mixed H2/H-infinity control problem. The contribution of this paper is to derive a gradient of the H2 cost function. Using this gradient, we propose a gradient method for H2 and mixed H2/H-infinity control problems. Numerical examples show the efficiency of our methods.

12:10-12:30 — WeA08.6

Synthesis of Fixed-Structure H-Infinity Controllers Via Constrained Particle Swarm Optimization, pp. 7843-7848

Maruta, Ichiro — Kyoto Univ.
Kim, Tae-Hyoung — Japan Science and Tech. Agency
Sugie, Toshiharu — Kyoto Univ.

This paper provides a design method of fixed-structure robust controllers satisfying multiple H-infinity norm specifications by using a sort of randomized algorithms. First, a new tool to perform general constrained optimization is developed which does not need any gradient or derivative of the objective function. This tool is based on PSO (particle swarm optimization), which attracts a lot of attention recently in the evolutionary computation area due to its empirical evidence of its superiority in solving various non-convex problems. Second, it is shown how to design a fixed-structure controller satisfying given multiple H-infinity specifications by using the developed optimization tool. Third, its effectiveness is evaluated through various numerical examples, because it is difficult to guarantee the performance of the proposed method theoretically due to a probabilistic nature of the PSO. The simulation results demonstrate its effectiveness clearly.

WeA09 311C
Hammerstein-Wiener System Identification (Invited Session)

Chair: Giri, Fouad — GREYC - Univ. de Caen
Co-Chair: Rodellar, Jose — Tech. Univ. of Catalonia
Organizer: Giri, Fouad — GREYC - Univ. de Caen
Organizer: Ikhouane, Faycal — Univ. Pol. de Catalunya

10:30-11:10 WeA09.1
Nonlinear System Identification under Various Prior Knowledge (I), pp. 7849-7858

Z;liwiD;ski, PrzemysB;aw — WrocB;aw Univ. of Tech.
Hasiewicz, Zygmunt — Wroclaw Univ. of Tech.
Mzyk, Grzegorz — Wroclaw Univ. of Tech.

In the note the class of block-oriented dynamic nonlinear systems is considered, in particular, Hammerstein and Wiener systems are investigated. Several algorithms for nonlinear system identification are presented. The algorithms exploit various degrees of prior knowledge - from parametric - to nonparametric. Eventually, a semiparametric algorithm, which shares advantages of both approaches is announced.

11:10-11:30 WeA09.2
Hammerstien Systems Identification in Presence of Hysteresis-Backlash Nonlinearity (I), pp. 7859-7864

Giri, Fouad — GREYC - Univ. de Caen
Rochdi, Youssef — Ec. D'INGENIEURS MOHAMMEDIA RABAT
Elayan, Elamari — Univ. of Caen
Chaoui, Fatima-Zahra — ENSET
Brouri, Adil — EMI

The identification of Hammerstein systems is discussed for the systems that include memory nonlinearities. The focus is made on nonlinearities of the hysteresis-backlash type. The linear subsystem and the nonlinear element are identified separately. The identification of the former is dealt with combining an appropriate system parametrization and a specific input signal. The latter is designed so that it provides persistent excitation and makes the internal signal measurable in the considered parametrization. When the model of linear subsystem becomes available, the determination of the nonlinear element turns out to be easier. This is coped with using two appropriate parameterizations and specific input signals. The whole identification method is shown to be consistent.

11:30-11:50 WeA09.3
Nonparametric Identification of the Nonlinear Element in Wiener Systems (I), pp. 7865-7870

Rochdi, Youssef — Ec. D'INGENIEURS MOHAMMEDIA RABAT
Chaoui, Fatima-Zahra — ENSET
Giri, Fouad — GREYC - Univ. de Caen
Brouri, Adil — EMI
Boulal, Anis — Univ. MOHAMED V EMI RABAT

We are considering the problem of identifying Wiener systems that includes memoryless nonlinearities. The focus is made on the determination of the system nonlinearity which is not necessarily invertible, smooth or parametric. To this end, a frequency approach is developed, that investigates the system output extrema. In the case where the nonlinearity is strictly monotonic, a simple experiment is performed involving the application of a sine signal. In the general case, such an experiment is repeated a few times with different amplitudes.

11:50-12:10 WeA09.4
Adaptive Tracking and Recursive Identification for a Class of Hammerstein Systems (I), pp. 7871-7876

Zhao, Wenxiao — Acad. of Mathematics and Systems Science, ChineseAcedemyof S
Chen, Han Fu — AMSS, Chinese Acad. of Sciences

In this work, a weighted least squares (WLS) based adaptive tracker is designed for a class of Hammerstein systems. Incorporating with the diminishing excitation technique, the proposed adaptive tracker leads to the minimality of the tracking errors and strong consistency of the estimates for the unknown system parameters. A numerical example is given and the simulation results are consistent with the theoretical analysis.

12:10-12:30 WeA09.5
Identification of a Magnetorheological Damper: Theory and Experiments (I), pp. 7877-7882

Rodriguez Tsouroudkdissian, Arturo — Univ. Pol. de Catalunya (UPC)
Ikhouane, Faycal — Univ. Pol. de Catalunya
Rodellar, Jose — Tech. Univ. of Catalonia
Luo, Ningsu — Univ. of Girona

Magnetorheological (MR) dampers are promising devices for vibration mitigation in structures due to their low cost, energy efficiency and fast response. To use these dampers efficiently it is necessary to have models that describe their behavior with a sufficient precision. However, a precise modeling of these devices using the laws of physics is an arduous task so that semi-physical models are used instead to describe their behavior. Two of these models are explored in this paper: a normalized version of the Bouc-Wen model and the Dahl friction model. A methodology for identification is proposed, and the obtained models are tested and validated experimentally.

WeA10 311B
Fault Detection I (Regular Session)

Chair: Jämsä-Jounela, Sirkka-Liisa — Helsinki Univ. of Tech.
Co-Chair: Aaslund, Jan — Linköping Univ.

10:30-10:50 WeA10.1
On Threshold Optimization in Fault Tolerant Systems, pp. 7883-7888

Gustafsson, Fredrik — Linköping Univ.
Nielsen, Lars — Linköping Univ.
Frisk, Erik — Linkoping Univ.
Krysander, Mattias — Linköping Univ.
Aaslund, Jan — Linköping Univ.

Fault tolerant systems are considered, where a nominal system is monitored by a fault detection algorithm, and the nominal system is switched to a backup system in case of a detected fault. Conventional fault detection is in the classical setting a trade-off between detection probability and false alarm probability. For the considered fault tolerant system, a system failure occurs either when the nominal system gets a fault that is not detected, or when the fault detector signals an alarm and the backup system breaks down. This means that the trade-off for threshold setting is different and depends on the overall conditions, and the characterization and understanding of this trade-off is important. It is shown that the probability of system failure can be expressed in a general form based on the probability of false alarm and detection power, and based on this form the influence ratio is introduced. This ratio includes all information about the supervised system and the backup system that is needed for the threshold optimization problem. It is shown that the influence ratio has a geometrical interpretation as the gradient of the receiver operating characteristics (ROC) curve at the optimal point, and furthermore, it is the threshold for the optimal test quantity in important cases.

10:50-11:10 WeA10.2
Reconstruction-Based Contribution for Process Monitoring, pp. 7889-7894

Alcala, Carlos — Univ. of Southern California
Qin, S. Joe — Univ. of Southern California

This paper presents a new method to perform fault diagnosis for data-correlation based process monitoring. As alternative to the traditional contribution plot method, reconstruction-based contribution of fault detection indices is proposed. The monitored indices are *SPE*, T^2 and a combined index . The lack of diagnosability of traditional contributions is analyzed for the case of single sensor faults with large fault magnitudes, whereas for the same case the proposed reconstruction-based contributions guarantee correct diagnosis. Monte Carlo simulation results are provided for the case of modest fault magnitudes by randomly assigning fault sensors and fault magnitudes.

11:10-11:30 WeA10.3

Sensor Placement for Fault Isolation in Linear Differential-Algebraic Systems, pp. 7895-7900

Krysander, Mattias	Linköping Univ.
Frisk, Erik	Linkoping Univ.
Aaslund, Jan	Linköping Univ.

An algorithm is proposed for computing which sensor additions that make a diagnosis requirement specification regarding fault detectability and isolability attainable for a given linear differential-algebraic model. Restrictions on possible sensor locations can be given and if the diagnosis specification is not attainable with any available sensor addition, the algorithm provides the solutions that maximize specification fulfillment. Previous approaches with similar objectives have been based on the model structure only. Since the proposed algorithm utilizes the analytical expressions, it can handle models where structural approaches fail. A Mathematica implementation of the algorithm can be downloaded from http://www.fs.isy.liu.se/Software/LinSensPlaceTool/.

11:30-11:50 WeA10.4

On Fault Detection under Soft Computing Model Uncertainty, pp. 7901-7906

Korbicz, Jozef	Univ. of Zielona Gora
Witczak, Marcin	Univ. of Zielona Gora

The paper deals with the problems of robust fault detection using soft computing techniques, in particular neural networks (Group Method of Data Handling, GMDH); multi-layer perceptron), and neuro-fuzzy networks (Takagi-Sugeno model). The model based approach to Fault Detection and Isolation (FDI) is considered. The main objective is to show how to employ the bounded-error approach to determine the uncertainty of the neural and fuzzy models. It is shown that based on soft computing models uncertainty defined as a confidence range for the model output, the adaptive thresholds can be defined. Finally, the presented approaches are tested on the servoactuator being a FDI benchmark in the DAMADICS project.

11:50-12:10 WeA10.5

Observer-Based Residual Generation for Linear Differential-Algebraic Equation Systems, pp. 7907-7912

Svärd, Carl	Linköping Univ.
Nyberg, Mattias	Linkoping Univ.

Residual generation for linear differential-algebraic systems is considered. A new systematic method for observer-based residual generation is presented. The proposed design method places no restrictions on the system to be diagnosed. If the fault of interest can be detected in the system, the output from the design method is a residual generator in state-space form that is sensitive to the fault of interest. The method is iterative and relies only on constant matrix operations such as multiplications, null-space calculations and equivalence transformations, and thereby straightforward to implement. An illustrative numerical example is included, where the design method is applied to a non-observable model of a robot manipulator.

12:10-12:30 WeA10.6

Leak Detection in Open Water Channels, pp. 7913-7918

Weyer, Erik	Univ. of Melbourne
Bastin, Georges	Univ. Catholique de Louvain

In this paper we present a simple cumulative sum algorithm for detection of leaks in open water channels. The algorithm compares the observed changes in water levels against the known in- and out-flows and raises an alarm if they are not in agreement. The algorithm is tested on data from an irrigation channel with very good results. Leaks are quickly detected and the algorithm is robust against uncertainty in the model parameters.

WeA11 311A

Nonlinear Adaptive Control I (Regular Session)

Chair: Ikonen, Enso	Univ. of Oulu
Co-Chair: Wang, Haiqing	Univ. of Duisburg-Essen

10:30-10:50 WeA11.1

Adaptive Process Control Using Controlled Finite Markov Chains Based on Multiple Models, pp. 7919-7924

Ikonen, Enso	Univ. of Oulu
Kortela, Urpo	Univ. of Oulu

Controlled finite Markov chain (CFMC) approach can deal with a large variety of signals and systems with multivariable, non-linear and stochastic nature. In this paper, adaptive control based on multiple models is considered. For a set of candidate plant models, CFMC models (and controllers) are constructed off-line. The state transitions predicted by the CFMC models are compared with frequentist information obtained from on-line data. The best model (and controller) is chosen based on the Kullback–Leibler distance. This approach to adaptive control emphasizes the use of physical models as the basis of reliable plant identification. Three series of simulations are conducted: to examine the performance of the developed Matlab-tools; to illustrate the approach in the control of a non-linear non-minimum phase van der Vusse CSTR plant; and to examine the suggested model selection method for the adaptive control.

10:50-11:10 WeA11.2

Adaptive Fuzzy Control Based on Fuzzy Neural Network for Uncertain Nonlinear Systems, pp. 7925-7930

Huang, Ying J.	Yuan Ze Univ.
Kuo, Tzu-Chun	Ching Yun Univ.

In this paper, an adaptive fuzzy controller based on fuzzy neural network is proposed for uncertain nonlinear systems. The main advantages are the simple design, no requirement of system model, and release of fixed universal range of fuzzy output. A fuzzy neural network is applied to on-line identify the control system and provide sufficient information of the adaptive laws for the proposed fuzzy controller. Finally, experimental results of a two-link robotic arm are given to verify the effectiveness of the proposed approach.

11:10-11:30 WeA11.3

Correction for Non-Identical Units in Multi-Unit Optimization, pp. 7931-7936

Woodward, Lyne	École Pol. de Montréal
Perrier, Michel	Ec. Pol.
Srinivasan, B.	Ec. Pol. Montreal

Extremum-seeking control is a class of methods where real-time static optimization of a dynamic system is achieved by controlling the gradient. Estimation of the gradient is a key issue in extremum-seeking methods. In multi-unit optimization, the gradient is obtained using finite difference of the outputs of multiple identical units driven with inputs that are offset by a design parameter. However, if the units are not identical, the stability of such a scheme is in question and the point where the scheme converges could be far from the desired optimum. This paper proposes correctors to compensate for the differences between the units. It is shown that the scheme with correctors is locally asymptotically stable and converges to the desired optimum for all the units. The multi-unit optimization method with correctors is applied to bioreactors producing green fluorescent protein.

11:30-11:50 WeA11.4

Adaptive Control of a Class of Nonlinear Discrete-Time Systems with Online Kernel Learning, pp. 7937-7942

Gao, Yanchen	Qingdao Mesnac Co., LTD.
Liu, Yi	Zhejiang Univ.
Wang, Haiqing	Zhejiang Univ.
Li, Ping	Zhejiang Univ.

An Online Kernel Learning based Adaptive Control (OKL-AC) framework for discrete-time affine nonlinear systems is presented in this paper. A sparsity strategy is proposed to control the complexity of OKL identification model, meanwhile to make a trade-off between the demanded tracking precision and the complexity of the control law. The forward increasing and backward decreasing learning stages are performed, both incorporating efficient recursive updating algorithms. Owing to these advantages, the adaptive control law based on the OKL identification model is easily obtained and can be efficiently updated. Numerical simulations show that the proposed simple OKL-AC strategy has satisfactory performance, including good tracking performance and fast learning ability, in both deterministic and stochastic environments.

11:50-12:10 WeA11.5

Dynamic Feedback Tracking Control of Nonholonomic Mobile Robots with Unknown Camera Parameters, pp. 7943-7948

Wang, Chaoli — The Univ. of Shanghai For Science and Tech. 200031
Liao, Qinwu — Univ. of Shanghai for Science and Tech.
Mei, Yingchun — Univ. of Shanghai for Science and Tech. , 200093, Chi

This paper investigated the tracking control of nonholonomic mobile robots with uncertainties. Nonholonomic kinematic systems with visual feedback are uncertain and more involved in comparison with common kinematic systems. Barbalat theorem and Lyapunov techniques were exploited to craft a dynamic feedback robust controller that enables the mobile robot configuration tracking despite the lack of depth information and the lack of precise visual parameters. The most interesting feature of this paper is that the problem was discussed in the image frame and the inertial frame, which made the problem easy and useful. The convergence of the error system by using the proposed method was rigorously proved. The simulation was given to show the effectiveness of the presented controllers.

12:10-12:30 WeA11.6

A Finite Step Scheme for General Near-Optimal Control –the Deterministic Case, pp. 7949-7954

Jiang, Danchi — Univ. of Tasmania

This paper reports a finite step scheme for the computation of near-optimal control of general nonlinear control systems. It is developed based on the first order estimation of the system and the associated adjoint variational equation. The search is an extension of the standard steepest descent method to the functional case based on the variation of the Hamiltonian function H. Convergence analysis are included to show this scheme does converge to a desired admissible control in finite steps. Consistency of the approximation of the associated adjoint equation is also discussed. A linear quadratic control example and some numerical simulations are also included for illustrative purpose.

WeA12 313

Hybrid Systems Modeling (Regular Session)

Chair: Mosterman, Pieter — The MathWorks, Inc.
Co-Chair: Camlibel, Kanat — Univ. of Groningen

10:30-10:50 WeA12.1

Stream and State-Based Semantics of Hierarchy in Block Diagrams, pp. 7955-7960

Denckla, Ben — -
Mosterman, Pieter — The MathWorks, Inc.

Block diagrams are often used in embedded system design for modeling both plant and controller, typically with continuous and discrete modeling, respectively. Though easy to use, advanced users and implementers of these languages often run afoul of subtle semantic problems these seemingly simple languages can have. Based on the stream- and state-based approaches, this paper discusses how the specialized state-based semantics of continuous-time block diagrams can interoperate hierarchichally with discrete-time block diagrams. The languages presented may serve as a reference of sorts, helping to clarify some of the underlying choices in block diagram language design, and in the process shedding light on the differences between and limitations of existing block diagram languages.

10:50-11:10 WeA12.2

Combinatorial Vector Fields for Piecewise Affine Control Systems, pp. 7961-7966

Wisniewski, Rafal — Aalborg Univ.
Larsen, Jesper Abildgaard — Aalborg Univ.

This paper is intended to be a continuation of Habets and van Schuppen (2004) and Habets, Collins and van Schuppen (2006), which address the control problem for piecewise-affine systems on an arbitrary polytope or a family of these. Our work deals with the underlying combinatorics of the underlying discrete system. Motivated by Forman (1998), on the triangulated state space we define a combinatorial vector field, which indicates for a given face the future simplex. In the suggested definition we allow nondeterminacy in form of splitting and merging of solution trajectories. The combinatorial vector field gives rise to combinatorial counterparts of the flow lines. The main result is then an algorithm for synthesis of supervisory control.

11:10-11:30 WeA12.3

Zero-Crossing Location and Detection Algorithms for Hybrid System Simulation, pp. 7967-7972

Zhang, Fu — The Mathworks
Yeddanapudi, Murali — The Mathworks, Inc
Mosterman, Pieter — The MathWorks, Inc.

Abstract: Computational models of embedded control systems often combine continuous-time with discrete-event behavior, mathematically representing hybrid dynamic systems. An essential element of numerical simulation of a hybrid dynamic system is the generation of discrete events from continuous variables that exceed thresholds. In particular, the occurrence of such an event has to be detected and the point in time where the threshold is first exceeded has to be located. This paper presents a number of problems that are encountered in event detection and location when using existing techniques. Solution strategies that balance efficiency and robustness are presented to address: (i) repeated detection of a zero-crossing event at consecutive time steps, (ii) masked zero-crossing events because of multiple zero-crossing functions, and (iii) chattering and Zeno behavior.

Keywords: Zero crossings, Hybrid system, Zeno system, Simulation

11:30-11:50 WeA12.4

Well-Posed Bimodal Piecewise Linear Systems Do Not Exhibit Zeno Behavior, pp. 7973-7978

Camlibel, Kanat — Univ. of Groningen

The phenomenon of infinitely mode transitions in a finite time interval is called Zeno behavior in hybrid systems literature. It plays a critical role in the study of numerical methods and fundamental system and control theoretic properties of hybrid systems. This paper studies Zeno behavior for bimodal piecewise linear systems with possibly discontinuous dynamics. Our treatment is inspired by the work of Imura and Van der Schaft on the well-posedness of the same type of systems. The main contribution of the paper is two folded. Firstly, we show that Imura-Van der Schaft conditions for well-posedness guarantee that Filippov solutions have certain local properties. Secondly, we employ these in order to prove that bimodal piecewise linear systems do not exhibit Zeno behavior.

11:50-12:10 WeA12.5

Concrete Syntax and Semantics of the Compositional Interchange Format for Hybrid Systems, pp. 7979-7986

Van Beek, D.A. (Bert) — Eindhoven Univ. of Tech.
Reniers, Michel — TU/e
Rooda, J.E. — Eindhoven Univ. of Tech.
Schiffelers, Ramon R.H. — Eindhoven Univ. of Tech.

The compositional interchange format for hybrid systems is syntactically and semantically defined in terms of an interchange automaton in an abstract format, allowing among others differential algebraic equations, variables that can be internal or external, operators for parallel composition, action hiding, variable hiding and urgent actions, synchronization by means of shared labels, and communication by means of shared variables and CSP channels. A concrete format is defined for modeling. Its semantics is defined in terms of a mapping to the abstract format. The concrete format adds inputs, outputs and open and closed scopes to enable modular and hierarchical specifications. The concrete format is illustrated by means of a bottle filling line example.

12:10-12:30 WeA12.6

Harmonic Analysis of Pulse-Width Modulated Systems, pp. 7987-7993

Almer, Stefan — Royal Inst. of Tech.
Jonsson, Ulf T. — Royal Inst. of Tech.

The paper considers the so-called dynamic phasor model as a basis for harmonic analysis of a class of switching systems. The dynamic phasor model is a powerful tool for exploring cyclic properties of dynamic systems. It is shown that there is a connection between the dynamic phasor model and the harmonic transfer function of a linear time periodic system and this connection is used to extend the

notion of harmonic transfer function to describe periodic solutions of non-periodic systems.

WeA13 314
Stochastic Control (Regular Session)

Chair: Do Val, Joao B.R. UNICAMP - FEEC
Co-Chair: Zhang, Hui Zhejiang Univ.

10:30-10:50 WeA13.1

On Statistical Control of Stochastic Servo-Systems: Performance-Measure Statistics and State-Feedback Paradigm, pp. 7994-8000

Pham, Khanh D. AIR FORCE Res. Lab.

This paper provides a concise and up-to-date analysis of the foundations of performance robustness of a linear-quadratic class of servo-systems with respect to variability in a stochastic environment. The dynamics of servo-systems are corrupted by a standard stationary Wiener process and include input functions that are controlled by controllers. Basic assumptions will be that controllers have access to the current value of the states of the systems and would like to learn about performance uncertainty of the systems that is now affected by other noncooperative learners, i.e. model deviations and environmental disturbances named Nature. The controller considered here optimizes a multi-objective criterion over time where optimization takes place with high regard for possible random sample realizations by Nature who may more likely not be acting in concert. It is found that the optimal servo in the finite horizon case is a novel two-degrees-of-freedom controller with: one, a feedback controller with state measurements that is robust against performance uncertainty; two, a model-following controller that minimizes the difference between the reference model and the system outputs.

10:50-11:10 WeA13.2

A Formula for the Optimal Cost in the General Discrete-Time LEQG Problem, pp. 8001-8008

Ainikkal, Shaiju Johny UNSW@ADFA
Petersen, Ian Richard Univ. of New South Wales - ADFA

This paper is aimed at deriving an explicit formula for the optimal cost for the discrete-time linear exponential-of-quadratic Gaussian (LEQG) control problem. The paper considers the general case with cross terms in the cost and noise covariance matrices. The result is applicable to discrete time minimax LQG and state estimation problems.

11:10-11:30 WeA13.3

Stochastic Optimal Control Based on Value-Function Approximation Using Sinc Interpolation, pp. 8009-8014

Weissel, Florian Univ. Karlsruhe (TH)
Huber, Marco F. Univ. Karlsruhe (TH)
Brunn, Dietrich Univ. Karlsruhe
Hanebeck, Uwe Univ. Karlsruhe

An efficient approach for solving stochastic optimal control problems is to employ dynamic programming (DP). For continuous-valued nonlinear systems, the corresponding DP recursion generally cannot be solved in closed form. Thus, a typical approach is to discretize the DP value functions in order to be able to carry out the calculation. Especially for multidimensional systems, either a large number of discretization points is necessary or the quality of approximation degrades. This problem can be alleviated by interpolating the discretized value function. In this paper, we present an approach based on optimal low-pass interpolation employing sinc functions (sine cardinal). For the important case of systems with Gaussian mixture noise (including the special case of Gaussian noise), we show how the calculations required for this approach, especially the nontrivial calculation of an expected value of a Gaussian mixture random variable transformed by a sinc function, can be carried out analytically. We illustrate the effectiveness of the proposed interpolation scheme by an example from the field of Stochastic Nonlinear Model Predictive Control (SNMPC).

11:30-11:50 WeA13.4

Improved Convergence Rate for a Recursive Procedure in a Production and Storage Problem, pp. 8015-8020

Salles, José Leandro Félix Federal Univ. of Espírito Santo
Do Val, Joao B.R. UNICAMP - FEEC

We study a stochastic optimal impulse control problem which arises in a production and storage system involving identical items and stochastic demand. The problem is posed in the class of piecewise deterministic Markov process and it can be solved by two successive approximation methods. The first uses an uniformly contraction operator that has identical end costs at demand arrival time and at completion of an item time. The other method proposed in this work uses an extension of this operator with different end costs at these times. We show that the second method yields a recursive procedure with faster convergence rate.

11:50-12:10 WeA13.5

Epsilon-Entropy and H_infinity Entropy in Continuous Time Systems, pp. 8021-8026

Zhang, Hui Zhejiang Univ.
Sun, Youxian Zhejiang Univ.

Based on the analysis of epsilon-entropy, information in continuous time linear multivariable stochastic systems is discussed. To describe time average information variation after a process transmitted through a continuous time system, the concept of system variety defined by the difference between epsilon-entropy rates of system input and output is proposed. Furthermore, an equivalent relation between system variety and the H_infinity entropy, an auxiliary performance index in H_infinity control theory, is derived by using spectral factorization. This connection gives information theoretic interpretation to H_infinity entropy, and provides new potential method to analyze and design continuous time stochastic systems.

12:10-12:30 WeA13.6

A Carleman Approximation Scheme for a Stochastic Optimal Control Problem in the Continuous-Time Framework, pp. 8027-8032

Mavelli, Gabriella Consiglio Nazionale Delle Ricerche
Palumbo, Pasquale IASI-CNR

The paper investigates the optimal control problem for a stochastic linear differential system, driven by a persistent disturbance generated by a nonlinear stochastic exogenous system. The assumption of incomplete information has been assumed, that is neither the state of the system, nor the state of the exosystem are directly measurable. The standard quadratic cost functional has been considered. The approach followed consists of applying the Carleman approximation scheme to the exosystem, which provides a stochastic bilinear system. Then, the optimal regulator is obtained (i.e. the solution to the minimum control problem among all the affine transformations of the measurements). Better performances of the regulator are expected using higher order system approximations.

WeA14 318
Networked Systems: Rate Constraints, Quantization and Unreliable Communication (Invited Session)

Chair: Zampieri, Sandro Univ. di Padova
Co-Chair: Quevedo, Daniel E. The Univ. of Newcastle
Organizer: Zampieri, Sandro Univ. di Padova

10:30-10:50 WeA14.1

Decentralized Stabilization of Networked Systems under Data-Rate Constraints (I), pp. 8033-8038

Matveev, Alexey S. St.Petersburg Univ.
Savkin, Andrey V. Univ. of New South Wales

The paper deals with an advanced networking scenario involving a noisy linear plant with multiple actuators and sensors connected via a complex communication network with varying topology. The network contains a large number of spatially distributed nodes equipped with CPU's that process and transmit data. Processing algorithms need to be designed for some nodes, whereas they are fixed for other nodes. During transmission, data may incur delays, be lost or corrupted. The objective is to stabilize the plant. A necessary and sufficient condition for stabilizability is given in terms of the so-called rate (capacity) domain of a communication network. It is shown that the problem of networked stabilization of noisy plants is ultimately reduced to a hard long-standing one of the information theory: calculating the capacity domains of communication networks.

10:50-11:10 WeA14.2

Observer-Based Quantized Output Feedback Control of Nonlinear Systems (I), pp. 8039-8043

Liberzon, Daniel Univ. of Illinois at Urbana-Champaign

This paper addresses the problem of stabilizing a nonlinear system by means of quantized output feedback. A conceptual framework is presented in which the control input is generated by an observer-based feedback controller acting on quantized output measurements. A stabilization result is established under the assumption that this observer-based controller possesses robustness with respect to output measurement errors in an input-to-state stability (ISS) sense. Designing such observers and controllers is a largely open problem, some partial results on which are discussed. The main goal of the paper is to encourage further work on this important topic.

11:10-11:30 WeA14.3

On Networked Control Architectures for MIMO Plants (I), pp. 8044-8049

Silva, Eduardo I — The Univ. of Newcastle
Goodwin, Graham C. — Univ. of Newcastle
Quevedo, Daniel E. — The Univ. of Newcastle

In this work we focus on control of MIMO LTI plants and explore the potential benefits of replacing a traditional diagonal non-networked control architecture with a networked full MIMO one. Diagonal terms of the networked MIMO architecture employ transparent links, whereas the off-diagonal terms use communication channels which are subject to signal-to-noise ratio constraints. Within this setup, we show how to design LTI coding systems which optimize overall performance. Unsurprisingly, for high-quality channels the full MIMO architecture is preferable to decentralized architectures. However, our analysis reveals that the achievable performance in the networked situation may become arbitrarily poor, if the signal-to-noise ratio constraints in the communication links are sufficiently severe. In these cases, traditional decentralized controller structures are preferable. In the present work, we limit our analysis to the two-input two-output case and illustrate our results for networked control systems with bit-rate limited communication channels.

11:30-11:50 WeA14.4

On the Feedback Information in Stabilization Over Unreliable Channels (I), pp. 8050-8055

Ishii, Hideaki — Tokyo Inst. of Tech.

We consider the remote stabilization of linear systems using shared communication channels where transmitted messages may randomly be lost. We extend the results on the limitations arising in such systems and study the case where there is no feedback information from the actuator side to the controller side. The proposed control scheme utilizes a protocol shared by the actuator and the controller to carry out state and input estimation.

11:50-12:10 WeA14.5

Optimal Linear Quadratic Regulator for Markovian Jump Linear Systems, in the Presence of One Time-Step Delayed Mode Observations (I), pp. 8056-8061

Matei, Ion — Univ. of Maryland
Martins, Nuno C. — Univ. of Maryland
Baras, John S. — Univ. of Maryland

In this paper, we provide the solution to the optimal Linear Quadratic Regulator (LQR) paradigm for Markovian Jump linear Systems, when the continuous state is available at the controller instantaneously, but the mode is available only after a delay of one time step. This paper is the _rst to investigate the LQR paradigm in the presence of such mismatch between the delay in observing the mode and the continuous state at the controller. We show that the optimal LQR policy is a time-varying matrix gain multiplied by the continuous component of the state, where the gain is indexed in time by the one-step delayed mode. The solution to the LQR is expressed as a collection of coupled Riccati iterations and equations, for the _nite and the in_nite horizon cases respectively. In the in_nite horizon case the solution of the coupled Riccati equations or a certi_cate of infeasibility is obtained by solving a set of linear matrix inequalities. We also explain the di_culties of solving the LQR problem when the mode is observed by the controller with a delay of more than one step. We show that, with delays of more than one time-step, the optimal control will be a time-varying nonlinear function of the continuous state and of the control input, without presenting an exact solution.

12:10-12:30 WeA14.6

A Probabilistic Analysis of the Average Consensus Algorithm with Quantized Communication (I), pp. 8062-8067

Carli, Ruggero — Univ. of Padova
Fagnani, Fabio — Pol. Di Torino
Frasca, Paolo — Pol. di Torino
Zampieri, Sandro — Univ. di Padova

In the average consensus problem the states of a set of agents, linked according to a directed graph, have to be driven to their average. When the communication between neighbors is uniformly quantized, such a problem can not be exactly solved by a linear time-invariant algorithm. In this work, we propose a probabilistic estimate of the error from the agreement, in terms of the eigenvalues of the evolution matrix describing the algorithm.

WeA15 317

Modeling Methods and Clinical Applications in Medical and Biological Systems I (Invited Session)

Chair: Andreassen, Steen — Aalborg Univ.
Co-Chair: Chase, J. Geoffrey — Univ. of Canterbury
Organizer: Andreassen, Steen — Aalborg Univ.
Organizer: Chase, J. Geoffrey — Univ. of Canterbury

10:30-10:50 WeA15.1

Cardiovascular Modelling and Identification in Septic Shock - Experimental Validation (I), pp. 8068-8073

Desaive, Thomas — Univ. of Liege
Lambermont, Bernard — Univ. of Liege
Ghuysen, Alexandre — Univ. of Liege
Kolh, Philippe — Univ. of Liege
Dauby, Pierre C. — Univ. of Liege
Starfinger, Christina — Univ. of Canterbury
Hann, Christopher E — Univ. of Canterbury
Chase, J. Geoffrey — Univ. of Canterbury
Shaw, Geoffrey M — Christchurch Hospital, Canterbury District Health Board

Cardiovascular disturbances are difficult to diagnose and treat because of the large range of possible underlying dysfunctions combined with regulatory reflex mechanisms that can result in conflicting clinical data. A cardiovascular system (CVS) model and patient specific parameter identification method could better aggregate the clinical data into a more direct and simpler form for clinicians. A previously developed model and parameter identification method is improved to accurately capture physiological response to septic shock under continuous hemofiltration, further confirming the potential for using this model-based approach in critical care. Clinical data is matched with mean absolute errors less than 8% and the optimized parameters closely follow a previous study using significantly more invasive procedures and measurements.

10:50-11:10 WeA15.2

Prediction Validation of Two Glycaemic Control Models in Critical Care (I), pp. 8074-8079

Pielmeier, Ulrike — Aalborg Univ.
Chase, J. Geoffrey — Univ. of Canterbury
Andreassen, Steen — Aalborg Univ.
Haure, Pernille — Aalborg Hospital
Steenfeldt Nielsen, Birgitte — Aalborg Hospital
Shaw, Geoffrey M — Christchurch Hospital, Canterbury District Health Board

Metabolic models can substantially improve control of hyperglycaemia in critically ill patients. Control efficacy depends on how accurately a model-based system is able to predict future blood glucose (BG) concentrations after a glycaemic control intervention. This research compares two metabolic models in terms of their predictive power. Predictions 30 minutes to 10 hour forward are made using the Glucosafe model (GS) and a clinically validated model (CC) from Christchurch in a retrospective study of 11 hyperglycemic patients, 6 from New Zealand and 5 from Denmark. Median and ranges of prediction errors are similar for predictions up to 360 minutes. Both models make better predictions on the Danish patients. At long prediction times of more than 5 hours, GS predictions tend to be more accurate in the cohort from New Zealand whereas the CC model tends to predict better in the cohort from Denmark. However, relative differences in root mean square (RMS) of prediction errors are not greater than 4–5% in both cohorts. For both models, outlying prediction errors are dominated by single patients, particularly type 1 diabetic patients. GS predicted BG values are generally higher compared to CC predicted values. As expected, the RMS prediction error increases with prediction interval for both models and cohorts. Results show the potential of both models for use in prospective clinical trials with 120–180 min sampling intervals. Predictive power is attributed to the type of cohort in terms of degree of illness and glycaemic stability as well as sensor type used.

11:10-11:30 WeA15.3

Decision Support of Inspired Oxygen Fraction Using a Model of Oxygen Transport (I), pp. 8080-8084

Karbing, Dan Stieper	Aalborg Univ.
Kjćrgaard, Sřren	Aalborg Hospital, Aarhus Univ.
Smith, Bram W	Aalborg Univ.
Allerřd, Charlotte	Aalborg Hospital, Aarhus Univ.
Espersen, Kurt	Rigshospitalet, Univ. of Copenhagen
Andreassen, Steen	Aalborg Univ.
Rees, Stephen Edward	Aalborg Univ.

Setting inspired oxygen fraction (FiO_2) is a complicated balance between ensuring adequate oxygenation and minimizing the risk of lung damage. This paper presents a retrospective test of a model-based decision support system (INVENT) for advising on FiO_2 levels in intensive care patients. Clinically determined FiO_2 levels and the resulting blood oxygenation are compared with INVENT determined FiO_2 levels and model simulated blood oxygenation. The results indicate that INVENT can maintain an acceptable level of oxygenation using similar or more appropriate levels of FiO_2 compared to clinical practice.

11:30-11:50 WeA15.4

Glucose-Insulin Pharmacodynamic Surface Modeling Comparison (I), pp. 8085-8090

Chase, J. Geoffrey	Univ. of Canterbury
Andreassen, Steen	Aalborg Univ.
Pielmeier, Ulrike	Aalborg Univ.
Hann, Christopher E	Univ. of Canterbury

Metabolic system modeling for use in glycaemic control is increasing in importance. Few models are clinically validated for both fit and prediction ability. For such models, this research introduces a new form of pharmaco-dynamic (PD) surface comparison for model validation. These 3D surfaces are developed for 3 validated models, including the well-known Minimal Model, and fit to clinical data. The approach is clearly highlights differences in modeling methods, dynamics utilized and physiological assumptions that may not appear as clearly in other validation approaches. The deficiencies of the Minimal Model in comparison to more physiologically representative models are illustrated in this context.

11:50-12:10 WeA15.5

Nonparametric Prediction of Free-Light Chain Generation in Multiple Myeloma Patients (I), pp. 8091-8096

Hattersley, John Glenn	Univ. of Warwick
Evans, Neil D.	Univ. of Warwick
Chappell, Michael	Univ. of Warwick
Mead, Graham	The Binding Site
Hutchison, Colin	Queen Elizabeth Hospital

Multiple Myeloma is a plasma cell cancer that produces excess Free Light Chains(FLC). Patients with this condition are treated with dialysis and chemotherapy. A previous compartmental model developed by Evans et al. [2006] described the removal of FLC through a hemodialysis membrane. In this model all rate constants were considered linear and the production of FLC a constant input function. It is known that the system rate constants and inputs are non-linear in nature due to the membrane dynamics and the use of chemotherapy to retard the production FLC producing cells. This study describes the use of maximum entropy deconvolution, in conjunction with a non-linear compartmental model, to recreate the FLC production rate in a non-parametric form, without the need for assumptions that are not supported by available data. Input functions are reconstructed from four different patients with a range of dialysis durations and FLC plasma concentrations to investigate the possible effects of chemotherapy on the underlying FLC production.

12:10-12:30 WeA15.6

Transferability Modelling in the TREAT Decision Support System (I), pp. 8097-8102

Zalounina, Alina	Aalborg Univ.
Andreassen, Steen	Aalborg Univ.
Leibovici, Leonard	Rabin Medical Center, Beilinson Hospital
Paul, Mical	Rabin Medical Center, Beilinson Hospital

One of the key-components for success of a decision support system is in its flexibility and applicability to different clinical locations. The present study is devoted to a system which is capable of successful transfer to a distant environment. We have developed a decision support system for antibiotic treatment (TREAT), which was adapted to four different hospitals in Europe. The system is based on a causal probabilistic network (CPN). The purpose of this paper is to present the models for transferability used in TREAT. The problem of transferability is addressed in the context of CPNs, emphasising the advantages of use of CPNs for solving the problem. The process of adapting TREAT is relatively easy; that is due to the modularity of the system. The system has been built using a modular architecture that allows rapid transfer of the system to different clinical environments. Such modularity can be archived by simple means which include the universal and modular structure of the CPN, the establishment of a large group of conditional probabilities in the CPN that are assumed to be independent of time and place, and the use of hierarchical Dirichlet methods for learning of data. Due to the universal structure of the CPN, the problem of transferability in TREAT concerns only the medical domain factors, not the topology of the system.

WeA16 316

Perspectives for an Human Centred Systems Engineering: Trends and Issues (Regular Session)

Chair: Mayer, Frédérique	ENSGSI
Co-Chair: Mkrttchian, Vardan	All Armenian Internet Univ. - HHH Univ.

10:30-10:50 WeA16.1

Convergent Cognitype for Speeding-Up the Strategic Conversation, pp. 8103-8108

Raikov, Alexander	Inst. of Control Sciences RAS

For speeding-up consent achievement in a team it is worth to utilize stabilization and convergence strategic conversation (meeting) technologies in coordination processes of mutual understanding amongst the team members regarding targets and actions. These technologies are based on fundamental thermo-dynamical relations, quantum effects and on ill-defined (ill-posed) problem solution methods in topological spaces. Developed methodology was realized as a Situation center. Approach was verified through many branch and corporate strategies.

10:50-11:10 WeA16.2

Elerning and Social Perspective in All Armenian Internet University, pp. 8109-8112

Mkrttchian, Vardan	All Armenian Internet Univ. - HHH Univ.
Brandt, Dietrich	Univ. of Tech.
Yeranosyan, Hasmik	All Armenian Internet Univ.

The aim of this paper is to provide an argument material in order to open up a discussion concerning educational and political strategies within the field of distance education using a work experience of All Armenian Internet University (AAIU). In the field of computer supported collaborative learning (CSCL) the best deifications are where the exploration of the new possibilities is represented by the emerging technologies. In this paper, there is a desire to build learning environments to support a range of distributed cognitive work, i.e., communities of learners, conceptual learning conversations, and knowledge building communities. Instructional designers are in the initial stages of exploring the commonalities and discontinuities between the varieties of CSCL activities in AAIU

11:10-11:30 WeA16.3

The Use of an Axiological Lens to Review Globalised Automation and Control Systems Projects (I), pp. 8113-8118

Stapleton, Larry	School of Science, Waterford Inst. of Tech.
Freeman, Amanda	Waterford Inst. of Tech.

Problems in the design, development and management of large scale systems have be related to the multi-cultural contexts in which these systems are developed and deployed. Culture can be defined in terms of human values (axiology). Using an axiological lens, this paper explores potential value conflicts between systems engineers and the praxis in which they are formally educated. The findings provide evidence to support an axiological perspective of systems engineering and suggest that axiology could be extremely useful in understanding various aspects of systems engineering development, ethics and management.

11:30-11:50 WeA16.4

An Approach to Knowledge Management in Research Organization, pp. 8119-8123

Gubanov, Dmitry — Inst. of Control Sciences RAS

On the increase of uncertainty and in the absence of coordination it is getting more and more complicated for companies to work successfully. In this concern Knowledge Management is of great interest as effective solution to the problem of effective adaptation of research companies to constantly changing environment, where new knowledge development and training are key factors of success. It is necessary to develop Knowledge Management System architecture taking into account unpredictability of the situation: what kind of knowledge may be required and how it may be connected with the knowledge available. Semantic Web technology make it possible to attach a special meaning to the data and information, contribute to the implementation of semiautomatic and automatic processes for effective knowledge use, new knowledge output based on a situation context. Synergetic effect after implementation of knowledge available will be motivating researchers more and more to replenish it and work with it. At present knowledge management tools should be prepared.

11:50-12:10 WeA16.5

Usability-Engineering in the Context of Product Development: Results of an Experts Focus Group, pp. 8124-8128

Roese, Kerstin — Univ. of Kaiserslautern

Effective and efficient usability engineering processes are to be aligned with requirements of the respective business and industry they are to be applied to. Nonetheless abstract, cross-industry standards are necessary and worthwhile to develop a common understanding of state of the art approaches towards user-centered product development and can serve as a guideline for process implementation. This paper presents results of an expert panel on the development of state of the art usability-engineering processes as agreed upon by usability professionals experienced in different industries.

WeA17 — 320A

Virtual-Remote Labs in Control Education: Real Experiences (Highlight Session)

Chair: Vlacic, Ljubo — Griffith Univ.
Co-Chair: Dormido, Sebastián — UNED
Organizer: Dormido, Sebastián — UNED

10:30-10:50 WeA17.1

Simulated versus Hardware Laboratories for Control Education: A Critical Appraisal (I), pp. 8129-8134

Welsh, James — Univ. of Newcastle
Daredia, Talib — Matrikon
Sobora, Frank — Univ. of Newcastle
Vlacic, Ljubo — Griffith Univ.
Goodwin, Graham C. — Univ. of Newcastle

The traditional approach to control education in Universities has been to enhance student learning with hardware style experiments.The associated experiments are always constrained by the fact that hardware must be provided. Thus typical experiments use tanks of water, servo motors, inverted pendula etc. These experiments are good in so far as they go. However, quoting a former student, "It is a bit like learning to fly a Jumbo Jet. One has the choice to learn on real hardware (say an ultralight aircraft) or on a simulator of the real aircraft under real flight scenarios". This paper explores this issue for control education and presents feedback from students comparing traditional hardware experiments with simulated experiments based around real world control system designs.

10:50-11:10 WeA17.2

Remote Lab: Online Support and Awareness Analysis (I), pp. 8135-8140

Salzmann, Christophe — Ec. Pol. Fédérale de Lausanne
Gillet, Denis — Ec. Pol. Fédérale de Lausanne (EPFL)
Scott, Peter — Open Univ.
Quick, Kevin — Open Univ.

This paper presents an initiative for integrating leading edge remote experimentation and synchronous collaboration solutions as a proof of concept to pave the way towards comprehensive learning environments for live interaction, not only between people themselves, but also between people and time-critical online equipments. In this context, a pilot test has been conducted with students from the EPFL enrolled in the automatic control course during the 2007 spring semester to investigate modality, utility, usability and acceptability issues. In such comprehensive environments, awareness plays a very important role to ease interaction and to support learning. This initiative also focuses on investigating advance real-time and embedded awareness features in learning environments.

11:10-11:30 WeA17.3

Grid Supported Learning Environment in Control Education (I), pp. 8141-8146

Szczytowski, Piotr — Ruhr-Univ. Bochum
Schmid, Christian — Ruhr-Univ. Bochum

In this paper, Grid technologies are introduced to build e-learning environments for virtual control laboratories. Service-oriented Grids open new fields of applications, the Learning Grids. The learning services concept and their deployment through Grid technologies are excellent means to integrate virtual control laboratories into e-learning environments for control education. An example application from a virtual laboratory demonstrates the advantages of a Grid over classical solutions. At the high end of this approach collaborative experimenting in a virtual scene is possible.

11:30-11:50 WeA17.4

A Remote Laboratory on PID Autotuning (I), pp. 8147-8152

Leva, Alberto — Pol. di Milano
Donida, Filippo — Pol. di Milano

This manuscript presents a remote, web-enabled laboratory devoted to PID autotuning - a subject of significant importance from both the theoretical and the application-oriented point of view, but seldom available in remote laboratories. In detail, the manuscript presents two PI/PID autotuning experiments on physical control systems; the experiments are accessible by means of a browser, and the code is available as free software. Some pedagogical issues are also briefly discussed.

11:50-12:10 WeA17.5

RACT: A Remote Lab for Robotics Experiments (I), pp. 8153-8158

Casini, Marco — Univ. di Siena
Chinello, Francesco — Univ. di Siena
Prattichizzo, Domenico — Univ. of Siena
Vicino, Antonio — Univ. di Siena

The "Robotics & Automatic Control Telelab" (RACT) is a remote laboratory on robotics developed at University of Siena, which extends the field of application of the "Automatic Control Telelab" (ACT). This extension consists of adding experiments on a remote robot manipulator. RACT is mainly intended for educational use, and its Matlab-based architecture allows students to easily put in practice their theoretical knowledge on robotics. The first implementation of RACT consists of a remote experiment on inverse kinematics and of an experiment on visual servoing. Experiments on visual servoing represent the most advanced feature of the remote lab and work is in progress to add more experiments of this type.

12:10-12:30 WeA17.6

Developing and Implementing Virtual and Remote Labs for Control Education: The UNED Pilot Experience (I), pp. 8159-8164

Dormido, Sebastián — UNED
Vargas Oyarzun, Hector — Univ. Nacional de Educacion a Distancia (UNED) Madrid
Sánchez Moreno, José — UNED
Dormido, Raquel — UNED
Duro, Natividad — Univ. Nacional De Educacion A Distancia (uned)
Dormido Canto, Sebastián — UNED
Morilla, F. — ETSI Informatica, UNED

Last years, research efforts on the development of virtual and remote laboratories in control engineering education have been reported in many conferences, workshops and journals. However, it is observed that pilot experiences about the utilization of web-based laboratories are not habitual practices. In this paper it is described the pilot experience of the Department of Computer Science and Automatic Control of the Spanish University of Distance Learning (UNED) about the introduction of three web-based laboratories in a course on process control. This experience begins with descriptions of the tools employed to develop client and server-sides and the collaborative environment used to publish the labs in Internet. Attention is due to the concept of task protocol. It consists essentially of an ordered list of activities that students must execute in the virtual and remote mode of each one of the three web-based laboratories. To conclude, results of the pilot experience are given by means of evaluation questionnaires.

WeA18 320B
Automation in the Semiconductor, Display, and Electronics Industry (Highlight Session)

Chair: Choi, Jungyun — Samsung Electronics
Co-Chair: Chae, Junjae — Korea Aerospace Univ.
Organizer: Song, Ji Oh — Samsung Electronics Co.,LTD.

10:30-10:50 WeA18.1
Cluster Tool for Control of Semiconductor and FPD Equipment (I), pp. 8165-8170

Choi, Yong Man — kornic
Aiga, Jo — kornic

The manufacturers of the semiconductor and the FPD equipment attempt to lineup various equipments to increase the productivity. The manufacturers of the elements also expand their automatic systems for the visual controlling software and collection of the various data to increase the productivity. However, most manufacturers of equipments confront with the limit in following the controlling software technology for this requirement. Therefore, the companies are searching for the solutions already verified and optimized as the measure of improving the competitiveness through the various control of the equipments and shortening of the development lead time. This paper introduces the Easycluster as an alternative which is the Cluster Tool SW for equipment control already verified through the application in a line for mass production.

10:50-11:10 WeA18.2
A Novel Value Innovation for a PE-CVD Fab Equipment by Using Cluster Tool Control Technology, pp. 8171-8172

Choi, Byeong-Kap — Samsung Electronics

This industrial paper deals with a new value innovation technology for a PE-CVD equipment, which results in productivity, usability, and extensibility enhancement of the system. The cluster tool control technology including control software played a key role in increasing the value of the equipment. Productivity, usability and extensibility enhancement is achieved by equipment remodeling and improvement technique. The technique is applied in a real industrial field of semiconductor mass production line and the verification of productivity and usability enhancement is done by comparing the previous data and the data after improvement. Also the extensibility improvement is proved by the capability of IMS processing of ARCL and AFL with mechanical movement between the processing steps which can not be done in the equipment before.

11:10-11:30 WeA18.3
A SERCOS NETWORK BASED MODULAR MOTION SOLUTION for SEMICONDUCTOR & FPD EQUIPMENTS (I), pp. 8173-8174

Ahn, Sung-Chan — Rockwell Automation Korea
Lee, Sang-Sub — Rockwell Automation Korea
Jung, Yong-Kuk — Rockwell Automation Korea
Lee, Sang-Hoon — Rockwell Automation Korea
Kang, Duk-Hyun — Rockwell Automation Korea

Recently, the field of semiconductor and FPD (Flat Panel Display) equipments has been the major application area of high precision servo systems. The requirements of this market are the PC-based motion control, multi-axis control, and the network based solution to reduce the installation, set-up and maintenance cost. In this paper, we presents a SERCOS network based modular motion solution (MMC-II and CSDM) which is recently adopted in OLB (Outer Lead Bonding) machine for FPD manufacturing equipments. This motion solution offers outstanding scalability and cost advantages through SERCOS network capability and modular servo drives with common DC bus configuration.

11:30-11:50 WeA18.4
PDP Visual Inspection System in PDP Aging Process, pp. 8175-8176

Ko, Min Seok — Samsung SDI
Kim, Jae Hyung — Samsung SDI
Choi, In Hwa — Samsung SDI
Heo, Kyung Hoe — Samsung SDI Production Engineering Lab.

PDP aging inspection process is the first step of inspecting defects in a lighted panel. The causes of appearing defects are particles in a clean room, a failure of a creating electrode. Aging inspection system is designed for contributing optimization of production by detecting these defects. The defects are mainly seen as line, dark or brighten cell and mura. This system has different algorithms according to a characteristic of defects. This system processes a panel in 12 seconds with accuracy in 99%. It consists of high definition camera for shooting a lighted 50 inch panel, PCs for controlling linear systems, communicating with main database system, processing data and image.

WeA19 320C
Automated Optical Inspection Systems for Electronics Manufacturing Industry (Invited Session)

Chair: Jeong, Dae Hwa — LG Electronics Inc.
Co-Chair: Kang, Heuiseok — Korea Inst. of Industrial Tech.
Organizer: Jeong, Dae Hwa — LG Electronics Inc.

10:30-10:50 WeA19.1
Defect Classification Using Bayesian Approach for Tape Substrate Inspection System (I), pp. 8177-8182

Roh, Young Jun — LG Electronics
Jeong, Dae Hwa — LG Electronics Inc.
Kim, CheolWoo — LG Electronics
Jung, ChangOok — LG Electronics

The inspection of ultra-fine pitch patterned tape substrate(TS) requires high resolution optics. In the process of picking out defects at the level of the critical dimension through image processing, however, trivial blemishes formed by dust or micro particles may be detected simultaneously. This leads to unnecessary work on the part of operators reviewing and verifying the additional detected points. To maximize the efficiency of the inspection process, we need to identify and classify the defect candidates whether it is a real pattern defect or simply a trivial blemish by dust. In this article, we propose a Bayesian approach to classify the defective images based on the measures of the image features. The features of the defective region in terms of shape and brightness are obtained from a series of proper image analysis with FFT. Based on the data collected from experiments, we devised a statistic model for classification.

10:50-11:10 WeA19.2
The Embedded Vision System for Portable Applications (I), pp. 8183-8184

Kang, Heuiseok — Korea Inst. of Industrial Tech.

A simple and cost-effective time switching method is to connect two camera modules into one camera interface port. The suggested embedded vision system is implemented and the image taken as expected. The design requirements for the hardware and the device driver are also considered. The captured image quality proves our suggestion could be a good candidate for two camera interface solutions without using complicated DSPs or FPGAs.

11:10-11:30 WeA19.3
A New Image Restoration Technique for SEM (I), pp. 8185-8189

Nakahira, Kenji — Hitahi, Ltd.
Miyamoto, Atsushi — Hitahi, Ltd.
Honda, Toshifumi — Production Engineering Res. Lab. Hitachi Ltd.

This paper proposes a new fast and effective method of image restoration to improve the resolution of SEM images. In our approach, image resolution is improved by deconvolution with the point spread function modeled as the intensity distribution of the electron beam at the specimen's surface. The beam intensity distribution under each imaging condition is estimated by electro-optical simulation to achieve high resolution. We propose an iterative technique for the deconvolution process with a cost function where the restored image at each iteration can be compared with the original image more directly. A wavelet shrinkage denoising algorithm was applied to efficiently suppress noise amplification in noisy images, The empirical results demonstrate the outstanding improvements in both resolution and noise suppression. The proposed iterative method also speeds up deconvolution by about 3 to 50 times more than the conventional Richardson-Lucy method.

11:30-11:50 WeA19.4

Region Mura Detection Using Efficient High Pass Filtering Based on Fast Average Operation (I), pp. 8190-8195

Kim, Seong-Hoon LG Electronics
Kang, Tae Gyu LG Electronics
Jeong, Dae Hwa LG Electronics Inc.

A Mura (also called "alluck") defect that causes local deterioration of colors or brightness on a LCD(liquid crystal display) panel is one of the critical issues in display manufacturing. In this paper, we propose mura detection method using frequency filtering. As a mean of frequency filtering to eliminate the low frequency background term, subtraction of the averaged image from the raw one is utilized. And a fast averaging algorithm has been devised for reducing computational costs. The validity and the performance of the proposed method is discussed through experimental studies on actual LCD panel mura defects.

11:50-12:10 WeA19.5

Optical Pattern Inspection for Flex PCB — Challenges & Solution (I), pp. 8196-8202

Kondala, Rambabu TATA Elxsi Ltd
Munivarkarasan, Dineshkumar Tata Elxsi Ltd, Bangalore
Kallipudi, Vijay Kumar Tata Elxsi Limited
Siddineni, Pandari Nath TATA Elxsi Limited
Roh, Young Jun LG Electronics

Due to the material properties and technology advancement in printed circuit flex tapes, traditional PCB inspection algorithms using reference image cannot be used. Flex tapes are flexible circuits enabling the design and production of lighter, faster and smaller electronic products. A flex tape is made of flexible polymer film that is laminated onto a thin sheet of conductive material and etched to produce a circuit pattern. The width of fine pitch patterns can be of a few microns. Due to the material characteristics of printed circuit tapes, such as thinness and flexibility, the images captured during inspection are distorted (stretch or shrink, tilt, meandering, etc.). These anomalies and shining tape surface make the possibility of using conventional PCB inspection algorithms using referential methods for pattern inspection, difficult. The goal of pattern inspection is to identify pattern defects — open, short, nick, protrusion, island, pinholes and dust particles. Non-repetitive and non-uniform distortions are some of the main challenges in inspecting these flexible tapes. Some of the other challenges faced during the design of the defect detection algorithm are non-uniform lighting and the gamut of sizes, shapes & orientation of defects as well as features on the printed circuit. Moreover, the algorithms need to take into account the stringent defect tolerance limits followed by the industry.

WeA20 321C

Informationally Structured Environments for Robotics (Invited Session)

Chair: Hashimoto, Hideki Univ. of Tokyo
Co-Chair: Er, Meng Joo NTU
Organizer: Hashimoto, Hideki Univ. of Tokyo

10:30-10:50 WeA20.1

Automated Calibration of Distributed Laser Range Finders Based on Object Tracking in Overlapping Sensing Regions, pp. 8203-8208

Sasaki, Takeshi The Univ. of Tokyo
Hashimoto, Hideki Univ. of Tokyo

In this paper, we address the automated calibration of the pose of distributed laser range finders in smart environments, which are spaces with multiple embedded and networked sensors and actuators. This method is based on object tracking in overlapping sensing regions: the positions of same tracked objects in each sensor's coordinate system are used to calculate relative position and orientation of the sensors. We focus on extension of this mobile-assisted approach in order to utilize general moving objects such as humans and not limited to mobile robots. In case that mobile robots are used as calibration objects, the model of the mobile robots can be used to determine which mobile robots are being tracked. However, if the general moving object is utilized, we have to judge whether two tracked objects in different sensors are same object or not. So estimation error is utilized for the decision on the corresponding object. Experimental results shows that this method can find the correct correspondence and achieve almost the same result as manual calibration case.

10:50-11:10 WeA20.2

Calibration of Widely Distributed Vision Cameras by Mobile Robots with Cooperative Positioning (I), pp. 8209-8214

Yokoya, Tsuyoshi Kyushu Univ.
Hasegawa, Tsutomu Kyushu Univ.
Kurazume, Ryo Kyushu Univ.

This paper proposes a calibration method of a distributed vision network in a unified world coordinate system. The vision network system is conceived to support a robot working in our daily human life environment: the system provides with visual observation of the dynamically changing situation surrounding the robot. Vision cameras are rather sparsely distributed to cover a wide area such as a block of a town. Position, view direction and range of view are the camera parameters of principal importance to be estimated by the proposed method. A set of calibration data for each distributed camera is provided by a group of mobile robots having a cooperative positioning function and visually distinguishable markers mounted on the body of the robot.

11:10-11:30 WeA20.3

Generating Robot Arm Motion by Using Generalized Environmental Information (I), pp. 8215-8220

Wang, Siliang Tokyo Metropolitan Univ.
Sato, Eri Tokyo Metropolitan Univ.
Yamaguchi, Toru Tokyo Metropolitan Univ.

In this paper, the authors establish a structured environment, in which environment knowledge is not only given to the visible robot that serves to people but also to the environment itself. It aims to provide services efficiently by using the visible robot and to construct a general system that information can be shared with the other robots. Through the experiment, it succeeded in constructing a robot arm motion generation system by generalizing environmental information under a structured environment. In the future, it comes to be able to provide more services by increasing other robot components that can cooperate with robot arm and the accuracy of robot's motion will be improved.

11:30-11:50 WeA20.4

Design of Ubiquitous Space for the Robotic Library System and Its Application (I), pp. 8221-8225

Kim, Bong Keun Intelligent Systems Res. Inst. NationalInstituteof Adva

Visions of ubiquitous robotics and ambient intelligence involve distributing information, knowledge, computation over a wide range of servers and data storage devices located all over the world, and integrating tiny microprocessors, actuators, and sensors into everyday objects as well in order to make them smart. In this paper, we introduce our ongoing research effort aimed at realizing ambient intelligence in the ubiquitous robot technology space. For this, the ubiquitous space for the robotic library is introduced and an RFID technology based approach for the librarian robot is proposed.

11:50-12:10 WeA20.5

Perception of Dynamic Environments in Autonomous Robots (I), pp. 8226-8231

Er, Meng Joo NTU
Bay, Zi Jing Nangyang Tech. Univ. DSO National Lab.
Zhou, Yi Singapore Pol.

Perception of dynamic environments is the first and most critical step in mobile robots. Without a good perception (e.g. mapping) that is close to the true environment of the robot, no accurate navigation or effective obstacle avoidance can be accomplished. This paper addresses the occlusion problem that occurs frequently in perception of dynamic environments. The use of the Bayesian Occupancy Filter (BOF) to address these issues is proposed in this paper. The BOF using a range sensor is implemented and problems encountered during the implementation of the BOF are discussed. Simulation results demonstrate the effectiveness of the proposed approach.

12:10-12:30 WeA20.6

Evaluation of Mental Stress by Analyzing Accelerated

Plethysmogram Applied Chaos Theory and Examination of Welfare Space Installed User's Vital Sign (I), pp. 8232-8235

Fujimoto, Yasunari — Tokyo Metropolitan Inst. of Tech.
Yamaguchi, Toru — Tokyo Metropolitan Univ.

Welfare environment is considered special care such as support to stand up, sit up, walk, take a medicine, etc. Therefore, it is usefulness that the welfare environment support customer by service robot and consider its mind. A analyze brain waves is a kind of mind understanding. However, big equipment is needed for accuracy. In this paper, authors research a possibility of diagnosis of stress by accelerated plethysmogram applied the criterion which combine two evaluation based on chaos theory; trajectory parallel measure method and size of neighborhood space in chaos attractor. And, it calculates time-series data of accelerated plethysmogram measured from forty-tester using proposed evaluations. The authors examine the result of its application to diagnose of stress. Finally, the authors examine that customer's vital information is usefulness to control a service robot and an environment of room based on an ambient Intelligence.

WeA21 — 321B
Dynamics and Control of Micro and Nano-Scale Systems I (Invited Session)

Chair: Moheimani, S.O. Reza — Univ. of Newcastle
Co-Chair: Sebastian, Abu — IBM Res.
Organizer: Moheimani, S.O. Reza — Univ. of Newcastle
Organizer: Sebastian, Abu — IBM Res.

10:30-11:10 — WeA21.1
Architectures for Tracking Control in Atomic Force Microscopes (I), pp. 8236-8250

Butterworth, Jeffrey Austin — Univ. of Colorado
Pao, Lucy Y. — Univ. of Colorado at Boulder
Abramovitch, Daniel Y. — Agilent Lab.

We evaluate the performance of two control architectures applied to atomic force microscopes (AFM). Feedback-only control is a natural solution and has been applied widely. Expanding on that, combining feedback controllers with plant-injection feedforward filters has been shown to greatly improve tracking performance in AFMs. Alternatively, performance can also be improved by the use of a closed-loop-injection feedforward filter applied to the reference input before it enters the feedback loop. In this paper, we compare the plant-injection architecture with the closed-loop-injection architecture when used in controlling AFMs. In particular, we find that even in the presence of plant uncertainty, the closed-loop-injection architecture yields better tracking performance of a raster scan.

11:10-11:30 — WeA21.2
Two Sensor Based H-Infinity Control of a Piezoelectric Tube Scanner (I), pp. 8251-8256

Mahmood, Iskandar Al-Thani — The Univ. of Newcastle
Liu, Kexiu — The Univ. of newcastle
Moheimani, S.O. Reza — Univ. of Newcastle

The performance of a feedback-controlled piezoelectric tube scanner is limited by its inherent nonlinear properties such as hysteresis and creep, its mechanical resonance modes and its displacement sensor bandwidth and associated noise properties. Capacitive sensors have emerged as the displacement sensor of choice in piezoelectric tube scanners. Resolution of a capacitive sensor is largely determined by its bandwidth and noise density which is typically in the order of 20 pm/root Hz for a +/-100 micrometer range. Consequently, to achieve sub-nanometer resolution, the sensor's bandwidth needs to be made small. Achieving satisfactory tracking performance using a low-bandwidth displacement sensor is a challenging task. To improve the bandwidth, the piezoelectric strain voltage induced in the electrode opposite to the actuating electrode is used as a secondary measurement. A two-sensor-based H-infinity controller is designed and implemented on a prototype piezoelectric tube nanopositioning system. The tube is driven by a charge amplifier to reduce the hysteresis. Experimental results demonstrate a significant increase in the tracking bandwidth due to the use of the additional sensor.

11:30-11:50 — WeA21.3
Two-Degree-Of-Freedom Tracking Control of Piezoelectric Tube Scanners in Two-Dimensional Scanning Applications (I), pp. 8257-8262

Maess, Johannes — Univ. of Stuttgart
Becker, Jens — Univ. of Stuttgart
Gaul, Lothar — Univ. of Stuttgart
Allgower, Frank — Univ. of Stuttgart

The precision of the raster scan motion of piezoelectric tube scanners, e.g. in scanning probe microscopy, is degraded by structural vibrations excited by the driving voltage signals. In order to eliminate these vibrations, a model–based, flatness–based feedforward control scheme is proposed that tracks the tip of the piezoelectric tube along the desired scan trajectory in the lateral plane. This scheme is derived from a modal analysis of the tube scanner dynamics which is obtained by finite element (FE) discretization. In order to achieve robustness of the trajectory tracking performance with respect to model errors or unknown external disturbances, the feedforward control is supplemented by a feedback controller in a two–degree–of–freedom design which feeds back the measured displacements at the top of the scanner. The feedback additionally compensates for the coupling between the two scanning directions, e.g. due to tube eccentricity. The control performance is investigated in simulations where the sample mass attached to the top of the tube, which represents the most realistic model error, is varied. Various simulation results demonstrate the achieved improvements in tracking accuracy by the proposed control over conventional approaches.

11:50-12:10 — WeA21.4
Real-Time State Estimation and Fault Detection for Controlling Atomic Force Microscope Based Nano Manipualtion (I), pp. 8263-8268

Liu, Lianqing — Shenyang Inst. of Automation
Xi, Ning — Michigan State Univ.
Luo, Yilun — Michigan State Univ.
Zhang, Jiangbo — Michigan State Univ.
Li, Guangyong — Michigan State Univ.
Wang, Yuechao — Chinese Acad. of Sciences

The main problem of Atomic Force Microscope (AFM) based nanomanipulation is the lack of real-time visual feedback. Although the model based visual feedback can partly solve this problem, the incorrect display caused by the uncertainties in the nano-environment often leads to a failed nanomanipulation. In this paper, a general strategy with three-level structure is proposed to overcome this problem. With this three-level strategy, the incorrect display can be not only real-time detected, but also on-line corrected. The difficulty to implement this strategy is that there is no continuous way to describe and model the system since both discrete and continuous commands are involved. A Petri-net based method is proposed to organize this strategy such that task scheduling, which usually deals with discrete events, as well as task planning, which usually deals with continuous events can be treated in a unified framework. This Petri-net organized strategy provides general instructions to AFM based manipulation for displaying a visual feedback which can be as close as possible to the true environment. The experimental results presented in the paper demonstrate the advantage of the proposed strategy. It also shows the increased efficiency of the AFM based nanomanipulation.

12:10-12:30 — WeA21.5
Hysteresis Inverse Iterative Learning Control of Piezoactuators in AFM (I), pp. 8269-8274

Leang, Kam K. — Virginia Commonwealth Univ.
Ashley, Seth — Virginia Commonwealth Univ.
Aridogan, Mustafa U. — Virginia Commonwealth Univ.

We consider the application of iterative learning control (ILC) in which the input update law exploits an inverse model of the hysteresis behavior for piezoactuators. Compared to ILC for hysteresis that updates the control input using the measured tracking error scaled by a constant (fixed) learning gain, the proposed ILC algorithm converges more rapidly. The approach is analyzed and experimental results are presented to demonstrate the method's ability for precision output tracking.

WeA22 — 321A
Mechatronic Trends in Trains (Invited Session)

Chair: Goodall, R.M. — Loughborough Univ.
Co-Chair: Mei, Tx — The Univ. of Leeds
Organizer: Goodall, R.M. — Loughborough Univ.

10:30-10:50 WeA22.1

A Mechatronic Approach for Anti-Slip Control in Railway Traction (I), pp. 8275-8280

Mei, Tx	The Univ. of Leeds
Yu, Jh	The Univ. of Leeds
Wilson, Da	The Univ. of Leeds

This paper presents a novel mechatronic approach for the detection of wheel slip/slide and anti-slip control in railway traction systems, to enable an optimal use of adhesion in poor contact conditions. The proposed technique explores the variations in wheelset dynamic properties caused by condition changes at the wheel-rail contact and detects slip conditions from the torsional resonant vibrations of the wheelset axle indirectly. The modeling of a typical traction system, consisting of an induction traction motor (with associated power inverter and field-orientated control) connected to a wheelset via a gearbox, is introduced. The development of the slip detection and control scheme is presented, and the effectiveness of the proposed technique is demonstrated using computer simulations.

10:50-11:10 WeA22.2

Control Alternatives for Yaw Actuated Force Steered Bogies (I), pp. 8281-8286

Simson, Scott	Central Queensland Univ.
Cole, Colin	Central Queensland Univ.

A new design for actively steered bogies (Simson S., 2007) has been proposed for tractive rollingstock to improve not only wheel rail wear and rolling contact fatigue but to also improve wheel rail adhesion. The new bogie design features forced steering with active yaw control of the secondary suspension. The control alternatives for the new bogie design are limited by the need for the control to act independently to wheel rail creep forces. Two control alternatives are presented, a full active method where the control is applied based on known track alignment and the vehicles position. And a semi active method where the track curvature is estimated from gyroscope inputs with no prior knowledge of the track and a target alignment is estimated.

11:10-11:30 WeA22.3

Vibration Damping of a Flexible Car Body Structure Using Piezo-Stack Actuators (I), pp. 8287-8292

Kozek, Martin	Vienna Univ. of Tech.
Benatzky, Christian	Vienna Univ. of Tech.
Schirrer, Alexander	Vienna Univ. of Tech.
Stribersky, Anton	Siemens Transportation Systems GmbH & Co KG

In this work piezo-stack actuators mounted in consoles are utilized to actively dampen vibrations of a flexible car body structure by introducing bending moments. Using an example of a heavy metro vehicle the complete design for the active vibration damping system is presented. Both analytical modeling and a system identification of the vehicle are described, issues of modal representation and model reduction are covered, and a robust controller design is motivated and explained. The excellent performance of the proposed method is documented by both experimental results from a scaled model and an extensive co-simulation of the overall system.

11:30-11:50 WeA22.4

Pantograph Dynamics and Control of Tilting Train (I), pp. 8293-8298

Luo, Ren	Southwest Jiaotong Univ.

The modeling methodology of tilting train is studied. The vehicle and pantograph are considered as nonlinear multiple rigid body systems, and the catenary is modeled by FEM method. The electrical mechanical actuators for carbody and pantograph tilting control are also considered in the tilting train model. The method of on-line curving detection, filtering and control is adopted for the tilting train. The passive and active controls for the pantograph lateral motions during tilting train curve negotiation are analyzed. The pantograph guideway on top of the carbody is designed, and the control strategy for the pantograph active control is investigated. It is known that the pantograph lateral and vertical displacement and the fluctuation of pantograph-catenary contact force can be minimized by the use of active control.

11:50-12:10 WeA22.5

Condition Monitoring and Fault Detection of Railway Vehicle Suspension Using Multiple-Model Approach (I), pp. 8299-8304

Tsunashima, Hitoshi	Nihon Univ.

This paper demonstrates the possibility to detect suspension failures of railway vehicles using a multiple-model approach from on-board measurement data. The railway vehicle model used includes the lateral and yaw motions of the wheelsets and bogie, and the lateral motion of the vehicle body, with sensors measuring the lateral acceleration and yaw rate of the bogie, and lateral acceleration of the body. The detection algorithm is formulated based on the Interacting Multiple-Model (IMM) algorithm. The IMM method has been applied for detecting faults in vehicle suspension systems in a simulation study. The mode probabilities and states of vehicle suspension systems are estimated based on a Kalman Filter (KF). This algorithm is evaluated in simulation examples. Simulation results indicate that the algorithm effectively detects on-board faults of railway vehicle suspension systems.

12:10-12:30 WeA22.6

Optimised Sensor Configuration for a Maglev Suspension, pp. 8305-8310

Michail, Konstantinos	Loughborough Univ.
Zolotas, Argyrios	Loughborough Univ.
Goodall, R.M.	Loughborough Univ.

This paper discusses a systematic approach for selecting the minimum number of sensors for an Electromagnetic levitation system that satisfies both deterministic and stochastic performance objectives. The controller tuning is based upon the utilisation of a recently developed genetic algorithm, namely NSGAII. Two controller structures are discussed, an inner loop classical solution for illustrating the efficacy of the NSGAII tuning and a Linear quadratic gaussian structure particularly on sensor optimization.

WeA23 323

Industrial Applications of Real-Time Distributed Embedded Systems (Regular Session)

Chair: Frey, Georg	Univ. of Kaiserslautern
Co-Chair: Berruet, Pascal	Univ. de Bretagne Sud

10:30-11:10 WeA23.1

It's Time for a Change: The Sun Java Real-Time System for Automation Systems (I), pp. 8311-8314

Bollella, Gregory	Sun Microsystems

Since the transition from using analog electronic circuits for control of physical devices, robots, transportation, production processes, etc., (just control systems hereinafter), to using digital electronics for control systems the industrial automation industry has really been working with, in a general sense, computers. Albeit, highly specialized computers, but computers, nonetheless. The evolution of industrial automation computers has taken a path very different from general-purpose computers (such as personal computers, servers, laptops, etc.). This paper makes the assertion that it is now necessary that the development of programs for control system computers move up the abstraction ladder to using high-level, modern, object-oriented, and distributed software development platforms and tools for the creation of control system programs. There are three categories of reasons; economics, software complexity, and availability of suitable platforms. The computer industry has been building cost-effective computing machines for some time and allowing that industry to provide control systems computers will drive the cost-per-unit down, significantly. The demands of control systems consumers is growing and can be met only via software, thus the software development effort for control systems is approaching that in the general-purpose computer market. Finally, since the availability of implementations of the Real-Time Specification for Java, general-purpose hardware and operating systems can support the precise temporal guarantees required for the implementation of control system applications, and indicates that the evolutionary paths of control system computers and general-purpose computers may be merging. All three areas will be further developed in the paper and talk.

11:10-11:30 WeA23.2

Sentient Objects for Designing and Controlling Service Robots (I), pp. 8315-8320

Kaiser, Jörg	Otto-von-Guericke-Univ. Magdeburg
Schulze, Michael	Otto-von-Guericke-Univ.
Zug, Sebastian	Otto-von-Guericke-Univ. Magdeburg
Cardeira, Carlos	IDMEC
Carreira, Fernando	Pol. Inst. of Lisbon

Services related to healthcare and the support for elderly people become more and more important. Autonomous or semi-autonomous robots may play an important role in this area. From a control system point of view these robots are networks of distributed smart components to perceive their environment and react on it in real time. The problem of developing or extending such a robot often is that the designer has to start from scratch struggling with low level issues, where reusability of already designed components would be highly desirable. The paper describes a robot application in the area of a meals distribution service that combines two design worlds. One is the conventional world of modelling the functional properties without any structural considerations, the other is the world of cooperating sentient objects. We explain how the notion of sentient objects will assist the design, simulation and also later extensions and adaptations of the robot.

11:30-11:50 WeA23.3

Solving the Deployment Problem of IEC 61499 Applications, pp. 8321-8326

Hussain, Tanvir	Univ. of Kaiserslautern
Frey, Georg	Univ. of Kaiserslautern

Distributed control systems now-a-days are consisting of more and more heterogeneous processing nodes. Standards are making it easier to use processors, networks, operating systems etc. of varying nature. This freedom of choice is quite beneficial as long as the control applications perform according to the functional and non-functional specifications. Non-functional requirements especially that related to satisfaction of certain temporal deadlines are quite important in control applications since they often consists of a number of real-time components. Therefore, when heterogeneous processing elements are used deployment of the software components appears to be a problematic task. This article presents a methodology to combat this problem using explanation based learning.

11:50-12:10 WeA23.4

Control Code Generation Using Model Engineering for an Electric Train, pp. 8327-8332

Frizon de Lamotte, Florent	Univ. Européenne de Bretagne - UBS
Berruet, Pascal	Univ. de Bretagne Sud
Rossi, André	Univ. de Bretagne Sud
Philippe, Jean-Luc	Univ. de Bretagne Sud

This paper addresses first experiments in the usage of model engineering to generate control/command code from a high-level description of the system featuring the notions of architecture and configuration. This principle has been applied generate IEC-61131-3 control/command code for an industrial PLC to control the circuit and the engines of an electric train. It has been implemented using the AMMA platform, more precisely the ATL transformation language.

12:10-12:30 WeA23.5

Enhancement of the Precision Time Protocol in Automation Networks with a Line Topology, pp. 8333-8338

Na, Chongning	Siemens AG
Obradovic, Dragan	Siemens
Scheiterer, Ruxandra Lupas	Siemens AG
Steindl, Günter	Siemens AG
Götz, Franz-Josef	Siemens AG

The precision time protocol (PTP) delivered by the IEEE 1588 standard has been proven to be an appropriate network synchronization protocol, which is widely applied in the areas of industrial automation, measurement and control, telecommunications and more. Many factors restrict the performance of the PTP protocol. In this paper, we highlight the influence of frequency drift on the synchronization performance. Based on analytic study, we develop an algorithm to improve the protocol, which is verified by simulation.

WeA24 324

Production Planning & Control (Regular Session)

Chair: Pogromsky, A. Yu.	Eindhoven Univ. of Tech.
Co-Chair: Song, Dong-Ping	Univ. of Plymouth

10:30-10:50 WeA24.1

Production Control and Steady-State Performance Analysis for a Two-Stage Manufacturing System with Finite Buffer Sizes, pp. 8339-8344

Song, Dong-Ping	Univ. of Plymouth

A two-station tandem manufacturing system with limited buffer sizes and production capacity is considered. The problem is to examine the stability of the system and to control the service rates to meet an exogenous Poisson demand. A sufficient and necessary condition for the system stability is provided. It is shown that the optimal control policy for this finite buffer capacity problem has the similar structural properties to that of the infinite buffer capacity problem. Three threshold-type control policies are presented and their stability conditions are shown to be the same. The stationary distributions under two threshold policies are obtained, which can then be used to compute steady-state performance measures and find the optimal threshold values. Numerical examples are given to demonstrate the results.

10:50-11:10 WeA24.2

An Advanced ATP Decision Support System in Stockout Situations, pp. 8345-8350

Lauras, Matthieu	Ec. des Mines d'Albi-Carmaux
Humez, Verane	Ec. des Mines d'Albi-Carmaux
Okongwu, Uche	Toulouse Business School
Dupont, Lionel	Ec. des Mines d'Albi-Carmaux

Order management is a major component of the order fulfillment process (OFP). The aim of this activity consists in maximizing the responsiveness, flexibility and efficiency of a customer order fulfilment. But what happens in case of shortage? Today, no particular method seems to allow managing bulk orders properly. In situations of stockout, the different actors involved in the OFP may have difficulties in deciding the best responsive solution that would preserve customer satisfaction. The aim of this paper is to achieve this goal by developing a multi-criteria decision support system, based on the Advanced Available-to-promise (AATP) technique.

11:10-11:30 WeA24.3

An Anti-Windup Based Approach to the Control of Manufacturing Systems, pp. 8351-8356

van den Bremer, W.A.P.	Eindhoven Univ. of Tech.
van den Berg, R.A.	Eindhoven Univ. of Tech.
Pogromsky, A. Yu.	Eindhoven Univ. of Tech.
Rooda, J.E.	Eindhoven Univ. of Tech.

This paper focusses on the problem of controlling the production rate of a discrete-event manufacturing system such that the total production meets a certain reference demand. There is a need for a simple and structured approach to design controllers for manufacturing systems. Therefore, we choose for a continuous approximation model of a manufacturing machine, which is controlled using a PI controller with anti-windup. Convergent systems theory and a nonlinear extension of frequency response functions are used to evaluate the performance of this continuous approximation model with the proposed controller. Next, the controller is implemented on the discrete-event system and performance is evaluated using discrete-event simulations. Simulation results of the manufacturing system with an anti-windup controller agree with the observations that were made during the frequency domain performance analysis of the continuous approximation.

11:30-11:50 WeA24.4

A Control and Monitoring Oriented Model of a Film Manufacturing Process, pp. 8357-8361

Hur, Sung-ho	Univ. of Strathclyde
Balderud, Jonas	Univ. of Strathclyde
Katebi, Reza	Univ. of Strathclyde

This paper describes the development of a control and monitoring oriented model of a plastic film manufacturing process. The model is mainly derived from first-principles and has been implemented in the Matlab/Simulink dynamic simulation environment. The development of the model forms the first phase of a project that aims to develop a nonlinear sub-space based monitoring, fault detection and trouble shooting system for the film manufacturing process.

11:50-12:10 WeA24.5

An Expert Mill Cutter and Cutting Parameters Selection System Incorporating a Control Strategy, pp. 8362-8367

Rubio, Luis	Basque Country Univ.
de la Sen, Manuel	Univ. del Pais Vasco

In this paper, remove material processes are taking into account for developing an expert mill cutter and cutting parameters selection system based on numerical methods of performance evaluation. The knowledge base is given by limitations in process variables, which let us to define the allowable cutting parameter space. The mentioned limitations lead to instabilities limitations due to tool-work-piece interaction, known as chatter vibrations. The power available in the spindle motor and milling force control restrictions are also considered as process limitations. Besides, an additional term is taken into consideration in order to be sure of avoiding chatter vibrations when the programmed spindle speed varies due to spindle deflections or perturbations. Then, a novel tool cost model is contrived. It is used to choose a suitable tool, among a known set of candidate available cutters, and to obtain the appropriate cutting parameters in an optimal way. Once the tool and the cutting parameters are obtained, the developed system is able to redefine the cutting parameters automatically if new considerations about machinery data are required through expert rules. Such optimal cutting parameters can be obtained by manipulating the cost function weighting factors. An example is presented in order to illustrate the method.

12:10-12:30 WeA24.6

Integrated Analysis of Quality and Production Logistics Performance in Asynchronous Manufacturing Lines, pp. 8368-8374

Colledani, Marcello — Pol. di Milano

The evaluation of quality and production logistics performance measures in production lines has been traditionally considered by two separate research areas. However, the industrial reality shows that quality control strategies have an impact on the system production logistics performance as well as the system configuration has an impact on the quality control system reactivity. Therefore, in order to support the phase of design, operation and management of production lines, integrated methodologies and tools able to capture these bilateral relations and to evaluate the overall system performance are needed. The paper presents a new approximate analytical method developed to estimate the quality and productivity performance measures of asynchronous production lines in which quality control chart are present. The control action performed to prevent machines from working out of control is integrated in the manufacturing system model and the delay in the transmission of the quality information, due to the system architecture, is directly taken into account. The method is proved to be accurate and useful to derive new insights regarding the behavior of the considered systems. The proposed approach paves the way to the development of innovative methodologies to design production systems, jointly achieving the required product quality and system productivity performance.

WeA25 328

Model Predictive and Optimization-Based Control: Applications (Regular Session)

Chair: Huang, Biao — Univ. of Alberta

Co-Chair: Othman, Sami — Univ. Claude Bernard Lyon 1

10:30-10:50 WeA25.1

Model Predictive Control of Free Surfactant Concentration in Emulsion Polymerization, pp. 8375-8380

Da Silva, Bruno — Univ. Lyon 1
Dufour, Pascal — Univ. Lyon 1
Othman, Nida — Univ. Claude Bernard Lyon 1
Othman, Sami — Univ. Claude Bernard Lyon 1

In emulsion polymerization processes, the surfactant concentration plays an important role in the latex stability, reaction kinetics and particle size distribution (PSD). Controlling the free surfactant concentration in the aqueous phase ensures the stability of the latex and the control of the micellar nucleation rate. The PSD is determined by particle nucleation, growth and stability which are highly nonlinear behaviors. The PSD affects the polymer rheology, adhesion, optical properties and mechanical strength. This work deals with the model predictive control (MPC) of free surfactant concentration using the surfactant feed rate as a control variable. The used strategy is a global method that aims to reduce the on-line calculation time due to the partial differential equations (PDE) model based optimization task resolution. In order to decrease the computational burden, the nonlinear PDE system is solved off-line. Then, a linearized PDE model around the previous off-line behavior is used to find the optimal variations for the on-line predictive control.

10:50-11:10 WeA25.2

Hybrid Fuzzy Predictive Control of a Batch Reactor Using a Branch and Bound and a Genetic Algorithm Approach, pp. 8381-8386

Causa Morales, Javier Jesús — Univ. de Chile
Karer, Gorazd — Univ. of Ljubljana
Nuńez, Alfredo — Univ. de Chile
Saez, Doris — Univ. de Chile
Skrjanc, Igor — Univ. of Ljubljana
Zupancic, Borut — Faculty of Electrical Engineering, Univ. of Ljubljana

The paper deals with model predictive control (MPC) of nonlinear hybrid systems with discrete inputs. It is often required to take into account the hybrid and/or nonlinear nature of real systems, therefore, a hybrid fuzzy model is used for MPC in the paper. Two approaches that are suitable for MPC of nonlinear hybrid systems with discrete inputs are compared on a batch reactor example: a branch & bound and a genetic algorithm. We have established that both algorithms are suitable for controlling such systems. The main advantages of the genetic algorithm are boundedness of computational time in one step and whole computation-e±ciency, whereas the main drawbacks are its inherent sub-optimality and the need for suitably tuned parameters. On the other hand, the branch & bound approach does not require parameter tuning and using a suitable cost function provides optimal results in considerably less time than an explicit enumeration method.

11:10-11:30 WeA25.3

Performance Assessment and Model Validation of Two Industrial MPC Controllers, pp. 8387-8394

Jiang, Hailei — Univ. of alberta
Shah, Sirish — Univ. of Alberta
Huang, Biao — Univ. of Alberta
Wilson, Bruce — Suncor Energy Inc.
Patwardhan, Rohit — Matrikon Inc.
Szeto, Foon — Suncor Energy Inc.

This paper presents two case studies on the performance evaluation and model validation of two industrial multivariate model predictive control (MPC) based controllers at Suncor Energy Inc., Fort McMurray, Canada: 1) a 7-output, 3-input Kerosene Hydrotreating Unit (KHU) with three measured disturbance variables that are used for feedforward control; and 2) a 8-output, 4-input Naphtha Hydrotreating Unit (NHU) with 5 measured disturbances.

The NHU and KHU controllers are actually on the product stripping distillation towers. The first case study focuses on potential limits to control performance due to constraints and limits set at the time of controller commissioning. The root causes of sub-optimal performance of KHU are successfully isolated. Data from the NHU unit with MPC on and with MPC off are analyzed to obtain and compare several different measures of multivariate controller performance. Model quality assessment for the two MPCs are performed. A new model index is proposed to have a measure or metric of simulation ability and prediction ability of a model. Open-loop identification of KHU and closed-loop identification of NHU are conducted using the asymptotic method (ASYM).

11:30-11:50 WeA25.4

Robustness Issues Related to the Application of Distributed Model Predictive Control Strategies, pp. 8395-8400

Al-Gherwi, Walid — Univ. of Waterloo
Budman, Hector M. — Univ. of Waterloo
Elkamel, Ali — Univ. of Waterloo

In this paper, a methodology is proposed to address robustness aspects related to the application of distributed model predictive control. Two problems are studied: the decomposition problem and the coordination problem in the presence of model errors. Three different MPC strategies are considered: centralized, fully decentralized, and Nash equilibrium based MPC. The methodology requires the computation of closed-loop system's variability via the solution of generalized eigenvalue problem which is formulated as a finite set of linear matrix inequalities. To select the best model decomposition or control strategy based on robust performance, the worst variability for each candidate is minimized by manipulating the input weights of the controller. Two case studies are presented to illustrate the application of the methodology.

11:50-12:10 WeA25.5

Simple Pulse-Step Model Predictive Controller, pp. 8401-8406

Schlegel, Milos | Univ. of West Bohemia in Pilsen
Sobota, Jaroslav | Univ. of West Bohemia in Pilsen

This paper describes a novel simple model based predictive controller with manipulated value constraints. This controller is suitable for substitution of the classical PID controller used in industrial practice. It is assumed that the controlled system is stable, linear and t-invariant FIR system. The discrete step response sequence is used as the process model. Alternatively it is possible to use three-parameter model. To make the open-loop optimization easier the set of admissible control sequences is restricted to stepwise "pulse-step" sequences. The optimization procedure is then executable in reasonable time. A single tuning parameter is available for manual fine-tuning of the controller - the control moves penalty coefficient.

12:10-12:30 WeA25.6

Reliable Optimal Control of a Fed-Batch Bio-Reactor Using Ant Colony Optimization and Bootstrap Aggregated Neural Networks, pp. 8407-8412

Al-Mahrouqi, Mahmood | Newcastle Univ.
Zhang, Jie | Newcastle Univ.

Optimal control of a fed-batch bio-reactor using ant colony optimisation and bootstrap aggregated neural network models is presented in this paper. In order to overcome the difficulties in developing detailed mechanistic models and to improve the reliability of data based empirical models, bootstrap aggregated neural networks were used to model a fed-batch bio-reactor using process operational data. Bootstrap aggregated neural networks can not only improve model prediction accuracy but also provide prediction confidence bounds. In order to overcome the problem of local minima in the optimisation, ant colony optimisation (ACO) is used. A modified ACO algorithm is proposed for continuous variable optimisation. In the proposed technique, model prediction confidence bounds are incorporated in the optimisation objective function so as to enhance the reliability of the calculated "optimal" control actions.

WeA26 327

Control of Power Systems I (Regular Session)

Chair: Wertz, Vincent | Univ. catholique de Louvain
Co-Chair: Weissbach, Tobias | Univ. Stuttgart

10:30-10:50 WeA26.1

ROBUST SPEED CONTROL OF PMSM USING Mixed NONLINEAR H_; /SMC Techniques, pp. 8413-8418

Ghafari, Alireza | Univ. of Tehran
Yazdanpanah, M. J. | Univ. of Tehran
Faiz, Javad | Univ. of Tehran

A new technique for high performance and robust speed control of permanent magnet synchronous motor (PMSM) using a mixed non-linear H_; and Sliding Mode Control (SMC) is applied. In spite of non-linear modes, motor parameters variation and uncertainty of load torque, non-linear robust techniques introduce a precise speed control. Since the load torque is an external disturbance and its variation and type is not generally available, H_; technique is a suitable approach to minimize its influence on the output. However, motor parameters variations throw away the response from H_; response and influence its response, therefore SMC technique is used to conduct the response towards H_; response. Combination of these two techniques gives a suitable technique to robust speed control of PMSM.

10:50-11:10 WeA26.2

Robust Decentralized Switching Power System Stabilisers for Interconnected Power Grids: Stability Using Dwell Time, pp. 8419-8424

Athanasius, Germane Xavier | Univ. OF NEW SOUTH WALES, AUSTRALIA
Pota, Hemanshu | Univ. of New South Wales
Ugrinovskii, Valery | Univ. of New South Wales

This paper addresses the problem of designing decentralized robust power system stabilisers for interconnected power systems by considering effects of parameter variations and interconnections from other generators. To make the controller robust against parameter variations around an operating point, variations in system parameters due to the load change are translated to the uncertainty framework and are represented using Integral Quadratic Constraints (IQCs). The operating range of the generator is divided into several zones with respect to its power output and separate controllers are designed for each zone to achieve robust stabilization in the vicinity of the operating point. As the operating point shifts from one zone to another a suitable controller is selected and switched. The stability of the switched system is achieved by allowing a "dwell time" between consecutive switchings. Jumps in system states during switching are taken into account in the derivation of the dwell time. Interconnection effects due to other machines in the grid are included as the uncertainty in the controller design. The controller design methodology is validated by simulating a two-area power benchmark power system.

11:10-11:30 WeA26.3

Optimal Control of Fuel Processing System Using Generalized Linear Quadratic Gaussian and Loop Transfer Recovery Method, pp. 8425-8430

Tsai, Huan-Liang | Da-Yeh Univ.
Lin, Jium-Ming | Chung Hua Univ.

This paper originally proposes an optimal control system which consists of both feedforward and statefeedback controllers using a generalized linear quadratic Gaussian and loop transfer recovery (GLQG/LTR) method. The control objective is focused on the regulatory performances of output vector in response to a desired stack current command in face of load variation. The proposed method provides another degree-of-freedom in optimal controller design and makes the compensated system have a prescribed degree of stability. Finally, the numerical simulations of a compensated fuel processing system reveal that the proposed method achieves better performance and robustness properties in both time-domain and frequency-domain responses than those obtained by the traditional LQ Method.

11:30-11:50 WeA26.4

Robust Coordinated Passivation Control for Generator Excitation and TCSC System, pp. 8431-8436

Sun, Li-Ying | Northeastern Univ.
Dimirovski, Georgi Marko | Dogus Univ. of Istanbul
Zhao, Jun | The Australian National Univ.

Transient stability problem for a single machine infinite bus system with the generator excitation and thyristor controlled series compensation when damping coefficients are measured inaccurately is investigated. A robust coordinated passivation controller is designed to achieve the stability of the rotor angle and speed. The excitation voltage control is obtained by means of adaptive back-stepping method and Lyapunov stability theory using a fourth-order two-input nonlinear model. A parameter updating law is obtained simultaneously, and the reactance modulated input is derived via the coordinated passivation approach. This way the feedback passivity of the overall system is achieved and the closed-loop system is made asymptotically stable. Simulation results for a given example of the SIMB benchmark case demonstrate the effectiveness of the proposed design.

11:50-12:10 WeA26.5

Performance Limitations Arising in the Control of Power Plants, pp. 8437-8442

Wertz, Vincent | Univ. catholique de Louvain
Silva, Eduardo Ignacio | The Univ. of Newcastle
Goodwin, Graham C. | Univ. of Newcastle
Codrons, Benoît | Lab.

This paper presents results on performance limitations for direct fired coal power plants. A specific feature of this system is the existence of a very large input delay between one of the inputs, namely coal flow, and the two outputs, load and vapour pressure. This problem motivates the main theoretical question addressed in this paper: To examine tracking performance limitations in one process variable when another process variable is constrained. Our main result makes explicit the performance trade-off between the two conflicting objectives, and also links the achievable performance to the delay structure of the plant. These results give insights into the benefits of MIMO control for power plants and into the necessary trade-off between fast tracking of load step changes and the need for minimizing the variations of the vapour pressure around its nominal value. The results provide a benchmark against which practical controller designs for power plants can be assessed.

12:10-12:30 WeA26.6

Designing a Bidding-Agent for Electricity Markets: A Multi Agent Cooperative Learning Approach, pp. 8443-8448

Nouri Dariani, Ali | Univ. of Tehran
Fazeli Neishabour, Arastoo | Sharif Univ. of Tech.
Rahimi-Kian, Ashkan | Univ. of Tehran
Ahmad Sharbafi, Maziar | Univ. of Tehran

In the restructuring process of power systems, bidding strategies are the main routes for making more profit and therefore, there has been a wide research on them. In this paper, we consider a bidding model that is based on the residual demand (RD). Our approach concerns the identification of RD and learning how to bid according to it. When the agents bid in a market, some knowledge about the environment is obtained, which may be more influential than the obtained sheer profit. So, the agent should learn when and how to pay attention to the environment. The agent's expertise is measured in each part of the residual demand curve and, then its shortcomings are identified. Our agent makes a balance between the profit making and knowledge increasing processes. The designed agent's mind consists of many subagents, each learning its own task and also cooperating with others simultaneously. In this regard, a credit assignment system is implemented among the agents and the cooperative learning trends are applied. Finally, through a few case studies our agent design method is verified.

WeA27 326
Control Software Technology (Regular Session)
Chair: Marcos, Marga | Univ. del País Vasco
Co-Chair: Thiry, Laurent | ENSISA

10:30-10:50 WeA27.1
Functional Metamodels for the Development of Control Software, pp. 8449-8454
Thiry, Laurent | ENSISA
Thirion, Bernard | ENSISA

The development of control software is a complex task: it requires the integration of many descriptions and tools for specification, design, deployment, etc. To reduce the gap between the various models used to describe a system, this paper proposes the concept of functional metamodels, i.e. precise descriptions of a modeling language embedded into a functional language. The interest of the concept is the ability to define frameworks to simplify the development process. In particular, the paper proposes a framework for specification, design and deployment and applies it to the example of a legged robot.

10:50-11:10 WeA27.2
A Metamodeling Approach for Safe Control Software, pp. 8455-8460
Collonville, Thomas | ENSISA
Thiry, Laurent | ENSISA
Perronne, Jean-Marc | ENSISA
Thirion, Bernard | ENSISA

Control software development is not an easy task. Lots of works deal with this problem and suggest solutions but in speci_;c context only. The problem is that these solutions are compartmentalized at the technical and theoretical levels. This paper suggests to use the emerging domain of Model Driven Engineering (MDE) to simplify the interoperability between the various domains and disciplines used in control software design. The approach proposed is illustrated with the development of a control software for a legged robot.

11:10-11:30 WeA27.3
Middleware Based on XML Technologies for Achieving True Interoperability between PLC Programming Tools, pp. 8461-8466
Estévez, Elisabet | Univ. del País Vasco
Marcos, Marga | Univ. del País Vasco
Orive, Dario | Univ. del País Vasco
López, A. Fabián | Faculty of Engineering, Univ. of the Basque Country
Irisarri, Edurne | Pol. Univ. Coll. Univ. of the Basque Count
Perez, Federico | Univ. of the Basque Country

Industrial Process Measurement and Control Systems are used in most of the industrial sectors to achieve production improvement, process optimization and time and cost reduction. Integration, reuse, flexibility and optimization are demanded to adapt to a rapidly changing and competitive market. In fact, standardization is a key goal to achieve these goals. The international standardization efforts have lead to the definition of the IEC 61131 standard. Part 3 of this standard defines a software model for defining automation projects as well as 5 programming languages. Nowadays, a major part of Programmable Logic Controllers (PLC) vendors follows this standard, although each programming tool adds particularities and stores the automation project in different manner. But, although they may use the same software model and the same programming languages, source code reuse is not available. This work presents an infrastructure that allows transferring source code from one PLC programming tool to any other transparently to the users. The proposal consists of a textual expression of the software model and the programming languages, as well as the mechanisms, based on XML technologies, to achieve tool interoperability.

11:30-11:50 WeA27.4
Towards the Conformance Analysis of IEC 61131-3 PLC Programming Tools, pp. 8467-8472
Estévez, Elisabet | Univ. del País Vasco
Marcos, Marga | Univ. del País Vasco
Sarachaga González, MŞ Isabel | Faculty of Engineering, Univ. of the Basque Country
Burgos, Arantzazu | E.U.I.T.I. de Bilbao, Univ. of the Basque Country

Industrial Process Measurement and Control Systems are used in most of the industrial sectors to achieve production improvement, process optimization and time and cost reduction. Integration, reuse, flexibility and optimization are demanded to adapt to a rapidly changing and competitive market. In fact, standardization is a key goal to achieve these goals. The international standardization efforts have lead to the definition of the IEC 61131 standard. Part 3 of this standard defines a software model for defining automation projects as well as 5 programming languages. Nowadays, a major part of Programmable Logic Controllers (PLC) vendors follows this standard, although each programming tool adds particularities and stores the automation project in different manner. This work presents an approach for analyzing the conformance to the IEC 61131-3 standard of a programming tool. The conformance analyser is designed at different levels, covering the data types, programming languages and software architecture. Besides, within each level of conformance, different sublevels can be certified.

11:50-12:10 WeA27.5
A Review of Matlab's SISOTOOL; Features and Contributions to Control Education, pp. 8473-8474
Tan, Chee Pin | Monash Univ.
Teoh, Kok Soo | Monash Univ.
Jones, Lim Jen Nee | Monash Univ. Sunway Campus Malaysia

'SISOTOOL' is one of the latest features in the Control System Toolbox in Matlab that enables software-based controller design for single-input-single-output (SISO) systems. This paper provides a review of SISOTOOL, in particular its features that contribute to Control education, which will be useful to the academic community in teaching Control at undergraduate level.

12:10-12:30 WeA27.6
Middleware for Control Kernel Implementation in Embedded Control Systems, pp. 8475-8480
Fernández, Adel | CUJAE, Havana, Cuba
Valles, Marina | Assistant Professor
Crespo, A. | Univ. Pol. de Valencia
Albertos, Pedro | Univ. Pol. de Valencia
Simo, Jose | Univ. Pol. de Valencia

Control tasks require a number of activities, not all of them with the same relevance and priority. The critical subtasks constitute what is denoted as the control kernel. The design of ECS should be structured, with a kernel unit providing the most basic features. Most of these activities, such as data acquisition or control action delivering, are common to a number of control loops implemented in the same CPU. In this paper, the architecture of a middleware (MW) for essential control activities to ensure economic, safe and reliable operation is discussed. It is specially designed for control purposes, interacting with the peripherals (sensors, actuators and communication channels), with the OS, and exchanging information with the bunch of control algorithm implemented in the application area. As part of the facilities of the middleware, some issues for improving in a transparent manner these characteristics are considered. Finally, an example of controller implementation by using this middleware is presented.

WeA28 330A

Engine Modelling (Regular Session)

Chair: Rizzo, Gianfranco — Univ. of Salerno
Co-Chair: Corde, Gilles — IFP

10:30-10:50 WeA28.1

Modelling, Parameter Identification and Dynamics Analysis of a Common Rail Injection System for Gasoline Engines, pp. 8481-8486

Corno, Matteo — Pol. di Milano
Savaresi, Sergio — Pol. di Milano
Scattolini, Riccardo — Pol. di Milano
Comignaghi, Emilio — FIAT Powertrain Tech. SPA
Palma, Antonio — Elasis SPA
Sofia, Marco — FIAT Powertrain Tech. SPA
Sepe, Eduardo — Elasis - Fiat Powertrain Tech.

The topic of this paper is the modelling, parameter estimation and analysis of a common rail direct injection system of a gasoline engine. After a brief description of the system, an analytical first-principles simulator is developed. Model parameters are identified and the simulator is validated using real data. It is shown how this approach can be useful to make a “virtual” (simulator-based) definition of the system by discussing trade-offs in the choice of several parameters of the injection system. In this work mechanics, fluid dynamics, and control algorithms are analyzed as a whole, in a genuine and modern “co-design” approach.

10:50-11:10 WeA28.2

Modelling and Control of the Air System of a Turbocharged Gasoline Engine, pp. 8487-8494

Moulin, Philippe — IFP
Chauvin, Jonathan — IFP
Youssef, Bilal — INPG

This paper investigates the modelling and the control of a turbocharged air system of a gasoline engine. The purpose of the work described here is to propose a new control strategy based on an original physical model of the system. This first part describes the development of a simple model of the system. Based on a complete representation of the system, some simplifications and assumptions are proposed in order to obtain a model with the adequate level of complexity for an integration in a control law. We describe a model based innovative control strategy. Experimental results are proposed on a 4 cylinder turbocharged gasoline engine. Conclusions stress the possibility of taking into account the model of this system by a simple, yet efficient in practice, control law.

11:10-11:30 WeA28.3

Air Mass Flow Analysis for SI Engine: EGR and Scavenging, pp. 8495-8500

Palma, Antonio — Elasis SPA
Palladino, Angelo — Univ. degli Studi del Sannio
Fiengo, Giovanni — Univ. degli Studi del Sannio
De Cristofaro, Ferdinando — Elasis
Garofalo, Fabio — Elasis S.C.p.A.
Glielmo, Luigi — Univ. of Sannio

In order to lower the Nitrogen Oxides (NOx) concentration in internal combustion engine emissions and to improve performance, Exhaust Gas Recirculation (EGR) and Scavenging mechanism are introduced. EGR recirculates a fraction of the exhaust gas back into the cylinders, thus diluting the intake air. This lowers the maximum combustion temperature and, since the formation of NOx is heavily dependent on temperature, it results in a reduction of NOx concentration. Similarly, the Scavenging phenomenon is the air mass flowing from intake manifold directly to exhaust manifold, due to an overlap of intake and exhaust valves, without participating at the combustion. In this paper, the authors present a mean value engine model, aimed at the challenging purpose of the analysis of EGR and Scavenging. The model is based on an innovative approach for engine dynamics conceived mainly on the analogy with electric systems.

11:30-11:50 WeA28.4

Real-Time Combustion Parameters Estimation for HCCI-Diesel Engine Based on Knock Sensor Measurement, pp. 8501-8507

Chauvin, Jonathan — IFP
Grondin, Olivier — Inst. Français du Pétrole
Nguyen, Emmanuel — IFP
Guillemin, Fabrice — IFP

Future internal combustion engine technologies require an accurate combustion monitoring and control. This can be performed through high frequency recordings of cylinder pressure. However, this solution is limited by the sensor cost and reliability. Another method consist in reconstructing combustion related variables from indirect measurements. In this paper, we propose a combustion indicator estimation method from the vibration trace of the engine block recorded with a standard knock sensor. The relevance of such a method is demonstrated through experimental results on an HCCI engine application.

11:50-12:10 WeA28.5

Recurrent Neural Networks for Air-Fuel Ratio Estimation and Control in Spark-Ignited Engines, pp. 8508-8513

Sorrentino, Marco — Univ. of Salerno
Arsie, Ivan — Univ. of Salerno
Pianese, Cesare — Univ. OF SALERNO
Rizzo, Gianfranco — Univ. of Salerno
Di Iorio, Silvana — Univ. of Salerno

The paper focuses on the experimental identification and validation of recurrent neural network (RNN) models for air-fuel ratio (AFR) estimation and control in spark-ignited engines. Suited training procedures and experimental tests are proposed to improve RNN precision and generalization in predicting AFR transients for a wide range of operating scenarios. The reference engine has been tested by means of an integrated system of hardware and software tools for engine test automation and control strategies prototyping. The simulations performed on the test-sets show the ability of the RNN to reproduce the target patterns with satisfactory accuracy. Finally, real time implementation of RNN has been accomplished by developing and testing an inverse neural network controller acting on the injection time to limit AFR excursions from stoichiometry.

12:10-12:30 WeA28.6

Grey-Box Control Oriented Engine Emissions Models, pp. 8514-8519

Hirsch, Markus — Johannes Kepler Univ. Linz, Center of Mechatronics
Alberer, Daniel — Johannes Kepler Univ. Linz
Del Re, Luigi — Johannes Kepler Univ.

Further improvements of emission control will require reliable estimation of emissions in real time. While many progresses are being done in terms of physical sensors, there is a wide agreement that virtual sensors and more in general real time emission models will play a central role in the next steps. While there is a deep understanding of the physics of the regulated pollutants, most general emission models tend to be too complex and poorly parametrized to be used on-line, while most data based models tend to be either insufficiently precise or of limited scope. To avoid this problem, this paper proposes a combined approach in which static maps are identified numerically, but the effect of dominant factors, like cylinder-head temperature and air path dynamics, is included on the basis of physical assumptions. Differently from most models developed for sensors, this approach is based on pure engine control unit (ECU) data, i.e. can be used for the computation of optimal control laws. As the paper shows, this strategy is able to provide not only real time estimation of NOx as a function of the ECU outputs, but also of particulate matter (PM).

WeA29 330B

Accident Reduction and Fault Tolerant Systems (Regular Session)

Chair: Gissinger, Gerard — Univ. of Mulhouse
Co-Chair: Gaspar, Peter — Computer & Automation Inst. of HAS

10:30-10:50 WeA29.1

Development of a Collision Avoidance Algorithm Using Elastic Band Theory, pp. 8520-8525

Ararat, Oncu — Istanbul Tech. Univ.
Aksun Guvenc, Bilin — Istanbul Tech. Univ.

This paper presents a new Collision Avoidance (CA) Algorithm which uses Elastic Band Theory. Researchers tried to develop warning systems to avoid collisions which warn drivers of possible collision risk with audio and or visual signs. However, these systems are not sufficient for avoidance of a collision in situations where the driver gives no response to the warnings. CA System is a kind of Active Safety System which takes control of the vehicle for a couple of seconds and applies emergency maneuver when the collision is unavoidable through driver action alone. The proposed CA algorithm uses Elastic Band Theory which is an obstacle avoidance method used in robotics. This paper aims to introduce this theory applied with modifications to road vehicle based systems and presents realistic simulation results using high fidelity vehicle models with several different collision scenarios.

10:50-11:10 WeA29.2

Analytical Study of Human Errors Causing Traffic Accidents from the View Point of Consciousness Transition, pp. 8526-8531

Yamada, Kiichi Hyundai Motor Japan R&D Center
Suzuki, Keisuke Daido Inst. of Tech.
Minakami, Yumie Hyundai Motor Japan R&D Center

The major human errors that have proven to be key factors in 80 to 90% of all traffic accidents include “distraction,” taking one’s eyes off the road while driving; “inattentiveness,” switching one’s consciousness from driving to other things; and “false perception” causing recognition mistakes in traffic due to visual illusions. To study human errors causing traffic accidents we evaluated evasive reaction time to an outside dangerous event under distraction and tried to analyze accident probability using reaction time, etc. The analysis integrates drivers’ evasive reaction time to dangerous events with variations in driving performance caused by the state transition of driver’s consciousness. Further more we estimate effectiveness of a warning system to the distraction.

11:10-11:30 WeA29.3

Control Concept for Forward Collision Warning and Mitigation, pp. 8532-8533

Hong, Daegun MANDO Corp.
Kang, Hyoung-Jin Mando Corp.
Yoon, Paljoo Mando Corp.

The forward collision warning and mitigation system is one of the key technologies for the active safety passenger cars. In this system, the false warning or false actuation caused by the misjudgment of the collision risk is fatal to the system reliability. Therefore, the system should be designed to minimize the false operation and maximize the system performance. This paper describes the control concept for the collision warning and mitigation system. The control concept includes the control strategy, system structure and hazard assessment method. Each element of the proposed concept is designed to satisfy the above system requirements.

11:30-11:50 WeA29.4

Sliding Mode Observer Based Predictive Fault Diagnosis of a Steer-By-Wire System, pp. 8534-8539

Hasan, Mohammad Sharif-ul Cummins, Inc.
Anwar, Sohel Purdue School of Engr. & Tech.

This paper presents a nonlinear observer and prediction based analytical redundancy for a Steer-By-Wire (SBW) system. A Sliding Mode Observer was designed to estimate the vehicle steering angle by using the combined linear vehicle model, SBW system, and the yaw rate feedback. The estimated steering angle along with the current input was used to predict the steering angle at various prediction horizons via a long range prediction method. This analytical redundancy methodology was utilized to reduce the total number of redundant road-wheel angle (RWA) sensors, while maintaining a high level of reliability. The Fault Diagnosis algorithm was developed using a majority voting scheme, which was then used to detect faulty sensor(s) in order to maintain safe drivability. The proposed observer-prediction based fault detection algorithms as well as the linearized vehicle model were modelled in MATLAB-SIMULINK. Two different fault types were used to evaluate the effectiveness of the proposed algorithms: persistent, and incipient faults. Simulation results show that the faulty sensor identification time decreases with the increase of prediction horizon illustrating advantages of the predictive analytical redundancy based algorithms against single point faults.

11:50-12:10 WeA29.5

A Fault-Tolerant Vehicle Control Design, pp. 8540-8545

Gaspar, Peter Computer & Automation Inst. of HAS
Szabo, Zoltan Hungarian Acad. of Sciences
Bokor, Jozsef Hungarian Acad. of Sciences

To improve the performance properties of heavy vehicles, i.e. to reduce the risk of rollovers, improve passenger comfort and road holding, a reconfigurable fault-tolerant control design of the active suspensions and the active brake is performed. However when a fault (loss in effectiveness) occurs at one of the suspension actuators a reconfiguration is needed in order to maintain the same performance level. The proposed reconfiguration scheme is based on an Hinf Linear Parameter Varying (LPV) method that uses the fault information as one of the scheduling variables. The LPV based control design and the operation of the control mechanism are demonstrated in a vehicle maneuver.

12:10-12:30 WeA29.6

Design, Tuning and Evaluation of Integrated ACC/CA Systems, pp. 8546-8551

Moon, Seung-Wuk Seoul National Univ.
Yi, Kyongsu Seoul National Univ.
Moon, Ilki Hyundai Motor Company

This paper describes design, tuning and evaluation of integrated Adaptive Cruise Control with Collision Avoidance (ACC/CA). The control scheme is designed to control the vehicle so that it would feel natural to the human driver during normal safe driving situations and to completely avoid rear-end collision in vehicle following situations. Driving situations are divided into safe, warning and dangerous mode and three different control strategies have been used depending on driving situations. The driving situations are determined using a non-dimensional warning index and time-to-collision. A confusion matrix method based on manual driving data is used to tune the control parameters of the integrated ACC/CA system. Using a simulation and a validated vehicle simulator, vehicle following characteristics of the controlled vehicle are compared to real-world manual driving radar sensor data. A Hardware-in-the-loop Simulation (HiLS) was developed and used for an evaluation of integrated ACC/CA System. Finally the integrated ACC/CA system is implemented in a real vehicle and has been tested in both safe traffic and the severe braking situation. It is shown that the proposed control strategy can provide with natural following performance similar to human manual driving in both high speed driving and low speed stop-and-go situations and can prevent the vehicle-to-vehicle distance from dropping to an unsafe level in a variety of driving conditions.

WeA30 330C

Intelligent Vehicles Navigation and Control I (Regular Session)

Chair: Hong, Keum-Shik Pusan National Univ.
Co-Chair: Mahony, Robert Australian National Univ.

10:30-10:50 WeA30.1

Moving Ground Target Tracking in Dense Obstacle Areas Using UAVs, pp. 8552-8557

Kim, Jongrae Univ. of Glasgow
Kim, Yoonsoo Univ. of Stellenbosch

Tracking moving ground targets using unmanned air vehicles(UAVs) has important applications in several areas. Keeping a close line of sight from a UAV to a target in a densely populated area is a challenging task because of many constraints. An algorithm for several UAVs to track a moving target cooperatively is proposed. From random samples on the ground and obstacles, a cost inversely proportional to chance to keep the target inside the camera field of view is defined. The centre of the flight path and the separation angles between UAVs along the circular flight path is optimally determined to minimise the cost. The efficiency of the algorithm is tested by Monte-Carlo simulations based on random scenario generators.

10:50-11:10 WeA30.2

Output Based Observation and Control for Visual Servoing of VTOL UAV's, pp. 8558-8563

Le Bras, Florent Delegation generale de l'armement
Hamel, Tarek Univ. de Nice Sophia Antipolis
Mahony, Robert Australian National Univ.

An Image-Based Visual Servo (IBVS) control strategy for stabilisation of Vertical Take-Off and Landing (VTOL) vehicles with respect to a fixed target is proposed. A visual feature based on the combination of the first order un-normalized spherical moment and the image length of the target image is considered. To avoid the lack of the measurement of the translational velocity of the camera and the thrust of the vehicle, a nonlinear observer-based visual servo controller is proposed. Local asymptotic stability of the system is

proved and an estimate of the basin of attraction for the closed-loop system is provided. Simulation results are finally presented to illustrate the performance of the control algorithm.

11:10-11:30 WeA30.3

MPC with Nonlinear H-Infinity Control for Path Tracking of a Quad-Rotor Helicopter, pp. 8564-8569

Raffo, Guilherme Vianna — Univ. de Sevilla
Ortega, M. G. — Univ. de Sevilla
Rubio, Francisco R. — Univ. de Sevilla

This paper presents a predictive and nonlinear robust control strategy to solve the path tracking problem for a quadrotor helicopter. The dynamic motion equations are obtained by the Lagrange-Euler formalism. The control structure is performed through a model-based predictive controller (MPC) to track the reference trajectory and a nonlinear H-infinity controller to stabilize the rotational movements. Simulations results in presence of aerodynamic disturbances and parametric uncertainty are presented to corroborate the effectiveness and the robustness of the proposed strategy.

11:30-11:50 WeA30.4

Using the Unscented Kalman Filter and a Non-Linear Two-Track Model for Vehicle State Estimation, pp. 8570-8575

Reif, Konrad — Berufsakademie Friedrichshafen, Univ. of CooperateEducation
Renner, Kerstin — Patentanwaltskanzlei von Kreisler Selting Werner
Saeger, Martin — RWTH Aachen

In order to evaluate the driving stability of a motor vehicle, the accurate determination of the vehicle sideslip angle is of significant importance. With the help of the sensor signals in today’s production vehicles, this state can only be determined with limited accuracy. We propose an algorithm for the determination and estimation of the vehicle state based on the Unscented Kalman Filter. In the described estimator a two-track model of the vehicle is used, which represents the road contact with the Pacejka’s Magic Formula tyre model.

11:50-12:10 WeA30.5

Aircraft Landing Control Based on CMAC and GA Techniques, pp. 8576-8581

Juang, Jih-Gau — National Taiwan Ocean Univ.
Lin, Wen-Pin — National Taiwan Ocean Univ.

This paper presents an intelligent control scheme that uses a cerebellar model articulation controller (CMAC) and genetic algorithms (GA) in aircraft automatic landing control and to make automatic landing systems (ALS) more intelligent. The proposed intelligent controller can act as an experienced pilot and guide the aircraft to a safe landing in severe turbulence environment. Current flight control law is adopted in the intelligent design. Tracking performance and adaptive capability are demonstrated through software simulation.

12:10-12:30 WeA30.6

Time-Varying Feedback Control of an Unmanned Autonomous Industrial Forklift, pp. 8582-8587

Tamba, Tua Agustinus — Pusan National Univ.
Hong, Keum-Shik — Pusan National Univ.
Tjokronegoro, Harijono A. — Bandung Inst. of Tech.

In this paper, the development of an unmanned autonomous forklift is discussed. A control architecture using vision, laser ranger finder, sonar, etc. for autonomous navigation is presented. The kinematics of a spin-turn mechanism is analyzed first, and then the obtained kinematics equations are transformed to the equations represented by path variables. These equations are nonlinear state equations to be used for control purpose. A time varying feedback control law via the chained form of Murray and Sastry (1993) is derived. The effectiveness of the proposed control law is examined through simulation.

WeB02 304A

Nonlinear Observers II (Regular Session)

Chair: Pascoal, Antonio M. — ISR-Inst. Superior Tecnico
Co-Chair: Oliveira, Paulo Jorge — Inst. Superior Técnico

14:00-14:20 WeB02.1

Unknown Input Observer Synthesis Method with Modified mathcal{H}_{infty} Criteria for Nonlinear Systems Using Sobolev Norms, pp. 8588-8593

Zemouche, Ali — Louis Pasteur Univ.
Boutayeb, Mohamed — Nancy Univ.

In this paper, we present an unknown input observer~(UIO) design method for a class of nonlinear systems in the presence of disturbances in both the dynamics of the system and the output. The main idea lies in the introduction of Sobolev norms to define a new criteria to study robustness of the observer. Contrarily to the classical mathcal{H}_{infty} criteria, this new criteria, called the emph{modified mathcal{H}_{infty} criteria}, allows to solve the problem of unknown input observer design in the presence of disturbances. Based on the Lyapunov stability theory and the modified mathcal{H}_{infty} criteria, new sufficient synthesis conditions are given in terms of Linear Matrix Inequalities (LMIs). To show the performances of the proposed method, we considered the problem of simultaneous synchronization and decryption in chaotic communication systems.

14:20-14:40 WeB02.2

Non-Linear Observer on Lie Groups for Left-Invariant Dynamics with Right-Left Equivariant Output, pp. 8594-8598

Bonnabel, Silvere — Univ. de Ličge
Martin, Philippe — Ec. des Mines de Paris
Rouchon, Pierre — ENSMP

We consider a left-invariant dynamics on an arbitrary Lie group. We show that it is possible, when the output map is right-left equivariant, to build non-linear observers such that the error equation is autonomous. The theory is illustrated by an inertial navigation example.

14:40-15:00 WeB02.3

A Nonlinear Observer for Rigid Body Attitude Estimation Using Vector Observations, pp. 8599-8604

Vasconcelos, José Fernandes — Inst. Superior Técnico
Silvestre, Carlos — Inst. Superior Tecnico
Oliveira, Paulo Jorge — Inst. Superior Técnico

This work proposes a nonlinear observer for attitude estimation on SO(3), exploiting the information of vector observations and biased angular rate measurements. It is shown that the attitude and bias estimation errors converge exponentially fast to the origin, for arbitrary angular velocity trajectories. The proposed attitude feedback law is an explicit function of the vector measurements and observer estimates, and convergence rate bounds are obtained using recent results for parametrized linear time-varying systems. The stability and convergence properties of the estimation errors are evidenced in simulation for time-varying angular velocities.

15:00-15:20 WeB02.4

Identification and Convergence Analysis of a Class of Continuous-Time Multiple-Model Adaptive Estimators, pp. 8605-8610

Aguiar, A. Pedro — Inst. Superior Tecnico
Hassani, Vahid — Inst. Superior Tecnico (IST)
Pascoal, Antonio M. — ISR-Inst. Superior Tecnico
Athans, Michael — Inst. Superior Tecnico

This paper discusses the identification and convergence, in a deterministic setting, of a class of Continuous-Time Multiple-Model Adaptive Estimators (CT-MMAE) for state-affine multiple-input-multiple-output systems with parametric uncertainty. The CT-MMAE is composed by a dynamic weighting signal generator and a bank of local continuous-time observers where each observer is designed using one element of a finite discrete model (parameter) set. The state estimate is generated by a weighted sum of the estimates produced by the bank of observers and the parameter estimate is selected to be the one that corresponds to the weighted signal with the largest value. We show that under suitable persistent of excitation like conditions the model identified is the one that exhibits less output error "power". Furthermore, a distance-like metric between the true plant and the identified model is derived. We also provide conditions for convergence of the state estimation error and for L2 and L-infinity input-to-state stability. These deterministic continuous time results complement existing knowledge for stochastic discrete-time MMAE designs.

15:20-15:40 WeB02.5

Asymptotically Optimal Nonlinear Filtering: Theory and Examples with Application to Target State Estimation, pp. 8611-8617

Çimen, Tayfun — ROKETSAN Missiles Industries Inc.
Merttopçuo_;lu, A. Osman — ROKETSAN Missiles Industries Inc.

The State-Dependent Riccati Equation (SDRE) filter, which is derived by constructing the dual of the well-known SDRE nonlinear regulator control design technique, has been studied in various papers, with mainly practical investigations of the filter. Until recently, theoretical aspects of the filter had not been fully investigated, leaving many unanswered questions, such as stability and convergence of the filter. The authors conducted an investigation of the conditions under which the state estimate given by this algorithm converges asymptotically to the first order minimum variance estimate given by the extended Kalman filter (EKF). Conditions for determining a region of stability for the SDRE filter were also investigated. The analysis was based on stable manifold theory and Hamilton-Jacobi-Bellman (HJB) equations. In this paper, the motivation for introducing HJB equations is justified with mathematical rigor, which is given by reference to the maximum likelihood approach to deriving the EKF. The application of the SDRE filter is then demonstrated on challenging examples to illustrate the theoretical aspects and design flexibility (additional degrees of freedom) of the algorithm when loss of observability is encountered. In particular, a realistic and detailed evaluation of the filter is carried out for the problem of target state estimation in an advanced tactical missile guidance application for analysis in the optimal guidance problem for air-air engagements using only passive sensor (angle-only) information. Simulation results are presented which show dramatic tracking improvement using the SDRE target tracker.

15:40-16:00 WeB02.6

Observer Forms for Perspective Systems, pp. 8618-8623

Dahl, Ola — School of Tech. and Society, Malmö Univ.
Wang, Yebin — Univ. of Alberta
Lynch, Alan Francis — Univ. of Alberta
Heyden, Anders — School of Tech. and Society, Malmö Univ.

Estimation of 3D position information from 2D images in computer vision systems can be formulated as a state estimation problem for a nonlinear perspective dynamic system. The multi-output state estimation problem has been treated by several authors using methods for nonlinear observer design. This paper shows that a perspective system can be transformed to two observer forms, and provides constructive methods for arriving at the transformations. These observer forms lead to straightforward observer designs. First, it is shown that using an output transformation, the system admits an observer form which leads to an observer with linear error dynamics. A second observer design is based on a time scaled block triangular form. Both designs assume a commonly used observability condition. The designs are demonstrated in simulation.

WeB03 304B

Output Feedback Sliding Mode Control (Regular Session)

Chair: Spurgeon, Sarah K. — Univ. of Leicester
Co-Chair: Kim, Kyung-Soo — Korea Advanced Inst. of Science and Tech.

14:00-14:20 WeB03.1

Stabilizability of Uncertain Switched Systems Via Static/Dynamic Output Feedback Sliding Mode Control, pp. 8624-8629

Lian, Jie — Northeastern Univ.
Dimirovski, Georgi Marko — Dogus Univ. of Istanbul
Zhao, Jun — The Australian National Univ.

The output feedback stabilizability problem of a class of uncertain switched systems is investigated using sliding mode control and a synthesis design solution derived. Firstly, a common sliding surface is constructed such that the system restricted to the sliding surface is asymptotically stable and completely invariant to matched and mismatched uncertainties under arbitrary switching. Secondly, static and dynamic output feedback variable structure controllers are designed that can drive the state of the switched system to reach the common sliding surface in finite time and remain them thereafter. A illustrative example is given to demonstrate the effectiveness of the proposed method.

14:20-14:40 WeB03.2

Sliding Mode Static Output Feedback Control for Uncertain Systems: A Polytopic Approach, pp. 8630-8635

Andrade Da Silva, Jose Manuel — Univ. of Leicester
Spurgeon, Sarah K. — Univ. of Leicester
Edwards, Christopher — Univ. of Leicester

This paper presents a sliding mode output feedback control design methodology based on LMI's under a polytopic perspective for a class of uncertain dynamical systems. Both matched and mismatched uncertainties are considered. The existence and reachability problems are formulated through a polytopic description and solved using LMI's. The proposed controller is static in nature. The reaching and sliding motion are guaranteed despite the presence of both matched and mismatched uncertainties. A simulation example is presented to demonstrate the effectiveness of the proposed approach.

14:40-15:00 WeB03.3

Output Feedback Control: A Robust Solution Based on Second Order Sliding Mode, pp. 8636-8641

Plestan, Franck — Ec. Centrale De Nantes-CNRS
Moulay, Emmanuel — Ec. Centrale de Nantes
Glumineau, Alain — Ec. Centrale Nantes
Cheviron, Thibault — DGA - CNRS

This paper proposes a new second order sliding mode output feedback controller. In the continuous case for which sampling frequency is supposed infinite, this controller uses only the output information and ensures desired trajectory tracking in a finite time in spite of uncertainties and perturbations. Moreover, in case of finite sampling frequency, it is shown that the controller needs also the sign of output time derivative to ensure the finite time convergence to an origin neighborhood.

15:00-15:20 WeB03.4

Static Output Feedback Sliding Mode Control for Time-Varying Delay Systems with Time-Delayed Nonlinear Disturbances, pp. 8642-8647

Yan, Xing-Gang — Univ. of Leicester
Spurgeon, Sarah K. — Univ. of Leicester
Edwards, Christopher — Univ. of Leicester

In this paper, a robust stabilization problem for a class of linear time-varying delay systems with disturbances is studied using sliding mode techniques. Both matched and mismatched disturbances, involving time-varying delay, are considered. The disturbances are nonlinear and have nonlinear bounds. A sliding surface is designed and the stability of the corresponding sliding motion is analysed based on the Razumikhin Theorem. Then a static output feedback sliding mode control with time-delay is synthesized to drive the system to the sliding surface in finite time. Simulation results show the effectiveness of the proposed approach.

15:20-15:40 WeB03.5

Discrete–time Output Feedback Sliding Mode Control of a Large Pressurized Heavy Water Reactor, pp. 8648-8653

Reddy, Datatreya — IIT Bombay
Park, Youngjin — KAIST
Bandyopadhyay, Bijnan — IIT Bombay
Tiwari, Akhilanand Pati — Bhabha Atomic Res. Centre

In this paper a novel method is presented to design a sliding mode spatial control for a large Pressurized Heavy Water Reactor (PHWR) using a new formulation of Multirate Output Feedback (MROF). In the new formulation of MROF, the outputs of the system should be some of the states of the system or system should be in special form. The non–linear model of PHWR including xenon and iodine dynamics is characterized by 70 state variables and 14 inputs and outputs each. Linear nodal model is obtained by linearizing the non–linear dynamic equations of the reactor about the full power operating point. The 14 outputs of the PHWR are the power levels in 14 zones, also these are the 14 states of the system. The PHWR model is perfectly suitable for the application of this new formulation in which the states of the system can be computed using reduced system matrix inversion. The PHWR is an ill–conditioned system and the computation of the states of the system using existing MROF require the larger matrix inversions which sometimes may not possible. The proposed approach avoids this difficulty and produces the similar result as it is produced by the existing technique. The proposed control method does not require state information of the system for feedback purposes and hence may be easier to implement. From simulation of the non–linear model of the reactor in representative transients, the proposed control scheme is found to be superior to other methods.

15:40-16:00 WeB03.6

Robust Static Output Feedback Sliding Mode Control Design Via an Artificial Stabilizing Delay, pp. 8654-8659

Seuret, Alexandre	Royal Inst. of Tech.
Edwards, Christopher	Univ. of Leicester
Spurgeon, Sarah K.	Univ. of Leicester
Fridman, E. M.	Tel-Aviv Univ.

It is well known that for uncertain linear systems, a static output feedback sliding mode controller can only be determined if a particular triple associated with the reduced order dynamics in the sliding mode is stabilizable. This paper shows that the static output feedback sliding mode control design problem can be solved for a broader class of systems if a known delay term is deliberately introduced into the switching function. Effectively the reduced order sliding mode dynamics are stabilized by the introduction of this artificial delay.

WeB04 308

Polynomial Design Methods (Invited Session)

Chair: Kucera, Vladimir	Czech Tech. Univ. in Prague
Co-Chair: Lampe, Bernhard P.	Univ. of Rostock
Organizer: Hromcik, Martin	Czech Tech. Univ.

14:00-14:20 WeB04.1

Sampled-Data Polynomial Modal Control of Linear Periodic Plants with Time-Delay (I), pp. 8660-8665

Lampe, Bernhard P.	Univ. of Rostock
Rosenwasser, Efim N.	Marine Tech. Univ. of Saint Petersburg

The paper deals with the problem of sampled-data polynomial modal control for a linear continuous-time periodic plant with delays at the input and the output of the sampled controller. It is assumed that the plant and the digital controller have the same period. The characteristic matrix of the closed-loop system is constructed. An algorithm is given for constructing the set of causal discrete-time controllers which place the modes of the closed system at given points of the complex plane.

14:20-14:40 WeB04.2

Real-Time 2DoF Control of a Quadruple Tank System with Integral Action (I), pp. 8666-8671

Herceg, Martin	Slovak Univ. of Tech. in Bratislava
Mikles, Jan	Slovak Tech. Univ.
Fikar, Miroslav	STU in Bratislava
Kvasnica, Michal	Slovak Univ. of Tech. in Bratislava
Cirka, Lubos	Slovak Univ. of Tech. Faculty of Chemical

In this paper we aim at polynomial synthesis of a two-degree-of-freedom (2DoF) controller with integral action for a coupled tank system using the Polynomial Toolbox. The main advantage of the proposed 2DoF controller is in computational savings compared to classical feedback design. It will be shown that the procedure leads to solving of two spectral factorizations where the closed loop poles are assigned with respect to given optimization weights. This makes the controller easy to tune. Moreover, experimental results show that desired tracking performance is fulfilled.

14:40-15:00 WeB04.3

Solving the Optimal PWM Problem for Odd Symmetry Waveforms (I), pp. 8672-8677

Kujan, Petr	Acad. of Sciences of the Czech Republic
Hromcik, Martin	Czech Tech. Univ.
Sebek, Michael	Czech Tech. Univ. in Prague

Optimal pulse width modulation (PWM) problem is an established method of generating PWM waveforms with low baseband distortion. In this paper we focused on computation of optimal switching angles of a PWM waveform for generating general odd symmetric waveforms with applications in control. We introduce an exact and fast algorithm with the complexity of only O(n^2) arithmetic operations. This algorithm is based on transformation of appropriate trigonometric equations for each harmonics to a polynomial system of equations that is transferred to a special system of power sums. The solution of this system is carried out by modification of Newton's identity via Pade approximation and orthogonal polynomials theory and property of symmetric polynomials. Finally, the optimal switching sequence is obtained by computing the zeros of two orthogonal polynomials in one variable.

15:00-15:20 WeB04.4

Algebraic Approach to LQ-Optimal Control of Spatially Distributed Systems: 2-D Case (I), pp. 8678-8683

Augusta, Petr	Acad. of Sciences of the Czech Republic
Hurak, Zdenek	Centre For Applied Cybernetics, Czech Tech. Univ.

In this paper we develop new results on control systems design for spatially distributed linear systems using an n-D systems approach. The basic ideas are explained using as an example heat conduction in a rod where the measurements and control action applied are based on an array of sensors and heaters. The first part of the analysis given shows how the process dynamics for this case can be approximately described by a 2-D transfer-function, i.e. a fraction of two bivariate polynomials. This is followed by stability analysis and tests. Finally, a simple algorithm for design of LQ controller is proposed.

15:20-15:40 WeB04.5

Stability Analysis and Design for Polynomial Nonlinear Systems Using SOS with Application to Aircraft Flight Control, pp. 8684-8689

Zhao, Dan	Nanyang Tech. Univ.
Wang, Jian Liang	Nanyang Tech. Univ.

In this paper, aircraft with control surface impairment faults is modelled as a set of affine parameter-dependent nonlinear systems with polynomial vector fields. Based on the Lyapunov stability theorem, sufficient conditions to test the stability of the closed-loop system are presented. The synthesis problem of stabilizing feedback controllers to enlarge the region of attraction is converted to an optimization problem based on sum-of-squares polynomial. Design and simulation results for the longitudinal model of an F-8 aircraft are presented to illustrate the effectiveness of proposed approach.

15:40-16:00 WeB04.6

A Technique of a Stability Domain Determination for Nonlinear Discrete Polynomial Systems, pp. 8690-8694

Benhadj Braiek, Naceur	Ec. Pol. de Tunisie
Jerbi, Houssem	Ec. Pol. de Tunisie
Bacha, Anis	Ec. Pol. de Tunisie

This paper is devoted to the asymptotic stability region estimation for nonlinear discrete polynomial systems. An algebraic method is derived for the enlargement of the guaranteed stability region in which the asymptotic stability is ensured. The advantages of the proposed method are the accuracy of determination of the largest stability boundary, its numerical and theoretical robustness and its applicability to wide classes of dynamical discrete systems. A numerical example illustrates the proposed method.

WeB05 307

Controller Constraints and Structure II (Regular Session)

Chair: Sandberg, Henrik	Royal Inst. of Tech. (KTH)
Co-Chair: Rodellar, Jose	Tech. Univ. of Catalonia

14:00-14:20 WeB05.1

Effect of Time-Delay on the Derivative Feedback Control of a 2-Degree-Of-Freedom Torsional Bar with Parameter Perturbations, pp. 8695-8700

Han, Qing-Long	Central Queensland Univ.
Yu, Xinghuo	RMIT Univ.
Feng, Yong	Harbin Inst. of Tech.
Chen, Guanrong Ron	City Univ. of Hong Kong

This paper is concerned with the derivative feedback control of a 2-degree-of-freedom (2-DOF) torsional bar with parameter perturbations. The time-delay is introduced into the controller and the maximum allowed time-delay bound is estimated by employing a discretized Lyapunov functional method. It is shown, through a numerical example with simulation results, that suitably introducing time-delay into the controller can indeed improve the performance of the stability of the closed-loop system.

14:20-14:40 WeB05.2

A Design Procedure for Overlapped Guaranteed Cost Controllers, pp. 8701-8706

Palacios, Francisco	Tech. Univ. of Catalonia (UPC)
Rodellar, Jose	Tech. Univ. of Catalonia
Rossell, Josep M.	Univ. Pol. de Catalunya

In this paper a quadratic guaranteed cost control problem for a class of linear continuous-time state-delay systems with norm-bounded uncertainties is considered. We will suppose that the systems are composed by two overlapped subsystems but the results can be easily extended to any number of subsystems. The main objective is to design overlapping guaranteed cost controllers with tridiagonal gain matrices for these kind of systems by using a linear matrix inequality (LMI) approach. With this idea in mind, we present a design strategy to reduce the computational burden and to increase the feasibility in the LMI problem. In this context, the use of so-called complementary matrices play an important role. A simple example to illustrate the advantages achieved by using the proposed method is supplied.

14:40-15:00 WeB05.3

Quantizer Design for Interconnected Feedback Control Systems, pp. 8707-8712

Zhai, Guisheng	Osaka Prefecture Univ.
Chen, Ning	Central South Univ.
Gui, Weihua	Central South Univ.

In this paper, we consider design of interconnected H_inf feedback control systems with quantized signals. We first assume that a decentralized state feedback has been designed for an interconnected continuous-time LTI system so that the closed-loop system is stable and a desired H_inf disturbance attenuation level is achieved, and that the subsystems' states are quantized before they are passed to the local controller. We propose a local-state-dependent strategy for updating the quantizers' parameters, so that the overall closed-loop system is asymptotically stable and achieves the same H_inf disturbance attenuation level. We then extend the result to the case of decentralized static output feedback where the measurement outputs are quantized, and propose a local-output-dependent strategy for updating the quantizers' parameters. Both the pre-designed controllers and the quantizers' parameters are constructed in a decentralized manner, depending on local information.

15:00-15:20 WeB05.4

Relations between Control Signal Properties and Robustness Measures, pp. 8713-8718

Larsson, Per-Ola	Lund Univ.
Hagglund, Tore	Professor

In this paper we consider control signal properties, such as maximum magnitude and activity, as well as system robustness measures. We derive an ideal controller and control signal for exponential disturbance rejection for a first order process with time delay. For the resulting closed-loop system, it is shown analytically that there are strong interconnections between robustness measures and control signal properties regarding load disturbance attenuation. The results imply that popular controller design methods implicitly take control signal properties into consideration.

15:20-15:40 WeB05.5

Control-Oriented Sensor/Actuator Location Measures for Active Noise Control, pp. 8719-8724

Sánchez-Peńa, Ricardo S.	Univ. Pol. de Catalunya
Cugueró, Miquel Ŕ.	Univ. Pol. de Catalunya (UPC)

In this work, a combination of measures to quantify sensor and actuator allocation according to performance, robustness and controller implementation criteria are defined. Their computation can be made with standard software, both for SISO and MIMO systems. A test is run on a simulated acoustic tube which validates the optimal measure against the best closed loop performance and lower controller order combination.

15:40-16:00 WeB05.6

Model Reduction of Interconnected Linear Systems Using Structured Gramians, pp. 8725-8730

Sandberg, Henrik	Royal Inst. of Tech. (KTH)
Murray, Richard M.	California Inst. of Tech.

The problem of structure-preserving model reduction of interconnected linear systems is considered in this paper. The problem is interesting because networked models often have high order, and standard model-reduction methods usually do not preserve interconnection structure. As a tool, balanced truncation and block-diagonal generalized controllability and observability Gramians are used. Block-diagonal generalized Gramians do not exist for all interconnected systems, but a class of systems that always has such Gramians is identified. Furthermore, it is shown how general interconnected systems can be associated with interconnected systems in this class. The block-diagonal Gramians are then used to compute the reduced models and also yield asymptotic a priori approximation error bounds and stability guarantees for the reduced models.

WeB06 310A

Infinite Dimensional Systems: Stabilization and Control

(Regular Session)

Chair: Guo, Bao-Zhu	The Chinese Acad. of Sciences
Co-Chair: Kugi, Andreas	Vienna Univ. of Tech.

14:00-14:20 WeB06.1

Backstepping Boundary Controllers and Observers for the Rayleigh Beam, pp. 8731-8736

Lertphinyovong, Jittichai	Chulalongkorn Univ.
Khovidhungij, Watcharapong	Chulalongkorn Univ.

We design an exponentially stabilizing feedback controller and observer for the Rayleigh beam using noncollocated measurement and actuation. Our strategy is to use a damping boundary feedback combined with a backstepping-like coordinate transformation to transform the system into an exponentially stable system. The same idea is used to design our observer. Simulation results are included to illustrate the performance of the closed-loop system.

14:20-14:40 WeB06.2

Approximate Stabilization of a Quantum Particle in a 1D Infinite Potential Well, pp. 8737-8742

Beauchard, Karine	Univ. Paris-Sud, France
Mirrahimi, Mazyar	INRIA Rocquencourt

We consider a non relativistic charged particle in a 1D infinite square potential well. This quantum system is subjected to a control, which is a uniform (in space) time depending electric field. It is represented by a complex probability amplitude, solution of a Schr ¨odinger equation on a 1D bounded domain, with Dirichlet boundary conditions. We prove the almost global approximate stabilization of the eigenstates by explicit feedback laws.

14:40-15:00 WeB06.3

Feedforward Control Design for the Inviscid Burger Equation Using Formal Power Series and Summation Methods, pp. 8743-8748

Wagner, Marc Oliver	Vienna Univ. of Tech.
Meurer, Thomas	Vienna Univ. of Tech.
Kugi, Andreas	Vienna Univ. of Tech.

This article presents a flatness–based approach to the trajectory planning and feedforward control problem for the inviscid Burger equation with and without an additional quadratic nonlinearity. It uses the property of formal power series parameterizability of the underlying partial differential equation and uniform Euler-summability of the resulting power series to derive a parameterization of the system state and the system input in terms of a flat output. The article thereby extends the application of the formal power series approach from parabolic to first–order hyperbolic distributed–parameter systems.

15:00-15:20 WeB06.4

Robust Regulation of Infinite-Dimensional Systems with Infinite-Dimensional Exosystems, pp. 8749-8754

Hamalainen, Timo	Tampere Univ. of Tech.
Pohjolainen, Seppo	Tampere Univ. of Tech.

In this paper a robust regulation problem for infinite-dimensional systems with infinite-dimensional exosystems is discussed. The exosystems considered in this paper have infinite number of eigenvalues on the imaginary axis and thus include periodic signals. It is shown that there exists a feedback controller which robustly regulates the class of signals generated by the exosystem and strongly stabilizes the closed-loop system. As far as the authors know, the result is new even for finite-dimensional systems.

15:20-15:40 WeB06.5

Boundary Output Feedback Stabilization of a One-Dimensional Wave Equation System with Time Delay, pp. 8755-8760

Guo, Bao-Zhu	Acad. of Math. and Syst. Sciences

Xu, Chengzhong Univ. Claude Bernard - Lyon1

The stabilization with time delay in observation and control represents extremely difficult mathematical challenges in distributed parameter systems control. It is well-known that the closed-loop stability achieved by some stabilizing output feedback laws is not robust for any small time delay. When this happens, it necessary to reconsider the stabilizing feedback control laws. We are concerned with a particularly interesting case: boundary output feedback stabilization of one-dimensional wave equation system for which the boundary observation suffers a time delay. This stabilization problem has been unsolved for over two decades. We construct an infinite-dimensional observer such that the estimation error converges exponentially to zero as time goes to infinity and we design a stabilizing state feedback law. Using the separation principle as in the finite dimensional cases, we show that the delay system is exponentially stabilized by the feedback law based on the estimated state.

15:40-16:00 WeB06.6

Strong Stabilization of a Non-Uniform SCOLE Model, pp. 8761-8766

Zhao, Xiaowei Imperial Coll. London
Weiss, George Tel Aviv Univ.

The SCOLE (NASA Spacecraft Control Laboratory Experiment) model is considered the best model for the coupled system consisting of a flexible beam with one end clamped and the other end linked to a rigid body. This model has been studied extensively, with most papers assuming that the flexible beam is uniform. In our study we allow the coefficients of the beam equation to vary with position, like in Guo [2002] which has considered the non-homogeneous structure of the beam. It has been proved that the exponential stabilization of the uniform SCOLE model is impossible to achieve by boundary feedback from the natural output signals (the speed and the angular velocity of the rigid body) (see Rao [1995]). Thus the non-uniform SCOLE model is not exponentially stabilizable in general, by using these signals. Although the exponential stabilization of the SCOLE model can be obtained by high order output feedback (see Guo [2002] and Rao [1995]), the corresponding closed-loop system is not well-posed. In addition, such a feedback is difficult to realize in practice. Thus we have to compromise for strong stabilization. Following a recent strong stabilization theorem for passive systems in Curtain and Weiss [2007], we have shown that the non-uniform SCOLE model is strongly stabilizable by static output feedback from either the speed or the angular velocity of the rigid body.

WeB07 310B

Optimal Control Theory II (Regular Session)

Chair: Lee, Kwang Soon Sogang Univ.
Co-Chair: Behera, Laxmidhar Indian Inst. of Tech. Kanpur

14:00-14:20 WeB07.1

Control of Multivariable Systems Using Modified Local Optimal Controller, pp. 8767-8772

Ashry, Mahmoud Univ. of manchester
Abou-Zayed, Usama Univ. of manchester
Breikin, Tim Univ. of manchester

In this paper, a modified local optimal control approach is proposed for multivariable systems. As for unknown plant dynamics, system identification must be performed to obtain a model based on which the local optimal controller is designed and implemented. The proposed method guarantee closed loop stability characteristic when dealing with non-minimum phase plant which is a considerable advantage over the original local optimal controller. In addition to computational efficiency and structure simplicity, experimental results on a lab-based test rig confirm the effectiveness and robustness of the proposed local optimal controller over a conventional genetically tuned PID.

14:20-14:40 WeB07.2

Formulas for Discrete Time LQR, LQG, LEQG and Minimax LQG Optimal Control Problems, pp. 8773-8778

Ainikkal, Shaiju Johny UNSW@ADFA
Petersen, Ian Richard Univ. of New South Wales - ADFA

The purpose of this paper is to provide a unified presentation of the formulas arising in the discrete-time finite-horizon linear Linear Quadratic Regulator problem, the Linear Quadratic Gaussian problem, the Linear Exponential of Quadratic Gaussian problem, and the minimax Linear Quadratic Gaussian problem. For these classes of optimal control problems, the paper presents formulas for optimal policies and optimal cost. This allows for a comparison between these different optimal control problems.

14:40-15:00 WeB07.3

Linear Quadratic Regulation for Continuous-Time Systems with Time-Varying Delay, pp. 8779-8784

Zhang, Huanshui Shandong Univ.
Wang, Wei Shenzhen Graduate School of Harbin Inst. of Tech.
Xie, Lihua Nanyang Tech. Univ.

In this paper we investigate the finite horizon linear quadratic regulation (LQR) problem for a linear continuous time system with time-varying delay in control input and a quadratic criterion. We assume that the time-varying delay is of a known upper bound, then the LQR problem is transformed into the optimal control problem for systems with multiple input channels, each of which has single constant delay. The purpose of this paper is to obtain an explicit solution to the addressed LQR problem via establishing a duality principle, which is applied to the optimal smoothing for an associated continuous time system with a multiple delayed measurement.

15:00-15:20 WeB07.4

A Suboptimal Controller Design Methodology for Input-Output Feedback-Linearizable Systems, pp. 8785-8790

Mohajerin Esfahani, Peyman Sharif Univ. and Tech.
Karimi-Ghartemani, Masoud Univ. of Toronto

This paper addresses suboptimal control of nonlinear systems which can be feedback-linearized from input to output. The case of input-to-state linearizable systems is also covered as a special case. The method is thus applicable to all nonlinear systems which can be partially linearized using the method of output-feedback linearization while having a stable internal (or zero) dynamics. The well-known LQR technique applied to the linearized system does not guarantee the suboptimality of the nonlinear system. This paper uses output feedback linearization technique to partially linearize the system and then designs an output-feedback for the feedback-linearized system in such a way that it ensures suboptimal performance of the original nonlinear system. The proposed method can optimize any arbitrary smooth function of states and input. The proposed controller is, however, suboptimal due to the facts that (1) the form of the controller is a linear static feedback of the linearized state, (2) the search algorithm may fall into a local extremum rather than a global, and (3) the calculated controller depends on the initial conditions. The method is successfully applied to control design of the longitudinal subsystem of a laboratory double-rotor helicopter and the results are discussed and compared with those of the LQR method.

15:20-15:40 WeB07.5

A New Iterative Procedure to Obtain H-Infinity, L-Infinity Optimal Regulators, pp. 8791-8796

Keviczky, Laszlo Hungarian Acad. of Sciences Comp. and Auto. Res. Inst.
Banyasz, Csilla Hungarian Acad. of Sciences

The sensitivity function in a generic two-degree of freedom (TDOF) control system can be decomposed into three major parts: design-, realizability- and modeling-loss. The paper investigates the optimality of the second term in infinite norm spaces and proposes a new iterative algorithm for the solution.

15:40-16:00 WeB07.6

Continuous-Time Single Network Adaptive Critic for Regulator Design of Nonlinear Control Affine Systems, pp. 8797-8802

Kumar, Swagat Indian Inst. of Tech. Kanpur
Padhi, Radhakant Indian Inst. of Science
Behera, Laxmidhar Indian Inst. of Tech. Kanpur

An optimal control law for a general nonlinear system can be obtained by solving Hamilton-Jacobi-Bellman equation. However, it is difficult to obtain an analytical solution of this equation even for a moderately complex system. In this paper, we propose a continuoustime single network adaptive critic scheme for nonlinear control affine systems where the optimal cost-to-go function is approximated using a parametric positive semi-definite function. Unlike earlier approaches, a continuous-time weight update law is derived from the HJB equation. The stability of the system is analysed during the evolution of weights using Lyapunov theory. The effectiveness of the scheme is demonstrated through simulation examples.

WeB08 310C
Optimization Based Controller Synthesis II (Regular Session)

Chair: Rakovic, Sasa V. ETH Zurich
Co-Chair: Sebe, Noboru Kyushu Inst. of Tech.

14:00-14:20 WeB08.1
Max-Min Optimal Control of Constrained Discrete-Time Systems, pp. 8803-8808

Baric, Miroslav Swiss Federal Inst. of Tech.
Rakovic, Sasa V. ETH Zurich
Besselmann, Thomas ETH Zurich
Morari, Manfred Swiss Federal Inst. of Tech.

This paper considers the optimal control problem for constrained discrete-time systems affected by measured and bounded disturbances and uncertainties in the underlying system equations. This problem setting leads to the sup-inf robust optimal control problems. Three classes of discrete-time systems permitting the characterization of the sup-inf value functions and robust optimal control policies are examined. The corresponding max-min optimal control problems are solved by using the dynamic programming.

14:20-14:40 WeB08.2
Robust Multi-Model Predictive Control Using LMIs, pp. 8809-8814

Falugi, Paola Supelec
Olaru, Sorin Supelec
Dumur, Didier Ec. Superieure d'Electricite

This paper proposes a novel robust predictive control synthesis technique for constrained nonlinear systems based on linear matrix inequalities (LMIs) formalism. Local discrete-time polytopic models have been exploited for prediction of the system behavior. This design strategy can be applied to a wide class of nonlinear systems provided a suitable embedding is available. The devised procedure guarantees constraint satisfaction and asymptotic stability. The proposed result extends previous works by allowing different local descriptions of nonlinearity and uncertainty and by handling less conservative input constraints. The multimodel prediction shows significant improvements in terms of closed-loop performance and estimation of the feasibility domain.

14:40-15:00 WeB08.3
Disturbance Rejection Control in Coordinated Systems, pp. 8815-8820

Kang, Keunmo Univ. of California San Diego
Zhang, David Univ. of California, San Diego
Bitmead, Robert Univ. of California San Diego

Coordinated system control with realistic disturbance is studied. We employ coordinated vehicles as an working problem. Vehicles attempt to keep a specified formation while avoiding collision in the presence of disturbance such as a wind gust. State estimators are used to estimate the self-states and the states of interacting vehicles via communication channels. Estimation performance is incorporated into control design and plays a central role in control performance. A numerical design approach is used to overcome limited knowledge about the disturbance and noises. A case study is given to demonstrate central ideas of the paper.

15:00-15:20 WeB08.4
New LMI Characterizations for Discrete-Time Descriptor Systems and Application to Multiobjetive Control System Synthesis, pp. 8821-8827

Sebe, Noboru Kyushu Inst. of Tech.

This paper presents new LMI characterizations for stability, H_2 and H_inf norms of discrete-time descriptor systems. Based on these characterizations, an iterative design procedure for multiobjective and structurally constrained feedback control are proposed. The first key idea of the iterative design procedure is embedding the previously designed feedback gain K^ in the descriptor representation of the closed-loop system. The second key idea of the iterative design procedure is linearizing the products terms of the actual controller parameter K and the auxiliary variables by the assignment of variables instead of the 'change of variables' technique.

15:20-15:40 WeB08.5
Design of Robust Quadratic-Optimal Controllers for Linear Multivariable Output Feedback PID Uncertain Control Systems, pp. 8828-8833

Chen, Shinn-Horng National Kaohsiung Univ. of applied sciences
Ho, Wen-Hsien National Kaohsiung First Univ. of Science andTechnology
Chou, Jyh-Horng National Kaohsiung First Univ. of Science andTechnology
Liu, Tung-Kuan National Kaohsiung First Univ. of ScienceandTechnology

By complementarily fusing the robust regional eigenvalue-assignability condition, the orthogonal-functions approach (OFA) and the hybrid Taguchi-genetic algorithm (HTGA), an integrative method is proposed in this paper to design the robust optimal eigenvalue-assignable output feedback PID (proportional-integral-derivative) controller such that (i) the eigenvalues of a linear multivariable uncertain closed-loop system can be retained inside the same specified region as the nominal closed-loop system does, and (ii) a quadratic finite-hoziron integral performance index for the linear nominal multivariable control system can be minimized. A design example of the robust optimal eigenvalue-assignable output feedback PID controller for an uncertain stirred tank system is given to demonstrate the applicability of the proposed integrative approach.

15:40-16:00 WeB08.6
Robust H_; Controller Design for Aircraft Lateral Dynamics Using Multi-Objective Optimization and Genetic Algorithms, pp. 8834-8839

Giacomán-Zarzar, Manuel ITESM, Campus Monterrey
Ramírez-Mendoza, Ricardo A. ITESM Campus Monterrey
Fleming, P.J. Univ. of Sheffield
Griffin, Ian Rolls-Royce
Molina-Cristobal, Arturo The Univ. of Sheffield

Two techniques are combined during the design of an optimal controller: Linear Matrix Inequalities (LMIs) and Multi-objective Genetic Algorithms (MOGAs). In this paper the LMI optimization technique is used to obtain a single controller while MOGA is used to convert the controller design into a multi-objective optimization procedure. The combination of these techniques is proposed in this document and is shown to be advantageous against independent application of the aforementioned techniques. It is also presented how the sensitivity and complementary sensitivity functions are shaped with the weighting functions, while restricting the magnitude of the control signals by adding them as a hard objective in the MOGA approach.

WeB09 311C
Subspace-Based System Identification (Regular Session)

Chair: Chiuso, Alessandro Univ. of Padova
Co-Chair: McKelvey, Tomas Chalmers Univ. of Tech.

14:00-14:20 WeB09.1
Subspace Identification of a Class of Large-Scale Systems, pp. 8840-8845

Massioni, Paolo Delft Univ. of Tech.
Verhaegen, Michel Delft Univ. of Tech.

This article concerns the system identification of a class of large scale systems called "circulant systems". Circulant systems have a special property that allows them to be decomposed into simpler subsystems through a state transformation. This property has been used in literature for control design, and here we show how it can be used for system identification. The approach that is proposed here will both reduce the complexity of the problem as well as provide models which have a circulant structure that can be exploited for control design.

14:20-14:40 WeB09.2
A Subspace Method for Frequency Selective Identification of Stochastic Systems, pp. 8846-8851

McKelvey, Tomas Chalmers Univ. of Tech.
Atala, Hector Ericsson
Blanco Parada, David Ericsson

A parametric method for the estimation of vector valued stochastic systems or equivalently the spectrum of a stochastic process is presented. The key feature is that the method can be used to frequency selectively fit the model to the data. This means that parts of the spectrum can be modeled with a lower model order than otherwise would be necessary if the entire spectrum would be modeled. The method is based on a frequency domain subspace method which delivers a state-space model. It explicitly takes into account that the frequency domain data is derived from finite data and hence suppress the leakage effects. Furthermore the method employs convex optimization to guarantee that the estimated parametric model represents a non-negative spectrum.

14:40-15:00 WeB09.3

Estimation of the Uncertainty in a Helicopter Dynamic Model Identified by the Subspace-Based Method Using Bootstrap Techniques, pp. 8852-8859

Li, Ping	Univ. of Leicester
Postlethwaite, Ian	the Univ. of Leicester
Turner, Matthew C.	Univ. of Leicester

Knowledge of the uncertainty in an identified model is of great importance, in particular for robust controller design. This paper presents a method for estimating the uncertainty in a state-space helicopter dynamical model identified from the subspace-based method using bootstrap techniques. Computer simulations are carried out to illustrate the operation and performance of the method using concatenated data sets generated from an unmanned rotorcraft model. The results obtained are in good agreement with those from conventional Monte Carlo simulations demonstrating the effectiveness of the method.

15:00-15:20 WeB09.4

Thermodynamic Identification of Buildings Using Wireless Sensor Networks, pp. 8860-8865

Toffoli, Elena	Univ. di Padova
Baldan, Giancarlo	Univ. of padua
Albertin, Guido	Univ. di Padova
Schenato, Luca	Univ. of Padova
Chiuso, Alessandro	Univ. of Padova
Beghi, Alessandro	Univ. di Padova

In this paper we study different strategies for identifying thermodynamic models of buildings using experimental data collected from large scale wireless sensor networks. Wireless sensor networks can easily provide temperature, humidity and solar radiation measurements from tens to hundreds of sensors, thus potentially providing a fine-grained spatial-temporal resolution. In order to cope with such a large number of inputs and outputs, we tested subspace identification algorithms which are suitable for identifying large scale MIMO systems. The identified model can be used to evaluate the thermodynamic efficiency of the building. We also explore different sensor selection strategies in order to choose among all sensors the most informative ones. Using a small set of sensors not only greatly reduces computational burden in the identification algorithms, but can also be used to predict with high accuracy the measurements of the other sensors using Kalman filters. The identification algorithms, the sensor selection strategies, and the Kalman filter adopted have been tested and compared using experimental data collected from 65 sensors deployed in a 80m2 _; 200m3 building over an 11 day period.

15:20-15:40 WeB09.5

Closed Loop LPV Identification of the Time-Varying Dynamics of a Variable Speed Wind Turbine, pp. 8866-8871

Wingerden, van, Jan-Willem	Delft Univ. of Tech.
Houtzager, Ivo	Delft Univ. of Tech.
Felici, Federico	EPFL
Verhaegen, Michel	Delft Univ. of Tech.

In this paper we present a closed-loop LPV identification algorithm that uses a periodic scheduling sequence to identify the rotational dynamics of a wind turbine. In the algorithm we assume that the system undergoes the same time variation several times, which make it possible to use time-invariant identification methods since the input and output data are chosen from the same point in the variation of the system. We use closed-loop time-invariant techniques to identify a number of extended observability matrices and state sequences that are, inherent to subspace identification, identified in a different state basis. We show that by formulating an intersection problem all the states can be reconstructed in a general state basis from which the system matrices can be estimated. The novel algorithm is applied on a wind turbine model operating in closed loop.

15:40-16:00 WeB09.6

Recursive Subspace Model Identification Based on Vector Autoregressive Modelling, pp. 8872-8877

Wu, Ping	Zhejiang Univ.
Yang, ChunJie	Zhejiang Univ.
Song, Zhi-Huan	Zhejiang Univ.

Recursive subspace model identification (RSMI) has been developed for a decade. Most of RSMIs are only applied for open loop data. In this paper, we propose a new recursive subspace model identification which can be applied under open loop and closed loop data. The key technique of this derivation of the proposed algorithm is to bring the Vector Auto Regressive with eXogenous input (VARX) models into RSMI. Numerical studies on a closed loop identification problem show the effectiveness of the proposed algorithm.

WeB10 311B

Fault Detection II (Regular Session)

Chair: Basseville, Michčle	CNRS-IRISA
Co-Chair: Kim, Yoonsoo	Univ. of Stellenbosch

14:00-14:20 WeB10.1

Fault-Tolerant Cooperative Target Tracking in Distributed UAV Networks, pp. 8878-8883

Kim, Yoonsoo	Univ. of Stellenbosch
Gu, Dawei	Univ. of Leicester
Postlethwaite, Ian	the Univ. of Leicester

In this paper, we propose a target tracking scheme for operation in distributed UAV networks in which sensors may read the target position incorrectly. The proposed scheme operates two algorithms concurrently: semi-decentralized dynamic data fusion and fault detection. The semi-decentralized dynamic data fusion algorithm employs a median-consensus algorithm using extended non-faulty neighbours (whose sensor readings for the target position are within a prescribed tolerance level) and subsequently makes local estimates of the target position converge to nearly the actual target position. Meanwhile, the fault detection algorithm first asks each UAV to find the global median of the local target position through extended neighbours, and then diffuses the determined global median to all the UAVs in the network. As a result, the fault detection algorithm allows UAVs to detect and isolate faulty sensors quickly and to carry on target tracking in the semi-decentralized dynamic data fusion mode. As opposed to existing target tracking schemes, the proposed scheme is deterministic and guarantees the complete detection and isolation of faulty sensors on UAVs and thus successful target tracking. Numerical examples are provided to support the developed ideas.

14:20-14:40 WeB10.2

Fault Detection of Networked Control Systems with Packet Dropout, pp. 8884-8889

Wang, Yongqiang	Tsinghua Univ.
Ding, Steven X.	Univ. of Duisburg-Essen
Zhang, Ping	Univ. of Duisburg-Essen
Li, Wei	Univ. of Duisburg-Essen
Ye, Hao	Tsinghua Univ.
Wang, Guizeng	Tsinghua Univ.

Fault detection of networked control systems with packet dropouts in both sensor- to-controller link and controller-to-actuator link is discussed in this paper. Two types of packet dropouts are considered. One is packet dropout characterized by a Bernoulli process, the other is characterized by a Markov chain. According to the system configuration, packet dropout in the sensor-to-controller link is known to the fault detection system, therefore a time varying parity space based residual generator which is fully decoupled from this influence is designed. Robustness to packet dropout in the controller-to-actuator link which is unknown is achieved by an adaptive threshold. Due to the known probability properties of the residual signal in parity space approach, upper bounds of false alarm rates of the designed thresholds are also given, which are very difficult to obtain in existent observer based fault detection approaches of networked control systems with packet dropout. It is verified that the proposed fault detection approach can also be realized by diagnostic observers by employing the relationship between parity vectors and observers.

14:40-15:00 WeB10.3

Information Based Fault Diagnosis, pp. 8890-8895

Niemann, Henrik	Tech. Univ. of Denmark
Poulsen, Niels K.	The Tech. Univ. of Denmark

Fault detection and isolation, (FDI) of parametric faults in dynamic systems will be considered in this paper. An active fault diagnosis

(AFD) approach is applied. The fault diagnosis will be investigated with respect to different information levels in the external inputs to the systems. These inputs are disturbance inputs, reference inputs and auxiliary inputs. The diagnosis of the system is derived by an evaluation of the signature from the inputs in the residual outputs. The changes of the signatures from the external inputs are used directly for detection and isolation of parametric faults.

15:00-15:20 WeB10.4

Process Fault Monitoring Using Data Fusion Based on Extended Kalman Filter Incorporated with Time-Delayed Measurements, pp. 8896-8901

Mosallaei, Mohsen — Petroleum Univ. of Tech. (PUT)
Salahshoor, Karim — petroleum Univ. of Tech.

A model-based process fault monitoring approach is proposed in this paper which utilizes a multi-sensor data fusion technique. The fusion algorithm is based on a discrete-time extended kalman filter (EKF). The presented EKF is modified to incorporate the asynchronous sensor measurements. The resulting approach will be evaluated for a variety of conditions including synchronous/asynchronous measurements, full-state and non full-state measurements and time-varying dynamics for monitoring single, double, triple and quadruple process faults. The simulation studies on a CSTR benchmark problem demonstrate the effectiveness of the proposed fault monitoring approach to deal with different circumstances.

15:20-15:40 WeB10.5

Disturbance Attenuation and Fault Detection Via Zero-Pole Assignment: A Dynamic Observer Approach, pp. 8902-8907

Dai, Xuewu — Univ. of Manchester
Gao, Zhiwei — The Univ. of Manchester
Breikin, Tim — Univ. of manchester
Wang, Hong — the Univ. of Manchester

In this paper, a zero-pole assignment approach is proposed for disturbance attenuation in dynamic fault detection observer design. The properties of dynamic observers are analysed and it is shown that the poles of a dynamic observer can be shifted and the additional zeros can be assigned arbitrarily. Then, a novel pole-zero assignment approach is proposed and its application to a continuous system is presented. In the simulation, the disturbances are low-frequency signals (<1 text{Hz}), which is more difficult to be attenuated compared to high-frequency disturbances. The dynamic observer shows the capabilities to attenuate such low-frequency disturbances. The zeros assignment in observer design would be the main contribution of this paper.

15:40-16:00 WeB10.6

Fault Detection and Isolation for Nonlinear Systems with Full State Information, pp. 8908-8912

Wang, Wei — Beihang Univ.
Yang, Bo — Beihang Univ.
Zhou, Kemin — Lousiana State Univ.
Ren, Zhang — Beihang Univ.

This paper considers robust fault detection for nonlinear systems with full state information. We propose and solve a multi-objective fault detection criterion by maximizing the smallest singular value of the transformation from faults to fault detection residuals while decoupling/or minimizing the largest singular value of the transformation from disturbance to the fault detection residuals.

WeB11 311A

Robust Adaptive Control (Regular Session)

Chair: Lin, Wei — Case Western Res. Univ.
Co-Chair: Blazic, Saso — Univ. of Ljubljana

14:00-14:20 WeB11.1

A New Leakage Term in the Adaptive Law, pp. 8913-8918

Blazic, Saso — Univ. of Ljubljana
Skrjanc, Igor — Univ. of Ljubljana
Matko, Drago — Univ. of Ljubljana

The hyperstability theory of adaptive control systems is extended to encompass plants with unmodelled dynamics and disturbances. The analysis not only shows that leakage in the adaptive law is a natural way to avoid robustness problems (which is a known result in adaptive control theory), but also provides a new adaptive law that is a sort of signal-dependent sigma-modification. The proposed adaptive law is less conservative than the sigma-modification, but still ensures the global stability of the system, which is formally proven in the paper. Since it is shown that the design parameter sigma' of the proposed adaptive law is directly related to the H-infinity norm of the parasitic dynamics, the criteria for system stability are derived. Based on these, some guidelines for choosing the leakage parameter sigma' and the bandwidth of the reference model are presented.

14:20-14:40 WeB11.2

An Adaptive H-Infinity Control for Robotic Manipulator with Compensation of Input Torque Uncertainty, pp. 8919-8924

Sato, Kazuya — Saga Univ.

This paper examines the problem of link position tracking control for robot manipulators with input toque uncertainty. It is assumed that the input torque uncertainty can be regarded as dead-zone phenomena at each link of manipulator and all the system parameters for robotic manipulator and dead-zone model are unknown. The proposed method ensures that the unknown parameters are estimated adaptively, besides, an approximated errors of input nonlinearities and external disturbances are attenuated by means of H_inf control performance. In spite of considering the nonlinear adaptive H_inf control problems, based on our proposed method, the compensator can design without solving the Hamilton-Jacobi-Isaacs equation. Numerical simulation results are given to illustrate the effectiveness of our proposed method.

14:40-15:00 WeB11.3

Unfalsified Virtual Reference Adaptive Switching Control of Plants with Persistent Disturbances, pp. 8925-8930

Battistelli, Giorgio — Univ. of Florence
Mosca, Edoardo — Univ. of Florence
Safonov, Michael G. — Univ. of Southern California
Tesi, Pietro — Univ. degli Studi di Firenze

This paper addresses virtual reference adaptive switching control whereby a datadriven supervisor aims at stabilizing an unknown time-invariant dynamic system by switching at any time in feedback with system one element from a finite family of candidate controllers. Under the only assumption of problem feasibility, viz. the controller family contains a stabilizing controller, the resulting switched system is shown to be stable against arbitrary exogenous persistent bounded disturbances.

15:00-15:20 WeB11.4

Semi-Global Robust Stabilization of a Family of Uncertain Nonlinear Systems by Non-Smooth Output Feedback: The Planar Case, pp. 8931-8936

Yang, Bo — Texas Tech. Univ.
Lin, Wei — Case Western Res. Univ.
Sun, Yuanzhang — Tsinghua Univ.

We present a preliminary result on robust semi-global stabilization via output feedback for a family of uncertain nonlinear systems which represent a generalized normal form of affine systems in the plane. The main contribution of this paper is to show that with only the knowledge of the bounding system of the uncertain planar system, it is possible to establish the semi-global stabilization result by nonsmooth output feedback, although the uncertain controlled plant is not in a triangular form, non-smoothly stabilizable and non-uniformly observable.

15:20-15:40 WeB11.5

Delay Independent Stabilization and ASC, pp. 8937-8942

Amemiya, Takashi — Setsunan Univ.

On the quadratic stabilization of uncertain linear time varying systems by means of linear state variable feedback, Wei introduced the concept of antisymmetric stepwise con_guration (ASC) and proved that having this con_guration is a necessary and su_cient condition for uncertain linear systems to be quadratically stabilizable by means of a linear state variable feedback. However, because his condition is constructed on the basis of quadratic lyapunov functions, his method is not applicable if the state variables contains delays. In this report the conditions for the delay independent stabilization so far obtained on the basis of delay di_erential inequalities is further developed and it is proved that generally to have ASC is also a su_cient condition for the delay independent stabilizability of linear uncertain delayed systems by means of linear state variable feedback.

15:40-16:00 WeB11.6

Self-Repairing and Adaptive Tracking for MIMO Systems with

Sensor Failures, pp. 8943-8948
Takahashi, Masanori — Tokai Univ.

This paper presents a new self-repairing control system (SRCS) for unknown stable multiple-input-multiple-output (MIMO) plants with sensor failures. The proposed method can automatically switch from the faulty sensors to the healthy ones if the sensor failures occur. Only the artificial test signals and the integrators are utilized to detect the sensor failures. Hence, the SRCS requires no mathematical model of the plant. Furthermore, the adaptive tracker is introduced not only to cope with uncertainties in parameters but also to eliminate the bias effects of the injected test signals.

WeB12 — 313
Reachability Computations for Hybrid Systems (Invited Session)
Chair: Gueguen, Herve — Supelec
Co-Chair: Bujorianu, Manuela — Univ. of Twente
Organizer: Gueguen, Herve — Supelec

14:00-14:40 — WeB12.1
Safety Verification and Reachability Analysis for Hybrid Systems (I), pp. 8949-8959
Gueguen, Herve — SUPELEC
Lefebvre, Marie-Anne — Supelec
Nasri, Othman — Supelec
Zaytoon, Janan — Univ. of Reims

Safety verification and reachability analysis for hybrid systems is a very active research domain. Many approaches that seem quite different, have been proposed to solve this complex problem. This paper presents an overview of various approaches for autonomous, continuous time hybrid systems and present them with respect to basic problems related to verification.

14:40-15:00 — WeB12.2
Reachability Computation for Hybrid Systems with Ariadne (I), pp. 8960-8965
Benvenuti, Luca — Univ. di Roma
Bresolin, Davide — Univ. of Verona
Casagrande, Alberto — Univ. of Udine
Collins, Pieter — CWI
Ferrari, Alberto — Parades Geie
Mazzi, Emanuele — PARADES
Sangiovanni-vincentelli, Alberto — Univ. of California at Berkeley
Villa, Tiziano — PARADES G.E.I.E.

Ariadne is an in-progress open environment to design algorithms for computing with hybrid automata, that relies on a rigorous computable analysis theory to represent geometric objects, in order to achieve provable approximation bounds along the computations. In this paper we discuss the problem of reachability analysis of hybrid automata to decide safety properties. We describe in details the algorithm used in Ariadne to compute over-approximations of reachable sets. Then we show how it works on a simple example. Finally, we discuss the lower-approximation approach to the reachability problem and how to extend Ariadne to support it.

15:00-15:20 — WeB12.3
Efficient Reachability Analysis for Linear Systems Using Support Functions (I), pp. 8966-8971
Girard, Antoine — Univ. Joseph Fourier
Le Guernic, Colas — VERIMAG

This work is concerned with the algorithmic reachability analysis of linear systems with constrained initial states and inputs. In this paper, we present a new approach for the computation of tight polyhedral over-approximations of the reachable sets of a linear system. The main contribution over our previous work is that it makes it possible to consider systems whose sets of initial states and inputs are given by arbitrary compact convex sets represented by their support functions. We first consider the discrete-time setting and then we show how our algorithm can be extended to handle continuous-time linear systems. Finally, the effectiveness of our approach is demonstrated through several examples.

15:20-15:40 — WeB12.4
Reachability Analysis of Uncertain Nonlinear Systems Using Guaranteed Set Integration (I), pp. 8972-8977
Ramdani, Nacim — INRIA
Meslem, Nacim — Univ. Paris XII
Candau, Yves — Univ. Paris XII

In this paper we show how to compute the reachable space for uncertain nonlinear continuous dynamical systems by using guaranteed set integration. We introduce two ways to do so. The first one is a full interval method which handles whole domains for set computation and relies on Taylor series and interval analysis. The second one relies on the theory of monotone dynamical systems and can be used with cooperative systems only but makes it possible to bracket the uncertain nonlinear system between two nonlinear dynamical systems where there is no uncertainty. In most cases, the bracketing systems derived are piecewise differentiable functions, hence cannot be directly integrated via interval Taylor models. Our contribution resides then in the use of hybrid automata to model the bounding systems. We give examples which show the potentials of both approaches in presence of parameter and input uncertainties.

15:40-16:00 — WeB12.5
Approximate Abstractions of Stochastic Hybrid Systems, pp. 8978-8983
Bujorianu, Manuela — Univ. of Twente
Bujorianu, Marius Constantin — Univ. of Twente
Blom, Henk A.P. — National Aerospace Lab. NLR

This paper considers the issue of developing approximate abstractions of stochastic hybrid systems. The stochastic continuous behaviour breaks many essential properties of hybrid automata. Our approach departs from the progress in stochastic reachability analysis and Markov chain approximations. For this purpose we have to introduce a new approximation scheme and look for a suitable metric. We construct an exponential timestepping approximation scheme for general Markov processes. This approximation scheme relies on the complex space of system trajectories involving a sensible choice of the metric. Fortunately, the Skorokhod metric is sly enough to overcome the problems.

WeB13 — 314
Applications of Stochastic Systems Theory (Regular Session)
Chair: James, Matthew R. — Australian National Univ.
Co-Chair: Cenedese, Angelo — Univ. of Padova

14:00-14:20 — WeB13.1
On the Estimation of Atmospheric Turbulence Layers, pp. 8984-8989
Beghi, Alessandro — Univ. di Padova
Cenedese, Angelo — Univ. of Padova
Masiero, Andrea — Univ. di Padova

The knowledge of the characteristics of the atmospheric turbulence is of fundamental importance in order to improve the performances of the adaptive optics systems in the next generation of telescopes. Starting from the statistical description of the turbulence, we derive a random field spatial model of the turbulent phase. Then we use this spatial statistical model to compute the spatial innovation. Finally, from the temporal covariances of the spatial innovation we estimate the number of the turbulence layers and their characteristics.

14:20-14:40 — WeB13.2
The Autocovariance Least Squares Technique for GPS Interference/Jamming Detection, pp. 8990-8995
Abdel-Hafez, Mamoun — American Univ. of Sharjah

In this paper, the Autocovariance Least Squares (ALS) technique is proposed for detecting the Global Positioning System (GPS) measurements' interference or jamming. The interference is modeled by a moderate increase in the measurements noise covariance matrix while jamming is modeled by a larger increase in the measurements noise covariance matrix. The method makes use of the dynamics of the system measured by an inertial measurement unit (IMU) and the propagated residual of an ultra-tightly coupled GPS/IMU Extended Kalman filter (EKF) to form a bank of statistics used to estimate the GPS measurement-noise covariance. Simulated scenarios of different levels of noise magnitude are applied and the proposed method is used to estimate the GPS pseudorange noise covariance matrix. Results are presented at the end of the paper to show the accuracy of the proposed algorithm. The algorithm presented in this paper is vital for high-integrity operation of autonomous navigation systems.

14:40-15:00 — WeB13.3
Multi-Loop Feedback Control for Atom Laser Coherence, pp.

8996-9001

Yanagisawa, Masahiro	Australian National Univ.
James, Matthew R.	Australian National Univ.

In this paper we present a multi-loop measurement feedback control scheme to improve atom laser coherence. The first loop (proposed by Thomsen and Wiseman, 2002) aims to cancel the decohering effects of the nonlinear atom-atom interactions via direct measurement feedback. However, there are nonlinear interactions with the optical probe field used in the measurement scheme which may also contribute to a degradation in atom laser performance. Accordingly, we introduce a second feedback loop to implement a LQG controller to reduce these effects. The multi-loop design achieves improved atom laser coherence.

15:00-15:20 WeB13.4

An Adaptive Sensor Fusion Method with Applications in Integrated Navigation, pp. 9002-9007

Jwo, Dah-Jing	National Taiwan Ocean Univ.
Weng, Tsu-Pin	National Taiwan Ocean Univ.

The Kalman filter (KF) is a form of optimal estimator characterized by recursive evaluation, which has been widely applied to the navigation sensor fusion. The adaptive algorithm is one of the approaches to prevent divergence problem of the Kalman filter when precise knowledge on the system models is not available. Two popular types of adaptive Kalman filter are the innovation-based adaptive estimation (IAE) approach and the adaptive fading Kalman filter (AFKF) approach. In this paper, an approach involving the concept of the two methods is proposed. The method is a synergy of the IAE and AFKF approaches. The ratio of the actual innovation covariance based on the sampled sequence to the theoretical innovation covariance is employed for dynamically tuning two filter parameters: fading factors and measurement noise scaling factors. The method has the merits of good computational efficiency and numerical stability. The matrices in the KF loop are able to remain positive definitive. Navigation sensor fusion using the proposed scheme applied to the loosely-coupled GPS/INS integration will be demonstrated.

15:20-15:40 WeB13.5

Regulation of a Manned Sea-Surface Vehicle Via Stochastic Optimal Control, pp. 9008-9013

Carravetta, Francesco	IASI-CNR
Felici, Giovanni	IASI
Palumbo, Pasquale	IASI-CNR

A control system is proposed for the regulation problem of the roll-motion of a manned sea-surface vehicle. Taking into account the roll-ship equations coming from the Conolly theory, a novel stochastic model has been proposed for the uncertainties driving the total mechanical torque acting on the vehicle, deriving from the wind and/or the sea-wave action. The proposed model results in a bilinear stochastic system to which a feedback controller is applied, giving linear-optimal performance with respect to a classical quadratic index. Open loop simulations carried out on real data validate the choice of the stochastic model of the uncertainties, producing a ship-roll time evolution which resembles the real data. Closed loop simulations on a virtual ship show the effectiveness of the proposed control scheme.

15:40-16:00 WeB13.6

Decentralized State Estimation of Distributed Phenomena Based on Covariance Bounds, pp. 9014-9020

Sawo, Felix	Univ. of Karlsruhe
Beutler, Frederik	Univ. Karlsruhe (TH)
Hanebeck, Uwe	Univ. Karlsruhe

This paper addresses the problem of decentralized state estimation of distributed physical phenomena observed by a sensor network. The centralized approaches are not scalable for large sensor networks, because all information has to be transmitted to a powerful central processing node requiring an extensive amount of communication bandwidth and a lot of processing power. Thus, for a decentralized reconstruction of distributed phenomena, we propose a novel methodology consisting of three steps: (a) conversion of the distributed phenomenon into a lumped-parameter system description, (b) decomposition of the resulting system in order to map the description to the actual sensor network, and (c) decomposition of the density representation leading to a decentralized estimation approach. The main problem of a decentralized approach is that due to the propagation of local information through the network unknown correlations are caused. This fact needs to be considered during the reconstruction process in order to get correct and consistent estimation results. For that reason, we employ a robust estimator (based on Covariance Bounds) for the local reconstruction update on each sensor node. By this means, the individual sensor nodes are able to estimate the local state of the distributed phenomenon using local estimates obtained and communicated by adjacent nodes only. The information about their correlations is not stored in the sensor network.

WeB14 318

Networked Systems: Consensus of Multi-Agent Systems and Related Results (Invited Session)

Chair: Angeli, David	Imperial Coll.
Co-Chair: Bliman, Pierre-Alexandre J	INRIA-Rocquencourt
Organizer: Bliman, Pierre-Alexandre J	INRIA-Rocquencourt
Organizer: Angeli, David	Univ. of Firenze

14:00-14:20 WeB14.1

Tight Estimates for Non-Stationary Consensus with Fixed Underlying Spanning Tree (I), pp. 9021-9026

Angeli, David	Imperial Coll.
Bliman, Pierre-Alexandre J	INRIA-Rocquencourt

This article is devoted to estimating the speed of convergence towards consensus for a general class of discrete-time multi-agent systems. In the systems considered here, both the topology of the interconnection graph and the weight of the arcs are allowed to vary as a function of time. Under the hypothesis that some spanning tree structure is preserved along time, and that some nonzero minimal weight of the information transfer along this tree is guaranteed, an estimate of the contraction rate is given. The latter is expressed explicitly as the spectral radius of some matrix depending upon the tree depth and the lower bounds on the weights.

14:20-14:40 WeB14.2

Robust Control in Uncertain Multi-Inventory Systems and Consensus Problems (I), pp. 9027-9032

Bauso, Dario	Univ. di Palermo
Giarre', Laura	Univ. di Palermo
Pesenti, Raffaele	Univ. Ca' Foscari di Venezia

We consider a continuous time linear multi--inventory system with unknown demands bounded within ellipsoids and controls bounded within polytopes. We address the problem of epsilon-stabilizing the inventory since this implies some reduction of the inventory costs. The main results are certain conditions under which epsilon-stabilizability is possible through a saturated linear state feedback control. The idea of this approach is similar to the consensus problem solution for a network of continuous time dynamic agents, where each agent evolves according to a first order dynamics has bounded control and it is subject to unknown but bounded disturbances. In this context, we derive conditions under which consensus can be reached. All the results are based on a Linear Matrix Inequalities (LMIs) approach and on some recent techniques for the modeling and analysis of polytopic systems with saturations.

14:40-15:00 WeB14.3

Contractive Distributed MPC for Consensus in Networks of Single and Double-Integrators (I), pp. 9033-9038

Ferrari-Trecate, Giancarlo	Univ. degli Studi di Pavia
Galbusera, Luca	Pol. di Milano
Marciandi, Marco Pietro Enrico	CESI Ricerca S.p.A.
Scattolini, Riccardo	Pol. di Milano

In this paper we propose an application of distributed model predictive control techniques to the problem of driving a group of autonomous agents towards a consensus point, i.e. a negotiated position in their state space. Agents are assumed to be governed by discrete- time single- or double-integrator dynamics and the communication network can be directed and time-varying. Our control protocols are called “contractive” due to a specific constraint imposed on the agents’ state path. Consensus is formally proven, also in presence of bounds on the norm of the inputs, by means of a geometrical analysis of the optimal paths.

15:00-15:20 WeB14.4

A Eulerian Approach to the Analysis of Rendez-Vous Algorithms (I), pp. 9039-9044

Canuto, Claudio	Pol. di Torino
Fagnani, Fabio	Pol. Di Torino
Tilli, Paolo	Pol. di Torino

In this paper we analyze rendez-vous algorithms in the situation when agents can only exchange information below a given distance threshold R. We study the system under an Eulerian point of view considering (possibly continuous) probability distributions of agents and we present convergence results both in discrete and in continuous time. The limit distribution is always necessarily a convex combination of delta functions at least R far apart from each other: in other terms these algorithms are locally aggregating. Numerical simulations seem to show that starting from continuous distributions, in general these algorithms do not converge to a unique delta (rendez-vous) in agreement with previous literature on this subject.

15:20-15:40 WeB14.5

Global Synchronization on the Circle (I), pp. 9045-9050

Sarlette, Alain	Univ. of Ličge
Tuna, S. Emre	Univ. of California, Santa Barbara
Blondel, Vincent	Univ. catholique de Louvain
Sepulchre, Rodolphe J.	Univ. de Liege

The convexity arguments used in the consensus literature to prove synchronization in vector spaces can be applied to the circle only when all agents are initially located on a semicircle. Existing strategies for (almost-)global synchronization on the circle are either restricted to specific interconnection topologies or use auxiliary variables. The present paper first illustrates this problem by showing that weighted, directed interconnection topologies can be designed to make any reasonably chosen configuration of the agents on the circle a stable equilibrium of a basic continuous-time consensus algorithm. Then it proposes a so-called “gossip algorithm”, which achieves global asymptotic synchronization on the circle with probability 1 for a large class of interconnections, without using auxiliary variables, thanks to the introduction of randomness in the system.

15:40-16:00 WeB14.6

Asymmetric Randomized Gossip Algorithms for Consensus (I), pp. 9051-9056

Fagnani, Fabio	Pol. Di Torino
Zampieri, Sandro	Univ. di Padova

Distributed averaging is a relevant problem in several application areas, such as decentralized computation, sensor networks, clock synchronization and coordinated control of mobile autonomous agents. Gossip randomized consensus algorithms provide a particular simple and efficient solution of such a problem. These algorithms however need bidirectional communication among agents and this can be a rather restrictive hypothesis in some contexts. In this contribution we analyze two important examples of asymmetric randomized consensus algorithms which do not need bidirectional communication and exhibit a speed of convergence comparable to the symmetric gossip. However, differently from the symmetric gossip, these algorithms do not converge to the average. We complete our analysis showing that under rather mild hypotheses, the displacement of the their final state from the average goes to zero as the number of agents goes to infinity.

WeB15 317

Modeling Methods and Clinical Applications in Medical and Biological Systems II (Invited Session)

Chair: Chase, J. Geoffrey	Univ. of Canterbury
Co-Chair: Andreassen, Steen	Aalborg Univ.
Organizer: Chase, J. Geoffrey	Univ. of Canterbury
Organizer: Andreassen, Steen	Aalborg Univ.

14:00-14:20 WeB15.1

A Mathematical Model of Cyclin B1 Dynamics at the Single Cell Level in Osteosarcoma Cells (I), pp. 9057-9062

Perez-Velazquez, Judith	Univ. of Warwick
Evans, Neil D.	Univ. of Warwick
Chappell, Michael	Univ. of Warwick
Errington, Rachel	Cardiff Univ.
Smith, Paul	Cardiff Univ.
Khan, Imtiaz	Cardiff Univ.

Cyclin B1 tracking provides information on cell cycle progression and cell-cycle regulator dynamics. We have developed a mathematical model which describes the continuous tracking of cyclin B1 through the cell cycle at the single cell level, including interactions with the cyclin B1 inhibitor, p21. The cell line used is a cancer cell line, human osteosarcoma (U-2 OS). An examination of the sensitivity of the model is presented, where the aim is to identify those parameters which have most influence on the cyclin B1 profile and its changes through the cell cycle. High temporal resolution cyclin B1 data involving non-invasive techniques (green fluorescent protein, GFP) were used to validate the model.

14:20-14:40 WeB15.2

Goal-Directed Therapy for General ICU Patients Using Aggregated Multi-Objective Optimisation (I), pp. 9063-9068

Wang, Ang	The Univ. of Sheffield
Panoutsos, George	Univ.
Mahfouf, Mahdi	The Univ. of Sheffield
Mills, Gary	Royal Hallamshire Hospital

SOPAVent (Simulation of Patients under Artificial Ventilation) is a blood gas model able to simulate patient ventilatory parameters subject to mechanical ventilation in the intensive care unit (ICU). In this paper, the SOPAVent model is further developed into a continuously updated model of patient ventilatory condition. The extended version of the model is used as the core component for a goal-directed optimisation strategy which aims to provide adaptive decision support for ventilatory therapy. Two objective functions are aggregated in an effort to interpret medical goals into an optimisation problem. The settings of the optimisation strategy are fine-tuned based on medical-goals and medical prioritization rather than mathematical optimality of solutions. The final decision support system is tested via a series of closed-loop simulations by assuming different clinical scenarios. Results show that the decision support system provides the correct advice for ventilator settings following adequate prioritization of competing medical goals.

14:40-15:00 WeB15.3

Nonlinear Model Predictive Control with Moving Horizon State and Disturbance Estimation - Application to the Normalization of Blood Glucose in the Critically Ill (I), pp. 9069-9074

Haverbeke, Niels	Katholieke Univ. Leuven
Van Herpe, Tom	Katholieke Univ. Leuven
Diehl, Moritz	Univ. of Heidelberg
Van den Berghe, Greet	Katholieke Univ. Leuven
De Moor, Bart	K.U.Leuven

In this paper we present a nonlinear model predictive control (NMPC) strategy that can be used to tackle nonlinear control problems with changing model parameters, unknown disturbance factors and specifications on the rates of change of the inputs. The closed-loop performance of the proposed NMPC strategy is demonstrated by applying it to the problem of blood glucose normalization in critically ill patients. A nonlinear patient model, that is particularly developed for describing the glucose and the insulin dynamics of these patients, is used for online state and disturbance estimation and control under a realistic disturbance realization. The results are satisfactory both in terms of control behavior (set point tracking and the suppression of unknown disturbance factors) and clinical acceptability.

15:00-15:20 WeB15.4

The Structural Identifiability of SIR Type Epidemic Models with Incomplete Immunity and Birth Targeted Vaccination (I), pp. 9075-9080

Chapman, James	Univ. of Warwick
Evans, Neil D.	Univ. of Warwick

This paper considers the implications of a structural identifiability analysis on a series of fundamental three-compartment epidemic model structures, derived around the general SIR (Susceptible-Infective-Recovered) framework. The models represent various forms of incomplete immunity acquired through natural infection, or from administration of a birth targeted vaccination programme. It is shown that the addition of a vaccination campaign has a negative effect on the structural identifiability of all considered models. In particular, the actual proportion of vaccination coverage achieved, an essential parameter, cannot be uniquely estimated from even ideal prevalence data.

15:20-15:40 WeB15.5

Modeling Neural Spiking Activity in the Sub-Thalamic Nucleus of Parkinson's Patients and Healthy Primates, pp. 9081-9086

Sarma, Sridevi	Massachusetts Inst. of Tech.
Cheng, Ming	Massachusetts General Hospital
Hu, Rollin	Massachusetts General Hospital
Williams, Ziv	massachusetts general hospital
Brown, Emery	MIT
Eskandar, Emad	massachusetts general hospital

How neurons in humans encode information about the outside world and how this processing changes when the brain is diseased are central questions in neuroscience and medicine. Historically, microelectrode recordings of single-unit neuronal activity have been confined to animal preparations. Recently, it has become possible to obtain single-unit recordings in humans undergoing deep brain stimulation surgery. In this study, we recorded neuronal activity from the sub-thalamic nucleus (STN) of the basal ganglia of patients with Parkinson's disease (PD). In parallel, identical experiments were conducted on a healthy primate, providing a rare opportunity to analyze STN neuronal activity recorded in both the disease and healthy state during the same behavioral tasks. We developed point process models of STN neurons to capture neural spiking dynamics as a function of extrinsic stimuli and the neuron's own spiking history. Our models quantify, for the first time, pathological signatures in PD neural activity such as bursting, 10-30Hz oscillations, and loss of directional plurality, which may directly relate to motor disorders observed in PD patients such as bradykinesia, resting tremor, and rigidity.

15:40-16:00 WeB15.6

Impedance Control of Two D.o.f CPM Device for Upper Limb Disorders, pp. 9087-9092

Miyaguchi, Shota	Kumamoto Univ.
Nojiri, Kousei	Kumamoto Univ.
Matsunaga, Nobutomo	Kumamoto Univ.
Kawaji, Shigeyasu	Kumamoto Univ.

Continuous passive motion (CPM) is an orthopedic treatment or a physiotherapy and is tried to apply after surgery for the injured radial collateral ligament (RCL) in the elbow joint. After the surgery, the reaction force at hand of the patient increases due to an increase of the joint stiffness and may be excessively large. For this, it is effective to reduce the excessive reaction force by controlling pro-/supination of forearm. Also, the RCL in the elbow joint is extended due to pro-/supination of forearm, and the extension may aggravate the injury of the RCL. Thus, it is required to suppress both the excessive extension of the RCL and the reaction force. In this paper, a novel impedance control of CPM device that can suppress both the excessive extension of the RCL and the reaction force is proposed.

WeB17 320A

New Trials for Control Education (Highlight Session)

Chair: Kang, Chul-Goo	Konkuk Univ.
Co-Chair: Melchiorri, Claudio	Univ. of Bologna
Organizer: Kang, Chul-Goo	Konkuk Univ.

14:00-14:20 WeB17.1

E-Learning Experiences in Control Education (I), pp. 9093-9098

Kang, Chul-Goo	Konkuk Univ.

Educational environment has been drastically changed since the advent of Internet and computers, for example, from classroom teaching to e-Learning education. Control education should try to positively make use of these new technologies in order to fill lack of control professionals well qualified and to redirect an overall decline of interest in control engineering study among young people. This paper presents a control engineering course developed for hands-on experience on motion control using a practical control problem, and also presents e-Learning experiences in undergraduate control education at the Department of Mechanical Engineering, Konkuk University.

14:20-14:40 WeB17.2

Use of Cranes in System Dynamics and Controls Education, pp. 9099-9104

Singhose, William E.	Georgia Inst. of Tech.
Vaughan, Joshua	Georgia Tech.
Danielson, Jon	Georgia Tech.
Lawrence, Jason	Georgia Inst. of Tech.

Cranes provide an excellent platform for teaching system dynamics and controls. Cranes have a simple pendulum-type oscillation that is useful for demonstrating basic ideas. Cranes also have additional dynamic effects such as motor dynamics, velocity limits, payload variations, and nonlinear slewing dynamics that make them well suited for advanced study. If the cranes are made remotely operable, then students can also study tele-operation and control of systems with time delays. System dynamics and control courses taught at the Georgia Institute of Technology utilize cranes in both the lecture and laboratory exercises. The primary goal of using the cranes is to provide hands-on experiences in system dynamics and implementation of controllers on real systems. This paper describes the cranes and the complementary curriculum.

14:40-15:00 WeB17.3

Control Engineering Education with Experiments on Real-Time Control System Implementation (I), pp. 9105-9110

Kim, Byung Kook	Korea Advanced Inst. of Science and Tech.

Control engineering education at Electrical Engineering, Korea Advanced Institute of Science and Technology is discussed, which emphasizes experiments on real-time control system implementation. In addition to various lectures for theoretical control system analyses, appropriate hands-on experiments are performed for control system implementation utilizing up-to-date embedded system technology. Various useful experiments are constructed based on systems ranging from simple systems with microcontrollers to real-time systems with embedded Linux, in order to get firm understanding of control systems from theory to implementation.

15:00-15:20 WeB17.4

Roboticad: An Educational Tool for Robotics, pp. 9111-9116

Falconi, Riccardo	Univ. of Bologna
Melchiorri, Claudio	Univ. of Bologna

RobotiCad is a user-friendly Matlab/Simulink toolbox for the modeling and simulation of robotic manipulators. With RobotiCad, starting from Denavit-Hartenberg parameters, it is possible to create the kinematic and dynamic models of any serial mechanical structure, together with its 3D graphical model. When a robot is created, it can be exported in a dedicated file that can be loaded in a Simulink scheme and easily interfaced with other block-sets. A robot, then, can be simulated and, eventually, an AVI file of the simulation can be obtained. Moreover, a rich collection of Matlab functions properly developed in order to study industrial robots is included in RobotiCad, e.g. functions for trajectory generation, manipulability analysis, control, and so on.

15:20-15:40 WeB17.5

Remote Experiments for Control Education, pp. 9117-9121

Han, Soo Hee	Seoul National Univ.
Kwon, Bo Kyu	Seoul National Univ.

This paper suggests remote experiments using the internet for the control education. The remote experiment is composed of equipment server computers, networks accessible to internet, and real plants such as inverted pendulums and crane systems. Additionally, it requires a server program that has I/O functions with plants and calculate the control, an interface program bridging between web and the server program, and the home page including the detail explanation for the usage. For effective educations, how to perform experiments and how to combine the experiment with lectures will be discussed. The simple experiments by entering a few control parameters and the complex experiments by designing overall controls, will be explained. Technologies related with the remote experiment will be introduced. It is demonstrated that the remote experiment will be very useful, particular for control education where students have difficulties in performing the experiments for lack of experimental equipments.

15:40-16:00 WeB17.6

Rapid Control Prototyping for Robot Soccer, pp. 9122-9127

Han, Soo Hee	Seoul National Univ.
Ahn, Choon ki	Seoul National Univ.

In this paper, we propose rapid control prototyping (RCP) for a robot soccer using the SIMTool that has been developed in Seoul National University, Korea for the control aided control system design (CACSD). The proposed RCP enables us to carry out the rapid design and the veriŽcation of controls for two-wheeled mobile robots (TWMRs), players in the robot soccer, without writing C codes directly and requiring a special H/W. On the basis of the proposed RCP, a blockset for the robot soccer is developed for easy design of a variety of mathematical and logical algorithms. All blocks in the blockset are made up of basic blocks offered by the SIMTool. User-deŽned algorithms can be easily and e±ciently constructed with just a combination of the blocks in the blockset. In order to validate the proposed RCP in a real game, we employ an o±cial simulation game for the robot soccer, the SimuroSot. Block diagrams are constructed for strategy, path calculation, and the interface to the SIMTool. We show that the algorithms implemented with the proposed RCP work well in the simulation game.

WeB18 320B
Automation (Highlight Session)

Chair: Qin, S. Joe — Univ. of Southern California
Co-Chair: Wang, Dingwei — Northeastern Univ.

14:00-14:20 WeB18.1
Development of Automatic Strapping Machine Using the PET Band (I), pp. 9128-9129

You, KiSung — Res. Inst. of Scienceadn Tech.
Jeong, Hee Don — RIST

We present an equipment development for PET Banding Header that complements the Steel Banding machine currently being utilized in Pohang steel works, South Korea. The PET Banding Header was developed due to the damages done on the surface of the cold rolling products whilst being transported. Because the PET Banding Header was designed as a friction-binding technology against the existing heat-binding technology, the intensity concentrated on the binding area was significantly improved and its efficiency was also increased because it was designed to be a wider range of the banding. In addition, for the cost-cutting of the new equipment in development, the PET Banding header allows for both the Steel Banding Machine and PET Banding Machine to be utilized together. As a result, being applied to the facilities in the field, we were able to reduce the facility investment, demonstrate the efficient facility maintenance, and more importantly, solve the complaints from the customers.

14:20-14:40 WeB18.2
Probabilistic Control of Mobile Robot (I), pp. 9130-9131

Ryu, HwangRyol — Res. Inst. of Science and Tech.
You, KiSung — Res. Inst. of Scienceadn Tech.
Choi, Chintae — RIST

We propose the use of Bayesian approach to a reactive robot control in conjunction with a nonlinear fltering scheme known as particle filters. The approach integrates the optimal control from Bayesian framework with one of the path planning methods known as Vector Field Histogram. Doing this ensures the particle filtering method to track an optimal steering direction. In addition, collision avoidance method is inherently embedded into that scheme due to the fast computing power and a simple implementation of these integrated approach.

14:40-15:00 WeB18.3
Data Based Multivariate Pseudo Correlation Analysis in Steel Industry for Optimized Variable Selection (I), pp. 9132-9137

Schrems, Andrea — Johannes Kepler Univ.
Pichler, Kurt — Linz Center of Mechatronics GmbH
Krimpelstätter, Konrad — Siemens VAI Metals Tech. GmbH & Co,
Del Re, Luigi — Johannes Kepler Univ.

Data driven variable selection, without including physical knowledge, is an important prerequisite for many applications in the field of data based modeling. This paper deals with a novel approach to optimize the dimension of the input space by a combination of common variable selection methods with multivariate correlation analysis. The results are input structures with revised pseudo correlations between input channels and a physically better interpretable structure. The presented method is successfully applied to measured data from steel industry. Some exemplary results are shown in this paper.

15:00-15:20 WeB18.4
A New Model and Control of Coating Process at Galvanizing Line (I), pp. 9138-9143

Shin, Kitae — POSCO
Chung, Wan Kyun — Pohang Univ. of Science & Tech.

This paper proposes a new practical synthesis model for coating weight control and robust design method of feedback controller in galvanizing process. The model combines both long term and short term model. Long term model have a function of classification, averaging and learning based on real measured data. Short term model is differential model based on linear change of inputs and outputs. A set of practical controller and a robust design method of feedback controller is proposed so that it can attenuate quickly the errors caused by time-delay and modeling error. The proposed model with controller were applied to continuous galvanizing line(CGL) at Kwang Yang Steel Works. As the results, a good performance on the deviation control of coating weight was obtained at top of coil and also the uniform coating weight on the surface of strip was realized.

15:20-15:40 WeB18.5
Fisher Discriminant Analysis for Semiconductor Tool Matching (I), pp. 9144-9148

Cherry, Gregory — AMD
Qin, S. Joe — Univ. of Southern California

This paper presents a new method to perform fault diagnosis for data-correlation based process monitoring. As alternative to the traditional contribution plot method, reconstruction-based contribution of fault detection indices is proposed. The monitored indices are SPE, T^2 and a combined index varphi. The lack of diagnosability of traditional contributions is analyzed for the case of single sensor faults with large fault magnitudes, whereas for the same case the proposed reconstruction-based contributions guarantee correct diagnosis. Monte Carlo simulation results are provided for the case of modest fault magnitudes by randomly assigning fault sensors and fault magnitudes.

15:40-16:00 WeB18.6
Integrated Scheduling System on Steel-Making and Continuous Casting with Application (I), pp. 9149-9150

Lu, Kebin — Baosteel Group
Huang, Kewei — Tech. Centre of Baosteel Group
Wang, Dingwei — Northeastern Univ.

The integrated scheduling problem of steel-making and continuous casting is discussed. To solve the problem we develop a scheduling system with the architecture of three tiers. Its main functions include: schedule making and adjusting, matching and optimization, abnormal logistics handling and production information management. A hybrid heuristic and optimization algorithm is developed for the solution. The scheduling system had been embedded into the whole MES of a big iron and steel group in China. This approach had been applied to a branch plant of stainless steel. The satisfactory results have been achieved.

WeB19 320C
Robotics Interaction (Regular Session)

Chair: Fahmy, A. A. — Cardiff Univ.
Co-Chair: Schmidt, Guenther — Tech. Univ. Muenchen

14:00-14:20 WeB19.1
Interactive Genetic Algorithm for Designing the Appearance of Software Robot Using Homologous Chromosome Representation, pp. 9151-9155

Choi, Seung-Hwan — Korea Advanced Inst. of Science and Tech.
Han, Seung-Beom — Korea Advanced Inst. of Science and Tech.
Kim, Jong-Hwan — Korea Advanced Inst. of Science and Tech.

A software robot requires plausible external features for intimate interaction with humans. The various appearance designs effectively contribute to provide him/her with an opportunity to select a preferable robot among them. This paper proposes genetic representation for the appearance of software robot, which is inspired by homologous chromosomes. User selection scheme is based on the interactive genetic algorithm. As user evaluates the preference of external features of software robot, proposed algorithm converges to the most preferable appearance to user's choice. The effectiveness of the proposed scheme is demonstrated through experiments.

14:20-14:40 WeB19.2
Development of User-Adaptive Value System of Learning Function Using Interactive EC, pp. 9156-9161

Suga, Yuki — Waseda Univ.
Sugano, Shigeki — Waseda Univ.

Ikuma, Yoshinori — Waseda Univ.
Ogata, Tetsuya — Kyoto Univ.

Our goal is to create a user-adaptive communication-robot. We are developing a system for evaluating human-robot interactions. Although such evaluation is indispensable for learning algorithms, users' preferences are too difficult to model because they are subjective. In this study, we used the interactive evolutionary computation (IEC) to configure the value system of a learning communicationrobot. The IEC is a genetic algorithm whose fitness function is performed by the user. In our experiment, we encoded the values of sensors (reward or punishment) into genes, and subjects interacted with the learning robot. Through the interaction, the subjects evaluated the robot by touching its sensors, and the robot learned appropriate combinations between input and output. Afterward, the subjects gave their scores to the experimenter, and the scores were regarded as the fitness values of the corresponding genes. These sequences were continued until the 4 generation, and then the subjects compared three of their best genes and two of the experimenter's. We found that the user-adaptive value system is suitable for the communication-robot.

14:40-15:00 — WeB19.3

Easing Wheelchair Control by Gaze-Based Estimation of Intended Motion, pp. 9162-9167

Bartolein, Christian — Univ. of Mannheim
Wagner, Achim — Univ. of Mannheim
Jipp, Meike — Univ. of Mannheim
Badreddin, Essam — Univ. of Heidelberg

An assistive system easing wheelchair control for severely disabled users is presented. To compensate for the restricted information that can be provided using speciality controls, the person's gaze is used to estimate the intended motion direction. The novelty of the presented method is that motionrelevant portions of natural gaze behavior can be distinguished from non-relevant. Producing wheelchair movement only from relevant gaze information leads to an increased acceptance of powered wheelchairs in the user group and to improved safety.

15:00-15:20 — WeB19.4

Fuzzy Hysteresis Coordinator for Neuro-Fuzzy Position Controlled Manipulators, pp. 9168-9173

Pham, D T — Cardiff Univ.
Fahmy, A. A. — Cardiff Univ.
Eldukhri, E. E. — Cardiff Univ.

A fuzzy coordination scheme for two neuro-fuzzy position controlled manipulators performing upper-limb rehabilitation is developed by maintaining certain kinematic relationship between robot manipulator's end-effectors. The basic idea of the new coordination strategy is to benefit from the use of the motion synchronization concept within acceptable tolerance for the vector connecting the two manipulator's endeffectors. In this scheme, each manipulator tracks its desired trajectory using its neurofuzzy Cartesian controller while synchronizing its motion with the other manipulator so that the position error computed for the vector connecting the two manipulator's endeffectors is reduced to zero or kept within acceptable tolerance.

15:20-15:40 — WeB19.5

Master-Slave Telecontrol of a Class of Underactuated Mechanical Systems with Communication Time-Delay, pp. 9174-9179

Peńaloza-Mejía, Ollin — CINVESTAV-IPN
Alvarez-Gallegos, Jaime — CINVESTAV-IPN
Marquez-Martinez, Luis Alejandro — CICESE Res. Center

This paper deals with the problem of time-delay telecontrol of a class of underactuated mechanical systems (UMS) in a master-slave configuration. This problem has been solved by designing some discontinuous causal compensators which have proved by formal stability analysis to guarantee position coordination of the mechanisms and to allow good force reflection to the master side, satisfying in this way classical objectives in the telecontrol of systems. Moreover, the whole closed-loop system behaves stable and results robust to parametric uncertainties and external disturbances. The performance of the proposed control scheme is visualized through experiments developed in a local network.

15:40-16:00 — WeB19.6

Kinesthetic Telepresent Control with Application to Defusing of Mines, pp. 9180-9185

Schmidt, Guenther — Tech. Univ. Muenchen
Kron, Alexander — TU Muenchen

This paper presents a novel approach to support disposal of explosive ordnances by application of bimanual haptic telepresent control techniques. For improved task execution the proposed system enables an operator to perceive multimodal feedback, in particular detailed kinesthetic and tactile feedback, from a remote task environment. Details of the developed experimental setup, comprising stereo vision, a two-handed human system interface and a corresponding two-arm teleoperator, are presented. Furthermore a novel structure adapting scheme for control of the force feedback display and the manipulator arms is introduced. The usability and effectiveness of the bimanual telepresent control system are demonstrated by focusing and evaluating as a most relevant task scenario, the execution of defusing operations in a remote task environment.

WeB20 — 321C

Robotics Estimation I (Regular Session)

Chair: Hu, Xiaoming — Royal Inst. of Tech.
Co-Chair: Zhang, Hai-Qiang — Beijing Inst. of Tech.

14:00-14:20 — WeB20.1

Three Dimension Curve Welding Seam Modeling for Seam Tracking, pp. 9186-9191

Chen, Haiyong — Chinese Acad. of sciences
Xu, De — Inst. of Automation, Chinese Acad. of Sciences
Wang, Hong — the Univ. of Manchester

A novel modeling method for 3D curve welding seam is presented in this paper based on a welding robot for large workpiece. The 3D curve welding seam tracking is implemented by macro and micro motion which can control translational motion of torch in a large range and implement accurate seam tracking in small range. As such, the self-teaching seam model and real-time seam model are established to accurately control position and orientation of torch. The self-teaching model is obtained by a cubic B-spline interpolation function. Then a continuous position model of a V-type seam is established by using the cubic parameter B-spline least square method. The orientation model of the seam is also established by using the position model and coordinates of seam characteristic points. These three models form the base of macro and micro translational motion control and real-time tracking control. Furthermore, in order to compare the performances of the different position modeling method, simulations have been carried out to produce the modeling results of cubic parameter B-spline least square method and polynomial least square method. The effectiveness of these seam model has been verified.

14:20-14:40 — WeB20.2

Door Detection without Apriori Color Knowledge, pp. 9192-9196

Zhang, Hai-Qiang — Beijing Inst. of Tech.
Dou, Li-Hua — Beijing Inst. of Tech.
Chen, Jie — Beijing Inst. of Tech.

Most existent door detection methods assume that the panels' colors are known and rely mainly on this apriori knowledge. However, the color is not always available especially when the environment is entirely unknown. In this paper, a door was defined as a rectangular region with almost a homogeneous color and proper size which one can enter or exit through. The proposed door detection framework features no need for any apriori color knowledge. We adopt the determined finite automaton to model the process which starts from motion detection to obtain the potential door regions roughly, then a combined algorithm is used to extract stable and interest edges which bound the subsequent region growing, finally the door regions could be located accurately by fusing all the preceding results. Experiments under various environments show that this framework is effective and adaptive.

14:40-15:00 — WeB20.3

Dynamic Object Identification by a Moving Robot Using Laser Data, pp. 9197-9202

Amarasinghe, Dilan — Memorial Univ. of Newfoundland
Mann, George K. I. — Memorial Univ. of Newfoundland
Gosine, Raymond G. — Memorial Univ. of Newfoundland

Detection of moving objects around a mobile robot is important for safe navigation. This paper presents a robust technique for detecting moving objects using a laser ranger mounted on a mobile robot. After the initial alignment of the two consecutive laser scans, each laser reading is segmented and classified according to object type, stationary, non-stationary or indeterminate. Laser reading segments are then analyzed using an algorithm to maximally recover the moving objects. The proposed algorithm has the ability to recover all possible laser readings that belong to moving objects. The developed algorithm is verified using experimental results in which, a walking human is detected by a moving robot.

15:00-15:20 WeB20.4

Stable Target Tracking Using Observer Based Velocity Estimation, pp. 9203-9208

Gustavi, Tove — Royal Inst. of Tech.
Hu, Xiaoming — Royal Inst. of Tech.

In applications where mobile robots are used to track non-cooperative moving objects it is often required that not only the position but also the velocity of the moving target can be measured. In this paper, we consider a problem in 2D where the tracking robots are equipped only with vision and position sensors and are unable to measure target velocity directly. Instead, two separate observers for target velocity are proposed and shown to stabilize the two tracking controls used by the robots. To evaluate the observers, results from simulations with observer based velocity estimates are compared to corresponding results where the velocity estimates are given by the standard Extended Kalman Filter algorithm.

15:20-15:40 WeB20.5

Robustness Analysis of Mobile Robot Velocity Estimation Using a Regular Polygonal Array of Optical Mice, pp. 9209-9214

Kim, Sungbok — Hankuk Univ. of Foreign Studies
Lee, Sanghyup — Hankuk Univ. of Foreign Studies

This paper presents the robust localization of an omnidirectional mobile robot using a regular polygonal array of optical mice that are installed at the bottom of a mobile robot. First, the basic principle of the proposed localization scheme is explained. Second, the velocity kinematics from a mobile robot to an array of optical mice is derived as an overdetermined linear system. Third, for a given set of optical mouse readings, the least squares velocity estimation of a mobile robot is obtained as the simple average. Fourth, the robustness of the proposed least squares velocity estimation against measurement noise, partial malfunction, and imprecise installation is analyzed.

15:40-16:00 WeB20.6

A Vision-Based Technique for Vehicle Slip and Velocity Estimation, pp. 9215-9220

Song, Xiaojing — King's Coll. London
Seneviratne, Lakmal D — King's Coll. London
Althoefer, Kaspar — King's Coll. London
Song, Zibin — King's Coll. London
Mohseni-Vahed, Shahram — King's Coll. London

This paper proposes a novel technique to estimate slips and velocities of an unmanned ground vehicle (UGV). A visual odometry sensor looking down the terrain surface is employed to measure the motion of the UGV, by tracking features selected from the terrain surface. The visual odometry sensor can provide motion information even when the terrain surface contains no distinctive features. A sliding mode observer (SMO) based-on a kinematic model is designed to deal with noise and uncertainty of the measurements from the visual odometry sensor, and simultaneously estimate the slip and velocity vectors of the UGV. The non-GPS slip and velocity estimation technique is independent of terrain parameters and robust to noise and uncertainty. Experimental results are given to show that the technique has good potential for vehicle slip and velocity estimation.

WeB21 321B

Dynamics and Control of Micro and Nano-Scale Systems II
(Invited Session)

Chair: Moheimani, S.O. Reza — Univ. of Newcastle
Co-Chair: Sebastian, Abu — IBM Zurich Res. Lab.
Organizer: Moheimani, S.O. Reza — Univ. of Newcastle
Organizer: Sebastian, Abu — IBM Res.

14:00-14:40 WeB21.1

Review of Feedforward Approaches for Nano Precision Positioning in High Speed SPM Operation (I), pp. 9221-9229

Devasia, Santosh — Univ. of Washington

This article reviews developments in feedforward control for Scanning Probe Microscopes (SPMs), which are key enabling tools in nanotechnologies. Feedforward control aids in precision positioning (at the nano scale) needed to achieve the current research goal of increasing SPM's operating speed.

14:40-15:00 WeB21.2

Optimal Model Matching Design for High Bandwidth, High Resolution Positioning in AFM (I), pp. 9230-9235

Lee, Chibum — Univ. of Illinois at Urbana-Champaign
Salapaka, Srinivasa — Univ. of Illinois

This paper introduces a two degree of freedom control design for achieving robust high resolution, high bandwidth positioning systems. Feedback designs have demonstrated a significant improvement in the performance of the flexure-stage based positioning systems in atomic force microscopes (AFM) that provide large travels with high resolution. In this paper, an optimal model matching framework, where both the feedback and feedforward controllers form the decision variables, is presented which facilitates achieving better performance in terms of the resolution bandwidth and robustness to modeling uncertainties in the closed-loop device. Feedback-only designs, which significantly diminish nonlinear effects of piezoactuation and other modeling uncertainties, are restricted by practical and fundamental limitations such as the control saturation and the Bode integral law. These limitations, which become even more prominent due to non-minimum phase zeros in the context of flexure stages with noncollocated actuators and sensors, typically lead to trade-off between resolution, bandwidth and the robustness of the positioning system. A two degree of freedom controller, achieves a better trade-off by exploiting feedforward designs that are not subject to some limitations that constrain the feedback-only designs. We show that our 2DOF design achieves performance objectives that are impossible for feedback-only designs. Experiments on positioning stages on a AFM show bandwidth improvements as large as 300% over existing feedback base designs.

15:00-15:20 WeB21.3

Track-Follow Control for High-Density Probe-Based Storage Devices (I), pp. 9236-9241

Pantazi, Angeliki — IBM
Sebastian, Abu — IBM Res.
Pozidis, Haralampos — IBM
Eleftheriou, Evangelos — IBM

Probe-based data-storage devices are being considered as ultra-high-density, small-form-factor and low-power alternatives to conventional data storage. Ultra-high storage densities of up to 1 Tb/in^2 or more can be achieved by using atomic force microscopy (AFM) techniques to write, read back, and erase data in very thin polymer films. High data rates are achieved by parallel operation of large arrays with thousands of micro/nanomechanical cantilevers. MEMS-based x/y micro-scanners are used to navigate the AFM probes over the storage medium. The ultra-high storage densities that probe-storage devices can realize pose a significant challenge to the control design for positioning and navigation. This paper focuses on the track-follow control of a MEMS-based micro-scanner for a high-density probe-based storage device. The positioning requirements are described, and controllers designed for tracking performance as well as controllers using sensor fusion are presented. Experimental results of information recorded at high densities and read back without errors validate the control performance.

15:20-15:40 WeB21.4

A Self Servo Writing Scheme for a MEMS Storage Device with Sub-Nanometer Precision (I), pp. 9242-9247

Sebastian, Abu — IBM Zurich Res. Lab.
Pantazi, Angeliki — IBM
Moheimani, S.O. Reza — Univ. of Newcastle
Pozidis, Haralampos — IBM
Eleftheriou, Evangelos — IBM

In the probe-based storage concept being pursued by IBM, a MEMS based micro-scanner is used to position the storage medium relative to the read/write probes. To achieve repeatable positioning over a large storage area, it is necessary to have medium-derived position information. Dedicated servo-fields are typically employed to obtain medium-derived position information. Sub-nanometer positioning resolutions are desirable while writing these servo-fields. Such precise positioning at acceptable bandwidth using a global position sensor requires the directed design of the closed-loop noise sensitivity transfer function so as to minimize the impact of sensing noise. This paper describes one such control architecture based on resonant controllers where the impact of measurement noise on positioning is minimal while providing sufficient damping and hence satisfactory tracking performance. It is estimated that the positioning error due to sensing noise is a remarkably low 0.25 nm. Experimental results are also presented that show error-free operation of the device at high densities.

15:40-16:00 WeB21.5

Plug-In Robust Compensator for a 3 DOF Piezoelectric Nanorobotic Positioner (I), pp. 9248-9253

Fall, Abdoulaye — Univ. of Orléans
Boukhnifer, Moussa — ENSI de Bourges-Univ. d'Orléans
Ferreira, Antoine — Univ. d'Orléans- ENSI de Bourges

In current AFM-based nanomanipulation systems, the commercial position closed-loop controller for piezoelectric nanopositioning stages are implemented with success in a wide range of industrial applications. Even if these controllers operate with satisfactory nominal tracking performance, considerable attention has been focused on appropriate control strategies to compensate hysteresis, nonlinearities, drift and creep for high bandwidths and large scanning regimes. As these closed-loop controllers are very cost-effective, a special interest in robust plug-in compensators seems to be a solution. We proposed in this paper a robust plug-in compensator using the H-infinity loop-shaping techniques which can be plugged into the existing controller without affecting thealready satisfactory nominal tracking performance of the existing closed-loop system. Dynamic modeling, identification and robust control of a 3 d.o.f. piezoelectric nanorobotic positioner are presented in this paper in order to improve the nanorobot performance under plant parameter variations and in the presence of external disturbances. Simulation and experimental results are given to validate the proposed plug-in robust compensator in the case of a nanorobotic manipulation task.

WeB22 321A

Estimation and Control of State and Disturbance in Mechatronic Systems (Regular Session)

Chair: Pao, Lucy Y. — Univ. of Colorado at Boulder
Co-Chair: Horowitz, Roberto — Univ. of California at Berkeley

14:00-14:20 WeB22.1

A Reset State Estimator for Linear Systems to Suppress Sensor Quantization Effects, pp. 9254-9259

Zheng, Jinchuan — The Univ. of Newcastle, Australia
Fu, Minyue — Univ. of Newcastle

This paper presents a reset state estimator to improve the position estimation for motion control systems with sensor quantization. The reset scheme is guided by the idea that the actual output is known exactly to be at the mid-point of the two consecutive quantizer levels and is within the range of a quantizer level bounded by half of quantization step size. Hence, using this information to update the estimated state can give a better estimation under the influence of disturbance and quantization noise. We also show that the reset scheme will not destroy the stability of a baseline estimator system. The reset state estimator is applied to a linear motor control system with an optical encoder. Simulation and experiment demonstrate that the reset state estimator can achieve smaller position estimation error and more accurate tracking accuracy than those of a standard state estimator.

14:20-14:40 WeB22.2

Extended Luenberger Observer for a MIMO Nonlinear Nonholonomic System, pp. 9260-9265

Ergueta, Edgar — Univ. of california, Berkeley
Seifried, Robert — Univ. of Stuttgart
Horowitz, Roberto — Univ. of California at Berkeley
Tomizuka, Masayoshi — Univ. of California, Berkeley

State of the art high speed color printers require sheets being accurately positioned as they arrive to the image transfer station (ITS). This goal has been achieved by constructing a steerable nips mechanism, which is located upstream from the ITS. This mechanism consists of two rollers which not only rotate to advance the paper along the track, but also steer the paper in the yaw direction. A recently developed nonlinear control strategy for the position of the sheet is briefly reviewed. The core of this paper focuses on the addition of a nonlinear observer used to estimate the longitudinal, lateral, and angular positions of a sheet, by detecting its motion along two of its perpendicular sides. The success of the approach presented is corroborated through simulations, in which the estimates from the extended Luenberger observer designed are used on a nonlinear feedback control strategy.

14:40-15:00 WeB22.3

A Performance Comparison of an EKF and a High Gain Observer for an Electropneumatic Positioning System: Simulation and Practical Results, pp. 9266-9271

Qiu, Zhiping — INSA
Pham, Minh Tu — INSA de Lyon
Smaoui, Mohamed — INSA de Lyon
Thomasset, Daniel — INSA de Lyon

The paper deals with an evaluation and comparison of the estimation performance of two non-linear observers in simulation as well as in a practical application. The objectives are to underline the different parameters synthesis of both observers, the choice of the numerical solver and the difficulty to obtain good performances with an electropneumatic system. A High Gain Observer and an Extended Kalman Filter (EKF) synthesis have been performed with Matlab, compared in the same Simulink model and finally implemented in the system.

15:00-15:20 WeB22.4

Design of Disturbance Observer Via the Robust Stabilization and H_; Loop Shaping Methods, pp. 9272-9277

Moon, Jun — Hanyang Univ.
Lee, Choong Woo — Hanyang Univ.
Chung, Chung Choo — Hanyang Univ.
Kim, Young Sik — LG Electronics Inst. of Tech.

The Disturbance observer (DOB) method is known to be effective in enhancing the performance of dynamic systems in the presence of disturbances. DOBs of various structures have been proposed to improve systems' sensitivity functions for better disturbance rejection performance and robustness. However, the improvement to the sensitivity function may deteriorate robustness and transient responses. In this paper, we propose a new systematic method of designing the DOB. This method is based on the robust stabilization of the normalized coprime factor plant description and H_; loop shaping method. In our method, good system robustness can be achieved by Nehari stability margin, and the design parameters of the Q-filter for system robustness and performance can be determined systematically using a target loop transfer function. We applied this method to a MEMS stage. Simulation results show that the disturbance effect of the stage is reduced, and a robust system is achieved in the presence of parameter uncertainties.

15:20-15:40 WeB22.5

Multirate Digital Servo Drive Based on Acceleration Observer and Disturbance Compensator, pp. 9278-9283

Chen, Chin-Sheng — National Taipei Univ. of Tech.
Teng, Ying-Tsung — National Taipei Univ. of Tech.

This paper presents a digital servo driver that realizes a novel multirate feedback controller based on position, velocity and acceleration feedback. The velocity and acceleration signals are firstly estimated by state observer using optical encoder information, and the estimated velocity is fed into discrete disturbance observer (DDOB) to estimate and compensate the external disturbance. In this scheme, controller with acceleration feedback can be realized by replacing the current loop with acceleration loop. When the DC servo motor is controlled by the proposed acceleration feedback control with disturbance compensation, the total servo system from acceleration to position becomes the acceleration controlled system which is fixed to a nominal double integral dynamics in the presence of parameter variation and torque disturbance. Hence, the fast and precise position control can be carried out easily. The proposed acceleration feedback controller and PD position feedback controller are evaluated experimentally on a DSP, which is implemented multirate control scheme, controlled DC servo motor positioning system. The experimental results show that this digital servo system is robust and remarkably sustains the same performance compared to the single fast rate control scheme.

15:40-16:00 WeB22.6

Disturbance Rejection in Parameter-Varying Web-Winding Systems, pp. 9284-9289

Zhong, Hua — Univ. of colorado at Boulder
Pao, Lucy Y. — Univ. of Colorado at Boulder

We propose a control scheme to reject disturbances in web tension that are caused by reel eccentricities in parameter-varying web-winding systems. When the web winds from one reel to the other, the nominal reel radii vary. In addition to this, the reels are not perfectly circular and the eccentricities introduce disturbances to the tension output. If the web is thin enough, in a certain time span, the nominal reel radii can be considered as constants and the reel eccentricities are periodic. In our design, the entire web winding process in which the whole pack of web winds from a full source reel to an empty take-up reel is investigated at a certain number of operating points. At each operating point, an adaptive controller that synthesizes the inverse input whose system response cancels the disturbances is developed. Gain-scheduling control is then used between different operating points. The scheme is simulated on a decoupled tension loop of an example reel-to-reel web-winding system that represents a digital tape system.

WeB23 323
Industrial Applications of Real-Time Embedded and Distributed Systems (Invited Session)

Chair: Pereira, Carlos Eduardo — Federal Univ. of Rio Grande do Sol
Co-Chair: Madsen, Jan — Tech. Univ. of Denmark
Organizer: Pereira, Carlos Eduardo — Federal Univ. of Rio Grande do Sol
Organizer: Goetz, Marcelo — Federal Univ. of Rio Grande do Sul
Organizer: Rammig, Franz — Univ. of Paderborn HNI

14:00-14:20 WeB23.1
On Hybrid Hw/Sw Components for Embedded System Design (I), pp. 9290-9295

Marcondes, Hugo — Federal Univ. of Santa Catarina
Fröhlich, Antônio Augusto — Federal Univ. of Santa Catarina

Embedded Systems are increasing in complexity, requiring the use of an adequate design methodology in their conception. These methodologies must deal with several metrics associated with the design of embedded systems. In order to attend these metrics, several software engineering techniques are being applied in embedded system design, as component-based design. Moreover, a design based on higher-level abstraction enable a better design space exploration between several hardware and software compositions. We define hybrid components as a development artifact that can be deployed by different combinations of hardware and software elements. Nevertheless, devising the proper interface for such component is certainly not a straightforward task. This paper presents a strategy to handle the construction of those hybrid components that delivers architectural transparency to clients, enabling the achievement of desired design metrics, through an effective design space exploration.

14:20-14:40 WeB23.2
Model-Driven Product-Line Architectures for Mobile Devices (I), pp. 9296-9301

White, Jules — Vanderbilt Univ.
Schmidt, Douglas C. — Vanderbilt Univ.

The large number of mobile device types and possible device configurations makes it possible to deliver mobile applications to user devices that are not fully compatible with device characteristics. In these situations, users must perform the tedious and error-prone tasks of altering their device configurations to meet the needs of applications. Mobile application product-lines and automated product variant selection engines are promising approaches for deriving and delivering custom tailored applications to devices, thereby eliminating the need for end-user configuration.

This paper provides three contributions to model-driven product-line variant selection for mobile devices. First, it describes an infrastructure-driven product variant configuration tool that tailors a product variant to the specific capabilities of a mobile device. Second, it shows how this tool automates the capture of device capabilities and maps them to product-line feature models. Third, it shows how a constraint solver can be used to derive a valid product variant and incorporate a device's resource constraints into the derivation process.

14:40-15:00 WeB23.3
System-Level Verification of Multi-Core Embedded Systems Using Timed-Automata (I), pp. 9302-9307

Madsen, Jan — Tech. Univ. of Denmark
Hansen, Michael R. — Tech. Univ. of Denmark
Brekling, Aske W. — Tech. Univ. of Denmark

A key challenge of implementing an embedded systems application on a heteroge- neous multi-core platform is to find the right mapping of the application onto the execution platform. The right mapping is dependent on the characteristics of the platform, i.e. processors and the network connecting them, as well as the application. As embedded systems are heavily resource constrained and often safety-critical, there is a strong desire to be able to reason about properties of the system at an early stage in the design process, i.e. at the system- level. In this paper, we present a system-level modelling framework which allows for cross- layer modelling and verification, covering the application layer, middelware layer (RTOS), and hardware layer. The modelling framework allows the designer to verify the impact of execution platform and application mapping on the schedulability (meeting hard real-time requirements), power consumption and memory utilization, while taking communication into account. The modelling framework is implemented using timed-automata in UPPAAL, Behrmann et al. [2004] and the feasibility of the framework is illustrated through a case-study of a real-time multimedia application consisting of 3 applications with a total of 103 tasks executing on a platform with 4 cores.

15:00-15:20 WeB23.4
A Dynamically Reconfigurable Automotive Control System Architecture (I), pp. 9308-9313

Rettberg, Achim — Univ. Paderborn
Anthony, Richard — The Univ. of Greenwich
Chen, DeJiu — Royal Inst. of Tech.
Jahnich, Isabell — Univ. Paderborn
de Boer, Gerrit — Robert Bosch GmbH
Ekelin, Cecilia — Volvo Tech. AB

This paper proposes a vehicular control system architecture that supports self-configuration. The architecture is based on dynamic mapping of processes and services to resources to meet the challenges of future demanding use-scenarios in which systems must be flexible to exhibit context-aware behaviour and to permit customization. The architecture comprises a number of low-level services that provide the required system functionalities, which include automatic discovery and incorporation of new devices, self-optimisation to best-use the processing, storage and communication resources available, and self-diagnostics. The benefits and challenges of dynamic configuration and the automatic inclusion of users' Consumer Electronic (CE) devices are briefly discussed. The dynamic configuration and control-theoretic technologies used are described in outline and the way in which the demands of highly flexible dynamic configuration and highly robust operation are simultaneously met without compromise, is explained. A number of generic use-cases have been identified, each with several specific use-case scenarios. One generic use-case is described to provide an insight into the extent of the flexible reconfiguration facilitated by the architecture.

15:20-15:40 WeB23.5
Real-Time Mesh Networks for Industrial Applications (I), pp. 9314-9319

Herms, Andre — Univ. of Magdeburg
Nett, Edgar — Univ. of Magdeburg
Schemmer, Stefan — rt-solutions.de GmbH

Wireless LANs (IEEE 802.11) are increasingly used in industrial applications. They reduce cabling costs, increase flexibility and enable mobile applications for maintenance or logistics tasks. Mesh networks provide a self-configuring and -healing wireless backbone for large scale deployments (e.g. in process automation). This paper presents a routing algorithm which provides QoS in wireless mesh networks, thus leveraging their use in industrial applications. It allows reserving bandwidth for real-time flows based on measurements of the physically available bandwidth. Thus it fully utilizes the bandwidth while still preventing congestion. Simulation results demonstrate the reliability of the algorithm and its advantage over previous works.

15:40-16:00 WeB23.6

Application Experiences with a Real-Time Java Processor (I), pp. 9320-9325

Schoeberl, Martin — Vienna Univ. of Tech. Austria

In this paper we present three different industrial real-time applications that are based on an embedded Java processor. Although from different application domains all three projects have one topic in common: communication. Today's embedded systems are networked systems. Either a proprietary protocol is used due to legacy applications or for real-time aspects or standard Internet protocols are used. We present the challenges and solutions for this variety of protocols in small, memory constraint embedded devices.

WeB24 324

New Trend in Decentralized Control (Invited Session)

Chair: Bakule, Lubomir — Acad. of Sciences of Czech Republic

Co-Chair: Brdys, Mietek M.A. — Univ. of Birmingham

Organizer: Bakule, Lubomir — Inst. of Information Theory and Automation of the ASCR

14:00-14:40 WeB24.1

Stabilization of Nonlinear Switched Continuous-Time Complex Systems (I), pp. 9326-9331

Bakule, Lubomir — Acad. of Sciences of Czech Republic

de la Sen, Manuel — Univ. del Pais Vasco

The objective of this paper is to propose an approach to decentralized robust stabilization with state-dependent supervisor for a class of nonlinear switched symmetric composite systems. The proposed methodology employs the structural properties of the system to construct a low order control design model as well as the multiple Lyapunov functions technique. Static output feedback gain matrices robustly stabilizing this model are designed by using bilinear matrix inequalities (BMIs). These inequalities can be used as linear matrix inequalities (LMIs) when selecting appropriate parameters in advance. The switching process is decentralized into independent switching rules operating only on local subsystems states. It is shown that if the set of gain matrices of this switching controller is implemented as an identical set into each local switching controller of the global decentralized controller, then the overall closed-loop system is globally asymptotically stable with robust stability degree alpha.

14:40-15:00 WeB24.2

Decentralized Robust Control of Large-Scale Time-Delay Systems (I), pp. 9332-9337

Iftar, Altug — Anadolu Univ.

Decentralized robust controller design problem for large-scale interconnected systems which involve uncertainties in the system matrices and uncertain time-delays is considered. An error bound, which accounts for the neglected interactions between the subsystem models and uncertainties in the interactions, in the subsystem models, and in the time delays is first derived using overlapping decompositions and expansions. A decentralized controller design approach, which uses this bound, is then proposed. The advantage of the proposed approach is that, all uncertainties and neglected dynamics are summarized in one frequency-dependent scalar function and satisfying a simple condition guarantees that the overall closed-loop system under decentralized controllers, which are designed considering local models, is robustly stable. The application of the proposed approach is demonstrated on a flow control problem in a data-communication network.

15:00-15:20 WeB24.3

Consensus Based Overlapping Decentralized Estimation with Missing Observations and Communication Faults (I), pp. 9338-9343

Stankovic, Srdjan — Univ. of Belgrade

Stankovic, Milos — Univ. of Illinois, Urbana-Champaign

Stipanovic, Dusan M. — Univ. of Illinois at Urbana-Champaign

In this paper a new algorithm for discrete-time overlapping decentralized state estimation of large scale systems is proposed in the form of a multi-agent network based on a combination of local Kalman filters and the dynamic consensus strategy, assuming intermittent observations and communication faults. Conditions are derived for the algorithm to provide, under general conditions concerning the agent resources and the network topology, asymptotic stability in the sense of bounded mean-square estimation error. It is also demonstrated how the consensus gains can be chosen by minimizing the total steady-state mean-square estimation error. Numerical examples illustrate some properties of the proposed algorithm.

15:20-15:40 WeB24.4

Flocking of Decentralized Multi-Agent Systems with Application to Nonholonomic Multi-Robots (I), pp. 9344-9349

Li, Qin — Pol. Univ.

Jiang, Zhong-Ping — Pol. Univ.

In this paper, we revisit the artificial potential based approach in the flocking control for multi-agent systems, where our main concerns are migration and trajectory tracking problems. The static destination or the tracking reference point is modeled by a virtual leader, whose information is utilized by some agents, called active agents (AA), for the controller design. We study a controller for the case where the set of AAs is fixed. By introducing dwell time for the topology-varying system, we define the solutions for the closed-loop system equations. The existence and uniqueness of the solution with any given non-singular initial condition is proved; and some results on the velocity consensus, collision avoidance, group configuration and robustness are proposed. Finally, we apply the proposed controllers to the flocking control of a team of nonholonomic mobile robots.

WeB25 328

Process Control Applications (Regular Session)

Chair: Stoustrup, Jakob — Aalborg Univ.

Co-Chair: Braslavsky, Julio H. — The Univ. of Newcastle

14:00-14:20 WeB25.1

Tuning of PID-Controller Based on the External Disturbance Spectrum, pp. 9350-9355

Torgashov, Andrey — Inst. for Automation and Control Processes FEB RAS

The paper presents the tuning method of digital PID-controllers based on the solution of parametric optimization problem under uncertain process model and given power spectrum densities (PSD) of stochastic disturbance and set point signals. The new approach for determination of set of stabilizing PID values is issued. It was used in the optimization procedure in order to check closed loop stability conditions during the search iterations.

14:20-14:40 WeB25.2

Laguerre-Volterra Observer-Controller Design and Its Applications, pp. 9356-9361

Zhang, Haitao — Huazhong (Central China) Univ. of ScienceandTechnology

Chen, Michael Z.Q. — Univ. of Leicester

Chen, Zhiyong — The Univ. of Newcastle

By expanding each kernel using the orthonormal Laguerre series, a Volterra functional series is used to represent the input-output relation of a nonlinear dynamic system. With the feedback of the modeling error, we give a novel nonlinear observer-controller design, based on which both the stabilization and tracking problems are solved. To illustrate the effectiveness of the design algorithm, we present the analysis of stability and steady-state performance. The algorithm is further applied on a chemical reactor temperature control system. The Laguerre-Volterra observer-controller design has shown its great potential for a large class of nonlinear dynamic systems frequently encountered in industrial applications.

14:40-15:00 WeB25.3

Constraint Control of Recycle Systems with Input Multiplicities, pp. 9362-9367

Seki, Hiroya — Tokyo Inst. of Tech.

Hoshino, Satoshi — Tokyo Inst. of Tech.

Naka, Yuji — Tokyo Inst. of Tech.

Recycle systems exhibit steady state input multiplicities due to interactions of the units, even though individual units are quite simple. When handling constraints, if prospective constraint variables show such nonlinearity, control problems may arise because the steady state gain changes its sign. Using the reactor/separator system with two material recycles as a process example, a robust constraint handling controller is designed by confining the input into the large gain directions. Such directions are obtained as the Pareto optimal front of the multi-objective optimization problem which minimizes energy consumption in each unit. Performance of the designed controller is demonstrated through simulations.

15:00-15:20 WeB25.4

A Simulation Study on Model Predictive Control and Extremum Seeking Control for Heap Bioleaching Processes, pp. 9368-9373

Godoy, Boris I	The Univ. of Newcastle
Braslavsky, Julio H.	The Univ. of Newcastle
Aguero, Juan C	The Univ. of Newcastle

Heap bioleaching processes are of increasing interest in the mining industry to recover metals from secondary ores. Recently, it has been proposed to use feedback control to improve the rate of mineral extraction. In this paper we compare two feedback approaches, namely Model Predictive Control (MPC) and Extremum Seeking Control (ESC), to improve copper extraction in a heap bioleaching process. Simplified linear models obtained in previous work are used to design an MPC strategy incorporating input constraints. ESC is tuned to maximise copper extraction rate using aeration rate. Simulation results run on a high complexity model of the process show that similar copper extraction rates can be obtained using either strategy. While better control efforts are obtained with MPC, ESC achieves similar results and shows potential for this intrinsically complex process, requiring little knowledge about the plant.

15:20-15:40 WeB25.5

An Active Defrost Scheme with a Balanced Energy Consumption and Food Quality Loss in Supermarket Refrigeration Systems, pp. 9374-9379

Cai, Junping	Aalborg Univ.
Stoustrup, Jakob	Aalborg Univ.
Rasmussen, Bjarne D.	GRUNDFOS Management A/S

This paper introduces food quality as a new parameter, together with energy, to determine an optimal cooling time between defrost cycles. A new defrost-on-demand scheme is proposed. It uses a feedback loop consisting of on-line model updating and estimation as well as a model based optimization. This scheme automatically adjusts the time interval between defrost cycles with varying operating conditions, continuously seeking an optimal time interval, featuring either an energy optimal time, or a trade-off between energy consumption and food quality loss. This adaptive approach is compared with traditional defrost schemes, found to be able to reduce energy consumption significantly.

15:40-16:00 WeB25.6

Multi-Model Approaches for Integrated Design of Wastewater Treatment Plants with Model Predictive Control, pp. 9380-9385

Francisco, Mario	Univ. of Salamanca
Vega, Pastora	Univ. of Salamanca

In this work some multi-model and norm based approaches for Integrated Design of processes and constrained Model Predictive Control systems have been proposed. The Integrated Design procedure provides simultaneously the plant dimensions and working point together with the parameters of the control system by solving a multi-objective constrained non-linear optimization problem. Particularly, the cost functions include investment, operating costs, and dynamical indexes based on the weighted sum of the H infinity and l1 norms of different closed loop transfer functions matrices of the system, following a novel robust approach. The paper illustrates the application of the proposed methodology for the Integrated Design of the activated sludge process of a wastewater treatment plant (WWTP).

WeB26 327

Control of Power Systems II (Regular Session)

Chair: Lamnabhi-Lagarrigue, Françoise	CNRS-EECI
Co-Chair: Majanne, Yrjö	Tampere Univ. of Tech.

14:00-14:20 WeB26.1

Stabilizing Multimachine Systems with Decentralized and Nonlinear Feedbacks, pp. 9386-9391

Zhou, Jun	Kyoto Univ.
Ohsawa, Yasuharu	Kyoto Univ.

Stabilization in multimachine (synchronous generators) power systems is dealt with through decentralized and nonlinear state feedback laws that are separately design in a generator-wise fashion, based on what we call the improved swing equations. Stability of the closed-loop power systems is robust with regard to perturbations in electric torques happening in the synchronous generators. The stabilization algorithm consists of decentralized control laws, and the feedback laws can provide us with more freedoms for accomodating various control indices.

14:20-14:40 WeB26.2

Short and Long-Term Dynamic Voltage Instability, pp. 9392-9397

Hossain, Md. Jahangir	UNSW@ADFA
Pota, Hemanshu	Univ. of New South Wales
Ugrinovskii, Valery	Univ. of New South Wales

This paper presents a novel approach to capture the development of dynamic voltage instability caused by the dynamics of different power system devices, such as loads, generators, automatic voltage regulators (AVR), overexcitation limiters (OXL), power system stabilizers (PSS), and on-load tap changing (OLTC) transformers using an accurate time-domain analysis. A small power system model is presented which allows one to analyse combinations of these effects, showing how different major forms of long-term and short-term dynamic voltage instability occur. Effects of line tripping, sudden change of load, and fault clearing time on dynamic voltage instability will also be discussed. Finally, advantages of the dynamic analysis over the static analysis will be investigated.

14:40-15:00 WeB26.3

On Transient Stability of Multi-Machine Power Systems: A "Globally" Convergent Controller for Structure-Preserving Models, pp. 9398-9403

Dib, Wissam	LSS-SUPELEC
Barabanov, Andrey E.	Saint Petersburg State Univ.
Ortega, Romeo	LSS-SUPELEC
Lamnabhi-Lagarrigue, Françoise	CNRS-EECI

The design of excitation controllers to improve transient stabilization of power systems is a topic of renewed interest in the control community. Existence of a state– feedback stabilizing law for multi–machine aggregated reduced network models has recently been established. In this paper we extend this result in two directions: first, in contrast with aggregated models, we consider the more natural and widely popular structure–preserving models (SPM) that preserve the identity of the network components and allow for a more realistic treatment of the loads. Second, we explicitly compute a control law that, under a detectability assumption, ensures that all trajectories converge to the desired equilibrium point, provided that they start and remain in the region where the model makes physical sense.

15:00-15:20 WeB26.4

Oscillation Behaviour of the Enlarged UCTE Power System Including the Turkish Power System, pp. 9404-9409

Lehner, Joachim	Univ. Stuttgart, Inst. of Process Engineering
Weissbach, Tobias	Univ. Stuttgart
Scheffknecht, Günter	Univ. Stuttgart

Due to deregulated energy market conditions and the planned extension of the UCTE power system towards Eastern Europe, as well as towards the Middle East and North Africa to close the so called “Mediterranean Ring”, the oscillation damping behaviour of the UCTE power system is gaining more and more in importance. Within the present paper, the oscillation damping behaviour of the enlarged UCTE power system after the synchronous connection with the Turkish power system is analysed, using time and frequency domain methods. Firstly the Turkish power system is analysed as a separate network in isolated operation as the case still is today. Subsequently the enlarged UCTE-system, including the Turkish power system is analysed. Differences in the oscillation behaviours are shown, precarious system constellations are identified and measures to solve occurring problems are given and discussed.

15:20-15:40 WeB26.5

Automatic Generation Controller Design in Deregulated and Networked Environment Using Predictive Control Strategy, pp. 9410-9414

Zhang, Jianhua — North China Electric Power Univ.
Hao, Jinhua — North China Electric Power Univ.
Hou, Guolian — North China Electric Power Univ.

In this paper, Generalized Predictive Control (GPC) algorithm is applied to design automatic generation control (AGC) systems in deregulated and networked environment. The proposed AGC approach can be used to deal with the effects caused by power market and communication networks. Finally, the developed scheme is implemented in a two-area AGC system, and the simulation results show the effectiveness of the proposed scheme.

15:40-16:00 WeB26.6

Nonlinear Control of PWM AC/DC Boost Rectifiers - Theoretical Analysis of Closed-Loop Performances, pp. 9415-9420

Giri, Fouad — GREYC - Univ. de Caen
Abouloifa, Abdelmajid — EMI
Lachkar, Ibtissam — EMI
Chaoui, Fatima-Zahra — ENSET

We are considering the problem of controlling AC/DC switched power converters of the Boost type. The control objectives are: (i) guaranteeing a regulated voltage for the supplied load, (ii) enforcing power factor correction (PFC) with respect to the main supply network. The considered problem is dealt with using a nonlinear controller that involves two loops in cascade. The inner-loop is designed, using the backstepping technique, to cope with the PFC issue. The outer-loop is designed to regulate the converter output voltage. Experimental tests show that the proposed controller actually meets the objectives it has designed for. While different controllers can be found in the relevant literature, it is the first time that a complete rigorous analysis of the controller performances is developed. Such a theoretical contribution is a major feature of this paper.

WeB27 326

Networked Control (Regular Session)

Chair: Stetsjura, Gennady — Inst. of Control Sciences RAS
Co-Chair: Roosta, Alireza — Shiraz Univ. of Tech.

14:00-14:20 WeB27.1

Architecture and Mechanism Design for Real-Time and Fault-Tolerant Etherware for Networked Control, pp. 9421-9426

Kim, Kyoung-Dae — Univ. of Illinois at Urbana-Champaign
Kumar, P. R. — Univ. of Illinois at Urbana-Champaign

We believe that a standard control software framework which enables rapid, reliable and evolvable application development is the key for the proliferation of the networked control systems. Accordingly, we have been working on developing a domainware for general purpose control system, called Etherware. Even though Etherware supports many of the distributed system domain requirements, it still needs further advances to be more suitable as a middleware for control systems. In this paper, we present an architecture and mechanisms for an enhanced middleware that supports networked control system design through enabling temporally correct interactions. We also propose an architecture and mechanisms for enhancing the robustness of networked control systems to faults, that we are currently implementing.

14:20-14:40 WeB27.2

Towards a Multi-Sector Cooperation in Air-Traffic Control Supported by a Meta-Common Workspace, pp. 9427-9432

Guiost, Benoit — Univ. de Valenciennes
Debernard, Serge — Univ. of Valenciennes
Poulain, Thierry — Univ. de Valenciennes
Millot, Patrick — Univ. of Valenciennes

For several years, the need for air traffic control has been continuously increasing. In order to maintain aircraft safety, different support tools have been built and assessed by our laboratory. The professional controllers who have tested these tools have made various criticisms. Our conviction is that it is necessary to design a more cooperative tool that would allow “true team work” to be established between air traffic controllers and their support tools, by making the support tool part of the team rather than a substitute for air traffic controllers. This paper presents a new support tool based on the delegation of tasks and a common workspace. The support tools’ assessments with professional controllers have highlighted a workload decrease due to the delegation and the sharing of information. In order to improve the support system, it is necessary to extend the common workspace to the adjacent sector of control.

14:40-15:00 WeB27.3

H1 Fieldbus Network Delay; a Digital Pole Placement Control Design, pp. 9433-9436

Abdel-Ghaffar, Hesham — Invensys Engineering & Service Egypt
Hammad, Sherif — Ain Shams Univ.
Zaki, Ahmed — Ain Shams Univ. Faculty of Engineering

This paper presents a pole-placement based control algorithm to treat ISA Fieldbus H1 delay problems. A digital network delay model is embedded with the process model in order to design a suitable closed-loop controller. The effect of different values of network delay against sampling time is analyzed. Pole-placement technique should not simplify zeros in order to achieve stability in closed-loop. Simulation results show the efficiency of the proposed control algorithm. It also gives a preliminary study on the effect of network delay jitter on closed loop performance.

15:00-15:20 WeB27.4

High Security Monitoring and Control of Process Via Internet, pp. 9437-9441

Roosta, Alireza — Shiraz Univ. of Tech.
Fakhrpour, Fakhrpour — Petroleum Univ. of Tech.

The World Wide Web (WWW) has become a convenient way to access information on the net because the WWW browser integrates different network services into a common easily accessible user interface. These features coupled with low investment cost are especially suited for accessing information of the remote control and monitoring system. This paper describes a unique Web-based application which is implemented based on the client/server architecture. The user can view the real-time condition of remote process. In addition, the user can also control the operation of the substation at the server site. For augmentation the security factor, the port number that received by the server (from the client) must be dynamic. It can be done by sending the coefficients of an m-order equation from the client side and solving it by the server to find port number. Therefore the hackers could not be able to find port number easily.

15:20-15:40 WeB27.5

Use of the Group Operations, Fractal Channels and Switching of Consecutive Channels in the Multiprocessing Control Systems, pp. 9442-9446

Stetsjura, Gennady — Inst. of Control Sciences RAS
Karavay, Mikhail — Trapeznikov Inst. of Control Sciences RAS

We present here three components (Group Operations, Fractal Channels, formation of the serial channels by comparators) of the new concept – the method “Calculation in the Common Channel.” This method allows executing the distributed calculations in the course of data transmission, and accelerates many types of calculations in control systems.

15:40-16:00 WeB27.6

SPI: An Active Queue Management Algorithm for HSTCP, pp. 9447-9452

Liu, Zhixin — Yanshan Univ.
Yang, Huilong — Inst. of Electrical Engineering,Yanshan Univ.
Guan, Xinping — Yanshan Univ.

In this paper, a Scalable Proportional Integral (SPI) active queue management (AQM) algorithm for High Speed TCP (HSTCP) is proposed. Based on the linearization model for HSTCP, we give a stability analysis for the closed loop interconnection systems (HSTCP and SPI AQM). Then, an adaptive parameters setting method for SPI AQM is presented. Using ns2 simulation, we illustrate that SPI shows satisfactory RTT fairness, TCP fairness and convergence performance, also SPI has good robustness in terms of link capacity, the number of connections, round trip time and buffer size.

WeB28 330A

Engine Control (Regular Session)

Chair: Isermann, Rolf — Univ. of Tech. Darmstadt
Co-Chair: Chamaillard, Y. — LME

14:00-14:20 WeB28.1

Neural Sliding-Mode Control of Engine Torque, pp. 9453-9458

Huang, Ting — Univ. of Illinois at Chicago
Liu, Derong — Univ. of Illinois at Chicago
Javaherian, Hossein — GM R&D
Jin, Ning — Univ. of Illinois at Chicago

In this paper, we investigate the applications of neural sliding-mode control method to automotive engine control. The scheme of neural sliding-mode control is realized by two parallel neural networks. The first neural network estimates the equivalent control term and the other one generates the corrective control term. The goal of the present learning control design of automotive engines is to track the commanded torque under various operating conditions. Using the data from a test vehicle with a V8 engine, we have developed a neural network engine model and neural network controllers based on the idea of sliding-mode control to achieve optimal torque control. In simulation studies of the neural sliding-mode design method, very good transient performance and fast speed of convergence have been observed. In this process, the tedious task of parameter tuning by trial-and-error has been eliminated. Distinct features of the present technique are the controller's real-time adaptation capability based on observed real vehicle data and its rapid convergence which allow the neural network controller to be further refined and improved in real-time vehicle operation through continuous learning and adaptation.

14:20-14:40 WeB28.2

Compensation of Sub-Harmonic Vibrations During Engine Idle by Variable Fuel Injection Control, pp. 9459-9466

Walter, Andreas — Univ. of Karlsruhe
Murt, Mustafa — --
Kiencke, Uwe — Univ. of Karlsruhe
Jones, Stephen — LuK GmbH & Co. oHG
Winkler, Thomas — LuK GmbH & Co. oHG

Today, in many passenger cars and light trucks, the conventional driveline is extended by a dual mass flywheel (DMF). The DMF reduces driveline oscillations by mechanically decoupling the transmission from the periodic combustion events that excite the engine crankshaft. Existing engine control systems are designed for conventional single mass flywheel (SMF) systems. In the future, to facilitate the optimal control of engines equipped with advanced DMF systems, such conventional control systems may require adaptation, modification or even replacement. The basic task of idle speed control systems is to maintain a defined setpoint of rotational engine speed independent from engine operating conditions (e.g. load disturbances). Due to the torque reactions of the DMF, control systems designed for engines with SMF can be disturbed, leading to unstable engine idle (e.g. sub-harmonic vibrations, oscillations following load rejection, etc.) In this approach, an optimised solution for idle speed control regarding conventional combustion engines equipped with DMF is introduced. The enhanced control system is based on conventional PID-control strategies with improved fuel injection scheduling. Using incremental (i.e. tooth-to-tooth) engine speed, critical dead times, which can lead to limit cycles in non-linear closed-loop control circuits, are minimised. Limit cycles, which are distinguishable as sub-harmonic vibrations at the same frequency, are effectively reduced by improving load rejection at idle. The implementation of these solutions in current engine management systems requires no additional sensors or other hardware.

14:40-15:00 WeB28.3

Control of Future Low Temperature Combustion Technologies with Nonlinear Model Based Predictive Control Based on Neural Networks, pp. 9467-9472

Hoffmann, Kai — RWTH Aachen Univ.
Seebach, Dieter — RWTH Aachen
Pischinger, Stefan — RWTH Aachen
Abel, Dirk — RWTH-Aachen Univ.

The combustion in future engines will work with a very high amount of recirculated exhaust gas in part load conditions to enable a low peak combustion temperature. This combustion suffers from instabilities of the process and a highly nonlinear behaviour. The paper presents the use of neural nets for observing the engine. A nonlinear model without feedback of measurements is linearised online and combined with an extended Kalman filter. This observer is compared to a neural net with observer structure by application to two different valve timing strategies. The more promising observer is combined with a model based predictive controller with a quadratic cost function. Its analytic solution is compared with quadratic programming for respecting constraints in the prediction for improving the control error.

15:00-15:20 WeB28.4

Robust Engine Torque Control by Discrete Event Disturbance Observer, pp. 9473-9478

Nagata, Takashi — Univ. of California, Berkeley
Tomizuka, Masayoshi — Univ. of California, Berkeley

A model-based approach is applied to robustly control torque generation in four-stroke spark ignition (SI) engines. Discrete event engine model (DEM) is adopted to describe the torque generation process consisting of discrete combustion strokes. Disturbance observer (DOB) is utilized to achieve robust stability and performance of the torque generation process. For a single-input, single-output model with throttle air intake as input and generated torque as output, the desired plant behavior is stably realized by the DOB over a desired frequency band which is sufficient for powertrain control applications. Numerical and experimental results show the effectiveness of the proposed DOB scheme.

15:20-15:40 WeB28.5

Adaptive Control of Engine Torque with Input Delays, pp. 9479-9484

Gruenbacher, Engelbert — Linz Center of Mechatronics
Del Re, Luigi — Johannes Kepler Univ.
Kokal, Helmut — AVL
Schmidt, Martin — AVL
Paulweber, Michael — AVL

Control of the inner engine torque of a combustion engine is very crucial for the overall performance of a dynamical combustion engine test bench. The main problem thereby is the usually unknown system behavior of the combustion engine, the time delay of the accelerator actuator which is used to control the combustion engine. In general the combustion engine is mounted on a combustion engine test bench in order to adjust the parameters of the engine control unit (ECU). Hence the system behavior can change quite fast. In this paper we will present an adaptive approach to control the combustion engine torque. Measurements on a dynamical combustion engine test bench will verify the proposed approach.

15:40-16:00 WeB28.6

Robust Model Predictive Control of a Diesel Engine Airpath, pp. 9485-9490

Langthaler, Peter — Johannes Kepler Univ.
Del Re, Luigi — Johannes Kepler Univ.

Model predictive control represents one of the most promising methods, also in fast industrial applications like a Diesel engine. But especially Diesel engine control meets problems of uncertainties and disturbances, thus model-plant mismatch is omnipresent, which obviously decreases the performance of model based control. This paper compares different robust predictive control strategies applied to a Diesel engine airpath.

WeB29 330B

Intelligent Vehicle, Safety and Body Systems (Regular Session)

Chair: Huh, Kunsoo — Hanyang Univ.
Co-Chair: Chwa, Dongkyoung — Ajou Univ.

14:00-14:20 WeB29.1

Evaluation of Lane Keeping Assistance Controllers in HIL Simulations, pp. 9491-9496

Hwang, Junyeon — Hanyang Univ.
Huh, Kunsoo — Hanyang Univ.
Kang, Hyoung-Jin — Mando Corp.
Yoon, Paljoo — Mando Corp.
Na, Hyuckmin — Mando
Jung, Hogi — Mando Co.

Lane Keeping Assistant Systems (LKAS) require the cooperative operation between drivers and active steering angle/torque controllers. An LKAS system is proposed in this study such that the desired path is generated to minimize the trajectory overshoot. Based on the reference path, an optimal controller is designed to minimize the cost function. A HIL (Hardware In the Loop) simulator is constructed to evaluate the proposed LKAS system. The single camera is mounted on the simulator and acquires the monitor images to detect lane markers. The performance of the proposed

system is evaluated by HIL system using the Carsim and the Matlab Simulink.

14:20-14:40 WeB29.2

A Study on Lane Keeping Assistance System Based on Steering Torque Control, pp. 9497-9498

Min, Suk Ki — Hyundai-Kia Motors
Shin, Dong Ho — Hyundai-Kia Motors
Lee, Jae Kwan — Hyundai-Kia Motors
Lee, In Sik — Hyundai-Kia Motors

In this paper, the design of steering torque controller for lane keeping assistance system and the experimental results of test driving are presented. The control system dynamics including vehicle-road relationship and steering system is modeled by system identification procedure based on experimental data. This paper is mainly focused on optimal control law for the desired lane keeping by using linear quadratic control theory. Moreover, nonlinear characteristic of vehicle lateral motion by variant vehicle speed has been compromised control gain scheduling methodology.

14:40-15:00 WeB29.3

Roll Angle Estimation for Smart Munitions under GPS Jamming Environment, pp. 9499-9504

Lee, Han Sung — Seoul National Univ.
Park, HeeYoung — Hyundai Heavy Industries Co., Ltd
Kim, KwangJin — Seoul National Univ.
Lee, Jang Gyu — Seoul National Univ.
Park, Chan Gook — Seoul National Univ.

A smart munition revolves by 2~3Hz when it flights. Before guidance starts, the roll estimation of a smart munition is an important factor to improve the navigation performance. The roll estimation algorithm is already known using IMU and GPS. But GPS can't be available as a measurement under GPS jamming environment. This paper explains how to estimate the roll angle of a smart munition under jamming environment by using IMU, earth magnetism measurements. The system and measurement models of the extended Kalman filter are designed for GPS jamming environment. Under GPS jamming environment, the proposed method shows better performance than the previous method by Monte Carlo simulation.

15:00-15:20 WeB29.4

A CAN-Based Distributed Control System for Autonomous All-Terrain Vehicle (ATV), pp. 9505-9510

Song, Bongsob — Ajou Univ.
Chwa, Dongkyoung — Ajou Univ.
Baek, Woonhyuk — Ajou Univ.
Jang, Seyong — AJOU Univ.
Song, Hoin — Ajou Univ.
Kim, Soontae — Ajou Univ.

This paper presents development of a longitudinal controller for an autonomous All-Terrain Vehicle (ATV). The developed ATV is a Controller Area Network (CAN) based distributed control system including multiple processors. Before developing the longitudinal controller, it is shown that the worst case response time of messages via CAN is bounded by appropriate assignment of priorities to all messages. Then, a control model for longitudinal control of ATV is proposed and validated experimentally. Finally, the longitudinal controller for ATV, based on a nonlinear control technique so-called Dynamic Surface Control (DSC), is designed and validated via simulation whether it can compensate for the worst case time delay and packet loss resulting from CAN communications.

15:20-15:40 WeB29.5

The Software Platform Development of a New Microcontroller for Automotive Body Systems, pp. 9511-9515

Chang, Jae Ho — CARNES company Ltd.

A new software platform (SWP) for automotive body electronic systems is introduced in this paper. This platform consists of three parts which are run time environment (RTE), generic layer and hardware abstraction layer (HAL). The RTE is a kind of dynamic interface layer to connect the application to basic software. The generic layer is independent of hardware and is normally not changed even though a microcontroller is changed. The HAL is a layer which depends on hardware and should be modified if the microcontroller and hardware configurations are changed. Our efforts are mainly focused on the development of RTE, HAL, and a few generic components for our new software platform. Some basic technologies such as configuration concept and code generation are acquired through this project. SWP configuration tool as well as SWP itself was developed for the convenience of application design based and SWP. SWP validator is also implemented for the automatic validation of various SWPs that will be developed in the near future. Finally, our new software platform shows that the reuse of applications can be realized by the new technologies of configuration concept. That was indirectly proven by SWP validator which performs same diagnostic software on two different platforms.

15:40-16:00 WeB29.6

Best Practice to Design Test Cases to Improve Reusability for Automotive Body Electronics System, pp. 9516-9521

Lee, Seungyong — Carnes

Verification and validation are getting more important for the success of system development. This is one of the issues in automotive domain as well. Therefore, proper verification and validation methods in automotive domain are necessary to identify system malfunction in early development phase. This paper introduces best practice and framework how to design test cases for automotive body electronics system by using a strict process and tool that enable to develop test cases effectively for increasing reusability.

WeB30 330C

Intelligent Vehicles Navigation and Control II (Regular Session)

Chair: Ozguner, Umit — Ohio State Univ.
Co-Chair: To, Thanh Binh — Volkswagen AG

14:00-14:20 WeB30.1

Rao-Blackwellised Inertial Simultaneous Localisation and Mapping, pp. 9522-9527

Kim, Jonghyuk — Australian National Univ.

This paper presents methods which enable the Rao-Blackwellised (R-B) particle filtering technique to be applicable for the airborne simultaneous localisation and mapping problem. Although R-B filter has been successfully applied to mobile/ground vehicles, its extension to flying vehicles has been impractical due to the high dimensionality involved in inertial navigation system (INS). To overcome this problem, the full INS state is further partitioned into an external state (vehicle pose) and an internal state (navigation and sensor calibration), with a particle filter being applied only to the external state. The computational complexity is further reduced by developing a hybrid R-B Inertial-SLAM. Simulation results will be presented with simulated flight data, showing reliable performances during loop-closures.

14:20-14:40 WeB30.2

A Low Cost Vision Based Localization System Using Fiducial Markers, pp. 9528-9533

Mutka, Alan — Faculty of Electrical Engineering and Computing
Miklic, Damjan — Faculty of Electrical Engineering and Computing, Univ.
Draganjac, Ivica — Faculty of Electrical Engineering and Computing, Zagreb
Bogdan, Stjepan — Univ. of Zagreb

This paper investigates a mobile robot self-localization system based on fiducial markers which are placed on the ceiling. Recently there have been many articles related to path planning and coordination of mobile agents within an unknown environment. These algorithms demand dedicated (and often expensive) hardware that is capable of handling complex tasks in real time. In this paper, we have explored the possibility to realize an inexpensive and simple navigation system, based on passive fiducial markers, which are able to guide an autonomous mobile robot along a predefined path. Fiducial markers provide not only improved performance in runtime, but also much better identification and localization. Marker design based on circle shape is presented. Using a low-cost webcam and appropriate marker detection algorithm three features are determined: robot position, new movement direction and marker ID. Experimental results are presented at the end of the paper.

14:40-15:00 WeB30.3

CityACC - on the Way towards an Intelligent Autonomous Driving, pp. 9534-9539

To, Thanh Binh — Volkswagen AG
Meinecke, Marc-Michael — Volkswagen AG

Schroven, Frank — Volkswagen AG
Nedevschi, Sergiu — Tech. Univ. of Cluj-Napoca
Knaup, Jörn Christian — Volkswagen AG

As comfort systems, the existing Adaptive Cruise Control systems (ACC-systems) function well on motorways and well-structured highways, but there are a lot of challenges for machine-supported driving in urban environments. This paper is aimed to introduce an innovative way to extension of the existing ACC-system for driving in the urban environments (so-called CityACC), where the secondary optical sensor (a stereo-camera) and an intelligent decision making algorithm are used for improving the performance of the whole system.

15:00-15:20 WeB30.4

Hybrid State System Development for Autonomous Vehicle Control in Urban Scenarios, pp. 9540-9545

Kurt, Arda — The Ohio State Univ.
Ozguner, Umit — Ohio State Univ.

This paper analyzes a hybrid-state-system-based controller for an autonomous vehicle in urban traffic and provides development procedures for hybrid-state systems for automatic control. The Ohio-State University Autonomous City Transport utilizes a discrete-state system, based on a finite state machine for high-level decision making and a continuous-state controller for low-level lateral and longitudinal control. The design procedure for the overall hybrid controller involves a series of capability grafts, each improving the ability of the vehicle to handle diverse situations. The design methodology, as demonstrated in a number of development steps, and architecture are capable of handling various urban scenarios, as demonstrated in a June 2007 site visit by Darpa officials.

15:20-15:40 WeB30.5

Point-To-Point Control and Trajectory Tracking in Wheeled Mobile Robots: Some Further Results and Applications, pp. 9546-9551

Ailon, Amit — Ben Gurion Univ. of The Negev
Zohar, Ilan — Ben Gurion Univ. of the Negev

This paper extends previous results in the framework of vehicle control. In particular the paper proposes simple control schemes for driving the vehicle from a given configuration to a prescribed posture in the configuration space, for tracking a time parameterizing path, and for driving a group of vehicles in convoy. We consider the point-to-point and tracking control problems when the controller accounts for the actuator dynamics.

15:40-16:00 WeB30.6

Constrained Model Predictive Control for Nonholonomic Vehicle Regulation Problem, pp. 9552-9557

Zhu, Yongjie — The Ohio State Unversity
Ozguner, Umit — Ohio State Univ.

A model predictive control architecture based on discrete time nonlinear car model is derived to solve regulation("parking") problem. Parameters of the proposed controller are chosen by considering terminal state constraints. This setup combined with terminal state penalty in the cost function could assure control stability. The generated trajectory satisfies minimum curvature requirements and actuator saturations of the vehicle are considered in controller design. Obstacle avoidance is realized by considering distance constraints in the open- loop optimization process. Simulation results are given to illustrate the feasibility of the proposed control architecture.

WeC01 — Atlantic Hall

Bio & Social Systems (Poster Session)

Chair: Pons, Marie-Noelle — ENSIC
Co-Chair: Dimirovski, Georgi Marko — Dogus Univ. of Istanbul

16:30-18:30 WeC01.1

Modeling of the Climate for a Greenhouse in the North-East of México, pp. 9558-9563

Leal Iga, Javier — Univ. Autonoma de Nuevo Leon, Monterrey, México.

Climate control is one of the principal reasons to use a greenhouse. The efficiency of the control depends of the precision of the model that better describes the dynamics variables inside the greenhouse. Is presented a modification of a climate model in an greenhouse in order to include the effects of: air density variations due to humidity changes, the humidity addition by nebulizers, the use of shade cloths and the use of forced ventilation. Such effects are required for greenhouses located in the north-east region of M´exico, because the warm extreme climate makes the use necessary of these elements like economic resources of cooling, being essential to include in the model the above mentioned effects. The introduced modifications are validated by comparisons between real measurements carried out in a greenhouse in this region of M´exico through of simulations. The results in section 5 show that the proposed model has a better behavior when effects mentioned are included on sections 3 and 4.

16:30-18:30 WeC01.2

An Agent Based Model for Agro-Ecosystem, pp. 9564-9568

Zhang, Youhua — Anhui Agricultural Univ.
Sa, Li — Univ.
Xiong, Fanlun — Univ.
Cheng, BoBo — Univ.
Xu, JiCheng — Univ.

This paper describes research using an agent-based artificial agro-ecosystem model to simulate the interaction between pest movements and trap crop physical design. The result of simulation shows that artificial agro-ecosystem model has a broad application prospect in the field of agro-ecosystem management.

16:30-18:30 WeC01.3

A Systems Engineering Approach to Viticulture On-Farm Irrigation, pp. 9569-9574

Ooi, Su Ki — The Univ. of Melbourne
Mareels, Iven — The Univ. of Melbourne
Cooley, Nicola — The Univ. of Melbourne
Dunn, Greg — The Univ. of Melbourne
Thoms, Gavin — Univ. of Melbourne

Water resources management presents an important research topic, because our planet is facing a serious water crisis. About 70% of all fresh water usage goes towards agriculture. Moreover, low water application efficiency are well reported in the literature. Improving on-farm irrigation efficiency can make a substantial contribution to a more sustainable utilization of the world's fresh water resources. It is argued that systems engineering principles can assist to realize the goal of improving water efficiency or produce quality in on-farm irrigation whilst maintaining productivity and quality of service. In approaching this resource management problem, wireless sensor network technologies and automation ideas are combined to improve economic productivity in dairy, horticulture and viticulture industries in such a way as to support continued growth in these major food industries in the face of a competitive water market. This paper reports the early progress of the project on smart irrigation system for viticulture and initial attempt in modeling the viticulture soil-water dynamics is briefly discussed. The results obtained are encouraging indicating that water automation is a promising technology

16:30-18:30 WeC01.4

Influence of the Time Step in Ann Modelling of Thermal Stratification of Solar Storage, pp. 9575-9578

Farkas, Istvan — Szent Istvan Univ.

In the present work an artificial neural network (ANN) model is introduced which was elaborated for modelling the layer temperatures in a storage tank of a solar thermal system. The model calculates the temperatures of 8 equal layers of the storage tank in several time interval from the average time interval data of the solar radiation, the water consumption, the ambient temperature, the mass flow rate of collector loop and the temperature of the layers in the previous time-step. The used time intervals are one hour, 30, 10, 5, 2 and 1 minutes. The introduced ANN model is convenient for describing the system in every case, and the identified models give acceptable results inside the training interval. The average deviation was 0.53 °C during the training and 0.76 °C during the validation in case of hourly data and these data were 0.07 °C and 0.08 in case of 1 minute time interval. The optimal time interval was found at 5 minutes.

16:30-18:30 WeC01.5

Enhancement of NDVI Information from Satellite Imagery by Combining with Low-Altitude Sensing, pp. 9579-9584

Han-ya, Issei — Hokkaido Univ.
Ishii, Kazunobu — Hokkaido Univ.
Noguchi, Noboru — Hokkaido Univ.

Precision farming (PF) was begun in the latter 20th century. In Japan and other countries, there are many researches on remote sensing which use different kinds of sensors and platforms. One of the applications of the remote sensing in agriculture is to obtain crop status images. Recently, field images can be obtained by QuickBird-2, SPOT and other satellites. However, these satellites are affected by the atmospheric conditions, and also the spatial resolution is fairly low. In addition, the images taken by these satellites have large position errors. And generally, a large number of ground truth reference points must be set to make image calibration successful. The objective of this study was to develop a reliable field monitoring system combining helicopter-based and satellite-based remote-sensing. Since an ambient illumination (AI) sensor is installed into the sensing system, the effect of atmospheric condition to the satellite image can be compensated. The normalized difference vegetation index (NDVI) of satellite was transformed to reflectance through the image by the unmanned helicopter. In addition, the images taken by the helicopter were also used for calibration of satellite imagery. Therefore, the helicopter-based system will contribute to enhance the satellite-based remote-sensing. In this study, the R2 value is 0.80 between helicopter-based NDVI and Quickbird2 satellite-based NDVI.

16:30-18:30 WeC01.6

The Study on the Effect of Biogas Addition on the Diesel Tractor Engine for the Development of a Biogas Controller, pp. 9585-9590

Jaber, Nizar — Hokkaido Univ.
Tsukamoto, Takayuki — Hokkaido Univ.
Noguchi, Noboru — Hokkaido Univ.

Using biogas to partially replace diesel fuel in agriculture tractors seems a good solution to reduce greenhouse gases and other pollutants. For this reason, a research project to convert a tractor to dual-fuel operation was initiated; this paper’s specific aim was to develop a control algorithm feeding biogas to the engine’s intake manifold. The effect of biogas addition on engine performance, focusing on brake specific heat consumption and fuel replacement rates, was first studied. Then several load estimation methods were assessed and the Manifold Absolute Pressure (MAP) sensor was chosen as a main load detector. Finally, a prototype algorithm was built upon an engine control unit and was tested. The algorithm was able to change biogas flow with engine speed and load, without knock and misfire.

16:30-18:30 WeC01.7

Development of the Heat and Mass Transfer Modell for Mixed-Flow Grain Dryer, pp. 9591-9595

Mellmann, Jochen — Leibniz-Inst. für Agrartechnik Potsdam-Bornim e.V. (ATB)
Gottschalk, Klaus — Leibniz-Inst. für Agrartechnik Potsdam-Bornim e.V. (ATB)
Istvan, Farkas — Szent István Univ.

A mathematical model of the coupled heat and mass transfer has been developed to calculate the drying process in a mixed-flow grain dryer. Periodical discharge operation of the dryer causes strong variations of temperature and moisture of the material. A series of quasi-stationary drying experiments have been carried out. These results are used to test and to improve the dryer model. The calculated results are in relative good agreement in the stationary operation period, which is relevant for practice

16:30-18:30 WeC01.8

Directional Classification of Cortical Signals Using a Liquid State Machine, pp. 9596-9600

Huang, Jiangshuai — Huazhong Univ. of Science and Tech.
Fang, Huijuan — Huazhong Univ. of Science and Tech.
Wang, Yongji — Hauzhong Univ. of Science And Tech.

Liquid State Machine (LSM) is a newly developed computational model with many interesting properties. It has great advantages of dealing with biologic computing when compared to the traditional computational model. In this paper, the LSM was used to deal with the direction classification problem of the spike trains which were distilled from the neurons in motor cortex of a monkey. In the output layer, a linear regression and back-propagation are employed as the training algorithms. The outcomes of the two algorithms are compared and show that ideal classification results were derived when using BP as the training algorithm.

16:30-18:30 WeC01.9

Automatic Drug Delivery in Anesthesia-The Design of an Anesthesia Assistant System, pp. 9601-9606

Simanski, Olaf — Univ. of Rostock
Kaehler, Ralf — Inst. of Energy and Enviroment Consultation
Schubert, Agnes — Univ. of Rostock
Janda, Matthias — Univ. of Rostock
Bajorat, Jörn — Univ. of Rostock
Hofmockel, Rainer — Univ. of Rostock
Lampe, Bernhard P. — Univ. of Rostock

The main goals of general anesthesia are adequate hypnosis, analgesia and mainte- nance of vital functions. For a number of surgical procedures neuromuscular block is essential. Furthermore patient safety and cost reduction as minimized drug consumption and shortened post-operative recovery are main issues and motivation of automation efforts in anesthesia. Since the beginning of the eighties engineers and physician are working together in the field of the development of closed-loop systems for drug delivery. The work gives only a short overview about the development of the automation in drug delivery systems over the last years without the claim of completeness and expressed the much more vision. In the final stage, the designed control system, the so called ”Rostocker assistant system for anesthesia control (RAN)” should be fitted out with the possibility to control four different drugs automatically. Currently the multiple-input multiple-output (MIMO) control of the depth of hypnosis and neuromuscular blockade is realized as well as the closed-loop control of deep hypotension. A pilot study for the closed-loop control of analgesia is currently running. The paper points some general remarks and the designed MIMO-system for controlling the depth of hypnosis and the neuromuscular blockade

16:30-18:30 WeC01.10

An Advanced Decision Support System for Medical Diagnosis, pp. 9607-9612

Dumitrache, Ioan — Univ. Pol. of Bucharest
Mihu, Ioana — Univ. Pol. of Bucharest
Voinescu, Monica — Univ. Pol. of Bucharest

This paper presents a clinical diagnosis support system which combines the advantages of Dempster-Shafer theory with Bayesian networks in order to simulate the uncertain medical reasoning. We propose a hierarchical structure using Dempster-Shafer at the upper level for evaluating more general hypothesis (disease groups) and Bayesian networks at the lower level for a more accurate analysis of specific diseases.

16:30-18:30 WeC01.11

Fractional Calculus in NMR, pp. 9613-9618

Magin, Richard — Univ. of Illinois at Chicago
Baleanu, Dumitru — Cankaya Univ. Faculty of Arts and Sciences
Feng, Xu — Univ. of Illinois at Chicago

Nuclear magnetic resonance (NMR) is a physical phenomenon widely used to study complex materials. NMR is governed by the Bloch equation, a first order non-linear differential equation. Fractional order generalization of the Bloch equation provides an opportunity to extend its use to describe a wider range of experimental situations. Here we present a fractional generalization of the Bloch equation for a simple spin 1/2 system in a static magnetic field using the Caputo fractional derivative.

16:30-18:30 WeC01.12

A Novel Clustering Method for Quick Partial Volume Estimation in MR Brain Images, pp. 9619-9624

Szilagyi, Laszlo — Budapest Univ. of Tech. and Ec.
Szilagyi, Sandor Miklos — Sapientia - Hungarian Science Univ. of Transylvania
Benyo, Balazs — Budapest Univ. of Tech. and Ec.
Benyo, Zoltan — Budapest Univ. of Tech. and Ec.

Automated brain MR image segmentation is a challenging pattern recognition problem that received significant attention lately. The most popular solutions involve fuzzy c-means (FCM) or similar clustering mechanisms. Several improvements have been made to the standard FCM algorithm, in order to reduce its sensitivity to Gaussian, impulse, and intensity non-uniformity noises. This paper presents a modified FCM-based method that targets accurate and fast segmentation in case of mixed noises. The proposed method extracts a scalar feature value from the neighbourhood of each pixel, using a context dependent filtering technique that deals with both spatial and grey level distances. These features are clustered afterwards by the histogram-based approach of the enhanced FCM algorithm. Results were evaluated based on synthetic phantoms and real MR images. Test experiments revealed that the proposed method provides better results compared to other reported FCM-based techniques. The time complexity of the proposed method is situated well below the traditional FCM algorithm. The achieved segmentation and the obtained fuzzy membership values represent excellent support for deformable contour model based cortical surface reconstruction methods.

16:30-18:30 WeC01.13

Improved Intensity Inhomogeneity Correction Techniques in MR Brain Image Segmentation, pp. 9625-9630

Szilagyi, Laszlo	Budapest Univ. of Tech. and Ec.
David, Laszlo	Sapientia - Hungarian Science Univ. of Transylvania
Szilagyi, Sandor Miklos	Sapientia - Hungarian Science Univ. of Transylvania
Benyo, Balazs	Budapest Univ. of Tech. and Ec.
Benyo, Zoltan	Budapest Univ. of Tech. and Ec.

Intensity inhomogeneity or intensity non-uniformity (INU) is an undesired phenomenon that represents the main obstacle for MR image segmentation and registration methods. Various techniques have been proposed to eliminate or compensate the INU, most of which are embedded into clustering algorithms. This paper proposes a pre-filtering technique for Gaussian and impulse noise elimination, and a smoothening filter that assists the fuzzy c-means (FCM) algorithm at the estimation of inhomogeneity as a slowly varying additive or multiplicative noise. The segmentation is produced by FCM algorithm together with the INU estimation. The slowly varying behaviour of the bias or gain field is assured by a smoothening filter that performs a context dependent averaging, based on a morphological criterion. The experiments using 2-D synthetic phantoms and real MR images show, that the proposed method provides accurate segmentation. The produced segmentation and fuzzy membership values can serve as excellent support for 3-D registration and segmentation techniques.

16:30-18:30 WeC01.14

Neural Observer to Trehalose Estimation, pp. 9631-9636

Cabrera, Agustin	Un. Prof. Inter. De Biotecnologia Del
Aranda-Barradas, Juan Silvestre	IPN
Chairez Oria, Isaac	CINVESTAV-IPN
Ramirez-Sotelo, Guadalupe	UPIBI-IPN

These It is generally accepted in yeast production industry that intracellular trehalose is an indicator of yeast fermentation capacity and viability. The disaccharide trehalose is a cytoplasmic compound, so it must be quantified after extraction by means of an off-line analytical method during a biomass production process. Thus, knowing experimental determinations of yeast trehalose content is always delayed; hence no opportune actions can be implemented in order to lead the production process toward a high intracellular trehalose concentration in the produced biomass. An attempt of predicting trehalose concentration in yeast cells through two different mathematical approaches is presented. On the one hand, a biomass and trehalose concentrations estimator was developed with a differential neural network technique. On the other hand, a structured model results are analyzed for explaining the main metabolic events that induce a trehalose accumulation in cells. Our results allow us to think that the coupling of both methods can provide acceptable information aimed at reaching high trehalose content in yeast. Indeed, by integrating the two alternatives, a trehalose-enriched yeast production process could be successfully driven.

16:30-18:30 WeC01.15

Surgery Planning Simulation for Closed Reduction and Internal Fixation, pp. 9637-9642

Jung, Hoeryong	Korea Advanced Inst. of Science and Tech.
Lee, Doo Yong	KAIST

Careful planning of operations is critical to success of the closed reduction and internal fixation (CRIF) surgery to fix proximal femur fractures. This paper presents a novel surgery planning simulation for the CRIF. The developed simulation employs 3D femur model reconstructed from actual patient's CT data, and enables the user to make a plan on the model using 2D mouse. A projection scheme is developed to map a selected point on the monitor screen onto the 3D femur model. A centerline of the femur neck and cross section images are provided to help the user make optimal planning. The centerline of the femur neck is extracted by connecting two center points of cross sections selected by the surgeon. The cross section image is generated using intersection points between the femur model and a plane selected by the user. The simulation also displays post-operative appearance of the femur using 3D implants models.

16:30-18:30 WeC01.16

Integration Solution for the Communication with Healthcare Devices in Intensive Care Units, pp. 9643-9648

Rodriguez Gonzalez, Jose Luis	CARTIF Foundation
Martin Toral, Susana	CARTIF Foundation
Perez Turiel, Javier	CARTIF Foundation

This paper presents a free Critical Care Information System (CCIS) that shows an essential infrastructure for critical care medical and nursing practice. Specifically, a Patient Integral Analysis Aid System (SAIP) in Intensive Care Units (ICU) has been developed to cover the needs discovered in these scenarios. An important part of this system is related to medical equipment that offers important information to help in medical diagnosis. ICU patients are usually connected to several of these devices which register their physiological parameters. The integration of these devices, in order to exchange the generated information, is difficult because they are developed by different manufacturers and with different communication protocols and information representations. To reach this objective, the developed drivers have a common interface for the access and collection of medical device data. The main goal of the present paper is to show the work done to obtain a real interoperability among medical devices from different manufacturers and with different communication protocols in ICU services for automatic data collection, storage and retrieval.

16:30-18:30 WeC01.17

System Identification for Control of a Main Irrigation Canal Pool, pp. 9649-9654

Rivas Perez, Raul	Havana Pol. Univ.
Feliu, Vicente	Univ. of Castilla-La Mancha
Castillo, Fernando J.	Univ. of Castilla La Mancha
Linares Saez, Antonio	Construcción y Tecnologia Ambiental S.A. BEFESA

In this paper, a system identification for control procedure of a main irrigation canal pool characterized by exhibiting large variations in their dynamical parameters when it discharge regimes change is developed. This procedure delivers not only a nominal model, but also a reliable estimate of the canal pool parametric uncertainty associated with the model. The complete identification for control procedure from experiment design to model validation taking into account prior physical information is presented. It is shown that a linear second order model with an ARMAX structure and a time delay describes adequately the main nominal dynamical behavior of this canal pool. Application of system identification for control in control system design of water distribution in main irrigation canal pools responds to the current necessity of introducing more effective and robust control systems.

16:30-18:30 WeC01.18

State Estimation in Biotechnological Processes Using a Software-Sensor Combining Full-Horizon Observer and Neural Networks, pp. 9655-9660

Hoerrmann, Joachim	Christian-Albrechts-Univ. of Kiel
Barth, Dorothee	Christian-Albrechts-Univ. of Kiel
Kraeling, Michael	Christian-Albrechts-Univ. of Kiel
Roeck, Helmut	Christian-Albrechts Univ. of Kiel

This paper presents an innovative method for the online determination of biomass in fermentation, using a combination of model-based full-horizon observer and Neural Network. The performance of the Neural Network depends highly on correct initial conditions of the unknown process values. Unfortunately, in biological processes it is impossible to guarantee reproducible initial conditions. On the contrary, the variations in the innoculated amount of bacteria oscillate between 30% in lab scale and more than 100%

in industrial applications. To reduce the effect of these variations to the Neural Network, we herein propose the use of an optimization based estimator to determine the initial conditions of the process values online in early process stages in order to improve the estimation results of the Neural Network.

16:30-18:30 WeC01.19

Fast Shake Mixing Control with Low Air Entrainment, pp. 9661-9666

Maeda, Masahiro — Gifu Univ.
Yano, Ken'ichi — Gifu Univ.

In this study, a fast shake mixing control system that allows control of the quantity of air entrainment, involving low mechanical stress and fluid bubbling by means of the suppression the sloshing of a fluid's surface, is developed. Mixing by means of horizontal shaking in a circular motion is addressed, with a CFD simulator being used for analysis of the liquid's behavior, and the quantity of air entrainment during mixing evaluated. To design a fast mixing control system, the hybrid shape approach was applied. In addition, a 3DOF robot manipulator was used to achieve an arbitrary mixing trajectory and velocity. As a result, air entrainment caused by the sloshing of the liquid's surface is elucidated. The effectiveness of the mixing control technique employing sloshing suppression is shown by simulations and experiments.

16:30-18:30 WeC01.20

Interval Observers for Uncertain Nonlinear Systems. Application to Bioreactors, pp. 9667-9672

Meslem, Nacim — Univ. Paris XII
Ramdani, Nacim — INRIA
Candau, Yves — Univ. Paris XII

This paper is about state estimation for nonlinear uncertain continuous-time systems in a bounded-error context. We introduce a method for designing a guaranteed interval observer which is based on (i) the application of M¨uller's theorem for bracketing the solution of ordinary differential equations in a way which ensures the positivity of the observation error, (ii) the analysis of the monotonicity of each component of system field vectors with respect to both the uncertain parameters and state variables and (iii) the choice of a tailor-made observation gain matrix in order to ensure that the observation error converges to the interior of a bounded box. The set of state estimation obtained in this context is a guaranteed approximation of the real solution set in the sense that no solution can be lost.

16:30-18:30 WeC01.21

Multi-Scale Framework for Modeling and Control of Fermentation Processes, pp. 9673-9678

Nandong, Jobrun — Curtin Univ. of Tech. Sarawak Campus
Samyudia, Yudi — Curtin Univ. of Tech.
Tade, Moses O. — Curtin Univ. of Tech.

In this paper, we propose a generalized multi-scale modeling framework for a continuous alcoholic fermentation using Saccharomyces cerevisiae. Based on the developed multi-scale modeling framework, a multi-scale control (MSC) strategy using PID-type controllers is then designed and compared with that of a single-scale control (SCC) strategy. Results indicate that MSC strategy could greatly improve the closed-loop performance. Also, with the right choice of control strategy by embedding micro-scale controller, this study shows that more complex controller algorithms might not be necessary.

16:30-18:30 WeC01.22

Modeling of Fermentation Processes Using Online Kernel Learning Algorithm, pp. 9679-9684

Liu, Yi — Zhejiang Univ.
Yang, Diancai — Qingdao Mesnac Co., LTD.
Wang, Haiqing — Zhejiang Univ.
Li, Ping — Zhejiang Univ.

A novel online identification method is developed for nonlinear multi-input multi-output process modeling issue, which is based on kernel learning framework and named as online kernel learning (OKL) algorithm in this paper. This proposed approach can adaptively control its complexity and thus acquire controlled generalization ability. The OKL algorithm performs first a forward increasing for incorporating a "new" online sample and then a backward decreasing for pruning an "old" one, both in a recursive manner. Furthermore, the prior knowledge about process can be easily integrated into the OKL scheme to improve its performance. Numerical simulations on a fed-batch penicillin fermentation process show that the proposed OKL algorithm can learn adaptively the dynamics of the process using relatively small samples, indicating the OKL is an attractive online modeling method for fermentation process..

16:30-18:30 WeC01.23

A Closed-Loop Exponential Feeding Law for Multi-Substrate Fermentation Processes, pp. 9685-9689

Pico-Marco, Enric — Tech. Univ. of Valencia
Navarro, Jose Luis — Univ. Pol. de Valencia

This article addresses the computation of invariant and stabilizing control laws for dual-substrate fed-batch fermentors. The design is based on two commonly used model structures. It will be shown how to derive partial state feedbacks, using only biomass and volume as measures, that keep the substrates at a desired concentration provided the model is good enough and does not change with time. In the paper an analysis of invariance and a study of global stability within the framework of partial stability is provided.

16:30-18:30 WeC01.24

Unknown Input Observers for Biological Processes, pp. 9690-9694

Rapaport, Alain — INRA
Dochain, Denis — Univ. Catholique de Louvain
Harmand, Jérome — INRA
Acuna, Gonzalo — Univ. de Santiago de Chile

This paper addresses the question of estimating unknown inputs in biological processes. The unknown inputs are either constant or periodic (as e.g. in municipal wastewater treatment plants where the loading rate is unknown yet of a period equal to one day). In particular the designed observer is able to recover the unknown periodic inputs over a few periods.

16:30-18:30 WeC01.25

Identification and Modeling of Co-Rhythmic Genes from Micro-Array Time Series Data, pp. 9695-9700

Wang, Wenxue — Texas Tech. Univ.
Ghosh, Bijoy — Texas Tech. Univ.

'Circadian Rhythm' is a biological phenomenon observed in a large number of organisms ranging from unicellular bacteria to human beings. In this paper, transcriptome data from Cyanothece, a photosynthetic cyanobacteria, has been analyzed for the purpose of discovering genes whose expressions are rhythmically close (co-rhythmic). Subsequently we study if these rhythms can be modeled, up to phase, using a cascade of three phase oscillators. One of the phase oscillator in the network is derived from the model of a 'limit cycle oscillator' using KaiC protein (the master clock). We conclude that 'Circadian Rhythms in Cyanothece transcriptome data can be dynamically modeled up to phase using a single master clock derived from limit cycle oscillator using KaiC protein cascaded with a pair of interconnected phase oscillators'. Biologically substrates of the phase oscillators are presently unknown.

16:30-18:30 WeC01.26

Global Sensitivity Analysis of Biochemical Reaction Networks Via Semidefinite Programming, pp. 9701-9706

Waldherr, Steffen — Univ. of Stuttgart
Findeisen, Rolf — Univ. of Stuttgart
Allgower, Frank — Univ. of Stuttgart

We study the problem of computing outer bounds for the region of steady states of biochemical reaction networks modelled by ordinary differential equations, with respect to parameters that are allowed to vary within a predefined region. Using a relaxed version of the corresponding feasibility problem and its Lagrangian dual, we show how to compute certificates for regions in state space not containing any steady states. Based on these results, we develop an algorithm to compute outer bounds for the region of all feasible steady states. We apply our algorithm to the sensitivity analysis of a Goldbeter--Koshland enzymatic cycle, which is a frequent motif in reaction networks for regulation of metabolism and signal transduction.

16:30-18:30 WeC01.27

Continuous Selection of the Fastest Growing Species in the Chemostat, pp. 9707-9712

Masci, Pierre — INRIA
Bernard, Olivier — Inria
Grognard, Frederic — INRIA Sophia-Antipolis

This paper proposes control laws for the continuous culture of microorganisms, which make it possible to select species which maximize a criterion. In particular, by controlling the dilution rate and the input substrate concentration, the species with the fastest growth rate in chosen environmental conditions can be selected.

In a first step a control is proposed for Monod and Droop models in order to achieve periodic substrate stresses, and a closed loop control is proposed to regulate the total biomass concentration. We show that this biomass regulation causes the selection of the fastest growing species if the system has a periodic behavior, and derive new selection criteria. Finally, the method is simulated using the Droop model for selecting species which maximize these criteria.

16:30-18:30 WeC01.28

Adaptive Extremum-Seeking Control Applied to Productivity Optimization in Yeast Fed-Batch Cultures, pp. 9713-9718

Dewasme, Laurent — Faculté Pol. de Mons
Vande Wouwer, Alain — Faculté Pol. de Mons

In this study, we consider the problem of optimizing the productivity of fed-batch cultures of S. cerevisiae, which are characterized by strongly nonlinear kinetic models based on the bottleneck assumption of Sonnleitner and K¨appeli [1986] and ethanol inhibition resulting from the fermentation of a possible excess of substrate feeding. In contrast with most published studies where the critical substrate level is assumed constant, we investigate the situation where this critical substrate level depends on the yeast respiratory capacity, and in turn on the oxygen and etahnol concentration in the culture medium. The challenge is thus to maintain the process at a high level of productivity by avoiding the accumulation of ethanol. To this end, an adaptive extremum seeking control scheme, coupled to an asymptotic observer, is developed based on Lyapunov stability arguments.

16:30-18:30 WeC01.29

Determination of Macroscopic Reaction Schemes: Towards a Unifying View, pp. 9719-9724

Bogaerts, Philippe — Univ. Libre de Bruxelles
Rooman, Marianne — Univ. Libre de Bruxelles
Vastemans, Vincent — Univ. Libre de Bruxelles
Vande Wouwer, Alain — Faculté Pol. de Mons

The systematic determination of macroscopic biological reaction networks from experimental data records of the evolution of a set of external substrates and cell products has received increasing attention in recent years. The purpose of this paper is to review existing methods, highlighting the potential connection between them using the concept of equivalence of reaction schemes and discussing potential extensions.

16:30-18:30 WeC01.30

Extended Luenberger Observer-Based Fault Detection for an Activated Sludge Process, pp. 9725-9730

Nejjari, Fatiha — Univ. Pol. de Catalunya
Puig, Vicenc — Univ. Pol. de Catalunya

In this paper, an observer-based fault detection and isolation (FDI) method for a biological wastewater treatment process (WWTP) is presented. The residual is generated utilizing an Extended Luenberger function observer. The FDI of a set of sensors faults is done by using a bank of Luenberger observers. The implementation of the proposed approach and the results obtained from its application to the WWTP demonstrate its simplicity and effectiveness.

16:30-18:30 WeC01.31

Network Effect on Loyalty for Service Systems, pp. 9731-9736

Liu, Q.G. — Tsinghua Univ.
Zhou, J. — Tsinghua Univ.

Customer loyalty is always an important index for service providers to consider in service systems. It represents the probability of repurchasing. The paper focuses on the study of loyalty in the networked environment. We propose one mathematical model to describe satisfaction and analyze how satisfaction and switching cost influence loyalty by using the catastrophe model. Comparing with previous studies, the proposed study considers the influence factors, such as word-of-mouth and past experience, reflects one's preference when facing othersresponse, and especially strengthens the effect of interaction between customers on loyalty. Utilizing a scale-free network, simulation experiments also show that customer interactions play an important role on loyalty.

16:30-18:30 WeC01.32

A Hands-On Laboratory for Introductory Automatic Control Courses, pp. 9737-9742

Su, Juing-Huei — Lunghwa Univ. of science and Tech.
Lee, Chyi-Shyong — Lunghwa Univ. of Science and Tech.
Hsieh, Cheng-Chang — Lunghwa Univ. of Science and Tech.
Lin, Kuo-En — Lunghwa Univ. of Science and Tech.
Chang, Jia-Hao — Lunghwa Univ. of Science and Tech.
Lin, Gu-Hong — Lunghwa Univ. of Science and Tech.

This paper presents a hands-on laboratory for introductory automatic control courses, which will be offered to the third or fourth year students of the department of electronic engineering in the Lunghwa University of Science and Technology. The aim of the hands-on laboratory is to help reinforce the learning process of the students in introductory automatic control courses from a practical point of view. Therefore, a low cost (~USD 60) but versatile educational platform based on the dsPIC microcontroller is devised as a learning aid to implement practical control algorithms for motion control systems. A monitor and control software running on the PC side is also developed to collect experimental results from and send commands via universal serial bus (USB) to the platform. All the necessary softwares are given at no cost to the students during the class. In addition to the theoretical part of automatic control systems and microcontroller structures, the hands-on laboratory consists of four parts of exercises which are used to help students learn step by step the automatic control theory, how to implement control algorithms in a microcontroller, and the performance requirements of motion control systems.

16:30-18:30 WeC01.33

A Hands-On Laboratory for Autonomous Mobile Robot Design Courses, pp. 9743-9748

Su, Juing-Huei — Lunghwa Univ. of science and Tech.
Lee, Chyi-Shyong — Lunghwa Univ. of Science and Tech.
Lin, Kuo-En — Lunghwa Univ. of Science and Tech.
Chang, Jia-Hao — Lunghwa Univ. of Science and Tech.
Chiu, Ming-Hsien — Lunghwa Univ. of science and Tech.
Lin, Gu-Hong — Lunghwa Univ. of Science and Tech.

This paper presents a hands-on laboratory for autonomous mobile robot design courses, which will be offered to the third or fourth year students of the department of electronic engineering in the Lunghwa University of Science and Technology. The aim of the hands-on laboratory is to introduce to the students the basic implementation issues of autonomous mobile robots from a practical point of view. Therefore, a simple line following robot with automatic control algorithms to detect the line position and to steer the motors, and a micro-mouse capable of solving a given maze are devised for the hands-on laboratory. These two autonomous mobile robot kits based on the dsPIC microcontroller are used to help students learn easily both the hardware and software implementation issues. SIMULINK behaviour models are also developed to help students quickly grasp the working principles of these two autonomous mobile robots. All the necessary software is given at no cost to the students during the class.

16:30-18:30 WeC01.34

Physical Workbench for Technical Training in Discrete Time Control, pp. 9749-9754

Llaría, Alvaro — ESTIA
Camblong, Haritza — ESTIA
Curea, Octavian — ESTIA
Jiménez, Jaime — Univ. del País Vasco, Escuela Técnica Superior de Ingenier

The aim of this paper is to present the BANCO project and its first results. ESTIA had not experimental setups to make work labs in the discrete-time control courses. It is why some Alecop setups have been improved to use them in these work labs. They were prepared to be used in the Control courses of the second and the third year. The made improvements concern especially an electronic module and its programming. This module allows the students to implement discrete-time control algorithms and to observe the behaviour of some real thermal, hydraulic and mechatronic processes. The main hardware parts of this module designed and constructed in ESTIA are a microcontroller card and a signal shaping card. In addition, the module communicates with a PC in order to program it. Experimental results obtained with a discrete time R-S-T control algorithm programmed in the module are compared to those obtained with an analog PI controller already existing in the Alecop setups. Now, the setups are being improved even more in order to be able to change some parameters of the processes and to apply systems identification algorithm to these processes.

16:30-18:30 WeC01.35

WinMechLab: A Windows-Based Software Tool for Real-Time Control of Mechatronic Systems, pp. 9755-9760

Campa, Ricardo — Inst. Tecnologico de la Laguna
Kelly, Rafael — CICESE

Real-time control of industrial processes has become an important issue in the recent years. Advances in hardware and software technologies allow the use of single-processor computers to perform real—time tasks. The paper first explains the basic elements of PC—based real—time control systems. Then, it describes the general operation of WinMechLab, a real—time single—processor platform for the simulation and control of mechanisms based on MS—Windows. Finally, we show the application of this software tool in a simple control task of a direct—drive didactic robot arm.

16:30-18:30 WeC01.36

CAN-Bus Based Rapid Control Prototyping System for Education Laboratories, pp. 9761-9766

Bucher, Roberto — Scuola Univ. Professionale
Balemi, Silvano — SUPSI (Scuola Univ. Professionale della Svizzera Italian

The central element of the educational activities in mechatronics at SUPSI is the mechatronics laboratory, where students integrate the topics introduced by various courses.

In order to increase the value of the laboratory to students and to reduce the cost of its creation and operation, a modular approach has been implemented, which relies on sensors and actuators communicating through the CAN bus as a standard communication protocol.

A library of interfaces for many CAN capable devices has been implemented both for Matlab/Simulink and for Scilab/Scicos. Rapid control prototyping techniques can be used to generate code for existing applications or to build new applications based on available devices.Additional devices can also be easily added thanks to a 4-tier design of the interfaces.

16:30-18:30 WeC01.37

Two-Input Two-Output Laboratory-Scale Temperature System Based on Peltier Modules, pp. 9767-9772

Barros, Péricles R. — Univ. Federal de Campina Grande
Acioli Junior, George — Univ. Federal de Campina Grande
Morais, João Batista — Univ. Federal de Campina Grande

A laboratory-scale temperature system for Control and Automation courses is presented. The system is a coupled two-input two-output process which use peltier modules for temperature control. This paper describes the laboratory-scale system in details. A linear dynamic model of the thermoelectric cooler including the heat sink and the cooling-load heat exchanger is developed and experiments are shown which illustrate the use of the system.

16:30-18:30 WeC01.38

A Process Control Platform for Education in the Virtual Factory Laboratory System, pp. 9773-9778

Wang, Jishuai — Zhejiang Univ.
Rong, Gang — Zhejiang Univ.
Gu, Haijie — Zhejiang Univ.
Wang, Qiang — Zhejiang Univ.
Feng, YiPing — ZheJiang Univ.

This paper describes an experimental platform which is useful for graduate and undergraduate education in control engineering. It contains a six-tank liquid level regulation system and a pilot distillation column, which can be used as stand-alone apparatus. Some extensions of the apparatus are made to increase the function of the platform. The compositions of distillate can be estimated by adding soft sensors to the distillation column. Integrating with liquid level regulation system makes the inlet and outlet flow of the distillation column controllable which provides a realistic engineering experimental environment. It is possible to describe the impacts of unloading from upstream and charging to downstream as in process industry. The platform has been used for graduate courses such as system identification, soft sensor designing and advanced control system.

16:30-18:30 WeC01.39

Four Rotor Helicopter Control Laboratory Plant, pp. 9779-9784

Toledo, Jonay — Univ. of La Laguna
Acosta, L. — Univ. of La Laguna
Sigut, M. — Univ. of La Laguna
Felipe, Jonatán — Univ. of La Laguna
Morales, Nestor — Univ. of La Laguna
Torres, Santiago — Univ. de La Laguna

In this paper, a test-bed for teaching in multivariable system is presented. Firstly, the different aspects of the prototype construction will be described, making a special emphasis in the mechanics, the design of the sensorial and actuation systems and the prototype control. Next, the real time control software will be explained. The mathematical model of the plant is presented in order to design a control strategy, test it in simulation and validate in the real system

16:30-18:30 WeC01.40

A Laboratory Platform for Project Based Training Concerning the Development of Complex Networked Control Systems, pp. 9785-9790

Kaufmann, Michael — Univ. of Karlsruhe
Schweiger, Frank — Tec-Solution
Bretthauer, Georg — Forschungszentrum Karlsruhe

Due to modern trends in the development of mechatronic systems, requirements on developers are changing. Beside the classical approaches to control design, engineers need competence in fields like integration of heterogeneous systems, communication between different components, interoperation between various software components, and simulation of complex systems. Further, development is carried out by teams of specialists. Teaching in the field of automatic control needs to be adapted to these new trends. A new laboratory platform has been developed and installed to other laboratory projects tailored to these requirements. A robot arm and corresponding control hardware is composed of carefully selected components used in industrial equipment. The robot is complemented by auxiliary systems which allow the accomplishment of a range of laboratory projects by groups of students. After acquiring particular skills in workshops during an advanced study phase, students form teams to complete a given team project. Project steps from analysis of requirements to test and presentation are planned and accomplished by the team. This process is very similar to industrial development processes and allows students to acquire valuable skills in mechatronic system design.

16:30-18:30 WeC01.41

Development of an Electronic Simulator Named "MPDT" for Control Education, pp. 9791-9796

Bui, Quyen T. T. — Pusan National Univ.
Pham, Thuong Cat — Inst. of Information Tech.
Hong, Keum-Shik — Pusan National Univ.

In this paper, the development of an electronic simulator named Mo-Phong-Doi-Tuong (MPDT) is presented. This newly developed MPDT simulator can simulate, in real-time, nonlinear processes (for instance, inverted pendulums, acrobots, autonomous vehicles, coupled liquid-level systems, and others) as well as linear processes. Besides, the developed MPDT has a 3D motion animation mode and allows users to build their own control objects. The MPDT is flexible and powerful equipment can replace many expensive control apparatuses used in control engineering laboratories. It can also be used to test a complicated controller (integration of PLC, PC/104, PC, microcontroller, etc.) and control algorithms for research and education in control engineering.

16:30-18:30 WeC01.42

An Integrated Internet-Based Package for Teaching Motion Control: Content and Testing Results, pp. 9797-9801

Buiu, Catalin — Pol. Univ. of Bucharest

In this paper, a motion control training package developed at POLITEHNICA University of Bucharest is described. The package is dedicated to automation technicians and students in automatic control. The main objective of the package is to present the basics of motion control in an interactive way using theory, movies, dynamic simulators, games and a remote lab. A statistical study on the educational impact of this innovative training package is demonstrating the positive impact on the learners compared to traditional learning methods.

16:30-18:30 WeC01.43

Development of Educational Web-Based Simulator and Its Evaluation, pp. 9802-9806

Mkrttchian, Vardan — All Armenian Internet Univ. - HHH Univ.
Kljajic, Miroljub — Univ. of Maribor
Škraba, Andrej — Univ. of Maribor
Yeranosyan, Hasmik — All Armenian Internet Univ.
Kljaji_; Borštnar, Mirjana — Univ. of Maribor

This paper discusses the development of the educational simulator for All Armenian Internet University (HHH University) and Faculty of Organizational Sciences University of Maribor Slovenia. In the developed simulator, lecturers can set information related to educational fields and students can bid and examine the educational fields with lecturers. The developed application program is composed of the physical three levels where the middle level is logically divided into two kinds of application programs. The divided application programs are interconnected by using the Web-service based on HTTP (Hyper Text Transfer Protocol) which makes the distributed computing technology possible.

16:30-18:30 WeC01.44

Virtual Laboratory for Distance Learning, Remote Process Control, pp. 9807-9811

Popescu, Dumitru — Pol. Univ. of Bucharest
Lupu, Ciprian — Pol. Univ. of Bucharest
Dimon, Catalin — Univ. Pol. of Bucharest
Matei, Ion — Pol. Univ. of Bucharest

This paper describes the philosophy behind the remote level control of a didactical platform. Issues related to the hardware and software architecture that allow remote access to the experimental platform using a simple Internet browser and some concepts about the control strategy used are presented. The virtual laboratory application is built primarily as an educational tool for distance learning, but these types of applications can be extended, with some considerations, to industrial process control.

16:30-18:30 WeC01.45

Experimental Identification - an Interactive Online Course, pp. 9812-9816

Cirka, Lubos — Slovak Univ. of Tech. in Bratislava
Fikar, Miroslav — STU in Bratislava
Kvasnica, Michal — Slovak Univ. of Tech. in Bratislava
Herceg, Martin — Slovak Univ. of Tech. in Bratislava

The aim of the article is to present an interactive online course on experimental identification.Besides teaching materials in the traditional workbook form, new computer based training and electronic media - Internet is used to enable interactive and computer supported way of learning.

16:30-18:30 WeC01.46

A Novel E-Laboratory for Remote Monitoring and Control, pp. 9817-9822

Li, Lixiong — Shanghai Univ.
Deng, Jing — Shanghai Univ.
Li, Kang — Queen's Univ. Belfast
Fei, Minrui — Shanghai Univ.

An internet-based laboratory for control engineering education is designed and implemented in this paper. This e-laboratory has a physical setup which is constructed for the research of multi-protocol conversion. Configuration software WebAccess is utilized to build the Human-Machine Interface (HMI) and the web server. With this B/S (Browser/server) structure, users can monitor and manipulate the physical setup during and beyond the regular working hours from any web-enabled location. A distinctive feature of this e-laboratory is its flexibility. Firstly, three types of control loops are constructed for flexible implementation of various control algorithms that can be developed by the users. Secondly, some new functionalities can be added easily by reconfiguring the intelligent controller and upper-level computer software. Experiments under different networked environment indicated that such e-laboratory is suitable for the research of NCS (networked control system). This laboratory is primarily designed for control engineering education, though the architecture can easily be extended to many other areas.

16:30-18:30 WeC01.47

Metabolic Control Analysis of Complex Biological Systems, pp. 9823-9827

Yun, Choamun — Korea Advanced Inst. of Science and Tech.
Kim, Young — Korea Advanced Inst. of Science and Tech.
Lee, Sang Yup — Korea Advanced Inst. of Science and Tech.
Park, Sunwon — Korea Advanced Inst. of Science and Tech.

A systematic approach is proposed for the metabolic control analysis of various dynamic behaviors in biological systems. The complex kinetic models are reduced by identifying the conservation relations and the time scale analysis. Subsequently, the biological systems are categorized into the three groups: systems with the steady-states, sustained oscillations, or other non-steady states. The sensitivities are measured to calculate the corresponding control coefficients that are defined considering the characteristics of the dynamics of the systems. The proposed approach is illustrated with its application to the dynamic behaviors of a complex biological model.

16:30-18:30 WeC01.48

Fibonacci and Futility, pp. 9828-9833

Chernyshov, Kirill — V.A. Trapeznikov Inst. of Control Sciences

The present paper deals with statements of a recently published book of the “Nauka” Publishing House (Moscow, 2005) on regularity of appearance of the Fibonacci golden mean as a quantitative characteristic in the social and economical sphere and necessity to follow it under increasing management efficiency. The present paper proposes a negative answer to the question on necessity of following the golden mean under managing social and economical systems. Such an answer is justified by formulation (as continued as required) a series of questions, motivated by real practice, which may not be scientifically answered, by a corresponding analysis, and by referring to serious relevant literature sources not mentioning the considered golden mean method.

WeC02 304A

Nonlinear Observers and Observability (Regular Session)

Chair: Xia, Xiaohua — Univ. of Pretoria
Co-Chair: Yaz, Edwin — Marquette Univ.

16:30-16:50 WeC02.1

Current Output Observer for Discrete-Time Nonlinear Stochastic Systems, pp. 9834-9839

Zhai, Tongyan — Marquette Univ.
Yaz, Edwin — Marquette Univ.
Jeong, Chung Seop — Marquette Univ.

A Current Output Observer is presented and its estimation error performance is compared to that of the Extended Kalman Filter. It is shown that performance improvement can be obtained by this new scheme with minor increase in computational load. In order to obtain stronger results, scalar nonlinear stochastic systems are focused on. These systems are categorized based on the derivatives of their nonlinear functions. It is shown that different state estimation performance is achieved when the Current Output Observer is applied to scalar nonlinear systems in these different categories, which allows the convergence property to be known before its implementation. This provides insight into what is going to happen in applications, e.g. for a nonlinear estimator used in chaotic synchronization. Simulation studies involving nonlinear estimation - based chaotic synchronization complement the theory presented.

16:50-17:10 WeC02.2

Stochastically Resilient Design of Mixed H2-Dissipative Observers *for Discrete-Time Nonlinear Systems*, pp. 9840-9845

Jeong, Chung Seop — Marquette Univ.
Yaz, Edwin — Marquette Univ.
Yaz, Yvonne — Milwaukee School of Engineering

A linear matrix inequality based mixed H2-Dissipative type state observer design approach is presented for smooth discrete time nonlinear systems with finite energy disturbances. This observer is designed to maintain H2 type estimation error performance together with either H-infinity or a passivity type disturbance reduction performance in case of randomly varying perturbations in its gain. A linear matrix inequality is used at each time instant to find the time-varying gain of the observer. Simulation studies are included to explore the performance in comparison to the extended Kalman filter.

17:10-17:30 WeC02.3

Uniformly Observable and Globally Lipschitzian Nonlinear Systems Admit Semi-Global Finite-Time Observers, pp. 9846-9851

Shen, Yanjun — China Three Gorges Univ.
Xia, Xiaohua — Univ. of Pretoria

It is well-known that high gain observers exist for nonlinear systems that are uniformly observable and globally Lipschitzian. Under the same conditions, we show that these systems admit semi-global and finite-time converging observers. This is achieved with a derivation of a new sufficient condition for local finite-time stability, in conjunction with applications of geometric homogeneity and Lyapunov theories.

17:30-17:50 WeC02.4

Possible Non-Integrability of Observable Space for Discrete-Time Nonlinear Control Systems, pp. 9852-9856

Kotta, Ülle — Inst. of Cybernetics at TUT
Schlacher, Kurt — Johannes Kepler Univ. of Linz

The purpose of this paper is to provide some explanation why for the continuous-time nonlinear control system the observable subspace of one-forms is always generically integrable and why this is not necessarily so in the discrete-time case. Moreover, a general subclass of discrete-time control systems is suggested for which the observable subspace is nonintegrable.

17:50-18:10 WeC02.5

An Invariant Observer for Earth-Velocity-Aided Attitude Heading Reference Systems, pp. 9857-9864

Martin, Philippe — Ec. des Mines de Paris
Salaün, Erwan — Ec. des Mines de Paris

In this paper we propose an invariant nonlinear observer (i.e. a “filter”) for estimating the velocity vector and orientation of a flying rigid body, using measurements from low-cost Earth-fixed velocity, inertial and magnetic sensors. It has a nice geometric structure which respects meaningful physical symmetries of the system. It can be seen as an easier-to-tune and computationally much simpler alternative to an Extended Kalman Filter.

18:10-18:30 WeC02.6

Observers Synthesis Method for a Class of Nonlinear Discrete-Time Systems with Extension to Observer-Based Control, pp. 9865-9870

Zemouche, Ali — Louis Pasteur Univ.
Boutayeb, Mohamed — Nancy Univ.

This note deals with a new observer synthesis method for a class of nonlinear discretetime systems. Thanks to the use of the Differential Mean Value Theorem (DMVT), we have obtained easily an extension of the work established in Zemouche et al. (2006) and Fan and Arcak (2003) to the discrete-time case. Based on the Lyapunov stability, a new sufficient synthesis condition is proposed. This condition is expressed in term of Linear Matrix Inequality (LMI) and then it is easily tractable using standard convex optimization algorithms. An extension to observer-based control is also presented. The design of the observer-controller gains is given in two manners. Firstly, the gains are computed by solving a LMI condition under an equality constraint. Since this latter induce a conservatism for the approach, then a systematic algorithm, that avoids the equality constraint, is proposed to solve the problem of observer-based control in two steps.

WeC03 304B

Sliding Mode Control (Regular Session)

Chair: Khalil, Hassan K. — Michigan State Univ.
Co-Chair: Loukianov, Alexander G. — CINVESTAV IPN GDl

16:30-16:50 WeC03.1

Adaptive Sliding Mode Attitude and Vibration Control of Flexible Spacecraft under Unknown Disturbance and Uncertainty, pp. 9871-9876

Hu, Qinglei — Harbin Inst. of Tech.

This paper is concerned with the development of a control system for rotational maneuver and vibration suppression of a flexible spacecraft. It is assumed that the system parameters are unknown. The design approach presented here treats the problem of spacecraft attitude control separately from the elastic vibration suppression problem. As a stepping stone, a state feedback sliding mode control command is designed for the reaction wheel to achieve the reference trajectory tracking control of attitude angle. This is followed by the design of an adaptive sliding mode control (ASMC) law using only the output for robust stabilization of spacecraft in the presence of parametric uncertainty and external disturbances. Although this controller has the ability to reject the disturbance, deal with uncertainty and to ensure that the system output errors asymptotically converge to the sliding mode during the commanded motion, it excites the elastic modes of flexible appendages. The undesirable vibration is actively suppressed by applying feedback control voltages to the piezoceramic actuators, in which the control voltages are determined using the modal velocity feedback control method. Both analytical and numerical results are presented to show the theoretical and practical merits of this hybrid approach.

16:50-17:10 WeC03.2

A New Design for Chattering Reduction in Sliding Mode Control, pp. 9877-9881

Chen, Chi-Che — National Taiwan Univ.
Chen, Min-Shin — National Taiwan Univ.

This paper discusses a new design of chattering reduction for sliding mode control. Conventionally, a boundary layer around the sliding surface is used to achieve smooth control signals. However, the boundary layer design become in-effective in chattering reduction when there is high-level measurement noise. To solve this problem, this paper proposes a dynamic sliding mode control, which, with the help of an LTR observer for uncertainty estimation, achieves chattering reduction even in very noisy environments.

17:10-17:30 WeC03.3

Robust Control of Uncertain Switched Delay Systems: A Sliding Mode Control Design, pp. 9882-9887

Lian, Jie — Northeastern Univ.
Dimirovski, Georgi Marko — Dogus Univ. of Istanbul
Zhao, Jun — The Australian National Univ.

This paper investigates the robust sliding mode control problem for a class of uncertain switched delay systems. A single sliding surface is constructed such that the reduced-order equivalent sliding motion restricted to the sliding surface is completely invariant to all admissible uncertainties. For the cases of known delay and unknown delay, the existence conditions of the sliding surface are proposed, respectively. The corresponding hysteresis switching laws are designed to asymptotically stabilize the sliding motion. Furthermore, variable structure controllers are developed to drive the state of the switched system to reach the single sliding surface in finite time and remain on it thereafter. Finally, a numerical example is given to illustrate the effectiveness of the proposed method.

17:30-17:50 WeC03.4

A New Terminal Sliding Mode Control for Robotic Manipulators, pp. 9888-9893

Zhao, Dongya — Shanghai Jiao Tong Univ.
Li, Shaoyuan — Shanghai Jiao Tong Univ.
Gao, Feng — Shanghai Jiao Tong Univ.

In this paper, a new terminal sliding mode control approach is developed for robotic manipulators. Unlike traditional terminal sliding mode control, the proposed approach can make system states converge to zero in a finite time without requiring explicitly using of system dynamic model. Theoretical analysis and simulation results are presented to illustrate the proposed approach. The controller parameter tuning method is also proposed.

17:50-18:10 WeC03.5

A Model Predictive Control Approach to Predict Sliding Surface, pp. 9894-9898

Montaseri, Ghazal | Univ. of Tehran
Yazdanpanah, M. J. | Univ. of Tehran

In this paper, a predictive control scheme for a class of nonlinear systems is proposed which combines the model predictive control (MPC) and sliding mode control (SMC).We call this new algorithm sliding mode model predictive control (SMMPC). In this algorithm the pre-designed switching surface is predicted via MPC strategy. First the system nonlinearity is handled by converting the state-dependent state-space representation into the linear time varying representation, and then this model is descritised. Finally the control sequence may be found by solving an open-loop optimal control problem in which the cost function weights the norm of pre-designed sliding surface and control law. Simulation results illustrate that the closed-loop system has desired properties such as robustness and chattering elimination.

18:10-18:30 WeC03.6
Integral Nested Sliding Mode Control for Robotic Manipulators, pp. 9899-9904

González Jiménez, Luis Enrique | Centro de Investigaciones y Estudios Avanzados del IPN, Unidad G
Loukianov, Alexander G. | CINVESTAV IPN GDl
Bayro-Corrochano, Eduardo Jose | Centro de Investigacion y de Estudios Avanzados del I.P.N. Cl

An Integral Nested Sliding Mode Control (INSMC) is proposed for n-link robotic manipulators tracking problem by employing Integral Sliding Mode (ISM) and Nested Sliding Mode (NSM) concepts. This controller has the robustness of NSM against matched and no matched perturbations, and the capability of ISM to reduce the sliding functions gains. Application to a two-link planar robot manipulator is presented as a simulation example.

WeC04 308
Linear Matrix Inequalities and Their Applications (Regular Session)

Chair: Kogan, Mark M. | Architecture And Civil Engineering Univ.
Co-Chair: James, Matthew R. | Australian National Univ.

16:30-16:50 WeC04.1
LMI Based Output-Feedback Controllers: Gamma-Optimal versus Linear Quadratic, pp. 9905-9909

Balandin, Dmitry V. | Res. Inst. for Appl. Math & Cyber.
Kogan, Mark M. | Architecture And Civil Engineering Univ.

Solution to the linear quadratic control problem is given in the class of linear dynamic output-feedback full order controllers. Necessary and sufficient conditions for existence of such an optimal controller are stated in terms of linear matrix inequalities provided that initial conditions for controller states to be zero. It is shown that parameters of the optimal controller depend on an initial plant state. As an alternative we introduce gamma-optimal controller which minimizes the maximal ratio of the performance index and square of the norm of the initial plant state. Numerical comparison for two kinds of these controllers is presented for inverted and double inverted pendulums.

16:50-17:10 WeC04.2
Controller Synthesis of an Uncertain Three Tank System Using Polytypic System Approach, pp. 9910-9915

Iqbal, Muhammad | CASE
Raza, Qarab | CASE
Bhatti, Aamer Iqbal | Muhammad Ali Jinnah Univ. Islamabad
Ayub, Ayaz | IDS

Many of the systems in process and aerospace industry can be modeled as a three tank system. LMI and NLMI based controller design methods have been applied to three tank system in literature. Nonlinear methods suffer from lack of ease for implementation, on the other hand, LMI based methods have to be unduly robust to cater for significant uncertainties arising from linearization around an equilibrium point. This paper presents an LMI based controller design method, which specifically uses second or higher order terms of nonlinear three tank model, thus resulting in a robust controller with no compromise on performance. A second degree error model is derived using small signal linearization method about an arbitrary operating point. A set of LMI's are formulated for each polytopic region and solved to obtain the corresponding state feedback controller gains for that particular polytopic region. The series of designed controllers drives the system states from starting point to the desired state through a series of connected polytopic regions. The controller is robust with respect to parameter variations due to the combined polytopic-LMI problem formulation. The effects of parametric variations and disturbances are accounted for in such a formulation via appropriate bounds. The performance of the designed controller is also compared with LMI based H_; controller.

17:10-17:30 WeC04.3
Observer Based Controller Design for Linear Systems with Input Constraints, pp. 9916-9921

Lens, Hendrik | TU Darmstadt
Adamy, Jürgen | Tech. Univ. Darmstadt

A systematic design method for observer based linear control of LTI systems with input constraints is introduced. The method allows to optimize the observer parameters with respect to the system's performance while at the same time the compliance with the constraints is guaranteed. To improve the results we further propose a method to design both the controller and the observer simultaneously. Since the presented methods are based on LMI techniques they are computationally very efficient. The proposed methods are demonstrated by means of an example.

17:30-17:50 WeC04.4
Quantum LQG Control with Quantum Mechanical Controllers, pp. 9922-9927

Nurdin, Hendra Ishwara | Australian National Univ.
James, Matthew R. | Australian National Univ.
Petersen, Ian Richard | Univ. of New South Wales - ADFA

Based on a recently developed notion of physical realizability for quantum linear stochastic systems, we formulate a quantum LQG optimal control problem for quantum linear stochastic systems where the controller itself may also be a quantum system and the plant output signal can be fully quantum. This is distinct from previous works on the quantum LQG problem where measurement is performed on the plant and the measurement signals are used as input to a fully classical controller with no quantum degrees of freedom. The difference in our formulation is the presence of additional non-linear and linear constraints on the coefficients of the sought after controller, rendering the problem as a type of constrained controller problem. Due to the presence of these constraints our problem is inherently computationally hard and this distinguishes it in an important way from the standard LQG problem. We propose a numerical procedure for solving this problem based on an alternating projections algorithm and, as initial demonstration of the feasibility of this approach, we provide a fully quantum controller design example in which a numerical solution to the problem was successfully obtained.

17:50-18:10 WeC04.5
Stabilization of the Inverted Pendulum with Backlash Using H_{infty}-LMI Technique, pp. 9928-9933

Pujol, Gisela | Escola Univ. d'Enginyeria Tecnica Industrial
Acho, Leonardo | EUETIB-Univ. Pol. of Catalunya

The rotary inverted pendulum, also named Furuta Pendulum, has been studied extensively for control performance evaluation in under-actuated mechanisms. The H_{infty} control invoking Linear Matrix Inequality (H_{infty}-LMI) has been also wide employed for linear control design. This paper deals with the feasibility of H_{infty}-LMI technique to stabilize the rotary inverted pendulum around its unstable equilibrium point when there exists a backlash nonlinearity in the actuator. So, the H_{infty}-LMI faces the nonlinear effect in the actuator and the non-linear pendulum model. Experimental realization of the designed H_{infty}-LMI control evidences the good performance of the controller subject to external perturbation too.

18:10-18:30 WeC04.6
Saturated LMI Control of Hysteretic Base-Isolated Structures, pp. 9934-9939

Pozo, Francesc | Univ. Pol. de Catalunya
Pujol, Gisela | Escola Univ. d'Enginyeria Tecnica Industrial
Acho, Leonardo | EUETIB-Univ. Pol. of Catalunya

The main objective of applying active control forces to base-isolated structures is to protect them in the event of an earthquake. An LMI-based control design is proposed to attenuate seismic disturbances in base-isolated structures under saturation actuators. Using a simplified model of the structure system, a control algorithm design is offered. Performance evaluation of the controller is carried out in a simplified model version of a benchmark building system, which is recognized as a state-of-the-art model for numerical experiments of structures under seismic perturbations. Experimental results show that the proposed algorithm is robust with respect to model and seismic perturbations. Finally, the performance indices show that the proposed controller behaves satisfactorily and with a reasonable control effort.

WeC05 307
Decentralized Control (Regular Session)
Chair: Middleton, Rick — National Univ. of Ireland
Co-Chair: Dallagi, Anes — Univ. of Alberta

16:30-16:50 WeC05.1
Modification of Model Predictive Control to Reduce Cross-Coupling, pp. 9940-9945
Middleton, Rick — National Univ. of Ireland
Adams, Gregory John — Univ. of Newcastle

We consider the problem of reducing interaction in the closed-loop response of model predictive control (MPC). Interaction in MPC may be caused by diagonal weighting of inputs in the MPC cost function that are not diagonally related to the outputs. If instead of weighting the plant inputs a suitable decoupled input signal is used in the MPC cost function, then a significant reduction in cross coupling can occur. In the case where the plant has a static interaction matrix, complete decoupling occurs. Simulation examples show that the procedure can be implemented via a simple modification to standard MPC algorithms, and is applicable to ill-conditioned and non-minimum phase plants.

16:50-17:10 WeC05.2
A Generalized Design of Decoupling Multivariable Control for Disturbance Rejection, pp. 9946-9951
Huang, Hsiao-Ping — National Taiwan Univ.
Lin, Feng-Yi — National Taiwan Univ.
Jeng, Jyh-Cheng — National Taiwan Univ.

In this paper, a systematic procedure is proposed for the generalized design of decoupling multivariable controller, which may result in a complete decoupling, partial decoupling or no decoupling, to achieve a better disturbance rejection response. Before the decoupling, a relative load gain (abbr. RLG) is defined to determine which control loops need to be decoupled and which control loops don't. By a transitional design matrix and its adjoint matrix, a completely or partially inverse-based multi-input-multioutput (MIMO) decoupler with generalized form is presented to decouple the process into the specified open-loop process. This decoupled open-loop process is further decomposed into several equivalent singleloop systems, equivalent open-loop processes and disturbances. Finally, the controller can be synthesized based on each equivalent system for disturbance rejection. Stability robustness of the system is tuned with measures for the modeling errors in the decoupled open-loop process. Simulation examples are illustrated to show that this proposed method is effective for disturbance rejection in MIMO systems.

17:10-17:30 WeC05.3
Decentralized PID Controller Design for a MIMO Evaporator Based on Colonial Competitive Algorithm, pp. 9952-9957
Rajabioun, Ramin — Tehran Univ.
Hashemzadeh, Farzad — Tehran Univ.
Atashpaz-Gargary, Esmaeil — tehran Univ.
Mesgari, Bahman — Tehran Univ.
Rajaee, Farzad — Faculty of Engineering, Campus#2, Univ. of Tehran

Recently, Colonial Competitive Algorithm (CCA) has proven its superior capabilities, such as faster convergence and better global minimum achievement in optimization problems. In this paper, CCA is utilized to optimize the coefficients of a decentralized PID controller for a MIMO evaporator system. The optimization criterion is considered as the Integral Absolute Error (IAE) to minimize the tracking error. As the first step, the evaporator's three input-three output transfer matrix is identified using measured dataset based on the prediction error model method. In order to design decentralize controllers, input-output pairing is performed based on the relative Gain Array method. Decentralized PID controllers are then designed using Ziegler-Nichols, Genetic Algorithm, and the proposed CCA techniques. The simulation results verify the superiority of CCA to the Ziegler-Nichols and Genetic Algorithm tuning techniques for decentralized PID controllers.

17:30-17:50 WeC05.4
Coordination of Decentralized Large-Scale Process Optimal Control Problems, pp. 9958-9963
Dallagi, Anes — Univ. of Alberta
Marcos, Natalia Iris — Univ. of Alberta
Forbes, J. Fraser — Univ. of Alberta

A key issue in decentralized decision-making is ensuring that the decentralized optimal solution results in the overall optimum. In this paper, we present a method to achieve tractable coordination schemes for large-scale dynamic systems. We will focus on the Interaction Prediction Principle, _rst introduced by Msearovic et al. [1970b], and present an extension to achieve zero-o_set. The proposed approach is illustrated using a forced-circulation evaporator system, in which we show how to decompose it and how to coordinate between its di_erent units.

17:50-18:10 WeC05.5
Robust Decentralized Data Fusion Based on Internal Ellipsoid Approximation, pp. 9964-9969
Zhou, Yan — Shanghai Jiao Tong Univ.
Li, Jianxun — Shanghai Jiao Tong Univ.

Based on M-estimate, the problem of robust estimation fusion in decentralized architecture when the sensor noises are contaminated by outliers is considered. A simple robust Kalman filtering (RKF) scheme with weighted matrices of innovation sequences is introduced for local state estimation. Then, to avoid both the inconsistency of the Kalman filter and the performance conservation of the covariance intersection method, an internal ellipsoid approximation method (IEA) is proposed to fuse the local estimation in the fusion center. Finally, to demonstrate robustness of the proposed RKF and the effectiveness of IEA strategy, a simple tracking example in the presence of outliers is introduced.

18:10-18:30 WeC05.6
Decentralized Boundary Control of Irrigation Canal Networks Via a Strict Lyapunov Method, pp. 9970-9975
Li, Li — The Univ. of Melbourne

A decentralized boundary control problem for irrigation canal networks is considered in this paper. The control scheme is based on a strict Lyapunov method introduced in Coron et al. (2007). A sufficient condition is presented to guarantee the closed-loop system to be locally convergent to a desired set point, which extends the results in Coron et al. (2007) for the single-pool case to a decentralized fashion for the multi-pool case. By eliminating the redundant variables, the derived condition involves certain contractive condition and discrete-time Lyapunov inequality with variables in a diagonal structure. This provides an easier way to check the existence of the solution. An application to a two-pool canal with overflow spillways is presented to demonstrate the proposed approach.

WeC06 310A
Descriptor Systems (Regular Session)
Chair: Marx, Benoit — Centre de Recherche en Automatique de Nancy
Co-Chair: Yung, Chee-Fai — National Taiwan Ocean Univ.

16:30-16:50 WeC06.1
Stability and L2-Norm Bound Conditions for Takagi-Sugeno Descriptor Systems, pp. 9976-9981
Marx, Benoit — Centre de Recherche en Automatique de Nancy
Ragot, Jose — CRAN-INPL

In this paper, the stability of Takagi-Sugeno (TS) descriptor systems is studied. In most of previous works concerning TS descriptor systems, the authors claimed that the study of polytopic matrix pencil (sum_i h_i(t) E_i, sum_i h_i(t) A_i) reduces to the study of an augmented polytopic matrix pencil (E*,sum_i h_i(t) A_i*) with a common matrix E*. The approach they have used is based on a state augmentation. In this paper, it is proved that this transformation introduces impulsive terms, because time derivate of the state variables are added in the state vector. The major contribution of this paper is to avoid this state augmentation. A new sufficient stability condition is established. Stability with guaranteed decay rate and L_2-norm bound are also studied. All results are given in the linear matrix inequality formalism.

16:50-17:10 WeC06.2

Bounded Real Lemma for Linear Discrete-Time Descriptor Systems, pp. 9982-9986

Yung, Chee-Fai	National Taiwan Ocean Univ.
Wang, Chih-Chieh	MiTAC International Corp.
Wu, Po-Feng	National Taiwan Ocean Univ.
Wang, He-Sheng	National Taiwan Ocean Univ.

Under some rank condition, a new version of bounded real lemma, which is expressed in terms of an admissible solution of a generalized discrete-time algebraic Riccati equation (GDARE) rather than inequality, is presented for linear discrete-time descriptor systems. When a linear discrete-time descriptor system is admissible, with the H-infinity norm of its transfer matrix less than a prescribed positive number r, a constructive procedure is also given to obtain an admissible solution of the above-mentioned GDARE.

17:10-17:30 WeC06.3

On the Regularity for Singular Linear System with Markov Jump Parameters, pp. 9987-9992

Manfrim, Amanda Liz Pacifico	Univ. of Sao Paulo
Terra, Marco Henrique	Univ. of Sao Paulo
Costa, Eduardo F.	Univ. de São Paulo
Ishihara, Joăo Yoshiyuki	Univ. of Brasília

In this paper we consider how to extend the regularity notion of usual singular (descriptor) systems to singular systems with Markovian jumping parameters. Three regularity definitions are introduced: the first one is based on a collection of matrices which defines the transitions of the continuous state and the other ones take into account the stochastic nature of the system, by using information regarding conditional first and second moments. Numerical examples illustrate the difference between these three notions.

17:30-17:50 WeC06.4

Gain-Scheduled Controller Synthesis Based on New LMIs for Dissipativity of Descriptor LPV Systems, pp. 9993-9998

Masubuchi, Izumi	Hiroshima Univ.
Suzuki, Atsushi	Hiroshima Univ.

This paper is concerned with synthesis of gain-scheduled controllers by representing LPV systems in the descriptor form. Based on a recent algebraic criterion characterizing dissipativity of descriptor systems, an improved synthesis method is proposed with removing limitations of descriptor representation in existing results. Specifications of exponential decay are also considered. A numerical example illustrates the procedure of the proposed synthesis method.

17:50-18:10 WeC06.5

Stabilisation of Singular LPV Systems, pp. 9999-10002

Chadli, Mohammed	Univ. de Picardie-Jules Verne
Daafouz, Jamal	CRAN -INPL
Darouach, Mohamed	Univ. Henri Poincare-Nancy

This paper deals with the class of singular LPV systems. Su±cient conditions on controllers design are developed in the LMI (Linear Matrix Inequality) terms. In order to reduce the conservatism of the developed result using quadratic method, an approach based on polyquadratic Lyapunov functions is proposed. Numerical example is given to illustrate the e®ectiveness of the obtained results.

18:10-18:30 WeC06.6

H-Infinity Control for Linear Discrete-Time Descriptor Systems: State Feedback and Full Information Cases, pp. 10003-10008

Yung, Chee-Fai	National Taiwan Ocean Univ.

This paper addresses the H-infinity state feedback (SF) and full information (FI) control problems for linear discrete-time descriptor systems. It is shown that, under some rank assumptions, necessary and sufficient conditions for the solution to the problems can be characterized by an invertible symmetric solution to a certain generalized discrete-time algebraic Riccati inequality (GDARI) involving only one unknown parameter. When the problems have solutions, one such SF controller and one such FI controller are also given, expressed in terms of an invertible symmetric solution to the above-mentioned GDARI. It is also shown that the SF controller given coincides with the FI controller given in the presence of the worst disturbance input.

WeC07 310B

Industrial Applications of Optimal Control (Regular Session)

Chair: Cantoni, Michael	Univ. of Melbourne
Co-Chair: Badreddin, Essam	Univ. of Heidelberg

16:30-16:50 WeC07.1

Intelligent Control for Flotation Process, pp. 10009-10014

Geng, Zengxian	Northeastern Univ. Shenyang,China
Chai, Tianyou	Northeastern Univ.
Yue, Heng	Northeastern Univ.
Wang, Hong	the Univ. of Manchester
Su, Chun-Yi	Concordia Univ.

In the flotation process, the concentrate grade and the tailing grade are crucial technical indices which reflect the product quality and efficiency. There are strong nonlinearity and uncertainty in such technical indices dynamic behaviors, which can hardly be described using accurate mathematical model. The technical indices which cannot be measured online continuously vary with boundary conditions. Therefore conventional control methods are incapable of keeping the actual the concentrate grade and the tailing grade within the target ranges. In this paper, an intelligent control method comprised of the setting layer and the closed loop control layer for the flotation reagent addition to the process has been presented. In flotation reagent feeding setting layer, a unit reagent pre-setting model, a feedback compensator and a feed forward compensator RBR based on (Rule-based reasoning) are integrated with a flotation reagent computation model to set the flotation reagent feeding. The control system updates automatically flotation reagent feeding when the boundary conditions changes. Successfully industrial application has shown that the concentrate grate has been increased by 0.52%, the tailing grade has been reduced by 4%, and the consumption of the flotation reagent feeding has been reduced by 17.5%. Significant application effect has been achieved.

16:50-17:10 WeC07.2

H_2/H_infty Multiobjectives for Fault Detection in Uncertain Polytopic Systems, pp. 10015-10020

Acuńa-Bravo, Wilber	Univ. de Los Andes
Rios-Bolivar, Addison	Univ. De Los Andes

This paper presents a novel technique for robust fault detection, based on a modified H2/H_; performance condition, which is described as LMI. Some theoretical results are shown in order to synthesize the residual generation scheme, for systems subjected to parametric uncertainty. The uncertainty parameters are supposed to belong to a polytope. The extended H2/H_; conditions are obtained by means of the well known projection lemma. Fault detection and isolation are done by using a filters bank (i.e. multifiltering) based on Luenberger's observer and one filter is obtained for each fault. Performance of the proposed synthesis technique is illustrated by a numerical example.

17:10-17:30 WeC07.3

Suboptimal Hybrid Model Predictive Control: Application to Sewer Networks, pp. 10021-10026

Ocampo-Martinez, Carlos	The Univ. of Newcastle
Ingimundarson, Ari	Tech. Univ. of Catalonia
Bemporad, A	Univ. of Siena
Puig, Vicenc	Univ. Pol. de Catalunya

This paper presents an application of the suboptimal hybrid model predictive control (HMPC) algorithm previously proposed by the authors to large scale sewer networks. HMPC relies on the on-line solution of mixed integer programs (MIP) that are known to be NP-complete and whose worst case complexity scales exponentially with problem size. Modern MIP solvers are on the other hand highly efficient at taking advantage of problem structure and usually achieve average optimization times that are much better than the worst case predicts. But as the MIP constraints depend on the current state of the plant, complexity can vary considerably and unpredictable behavior can occur. To circumvent unpredictability and to be able to enforce hard real-time computation constraints, the number of feasible nodes in the MIP problem is limited online by adding constraints to the number of possible mode sequences over the prediction horizon. It is shown that in realistic scenarios concerning control of large scale sewer networks, depending on the value of parameters related to the mode sequence constraints (MSC), drastic reductions can be achieved in optimization time. Practical issues of the approach are also addressed.

17:30-17:50 WeC07.4

Extremum-Seeking-Based Receding-Horizon Optimal Control of Plasma Current Profile in the DIII-D Tokamak, pp. 10027-10032

Ou, Yongsheng — Lehigh Univ.
Xu, Chao — Lehigh Univ.
Schuster, Eugenio — Lehigh Univ.
Luce, Tim — General Atomics
Ferron, J. R. — General Atomics
Walker, Michael — General Atomics
Humphreys, D.A. — General Atomics

A key goal in the control of a magnetic fusion reactor is to maintain current profiles that are compatible with a high fraction of self-generated non-inductive current as well as with magnetohydrodynamic (MHD) stability at high plasma pressure. This enables high fusion gain and noninductive sustainment of plasma current for steady-state operation. The approach taken toward establishing such plasma current profiles at the DIII-D tokamak is to create the desired profile during the plasma current ramp-up and early flattop phases. The evolution in time of the current profile is related to the evolution of the poloidal flux, which is modeled in normalized cylindrical coordinates using a nonlinear partial differential equation (PDE) usually referred to as the magnetic diffusion equation. We propose, and test in simulations, an extremum-seeking-based, receding-horizon, diffusivity-interior-boundary control scheme designed to match as close as possible a desired current profile within a prespecified time interval.

17:50-18:10 WeC07.5

Distributed Controller Design for Open Water Channels, pp. 10033-10038

Li, Yuping — Univ. of Melbourne
Cantoni, Michael — Univ. of Melbourne

In the design of an automatic controller to achieve water-level set-point regulation and off-take load-disturbance rejection for an open water channel, a key concern is an inherent trade-off between local performance and the way water-level errors propagate due to control action. Here a structured optimal controller synthesis problem is formulated to systematically manage this trade-off, using H1 loop-shaping ideas. The loop-shaping weights can be scalably designed and the imposed structure ensures the controller only involves local information exchange. Importantly, the distributed control structure we consider confines water-level error propagation to upstream pools, with corresponding benefits in terms of water distribution efficiency. Moreover, it coincides with the interconnection structure of a channel, and so the corresponding optimal synthesis problem has a convex characterisation; detailed state-space formulae are provided. Field test data are presented to illustrate overall performance.

18:10-18:30 WeC07.6

Application of a Game-Theoretic Multi-Loop Control System Design with Robust Performance, pp. 10039-10044

Wellenreuther, Andrea — Univ. of Heidelberg
Gambier, Adrian — Univ. of Heidelberg
Badreddin, Essam — Univ. of Heidelberg

The game-theoretic view of control system design for multi-loop systems is extended in this work to ensure a closed-loop system with robust stability. The control system design is modeled as a differential cooperative game to incorporate interactions between the multiple loops of the control system. A robust stability indicator is formulated as an additional cost function. The developed approach is applied to a reverse osmosis desalination plant with different constraint settings on the control signals. The solution of the game provides Pareto-optimal sets, depending on the control signal constraints. Single points are chosen from the Pareto-optimal sets resulting in controller parameters leading to a reverse osmosis system with optimal performance concerning the error convergence, control effort and robust stability.

WeC08 — 310C

Convex Optimization and Relaxations (Regular Session)

Co-Chair: Tibken, Bernd — Univ. of Wuppertal

16:30-16:50 WeC08.1

Structure Exploitation in Semi-Definite Programs for Systems Analysis, pp. 10045-10050

Johansson, Janne Harju — Linköping Univ.
Hansson, Anders — Linkoping Univ.

A wide variety of problems involving analysis of systems can be rewritten as a semidefinite program. When solving these problems optimization algorithms are used. Large size makes the problems unsolvable in practice and computationally more effective solvers are needed. This paper investigates how to exploit structure and problem knowledge in some control applications. It is shown that inexact search directions are useful to reduce the computational burden and that operator formalism can be utilized to derive tailored calculations.

16:50-17:10 WeC08.2

Improved Approach for Optimization Problems of Determining the C-Numerical Range, pp. 10051-10056

Fan, Youping — Univ. of Wuppertal
Tibken, Bernd — Univ. of Wuppertal

In quantum computing and quantum control, the investigation of the C-numerical range is of great importance. One relevant optimization problem can be represented as maximizing the trace function $Re[tr(U A^+ U^+ C)]$ subject to the unitary matrix conditions $U^+ U$ = *I<inf>n</inf>* and UU^+ = *I<inf>n</inf>*.

To solve this NP-hard problem, the Positivstellensatz from the real algebraic geometry is used to construct a dual relaxation problem, which is represented with a linear objective function subject to some matrix inequalities constraints. In general this results in some bilinear terms with respect to the decision variables in the matrix constraints. Instead of further relaxation to those bilinear terms, so that a pure linear matrix inequalities (LMIs) optimization problem is derived, we reformulate this dual structure as a generalized eigenvalue problem (GEVP) with some LMIs constraints and some linear-fractional LMIs conditions. The GEVP dual relaxation provides a tractable approach for finding high quality bounds to the hard primal problem under acceptable computational effort.

Numerical results of a benchmark example from quantum computing are presented and demonstrate that the improved approach yields much more competitive bound of the C-numerical range in comparison with other methods.

17:10-17:30 WeC08.3

Guaranteed Bounds for Robust LMI Problems with Polynomial Parameter Dependence, pp. 10057-10062

Warthenpfuhl, Sascha Alexander — Univ. of Wuppertal
Tibken, Bernd — Univ. of Wuppertal

Many problems from control theory can be stated as so-called robust LMI problems. In this paper, the theorem of Ehlich and Zeller, a powerful tool for analyzing polynomials and rational functions, will be presented and applied to the robust LMI problems which are used to analyze uncertain systems.

17:30-17:50 WeC08.4

An Off-Line MPC Strategy for Nonlinear Systems Based on SOS Programming, pp. 10063-10068

Franze', Giuseppe — Univ. della Calabria
Casavola, Alessandro — Univ. Della Calabria
Famularo, Domenico — Univ. degli Studi Mediterranea di Reggio Calabria
Garone, Emanuele — Univ. della Calabria

A novel moving horizon control strategy for input-saturated nonlinear polynomial systems is proposed. The control strategy makes use of the so called sum-of-squares (SOS) de- composition, i.e. a convexification procedure able to give sufficient conditions on the positiveness of polynomials. The complexity of SOS-based numerical methods is polynomial in the problem size and, as a consequence, computationally attractive. SOS programming is used here to derive an “off-line” model predictive control (MPC) scheme and analyze in depth his properties. Such an approach may lead to less conservative MPC strategies than most existing methods based on the global linearization approach. An illustrative example is provided to show the benefits of the proposed SOS-based algorithm.

17:50-18:10 WeC08.5

Distribution-Dependent Robust Linear Optimization with

Asymmetric Uncertainty and Application to Optimal Control, pp. 10069-10074

Paschalidis, Ioannis	Boston Univ.
Kang, Seong-Cheol	Boston Univ.
Li, Keyong	Boston Univ.

We consider a linear programming problem in which the constraint matrix is uncertain. Each element of the constraint matrix is modeled as a random variable whose range is asymmetrically bounded around its mean. We construct a formulation that yields a solution with a better objective value, compared to the classical robust optimization approach, while taking the risk that the solution may become infeasible to the original problem. We address the risk by establishing upper bounds on the probability that it violates the constraints of the problem. These bounds exploit full distributional information on the random elements or limited distributional information such as the true means or sample means of the random elements. We explore the application of our methodology to the optimal control of linear uncertain systems with constraints.

18:10-18:30 WeC08.6

Incremental Regression Function Construction with Small Landmarks, pp. 10075-10080

Wang, Gang	Hong Kong Univ. of Science and Tech.
Qin, Shiyin	Beihang
Huang, Pipei	Beihang

In automatic control and its related applications, many problems can be formulated as the regression estimation problem. In this paper, we construct a nonlinear regression model by using kernels as basis functions in a dictionary and applying the L1 norm as the regularizer. The regression function obtained from this model possesses the sparseness property where only a subset of points are used to represent the function. We call this subset of points as landmarks. It is a convex optimization problem. However, instead of using the standard optimization tools to solve a convex problem for a particular regularization value, we develop an efficient regularization path algorithm that can trace all solutions for all possible regularization parameter values. It overcomes the computational difficulty in model selection. Since the algorithm generally adds basis functions incrementally to improve the prediction accuracy, the regression function can be represented concisely with small landmarks.

WeC09 311C

Recursive Identification (Regular Session)

Chair: Niedzwiecki, Maciej,Jan	Gdansk Univ. of Tech.
Co-Chair: Rotkowitz, Michael	The Univ. of Melbourne

16:30-16:50 WeC09.1

Recursive Parameter Estimation by Means of the SG-Algorithm, pp. 10081-10086

Evestedt, Magnus	Uppsala Univ.
Medvedev, Alexander V.	Uppsala Univ.

Recursive parameter estimation in linear regression models by means of the Stenlund-Gustafsson algorithm is considered. The manifold of stationary solutions to the parameter update equation is parameterized in terms of excitation properties. It is shown that the parameter estimation error vector does not diverge under lack of excitation, therefore achieving the purpose of anti-windup. Furthermore, an elementwise form of the parameter vector estimate is suggested revealing the effect of individual matrix entries in the Riccati equation on the parameter estimation updates. Simulations are performed to illustrate the loss of convergence rate in the estimates versus the decrease of computational power needed for two specific approximations of the Riccati equation in the elementwise form.

16:50-17:10 WeC09.2

Optimal and Suboptimal Smoothing Algorithms for Identification of Time-Varying Systems with Randomly Drifting Parameters, pp. 10087-10092

Niedzwiecki, Maciej,Jan	Gdansk Univ. of Tech.

Noncausal estimation algorithms, which involve smoothing, can be used for off-line identification of nonstationary systems. Since smoothing is based on both past and future data, it offers increased accuracy compared to causal (tracking) estimation schemes, incorporating past data only. It is shown that efficient smoothing variants of the popular exponentially weighted least squares and Kalman filter based parameter trackers can be obtained by means of backward-time filtering of the estimates yielded by both algorithms. When system parameters drift according to the random walk model, the properly tuned two-stage Kalman filtering/smoothing algorithm, derived in the paper, achieves the Cramer-Rao type lower smoothing bound, i.e. it is the optimal noncausal estimation scheme. Under the same circumstances performance of the modified exponentially weighted least squares algorithm is often only slightly inferior to that of the Kalman filter based smoother.

17:10-17:30 WeC09.3

Elementwise Decoupling and Convergence of the Riccati Equation in the SG-Algorithm, pp. 10093-10098

Medvedev, Alexander V.	Uppsala Univ.
Evestedt, Magnus	Uppsala Univ.

It is shown that the difference Riccati equation of the Stenlund-Gustafsson (SG) algorithm for estimation of linear regression models can be solved elementwise. Convergence estimates for the elements of the solution to the Riccati equation are provided, directly relating convergence rate to the signal-to-noise ratio in the regression model. It is demonstrated that the elements of the solution lying in the direction of excitation exponentially converge to a stationary solution while the other elements experience bounded excursions around their current values.

17:30-17:50 WeC09.4

Recursive Sparse Estimation Using a Gaussian Sum Filter, pp. 10099-10105

Blackhall, Lachlan	The Australian National Univ.
Rotkowitz, Michael	The Univ. of Melbourne

We develop a recursive estimator that systematically arrives at sparse parameter estimates. The algorithm is computationally feasible for moderate parameter estimation problems and leverages the Gaussian sum filter to provide both sparse parameter estimates and credible Bayesian intervals for non-zero parameters in a recursive fashion. Simulations show extremely promising accuracy, as well as a robustness not enjoyed by other sparse estimators.

17:50-18:10 WeC09.5

Fast Moving Window Algorithm for QR and Cholesky Decompositions, pp. 10106-10111

Liang, Wuxing	Queen's Univ. Belfast
Kruger, Uwe	Queens Univ. of Belfast
Wang, Xun	Queen's Univ. Belfast
Xie, Lei	National Key Lab. of Industrial Control Tech.
Littler, Tim	Queen's Univ. Belfast

This paper proposes a fast moving window algorithm for QR and Cholesky decompositions by simultaneously applying data updating and downdating. The developed procedure is based on inner products and entails a similar downdating to that of the Chambers' approach. For adding and deleting one row of data from the original matrix, a detailed analysis shows that the proposed algorithm outperforms existing ones in terms or computational efficiency, if the number of columns exceeds 7. For a large number of columns, the proposed algorithm is numerically superior compared to the traditional sequential technique.

18:10-18:30 WeC09.6

An Information Theoretic Approach to Hybrid Deconvolution Problems, pp. 10112-10117

Fagnani, Fabio	Pol. Di Torino
Fosson, Sophie Marie	Scuola Normale Superiore di Pisa

Recovering the input of a system from a noisy lecture of the output is both a typical inverse ill-posed problem and a transmission paradigm. If the input-output relation is given by a convolution integral, we are concerned with the well-known deconvolution problem, which occurs in several scientific frameworks. In this paper, we develop an original information-theoretic analysis and we design an encoding-decoding scheme for deconvolution. We propose different decoding algorithms to identify the input and we show both theoretical and simulations' results.

WeC10 311B

Fault Detection III (Regular Session)

Chair: Patton, Ron J.	Univ. of Hull

Co-Chair: Gertler, Janos J. George Mason Univ.

16:30-16:50 WeC10.1

Adaptive Fault Detection for a Class of Nonlinear Systems Based on Output Estimator Design, pp. 10118-10123

Chen, Wei-tian Simon Fraser Univ.
Saif, Mehrdad Simon Fraser Univ.

This paper considers output estimator based fault detection problem for a class of nonlinear systems with unknown system parameters. Because observer design for such systems is extremely difficult if not impossible, output estimator design is used for the purpose of fault detection. In order to achieve output estimator design using adaptive approaches, a multi-input multi-output (MIMO) nonlinear system is first decomposed into a group of multi-input single-output (MISO) nonlinear systems. For each MISO nonlinear system, an output equation is derived through filtering the output, the inputs, and those nonlinear functions of the outputs, which depends linearly on all unknown system parameters. Based on the output equation and using adaptive approaches, an adaptive output estimator is designed for the corresponding output. By defining residuals using the adaptive output estimation errors resulting from the output estimators, a fault detection scheme is proposed. The efficacy of the proposed fault detection scheme is tested on a single-link flexible robot manipulator model thorough computer simulations.

16:50-17:10 WeC10.2

Robust Consistency-Based Diagnosis of Nonlinear Systems by Set Observation, pp. 10124-10129

Wolff, Florian Univ. Karlsruhe (TH)
Krutina, Patrick Univ. Karlsruhe (TH)
Krebs, Volker G. Univ. Karlsruhe (TH)

Achieving robustness and a high fault sensitivity simultaneously is one of the most important goals of diagnosis system design. The idea of the so-called passive approach, which has been given relatively little attention in literature so far, is to include the effects of measurement and model uncertainties in the residual. In the subsequent residual evaluation, these uncertainties can then be accounted for such that false alarms can be precluded.

Following this passive approach, we present a new model-based diagnosis algorithm based on state-set observation of nonlinear continuous-time systems. A set-valued observer following the well-known predictor-corrector scheme is used to calculate a set of system states. These sets are consistent with the underlying system model as well as with the discrete measurements including both model and measurement uncertainties. In the prediction step, a validated ODE solving method is applied for calculation of the consistent state set. To the authors knowledge, such a nonlinear continuous-time set-valued observer has not yet been used for diagnosis tasks. The performance of the method is demonstrated using measured data of fault-free and faulty operation of an inverted pendulum as a benchmark system.

17:10-17:30 WeC10.3

Fault Detection for Singular Ts Fuzzy Systems with Time-Delay, pp. 10130-10135

Chen, Li Shandong Ec. Univ.
Zhong, Maiying Shandong Univ.

The robust fault detection filter design problem for singular TS fuzzy systems with time-delay is studied. Using an observer based fuzzy fault detection filter as the residual generator, the fault detection filter design is converted to an H_; fltering problem such that the generated residual is the H_; estimation of the fault. Su±cient conditions are given, which guarantee the robust H_; fault detection filter exists. And by using the cone complementarity linearization iterative algorithm, the fault detection filter design is converted to solving a sequence of convex optimization problems subject to LMIs. The premise variables of the designed fuzzy filter are not demanded to be the same as the premise variables of the TS fuzzy model of the plant.

17:30-17:50 WeC10.4

Two Improved Approaches to Fault Detection with Unknown Inputs, pp. 10136-10141

Xu, Jun National Univ. of Singapore
Lum, Kai-Yew National Univ. of Singapore
Loh, Ai-Poh National Univ. of Singapore
Xie, Lihua Nanyang Tech. Univ.

This paper addresses the fault detection problem based on H_; performance and L2-gain performance. Two improved approaches compared with the recent results (Wang et al., 2005, Ding et al., 2000) are presented. One uses the inverse transfer function and state space representation to consider the H_; performance. The other uses dilated matrix formulation to handle different Lyapunov matrices based on L2-gain performance. All these conditions can be efficiently solved by LMI techniques.

17:50-18:10 WeC10.5

Fault Diagnosis for Switching System Using Observer Kalman Filter IDentification, pp. 10142-10147

Akhenak, Abdelkader Ec. des Mines de Douai
Bako, Laurent Ec. des Mines de Douai
Duviella, Eric Ec. des Mines de Douai
Pekpe, Komi Midzodzi Cran
Lecoeuche, Stéphane Mines de Douai

In this paper we propose a strategy for fault detection and isolation without any fixed model of the system to be supervised. The proposed approach is based on the identification of the parameters characterizing the system without any {it a priori} knowledge. Our contribution consists in developing a specific identification scheme that is insensitive to a certain type of faults. The identified parameters are then invariant to the presence of actuator or sensor faults. Thereafter, a fault estimation procedure is proposed in order to detect sensor or actuator faults. The paper ends with a simulation example which highlights the effectiveness of the proposed approach.

18:10-18:30 WeC10.6

A Direct Approach to Fault Detection in Non-Uniformly Sampled Systems, pp. 10148-10153

Izadi, Iman Univ. of Alberta
Shah, Sirish Univ. of Alberta
Chen, Tongwen Univ. of Alberta

Non-uniformly sampled systems are widely found in industry. In these systems the process output is sampled and the control input is generated at non-uniformly distributed time instants. In this paper, an optimal residual generator is developed for fault detection in non-uniformly sampled systems. In the direct approach used here, the intersample behavior of fault and disturbance is captured by introducing operators that map continuous-time signals to discrete-time signals. No periodicity assumption is made for the sampling instants.

WeC11 311A

Adaptive, Nonlinear and Robust Control (Regular Session)

Chair: Bobtsov, Alexey Saint-Petersburg State Univ. of Information Tech. Mechanics and Optics
Co-Chair: Gu, Dawei Univ. of Leicester

16:30-16:50 WeC11.1

Multichannel Adaptive Stochastic Filtering for Active Noise Control in Personal Computers, pp. 10154-10159

Kinney, Charles Univ. of California at San Diego
Lee, Intae Univ. of California, San Diego
de Callafon, Raymond Univ. of California, San Diego
Jam, Mehrban Hewlett-Packard

In this paper, the feasibility of using active noise control inside personal computers is demonstrated by applying an adaptive filter to Hewlett-Packard's Blackbird 002 Gaming PC. Conditions relating the control signals and the sound heard by an external listener are presented as a means of evaluating the hardware design before applying the adaptive filter. A multichannel stochastic adaptive filter is derived by vectorizing the equations and applying gradient descent and Newton's method. For implementation purposes, data-based approximations to the gradient and hessian are provided. It is shown that a 6dB reduction in sound pressure level is obtainable by adding reference microphones, error microphones, a speaker, and some acoustical foam into the system even though the length of the noise cancelation system is small, approx. 6", compared to the fundamental wavelength of the noise, approx 23"

16:50-17:10 WeC11.2

Adaptive Observer Design for Chaotic Duffing System, pp. 10160-10165

Bobtsov, Alexey Saint-PetersburgStateUniversityo fInformationTechnologiesMec hani

Pyrkin, Anton | Saint-Petersburg State Univ. of Information Tech. Mec
Slita, Olga | Baltic State Tech. Univ.
Nikolaev, Nikolay | Saint-Petersburg State Univ. of Information Tech. Me

Problem of unknown encoded parameter reconstruction is solved by means of procedure of design of adaptive observer for chaotic Duffing system. Unlike known analoguess, the problem in question is only solved using measurements of output of chaotic system and in conditions of full parametrical uncertainty.

17:10-17:30 WeC11.3

Stability Analysis and Control Design for an Underactuated Walking Robot Via Computation of a Transverse Linearization, pp. 10166-10171

Freidovich, Leonid | UmeÍ Univ.
Shiriaev, Anton | Umea Univ.
Manchester, Ian | UmeÍ Univ.

The problem is to create a hybrid periodic motion, reminiscent of walking, for a model of an underactuated biped robot. We show how to construct a transverse linearization analytically and how to use it for stability analysis and for design of an exponentially orbitally stabilizing controller. In doing so, we extend a technique recently developed for continuous-time controlled mechanical systems with degree of underactuation one. All derivations are shown on an example of a three-link walking robot, modeled as a system with impulse effects.

17:30-17:50 WeC11.4

Robust Adaptive Fault-Tolerant Control of the F-14 Aircraft under Sensor Failures, pp. 10172-10177

Fekri, Sajjad | Univ. of Leicester
Gu, Dawei | Univ. of Leicester
Postlethwaite, Ian | the Univ. of Leicester
Athans, Michael | Inst. Superior Tecnico

This paper presents a novel fault detection and isolation (FDI) architecture applied to the lateral-directional axis of an F-14 aircraft during powered approach to landing under sensor failures. The fault-tolerant architecture employed is based on the so-called “Robust Multiple-Model Adaptive Control” (RMMAC) and hence is referred to as “RMMAC/FDI”. The results demonstrate successful stability and performance of the RMMAC/FDI architecture.

17:50-18:10 WeC11.5

Aircraft Airbrakes Compensation Design Using Iterative Inversion, pp. 10178-10183

Ronceray, Lilian | Airbus France
Mouyon, Philippe | ONERA
Tebbani, Sihem | Supelec
Puyou, Guilhem | Airbus France
Alazard, Daniel | Univ. de Toulouse - ISAE

This paper deals with the synthesis of an open-loop control law of a civilian aircraft for the compensation of the pitching moment generated by the extension of airbrakes. The proposed method uses in-flight recorded data and is based on impulse response identification and inverse simulation, whose results are used to design the controller upon qualitative assumptions. Results are then given for both the inversion and the synthesis for different flight cases. The robustness of the method to measurement noise is also assessed.

18:10-18:30 WeC11.6

Design of Adaptive Sliding Mode Controller (ASM) for a Distillation Column, pp. 10184-10189

Biswas, Pinak Pani | IIT Kharagpur
Ray, Shubhabrata | IIT Kharagpur
Samanta, Amar Nath | Indian Inst. of Tech.

In this work adaptive sliding mode controller is designed and implemented on a simulated high purity binary distillation column. The sliding mode controller design procedure is composed of approximate linearization and recursive backstepping approach. This makes the controller capable of eliminating the destabilizing effect of unknown structured plant parameter and uncertainty due to process model mismatch. Each of the first n-1 virtual control law is designed using zero order sliding mode controller to eliminate unmatched uncertainty. In the final step general sliding mode controller is used for eliminating the matched uncertainty of the process. The proposed control law also guarantees the exact output tracking in the presence of unknown unstructured process parameter.

WeC12 313

Analysis and Control of Hybrid Systems (Regular Session)

Chair: Lunze, Jan | Ruhr-Univ. Bochum
Co-Chair: Imura, Jun-ichi | Tokyo Inst. of Tech.

16:30-16:50 WeC12.1

Reachability and Robust Control of PWA Systems with Parameter Variations and Bounded Disturbance, pp. 10190-10195

Thomas, Jean | Beni-Sueif Univ.
Dumur, Didier | Ec. Superieure d'Electricite
Olaru, Sorin | Supelec
Buisson, Jean | Supélec

This paper considers discrete-time, uncertain PWA (piecewise affine) systems affected by parameter variations and bounded disturbances, where reachability technique based on polyhedral approach is developed and the robust control problems are investigated. Checking attainability and calculating the state space regions for which a robust control is assured despite the possible disturbance and the parameter variations is performed using a geometrical approach. A model predictive control law derived from a quadratic cost function minimization is further examined as an alternative sub-optimal approach for decreasing the computational load. The proposed technique is applied in simulation to a two-tank benchmark.

16:50-17:10 WeC12.2

Robust Explicit Time Optimal Controllers for Linear Systems Via Decomposition Principle, pp. 10196-10200

Sui, Dan | NUS
Feng, Le | The Norwegian Univ. of Science and Tech.
Hovd, Morten | Norwegian Univ. of Tech. and Science

One of the key problems in time optimal control (TOC) is the inherent computational complexity, which restricts its application to low dimensional systems. Considering a constrained linear system with bounded disturbances, this paper proposes a novel approach to reduce the computational complexity of TOC, where the terminal controller is nonlinear. It comprises several predetermined local linear feedback laws, resulting in a large terminal set. Starting from this relatively large terminal set, a large domain of attraction of the proposed TOC controller can be obtained by using a short horizon, and consequently leads to a low on-line computational effort. Furthermore, by formulating a suitable cost function, as time evolves, the TOC controller reaches the desired controller to obtain a good asymptotical behavior. The performance of the proposed approach is assessed via a numerical example.

17:10-17:30 WeC12.3

Finite Abstractions of Discrete-Time Linear Systems and Its Application to Optimal Control, pp. 10201-10206

Tazaki, Yuichi | Tokyo Inst. of Tech.
Imura, Jun-ichi | Tokyo Inst. of Tech.

Optimal control and reachability analysis of continuous-state systems often require computational algorithms with high complexity. The use of finite abstractions of continuous-state systems reduces such problems to path-planning problems on directed graphs with a finite number of nodes, which can be computed efficiently. In this research, we propose a method to design an approximately bisimilar finite abstraction of stabilizable discrete-time linear systems, considering the minimization of the complexity of the resultant finite automaton. Moreover, we show that a suboptimal solution to optimal control problems with a known error bound is obtained by simulating the optimal path of an approximately bisimilar finite abstraction.

17:30-17:50 WeC12.4

A New Hybrid System Identification Algorithm with Automatic Tuning, pp. 10207-10212

Lauer, Fabien | Nancy-Univ.
Bloch, Gerard | Nancy Univ.

Hybrid system identification is composed of two subproblems: estimate the discrete state or mode for each data point, and estimate the submodel governing the dynamics of the continuous state for each mode. For linear hybrid systems, the paper proposes to tackle these problems in a single step by simultaneously approximating each submodel while associating data points to each of these. The method borrows ideas from bounded-error approaches and Support Vector Regression to extend the algebraic procedure. The algorithm can easily deal with noise by fixing a predefined accuracy threshold. This bound on the error can be different for each mode when the noise level is considered to switch with the system. An extension of the algorithm to automatically tune itself in accordance with the noise level of each mode is also provided. The method can be seen as an an extension of the algebraic approach, but also as an alternative to the bounded error approach when a predefined or preferred model structure is given or when the noise level is unknown. An extension of the method to nonlinear submodels is provided in the companion paper (Lauer and Bloch, 2008).

17:50-18:10 WeC12.5

Hybrid Adaptive Observer for a Brushless DC Motor, pp. 10213-10218

Niemczyk, Piotr — Aalborg Univ.
Porchez, Thomas — Aalborg Univ.
Bendtsen, Jan Dimon — Aalborg Univ.
Kallesře, Carsten Skovmose — Grundfos Management A/S

In this paper a novel hybrid adaptive observer for Brushless DC Motors (BLDCM) is presented. It uses two current measurements of BLDCM phases to estimate the angle and the speed of the rotor. The observer is designed on the basis of a hybrid model, which is also presented in this paper. The parameters of the observer are found using an off-line optimization approach. The observer is practically implementable and verified off-line against real measurements.

18:10-18:30 WeC12.6

Observability of Affine Discrete-Time Asynchronous Switched Systems, pp. 10219-10224

Kajdan, Rudy — Univ. d'Orléans
Aubry, Didier — Univ. d'Orléans
Kratz, Frederic — ENSIB

This paper deals with observability of affine discrete-time asynchronous switched systems, that is affine switched systems whose switching times may be different from sampling instants. Two observability notions are studied: pathwise observability and mode observability. We show that there exist some sampling frequencies that preserve pathwise observability if any subsystem is observable. Necessary and sufficient conditions are given for mode observability in the autonomous case. The theoretical results are illustrated through an example.

WeC13 314

Stochastic System Identification (Regular Session)

Chair: Fuchs, Jean Jacques — Univ. de Rennes
Co-Chair: Vasiliev, Vyacheslav — Univ. of Tomsk

16:30-16:50 WeC13.1

On the Use of Sparse Representations in the Identification of Line Spectra., pp. 10225-10229

Fuchs, Jean Jacques — Univ. de Rennes

Sparse representations is a technique that consists in decomposing a signal into a small number of components, chosen from a user-designed over-complete set of vectors. While it is mostly used to obtain an approximate model of a signal or image, for compression or coding purposes, it can also be applied for identification, estimation or even detection purposes, when there exists a true exact sparse representation, which is then the object of interest. We consider the basic problem of the identification of real sinusoids in noise. While, in case of regular sampling the competition is formidable, for irregular sampling, it is far less exacting. The approach, we propose, applies to irregular samples without additional difficulty and attains performances close to the Cramer-Rao bound for quite reasonable computational costs.

16:50-17:10 WeC13.2

On Sequential Parameter Estimation of a Linear Regression Process, pp. 10230-10235

Kuechler, Uwe — Humboldt Univ. Berlin
Vasiliev, Vyacheslav — Univ. of Tomsk

This paper presents a sequential estimation procedure for unknown parameters of a stochastic linear regression. As examples the sequential estimation problem of two dynamic parameters in stochastic linear systems with memory and in autoregressive processes is solved. The estimation procedure is based on the least squares method with weights and yields estimators with guaranteed accuracy in the sense of the Lq_;norm (qe;2). The proposed procedure works in the mentioned examples for all possible values of the unknown dynamic parameters on the plane R^2 with the exception of some lines. The asymptotic behavior of the duration of observations is investigated. It is shown, that the proposed general procedure may be applied to the sequential parameter estimation problem for affine stochastic delay differential equations as well as autoregressive stochastic differential equations of arbitrary order.

17:10-17:30 WeC13.3

The Gradient Algorithm for Parameter and Output Estimation for Dual-Rate CARARMA Systems, pp. 10236-10239

Yang, Huizhong — Jiangnan Univ.
Tian, Jun — Jiangnan Univ.

A recursive generalized extended stochastic forgetting gradient algorithm is used to identify the dual-rate stochastic systems based on the polynomial transformation technique. A time-varying forgetting factor is included to improve the rate of convergence. The intersample output estimation algorithm is also studied in the paper. Finally, a simulation example shows that the algorithm is excellent effective in parameter identification and output estimation.

17:30-17:50 WeC13.4

Identification for a Kind of Disturbed Multi-Dimensional Wiener System, pp. 10240-10245

Fan, Dan — Tsinghua Univ.
Luo, Guiming — Tsinghua Univ.
Zhao, Yue — Tsinghua Univ.
Kwon, Wook Hyun — Seoul National Univ.

Multi-Input Single-Output (MISO) Wiener system is comprised of a multi-dimensional linear subsystem and a memoryless nonlinear block. In this paper a disturbed MISO Wiener system is concerned, of which the nonlinearity is discontinuous piece-wise linear characteristic. A recursive algorithm is proposed for identifying all of unknown system parameters. It is shown that the algorithm is convergent. Finally, some simulation results illustrate the identification theoretic results.

17:50-18:10 WeC13.5

Optimal State Filtering and Parameter Identification for Linear Stochastic Time-Delay Systems, pp. 10246-10251

Basin, Michael V. — Autonomous Univ. of Nuevo Leon
Shi, Peng — Faculty of Advanced Tech.
Calderon Alvarez, Dario — Autonomous Univ. of Nuevo Leon

This paper presents the optimal joint state filtering and parameter identification problem for linear stochastic time-delay systems with unknown parameters. The original identification problem is reduced to the optimal filtering problem for incompletely measured polynomial (bilinear) timedelay system states over linear observations with an arbitrary, not necessarily invertible, observation matrix, where the unknown parameters are considered standard Wiener processes and incorporated as additional states in the extended state vector. The obtained solution is based on the designed optimal filter for incompletely measured bilinear time-delay states over linear observations, taking into account that the optimal filter for the extended state vector also serves as the optimal identifier for the unknown parameters. In the example, performance of the designed optimal state filter and parameter identifier is verified for a linear time-delay system with an unknown multiplicative parameter over linear observations. Both, stable and unstable, linear systems are examined.

18:10-18:30 WeC13.6

Localization Based on Observations Linear in Log Range, pp. 10252-10257

Gustafsson, Fredrik — Linköping Univ.
Gunnarsson, Fredrik — Linköping Univ.

AbstractReceived signal strength (RSS) is used in wireless networks as a ranging measurement for positioning and localization services. This contribution studies conceptually different networks, where neither transmitted power or the path decay constant can be assumed to be known. The application in mind is a rapidly deployed network consisting of a number of sensor nodes with low-bandwidth communication, each node consisting of a number of sensor types measuring RSS. Typical sensors measure acoustic, seismic, magnetic and IR power emitted from a target. First, a model linear in the unknown nuisance parameters (transmitted power and path loss constant) is presented and validated from real data. Then, the separable least squares principle is applied to the non-linear least squares (NLS) cost function, after which a cost function of only the unknown position is obtained. Results from field trials are presented to validate the method.

WeC14 318
Advances in Networked Systems: Asynchronous Control, Estimation and Synchronization Problems (Invited Session)

Chair: Ben Gaid, Mongi — IFP
Co-Chair: Johansson, Karl Henrik — Royal Inst. of Tech.
Organizer: Ben Gaid, Mohamed El Mongi — INRIA
Organizer: Johansson, Karl Henrik — Royal Inst. of Tech.
Organizer: Canudas de Wit, Carlos — CNRS-GIPSA-Lab.

16:30-16:50 WeC14.1
A Design Methodology for Weakly-Hard Real-Time Control (I), pp. 10258-10264

Ben Gaid, Mongi — IFP
Simon, Daniel — Inria Rhone-alpes
Sename, Olivier — INPG

The problem of the integrated control and weakly-hard real-time scheduling is addressed. First, an abstract model of control tasks execution is introduced, allowing the establishment of a formal relationship linking control performance to deadline misses. Then, the notion of accelerable control task is introduced. An accelerable control task has the property that more executions are performed, better is the control performance. Thanks to this latter property, it becomes straightforward to design the control laws according to the average execution times of control tasks, and guaranteeing that in the worst-case scenario, the minimal allowable performance will be achieved. Based on Bellman optimality principle, sufficient conditions for a given control task to be accelerable are stated. A design method of optimal control laws for the weakly-hard execution model is then proposed.

16:50-17:10 WeC14.2
Stabilization of Lebesgue Sampled Systems with Bounded Controls: The Chain of Integrators Case (I), pp. 10265-10270

Marchand, Nicolas — GIPSA-Lab. CNRS

In this paper, the stabilization of a chain of integrators in the Lebesgue sampling context is considered. Lebesgue sampling refers to a sampling scheme where measurements are not taken at periodic instants but when variables crosse a priori defined levels. The paper proposes a nonlinear control law that stabilizes the system in the sense that it renders asymptotically stable any a priori given hyper-rectangle strictly larger and encompassing the smallest set where the states fail to be detectable because of the quantization precision. The control law is a sum of saturated linear feedback computed with quantized measurements.

17:10-17:30 WeC14.3
On Iterative System Design and Separation in Control Over Noisy Channels (I), pp. 10271-10276

Bao, Lei — Royal Inst. of Tech. (KTH)
Skoglund, Mikael — Royal Inst. of Tech.
Johansson, Karl Henrik — Royal Inst. of Tech.

We study a closed-loop control system with feedback transmitted over a noisy discrete memoryless channel. We design encoder--controller pairs that jointly optimize the sensor measurement quantization, protection against channel errors, and control. The design goal is to minimize an expected linear quadratic cost over a finite horizon. As a result of deriving optimality criteria for this problem, we present new results on the validity of the separation principle subject to certain assumptions. More precisely, we show that the certainty equivalence controller is optimal when the encoder is optimal and has full side-information about the symbols received at the controller. We then use this result to formulate tractable design criteria in the general case. Finally, numerical experiments are carried out to demonstrate the performance obtained by various design methods.

17:30-17:50 WeC14.4
Passivity of Interconnected Asynchronous Discrete-Time Systems (I), pp. 10277-10282

Canudas de Wit, Carlos — CNRS-GIPSA-Lab.
Ramos Cueli, José — INRIA Rhône-Alpes

This paper presents a constructive algorithm to design local controllers for feedback systems that are interconnected via time-varying and asynchronous sampling. These systems result in many application fields such as remotely-operated systems, interconnected vehicle control loops, and more generally in component-based control design where synchronous exchange of information is not feasible. The design is based on the (MASP) emph{MAximum Sampling time preserving Passivity}, and uses discrete-time passivity considerations. The paper first explores several ways to compute the MASP for linear systems, and then proposes a numerical algorithm to compute local feedback loops providing a MASP compatible with the maximum sampling-time upperbound of each sub-system. This results in a exponentially stable interconnection. The paper also presents a simulation example of this design.

17:50-18:10 WeC14.5
Analysis of Networked Estimation under Contention-Based Medium Access (I), pp. 10283-10288

Rabi, Maben — Royal Inst. of Tech. (KTH)
Stabellini, Luca — Royal Inst. of Tech. (KTH)
Almstrom, Peter — Royal Inst. of Tech.
Johansson, Mikael — Royal Inst. of Tech.

We treat a problem in networked estimation where the focus is on sampling and transmitting measurements of the plant over a shared medium. The object is to choose the sampling rate at the sensor while taking the statistics of a contention based MAC protocol into account. In particular, we seek a trade-off between the reliable delivery of individual data packets and the input data load on the communication medium. Our analysis of the shared channel computes a probability of packet loss for an assumed IID loss process. This loss rate depends on the input packet stream intensities. We compute the estimation distortion with IID losses of periodically generated samples, as a function of the packet loss rate. This throws up a condition for stable estimator performance. We investigate the scalability limits of this stability as a function of the number of nodes. When stable estimation is possible, we provide a procedure that computes the input packet rate for the network that minimizes the average estimation distortion. We reproduce the analysis of estimation performance when the sensors sample asynchronously according to independent Poisson counters.

18:10-18:30 WeC14.6
A PI Consensus Controller for Networked Clocks Synchronization (I), pp. 10289-10294

Carli, Ruggero — Univ. of Padova
Chiuso, Alessandro — Univ. of Padova
Schenato, Luca — Univ. of Padova
Zampieri, Sandro — Univ. di Padova

In this paper we propose a novel distributed clock synchronization protocol for networks of clocks which have different initial offsets and internal clock speeds. The algorithm is based on an PI-like consensus protocol where the proportional (P) part compensates the different clock speeds while the integral part (I) eliminates the different clock offsets. This synchronization protocol is formally studied in its synchronous implementation and we provide both convergence guarantees as well optimal design using standard optimization tools when the underlaying communication graph is known. We also show how this protocol can be readily used to study the effect of noise and external disturbances on the steady-state performance. Finally, some simulations are presented.

WeC15 317
Modeling Methods and Clinical Applications in Medical and Biological Systems III (Regular Session)

Chair: Bai, Er-Wei — Univ. of Iowa
Co-Chair: Zurakowski, Ryan — Univ. of Delaware

16:30-16:50 WeC15.1
A New Delay-SIR Model for Pulse Vaccination, pp. 10295-10300

Briat, Corentin — INPG/ENSIEG
Verriest, Erik I. — Georgia Inst. of Tech.

This paper introduces a new model for disease outbreaks. This model describes the disease evolution through a system of nonlinear differential equations with distributed-delay. The main difference between classical SIR-model resides in the fact that the recovery rate of the population is expressed as a distributed-delay term modeling the time spent being sick by infected people. This model is identified to fit realistic measurements which shows the effectiveness of the model. Finally, we develop an optimal campaign vaccination strategy based on recent results on the impulsive control of time-delay systems.

16:50-17:10 WeC15.2

Challenging the Optimality of the Pulse Excitation in Magnetic Resonance Imaging, pp. 10301-10306

Tahayori, Bahman — The Univ. of Melbourne
Johnston, Leigh — Univ. of Melbourne
Mareels, Iven — The Univ. of Melbourne
Farrell, Peter M. — Univ. of Melbourne

The design of excitation signals for Magnetic Resonance Imaging (MRI) is cast as an optimal control problem. An appropriate cost criterion, the Signal Contrast Efficiency (SCE), is developed. It is to be optimised subject to dynamics expressed by the Bloch equations. The solution to the optimisation problem is potentially useful for all forms of MRI including structural and functional imaging. Here, we demonstrate that signals other than pulse excitations, which are ubiquitous in MRI, can provide adequate excitation, thus challenging the optimality and ubiquity of pulsed signals. A class of on-resonance piece-wise continuous amplitude modulated signals is introduced. It is shown that despite the bilinear nature of the Bloch equations, the optimisation problem is largely analytically tractable for this class of signals, using Galerkin approximation methods. Simulations demonstrate that this class of signals may provide an attractive alternative to pulsed excitation signals for MRI.

17:10-17:30 WeC15.3

Model Simplification of Signal Transduction Pathway Networks Via a Hybrid Inference Strategy, pp. 10307-10312

Jia, Jianfang — North Univ. of China
Yue, Hong — Univ. of Strathclyde

A full-scale mathematical model of cellular networks normally involves a large number of variables and parameters. How to effectively develop manageable and reliable models is crucial for effective computation, analysis and design of such systems. The aim of model simplification is to eliminate parts of a model that are unimportant for the properties of interest. In this work, a model reduction strategy via hybrid inference is proposed for signal pathway networks. It integrates multiple techniques including conservation analysis, local sensitivity analysis, principal component analysis and flux analysis to identify the reactions and variables that can be considered to be eliminated from the full-scale model. Using an I·B-NF-·B signalling pathway model as an example, simulation analysis demonstrates that the simplified model quantitatively predicts the dynamic behaviours of the network.

17:30-17:50 WeC15.4

Control Problems in Antiangiogenic Therapy - Comparison of Six Models, pp. 10313-10318

Swierniak, Andrzej — Silesian Tech. Univ.

Six models of antiangiogenic therapy are compared and analyzed from control theoretic point of view. All of them consist of a model of tumor growth bounded by the capacity of a vascular network developed by the tumor in the process of angiogenesis and different model of dynamics of this network and they are based on the idea proposed by Hahnfeldt et al. Moreover we analyse optimal control problems resulting from their use to treatment protocols design.

17:50-18:10 WeC15.5

Bifurcations in a Mathematical Model of Non-Basal Testosterone Production, pp. 10319-10324

Churilov, Alexander — St.Petersburg State Marine Tech. Univ.
Medvedev, Alexander V. — Uppsala Univ.
Shepeljavyi, Alexander — St. Petersburg State Univ.

A recently proposed by the authors impulsive mathematical model of non-basal testosterone secretion of the hypothalamic-pituitary-testicular axis in the male is considered. Conditions for existence of periodic solutions in the model, their parametrization and stability are studied. Parameter bifurcations which lead to periodic oscillations of hormone levels with one or two pulses of gonadotropin releasing hormone (GnRH) in the least period are explored. The feasibility of the periodic mode with two pulses of GnRH is validated using experimental data.

18:10-18:30 WeC15.6

Resistance Risk Management in HIV Therapy Switching with Explicit Quiescent T-Cell Modeling, pp. 10325-10330

Zurakowski, Ryan — Univ. of Delaware
Luo, Rutao — Univ. of Delaware

Highly Active Antiretroviral Therapy (HAART) has proven remarkably effective in controlling the development of HIV. However, drug resistance may compromise these benefits. During the use of HAART, drug-resistant strains can develop and become the dominant species. Because the number of independent treatment regimens is limited, once resistance to all available drug classes arises, the patient will die. Drug resistance is therefore a critical problem for HIV treatment. In this paper, we explicitly model one known reservoir compartment, the quiescent infected CD4+ T cells, and explore the effects of this reservoir on a drug-switching strategy designed to minimize the further development of drug-resistant virus.

WeC17 320A

Control Education: Curricula (Regular Session)

Chair: Keel, Lee H. — Tennessee State Univ.
Co-Chair: Rossiter, J. Anthony — Univ. of Sheffield

16:30-16:50 WeC17.1

Typical Control Curricula and Using Software for Teaching/assessment: A UK Perspective, pp. 10331-10336

Rossiter, J. Anthony — Univ. of Sheffield
Giaouris, Damian — Univ. of Newcastle
Mitchell, Richard — Univ. of Reading
McKenna, Paul — Glasgow Caledonian Univ.

This paper describes some of the preliminary outcomes of a UK project looking at control education. The focus is on two aspects: (i) the most important control concepts and theories for students doing just one or two courses and (ii) the effective use of software to improve student learning and engagement. There is also some discussion of the correct balance between teaching theory and practise. The paper gives examples from numerous UK universities and some industrial comment.

16:50-17:10 WeC17.2

A Challenge for a New Organization in Systems and Control Curricula, pp. 10337-10342

Dourado, Antonio — Univ. of Coimbra

The traditional control curricula organization is not adequate for the new generations of students. This paper proposes the challenge to change completely the sequence of traditional control subjects. Firstly it proposes to develop control as a branch of information processing sciences. Paradigms for information are proposed: integral-differential paradigm, data-paradigm, linguistic paradigm. The control curricula in undergraduate education should start by fuzzy control, exploiting heuristics, games, intuition, in order to stimulate the student's interest for the area. Control may be faced as a branch of machine learning and controllers have learning capabilities that can be classified into a proposed hierarchical structure. One introductory course for systems and one for control are proposed with syllabus oriented by this view.

17:10-17:30 WeC17.3

Whether the Spreaded Good Opinion about Fuzzy Controllers Is Justified, pp. 10343-10348

Gessing, Ryszard — Pol. Slaska

In the paper, using some MATLAB fuzzy logic toolbox Demos, in which the fuzzy controllers are compared with the classical PID ones, it is shown that the well tuned classical PID are significantly better than those fuzzy presented in the Demos. It is shown, that using fuzzy approach, it is very difficult to shape the input-output nonlinearity, describing the so called fuzzy block of the fuzzy controller. It is also shown, that the linear fuzzy block (created to obtain comparable results with the classical PID controllers) is not justified at all, because it may be replaced by the usual summing junction connection, which is significantly simpler. The considerations of the paper do not support the idea of fuzzy controllers.

17:30-17:50 WeC17.4

Method and Practice of the Education Quality Evaluation on Master of Engineering in Control Engineering of China, pp. 10349-10354

Pan, Quan — Northwestern Pol. Univ.
Wang, Xiong — Tsinghua Univ. China
Cheng, Yongmei — Northwestern Pol. Univ.
Liu, Yong — NorthwesternPolytechnical Univ.

This paper describes the guiding principles, criteria and methodology of the education quality evaluation on master of engineering degree in control engineering of China. The practice of two-year long “point, line and plane” comprehensive evaluation methods (PLPEM) is summarized, which includes the self-evaluation within every university, evaluation on selected universities and evaluation on a specific aspect of education process. The effective evaluation result feedback mechanism (EERFM) is also introduced. The effectiveness of evaluation is finally justified by the scoring data. This paper also explores and practices the establishment of the long-term self-regulatory based education quality assurance system of master of engineering in control engineering of China.

17:50-18:10 WeC17.5

Undergraduate Control Education: Theory and Practices, pp. 10355-10358

Thakar, Vishvjit — A.D. Patel Inst. of Tech.
Joshi, Rutvij — A.D.Patel Inst. of Tech.

The paper present control theory courses and laboratory practices which may be useful in reorienting undergraduate course structure. Generally, undergraduate control courses are offered to various disciplines such as electrical,mechanical,electronics,communication,chemical,aerospace and mechatronics. As per the need one, two or three courses are offered at some universities. For a specialized discipline such as instrumentation and control , more courses are offered with inclination towards industrial controls like Programmable Logic Contollers (PLCs) and Distributed Control System (DCS). The work proposes a course structure which represent content useful for all the disciplines. The content may be covered in more than one courses. The paper assumes that, before the first course of control is introduced, students' have cleared courses of physics for basic laws of motion and mathematics which deals with differential equations and its solutions. The work presented also discusses use of computational and simulation tools to support theory as well as laboratory. The paper presents control laboratory practices which may be incorporated as a separate module.

18:10-18:30 WeC17.6

New Approaches to Control Education, pp. 10359-10364

Mitra, S. Mitra — Texas A&M Univ.
Keel, Lee H. — Tennessee State Univ.
Bhattacharyya, Shankar P. — Texas A & M Univ.

In this paper, we describe recent developments in theory and computational aids that signal a new approach to a design oriented control education curriculum at both the undergraduate and graduate levels. The main features of this approach are: a) Analytical results developed for low order controllers such as Proportional-Integral-Derivative (PID) and lead/lag controllers which account for 99% of controllers in applications, b) Development of tools to obtain complete sets of controllers achieving stability, performance and their efficient graphical representations and c) An approach to design based on raw measured data rather than identified models. The paper is illustrated with examples of design using both recently developed commercially available software and custom software developed by us.

WeC18 320B

Future Industrial Development (Highlight Session)

Chair: Malik, O.P. — The Univ. of Calgary
Co-Chair: Caccia, Massimo — CNR-ISSIA

16:30-16:50 WeC18.1

Development of Scaled PRT System Based on In-Track Linear Induction Motor (I), pp. 10365-10366

Quan, Zhonghua — POSCON Corp.
Kim, HyunSoo — POSCON Corp. R&D Center
Ryou, MyungSeon — POSCON Corp. R&D Center
Kim, MalSoo — POSCON Corp. R&D Center
Choi, ChangHo — POSCON Corp. R&D Center
Choi, Seunggap — POSCON Corp.

This paper introduces a scaled PRT system, by which the expense and time for development can be reduced and the field applicability can also be improved. Furthermore, due to the propulsion based on the in-track linear induction motor (LIM), the need to carry motors and controllers on each vehicle and to provide guideway power rails can be eliminated, and thus the economical efficiency can be improved for larger systems with a large number of vehicles.

16:50-17:10 WeC18.2

Design of High Reliable Safety Data Link(HR-SDL) for Safety Grade PLC for Nuclear Power Plants (I), pp. 10367-10368

Choi, KyungChul — POSCON Corp. R&D Center
Song, SeungWhan — POSCON Corp. R&D Center
Noh, YoungHun — POSCON Corp. R&D Center
Yun, DongHwa — POSCON Corp.
Jung, ChangHwa — POSCON Corp. R&D Center

This paper is concerned with a Safety Data Link communication for Safety Grade PLC. Safety Data Link provides peer-to-peer communication between PLCs. The link transmits a safety control signals such as a trip signals to other channels. This link uses Profibus-FDL protocol based on SDN(Send Data with No acknowledge) in order to prevent handhsaking.

17:10-17:30 WeC18.3

A Generation IV Nuclear Power Plant Nautral Circulation System Design for Emergency Cooling (I), pp. 10369-10370

Lee, HyongWon — POSCON Corp. R&D Center
Kim, Jae Sig — POSCON Corp. R&D Center

While the current Generation II and III nuclear power plant designs provide economically competitive electricity supplies in many countries, further advances in nuclear energy system design are pursued as Generation IV systems. Goals of Gen-IV (Generation IV) systems are mainly high economical competitiveness, enhanced safety, sustainability including waste minimization, and proliferation-resistance. Almost 100 different concepts and ideas were suggested from researchers in over ten countries. They are proposed as the future energy systems to meet the goals. In this paper, one of the most substantial elements, a Gen-IV nuclear reactors emergency cooling system design has been described by natural circulation using decay heat after reactor shutdown at state of loss of cooling severe accident.

17:30-17:50 WeC18.4

Identification of Synchronous Generator Using Nonlinear Feedback Model, pp. 10371-10376

Sadabadi, Mahdiye Sadat — Amirkabir Univ. of Tech.
Karrari, Mehdi — Amirkabir Univ. of Tech.
Malik, O.P. — The Univ. of Calgary

In this paper, the new approach for identification of synchronous generator using nonlinear feedback model and with piecewise linear map is investigated. In this method, synchronous generator model consists of a linear-dynamic block in forward path and a nonlinear-static block in feedback path. The identification method simultaneously approximates these blocks without requiring prior assumptions on the form of the static non-linearity. In this study, the field voltage is considered as the input and the active output power and the terminal voltage are considered as the outputs of the synchronous generator. The proposed method has been tested on a synchronous machine. Experimental results show good accuracy of the identified model.

17:50-18:10 WeC18.5

An Innovative Marking Machine Integrated with a GNU/Linux-Based Embedded Real-Time Platform (I), pp. 10377-10382

Caccia, Massimo — CNR-ISSIA
Ravera, Gianfranco — Green Project Srl
Bertone, Alessio — Green Project Srl
Bruzzone, Gabriele — CNR-ISSIA

This paper discusses the integration of a stamping marking machine with a GNU/Linux-based platform for embedded real-time systems. The work, carried out in cooperation between a Small Medium Enterprise and a public research organisation, points out the possibility of adopting standard hardware and software technologies, and, in particular, free software, in the field of advanced industrial automation. Laboratory, and, in the final version of the paper, field trials, demonstrate the performance of the proposed system.

18:10-18:30 WeC18.6

BRIS for KSTAR Superconducting Coil (I), pp. 10383-10384

Song, Inho — Korea Univ.
Ahn, HyunSik — Korea Univ.
Jang, GyeYeong — Korea Univ.
Park, KiWon — POSCON
Yun, MinSeong — POSCON
Shin, HyunSeok — POSCON
Lee, YeongWun — POSCON
Choi, ChangHo — POSCON Corp. R&D Center
Cho, Moohyun — POSTECH

The Blip Resistor Insertion System (BRIS) is developed for Korea Superconducting Tokamak Advanced Research project. The BRIS, which consists of turn on/off switch and blip resistor, is employed to provide fast magnetic coil current swing to PF coils for the plasma initiation and reduce the PF coil driving voltage for the improvement of grid power requirements. The switch must have the characteristics of high dc current cutoff, long lifetime and reliability. BRIS turns off and on maximum 25 kA dc current during 100 ms and generates high dI/dt for plasma initiation.

WeC19 320C

Networked Robotic Systems (Regular Session)

Chair: Kim, Dong-Han — Kyung Hee Univ.
Co-Chair: Naso, David — Pol. di Bari

16:30-16:50 WeC19.1

Probabilistic and Self-Organized Strategies to Coordinate Multiple Robotic Pursuers in the Pursuit of an Adversarial Evaders, pp. 10385-10390

Zheng, Jianying — Chinese Acad. of Sciences
Yu, Haibin — Chinese Acad. of Sciences
Liang, Wei — Yu Haibin
Peng, Zeng — Shenyang Inst. of Automation

this paper addresses the problem of coordinating multiple robotic pursuers in tracking and catching an adversarial evader in a dynamic environment. We assume that the adversarial evader can be detected independently by one pursuer but two pursuers are needed for a successful capture. We aim to reduce the capture time of the evader. Therefore, we model the motion of the evader by the probabilistic method and incorporate the model into directing the motion of the pursuers. In addition, we keep the pursuer communicating with at least another pursuer so that the evader found can be known immediately by another pursuer and then a quick capture can be produced by these two pursuers. By combining the two issues above, the evader can be detected and captured as quickly as possible. Finally, we present the simulation results to demonstrate the performance of our algorithm in an indoor environment. The results show that our method can greatly reduce the capture time of the evader.

16:50-17:10 WeC19.2

CSMA/CD-R for a Wireless Multi-Robot Commuication, pp. 10391-10396

Kim, Dong-Han — Kyung Hee Univ.
Kim, Jong-Hwan — Korea Advanced Inst. of Science and Tech.

This paper proposes a medium access protocol, CSMA/CD-R (Carrier Sense Multiple Access/Collision Detection with Reservation), designed for a distributed robot system based on wireless network without any centralized mechanism. It employs stations to reserve a communication channel after communication collision such that it shows better performance than conventional CSMA protocol for the wireless communication of the distributed robot system. The effectiveness and applicability of the proposed protocol are demonstrated by carrying out both computer simulations and real experiments with the developed multi-robot system.

17:10-17:30 WeC19.3

Multi-Robot Tracking of Mobile Target Based on Communication, pp. 10397-10402

Liu, Lei — Huazhong Univ. of Science and Tech.
Wang, Yongji — Hauzhong Univ. of Science And Tech.

Multi-robot tracking of mobile target is studied in the paper, which is based on the communication and sensors. For an independent tracking robot, the processes are separated into three layers and four tasks, and allocated to different robots for distinct roles in tracking, which is named the Distributed Decision Control System (DDCS). After that, two tracking models, centralized and distributed models, are designed for multi-robot tracking. Furthermore, a Proportional Navigation Guidance Law (PNGL) and I-Ć; formation control algorithm are mentioned to realize the robot motion control. At last the simulation has shown the feasibility and validity of both models.

17:30-17:50 WeC19.4

Implementation of the High Availability Concept in Networked Robotic Systems, pp. 10403-10408

Anton, Florin Daniel — Univ. Pol. of Bucharest
Borangiu, Theodor — automatics
Anton, Silvia — Univ. Pol. of Bucharest

In today's complex enterprise environments, providing continuous service for applications is a key component of a successful robotized implementing of manufacturing. High availability (HA) is one of the components contributing to continuous service provision for applications, by masking or eliminating both planned and unplanned systems and application downtime. This is achieved through the elimination of hardware and software single points of failure (SPOF). A high availability solution will ensure that the failure of any component of the solution - either hardware, software or system management, will not cause the application and its data to become permanently unavailable. High availability solutions should eliminate single points of failure through appropriate design, planning, hardware selection, software configuring, application control, carefully environment control and change management discipline. In short, one can define high availability as the process of ensuring an application is available for use by duplicating and/or sharing hardware resources managed by a specialized software component. A high availability solution in robotized manufacturing provides automated failure detection, diagnosis, application recovery, and node (robot controller) reintegration. The paper discusses the implementing of a high availability solution in a robotized manufacturing line.

17:50-18:10 WeC19.5

Deployment of Mobile Sensor Networks with Discontinuous Dynamics, pp. 10409-10414

Lee, Jaeyong — Samsung Heavy Industries
Jayasuriya, Suhada — Texas A&M Univ.

In this paper, we analyze the stability of a network that uses piecewise smooth potential functions. A gravitation-like force is applied to deploy a group of agents and to form a certain configuration. We use a nonsmooth version of the Lyapunov stability theory and LaSalles invariance principle to show asymptotic stability of the network which is governed by discontinuous dynamics. Hexagonal deployment using such a force is shown through simulation.

18:10-18:30 WeC19.6

Matrix-Based Scheduling and Control of a Mobile Sensor Network, pp. 10415-10420

Schiraldi, Vito — Pol. di Bari
Giordano, Vincenzo — Pol. di Bari
Naso, David — Pol. di Bari
Turchiano, Biagio — Pol. di bari
Lewis, Frank L. — Univ. of Texas at Arlington

This paper considers real-time coordination of a mobile sensor network composed of heterogeneous resources with partially overlapping functionalities in charge of executing multiple sequences of interconnected tasks. A discrete event controller based on a matrix-based formalism is adopted to combine in a single framework task planning, dynamic resource assignment with look-ahead, and shared resource conflict resolution with utility-based method. The matrix based controller is modular and can be easily reconfigured if mission characteristics or network topology change. Simulations and preliminary results on an experimental platform are provided to illustrate the main features of the proposed control approach.

WeC20 321C

Robotics Estimation II (Regular Session)

Chair: Poulsen, Niels K. — The Tech. Univ. of Denmark
Co-Chair: Plestan, Franck — Ec. Centrale De Nantes-CNRS

16:30-16:50 WeC20.1

Sensor Fusion Using Fuzzy Integrals and Diverse Bayesian Networks, pp. 10421-10426

Walls, Jamie — North Carolina A&T State Univ.
Esterline, Albert — North Carolina A&T State Univ.
Homaifar, Abdollah — North Carolina A&T State Univ.

This paper investigates and contrasts the use of different Bayesian networks and a fuzzy integral for real-time sensor fusion using sonar and rangefinder laser values on an ActivMedia robot. Bayesian networks have become increasingly popular because of their ability to capitalize on the conditional probabilities present in an influence chain. The Choquet fuzzy integral, which has primarily been used for statistical analysis, has a great power of description. Comparison of the two methods indicates that noise within the sensor network can drastically affect the accuracy of the results, especially those obtained using the Bayesian network.

16:50-17:10 WeC20.2

Kalmtool Used for Mobile Robot Navigation, pp. 10427-10432

Mogensen, Lars V. — Tech. Univ. of Denmark
Andersen, Nils A. — Tech. Univ. of Denmark
Ravn, Ole — Tech. Univ. of Denmark
Poulsen, Niels K. — The Tech. Univ. of Denmark

This paper presents an application of a simulation platform for sensor fusion in mobile robotics. The platform is based on the Kalmtool toolbox which is a set of MATLAB tools for state estimation of nonlinear systems. The toolbox contains functions for extended Kalman filtering as well as several other state of the art filters. Two robotic platforms are considered, a Medium-size Mobile Robot and a Hako tractor. The system models for the vehicles are derived and by using Kalmtool suitable filter coefficients are found.

17:10-17:30 WeC20.3

WLAN Based Pose Estimation for Mobile Robots, pp. 10433-10438

Roehrig, Christof — Univ. of Applied Sciences Dortmund
Kuenemund, Frank — Univ. of Applied Sciences Dortmund

Nowadays, many buildings are equipped with a WLAN infrastructure, as an inexpensive communication technology. In this paper a method to estimate position and heading (pose) of a mobile robot using WLAN technology is described. The proposed technique for localizing a mobile robot is based on the use of received signal strength values of WLAN access points in range. A radio map based method and Euclidean distance in combination with Delaunay triangulation and interpolation is proposed. Measured signal strength values of an omnidirectional antenna and a beam antenna are compared with the values of a radio map, in order to estimate the pose of a mobile robot, whereby the directionality of the beam antenna is used to estimate the heading of the robot. The paper presents the experimental results of measurements in an office building.

17:30-17:50 WeC20.4

Absolute Orientation Angle Estimation of a Quadruped Robot Using Nonlinear Observers, pp. 10439-10444

Rengifo-Rodas, Carlos-Felipe — Ec. Centrale De Nantes - CNRS - Univ. del Cauca
Plestan, Franck — Ec. Centrale De Nantes-CNRS
Aoustin, Yannick — CNRS, Univ. of nantes

This paper presents the application of two nonlinear observers in order to estimate the absolute orientation angle of a quadruped walking robot. The designed observers are based on high gain and high order sliding mode approaches. A loss of observability during the robot step appears: this problem is dealed by using two different observers structures.

17:50-18:10 WeC20.5

Estimation of 3-D Transformation from 2-D Observing Image Using Dual Quaternion, pp. 10445-10450

Chiang, Yi-Te — Lee-Ming Inst. of Tech.
Huang, Po-Yen — National Taiwan Univ.
Chen, Hung-Wei — National Taiwan Univ.
Chang, Fan Ren — National Taiwan Univ.

In this thesis, we use dual quaternion to replace rotation matrix R and translation vector t which expressed object's transformation in usual. The best benefit of dual-quaternion is that it is able to handle rotation and translation simultaneously and apply continuous product of dual quaternion operating with a kind of special vector

;dual vector to express a serious of rotation and translation. We find that dual quaternion has special relationship in 3-D transformation and 2-D image plane, and use this relationship to estimate object's transformation from 2-D observing image. Because of the benefit of dual quaternion

;easily to handle and express a serious of transformation, we make above estimation more practically and reality using dual-quaternion. At last, we design a simulation to prove our method has better practicality and is more convenient to estimate 3-D transformation.

18:10-18:30 WeC20.6

Force Distribution Estimation of Wheeled Mobile Robot: Application to Friction Coefficients Estimation, pp. 10451-10455

Choi, Hyun Do — KAIST
Kang, Hyunsuk — Korea Advanced Inst. of Science and Tech.
Hyun, Kyung Hak — KAIST
Kim, Soohyun — KAIST
Kwak, Yoon Keun — KAIST

Unevenness of rough terrain causes mobile robots to be in the various wheel contact conditions so that the normal force of each wheel is affected by not only vehicle states but also geometry of terrains. For this reason, it is difficult to predict traversability of a mobile robot and maximum friction coefficients while these are key information of unmanned robot companion application. Here, we present a normal force estimation method that uses static equilibrium relation of rough terrain vehicle. The method obtains least-squares solution of static equation formulated with variables from robot configuration and contact angle, and traction force. The method is validated through simulations that show a good agreement of the estimated normal force with the real one. Finally, we present the application where the proposed method is essential.

WeC21 321B

Dynamics and Control of Micro and Nano-Scale Systems III

(Invited Session)

Chair: Moheimani, S.O. Reza — Univ. of Newcastle
Co-Chair: Sebastian, Abu — IBM Res.
Organizer: Moheimani, S.O. Reza — Univ. of Newcastle
Organizer: Sebastian, Abu — IBM Res.

16:30-17:10 WeC21.1

Control and Systems Approaches to Atomic Force Microscopy (I), pp. 10456-10467

Agarwal, Pranav — Univ. of Minnesota, twin cities
Salapaka, Murti V. — Univ. of Minnesota, twin cities

The atomic force microscope (AFM) and its derivative technologies have heralded a new era in science and technology. AFM and related instruments were primarily designed by physicists. In recent years there is a substantial presence of engineers with controls and systems background who are contributing to AFM related technologies. This article provides a tutorial on the control and systems approaches to AFM. This paper also delineates the impact controls and systems perspectives have on AFM related research and indicates future directions.

17:10-17:30 WeC21.2

Modeling and Control of Electrical Breakdown Process of Carbon Nanotubes (I), pp. 10468-10473

Luo, Yilun — Michigan State Univ.
Xi, Ning — Michigan State Univ.
Liu, Lianqing — Shenyang Inst. of Automation
Zhang, Jiangbo — Michigan State Univ.

Carbon nanotubes (CNTs) have been found as the promising semiconducting material for the future high performance nanoelectronics. As an important property for applications of a semiconductor, the band gap of a multi-walled CNT is related to its diameter. The capability of adjusting the material band gap is extremely important in sensor and electronics manufacturing. This paper discusses a real-time control method for the selective carbon shell breakdown process to tailor the CNT's band structure. The control method is designed based on the quantum state space model that describes the electron transport in the CNT. The state space anomaly during breakdown process can be observed using robust fault diagnosis technique by combining analytical approach and heuristic approach. The experimental results reported in this paper verify the theoretical findings. As a result, a MWCNT can be converted into a semiconducting material with pre-determined band gap.

17:30-17:50 WeC21.3

Dynamics of Integrated Silicon Micro-Heaters (I), pp. 10474-10479

Sebastian, Abu IBM Zurich Res. Lab.
Wiesmann, Dorothea IBM Zurich Res. Lab.

Micro-cantilevers with integrated heaters serve as powerful tools for investigation and manipulation at the nanometer scale. They can be used to locally heat surfaces. They can also serve as low-cost, highly integrable topography sensors, and find application as position sensors for nanopositioning applications. In this paper we present a tractable feedback model that captures the thermo-electric dynamics of these micro-heaters. A systems approach is preferred over a modeling approach based on the underlying physical mechanisms. Experimental results on the write/read heaters and the thermal position sensors from a probe-based data-storage device are presented.

17:50-18:10 WeC21.4

Real-Time Monitoring of Thin Film Microstructure in Chemical Vapor Deposition Using a Modified Moving Horizon Estimation (I), pp. 10480-10485

Xiong, Rentian Georgia Inst. of Tech.
Grover Gallivan, Martha Georgia Inst. of Tech.

A modified moving horizon estimator (mMHE) was proposed to estimate thin film thickness, growth rate, surface roughness and refractive indices in situ from a dual-wavelength reflectance measurement during chemical vapor deposition (CVD). mMHE was compared with the commonly used recursive least squares fitting (RLS) method in both simulated and experimental CVD processes. The results indicate that mMHE yielded more accurate estimates than RLS by incorporating the a priori estimate in the objective function.

18:10-18:30 WeC21.5

External Force Assisted Nanorobotic Assembly of 3-D Helical Nanobelts (I), pp. 10486-10491

Hwang, Gilgueng Inst. of Industrial Science, The Univ. of Tokyo
Bagutti, Lorenzo ETH Zurich
Hashimoto, Hideki Univ. of Tokyo

In this paper three-dimensional (3D) suspended helical nanobelts (HNBs) with ultra-high flexibility are assembled by the external field guidance. Electromagnetic (EM) and electrostatic (ES) force by external potential are characterized quantitatively to guide the assembly of HNBs to create_;force sensing probe. Both ends of HNBs and target electrodes are attached with ferromagnetic metal connector. By the help of this hybrid nanorobotic assembly approach, we could successfully create force sensing probe by aligning and closing HNBs in vertical way and soldering to interconnect HNBs onto electrodes. Adhesive force between HNBs and electrodes are characterized to show its assembly performance quantitatively. The demonstrated approach shows that external force assisted assembly is an effective way for assisting serial nanorobotic assembly, interconnection soldering which may potentially reduce the production cost and time for future manufacturing realization.

WeC22 321A

Identification and Diagnosis of Mechatronic Systems (Regular Session)

Chair: Braatz, Richard D. Univ. of Illinois at Urbana-Champaign
Co-Chair: Wang, Danwei Nanyang Tech. Univ.

16:30-16:50 WeC22.1

Modelling and Identification for Control Design of Compliant Fluidic Actuators with Rotary Elastic Chambers: Hydraulic Case Study, pp. 10492-10497

Mihajlov, Miroslav Univ. of Bremen
Ivlev, Oleg Friedrich-Wilhelm-Bessel-Inst. Forschungsgesellschaftm.b.H
Graeser, Axel Univ. of Bremen

This paper reports on the development of a comprehensive nonlinear mathematical model of a novel inherently compliant fluidic actuator with Rotary Elastic Chambers (REC–actuator). The actuator is intended for robotic devices working in direct physical contact with humans and can be operated by both, liquid as well as gaseous working fluid. In the hydraulic realization the REC-actuator is controlled by a custom developed bi-directional miniature pump. Applying physical modelling principles, a general model of the hydraulic REC-actuator is firstly developed. The actuator torque and volume characteristic, the hydraulic capacity, the volumetric displacement and the torque losses are defined as the main model components. Each of these components are unknown functions of the angular displacement and/or pressures in the actuator chambers which makes the modeling and identification procedure different as well as more complex than the one commonly performed for a “conventional” hydraulic actuator (a single vane motor in this case). For each of the mentioned characteristics a dedicated experiment is designed and carried out. Based on the collected data, analytical models of the characteristics are determined (including model structure and parameter estimation) and the final nonlinear model in the state space is obtained. The developed model suitable for control design is verified, showing good agreement between the simulation and experimental results.

16:50-17:10 WeC22.2

A New Identification Method for Mechatronic Systems in Closed-Loop from Only Control Data, pp. 10498-10503

Gautier, Maxime IRCCyN
Janot, Alexandre IRCCyN
Vandanjon, Pierre-Olivier Lab. Central des Ponts et Chaussées

The identification of the dynamic parameters of robot is based on the use of the inverse dynamic model which is linear with respect to the parameters. This model is sampled while the robot is tracking trajectories which excite the system dynamics in order to get an over determined linear system. The linear least squares solution of this system calculates the estimated parameters. The efficiency of this method has been proved through the experimental identification of a lot of prototypes and industrial robots. However, this method needs joint torque and position measurements and the estimation of the joint velocities and accelerations through the pass band filtering of the joint position at high sample rate. The new method needs only torque data at a low sample rate. It is based on a closed loop simulation which integrates the direct dynamic model. The optimal parameters minimize the 2 norm of the error between the actual torque and the simulated torque assuming the same control law and the same tracking trajectory. This non linear least squares problem is dramatically simplified using the inverse model to calculate the derivatives of the cost function.

17:10-17:30 WeC22.3

Hydrodynamic Parameter Estimation of an Open Frame Unmanned Underwater Vehicle, pp. 10504-10509

Avila, Juan Pablo Julca Univ. of Sao Paulo
Maruyama, Newton Univ. of Sao Paulo
Adamowski, Julio Cezar Univ. of Sao Paulo

A semi-autonomous unmanned underwater vehicle (UUV), named VSOR, is being developed at the Laboratory of Sensors and Actuators at the University of Sao Paulo. The vehicle has been designed to provide inspection and intervention capabilities in specific missions in deep water oil fields. This work presents a methodology to identify the drag coefficients and virtual mass/inertia of an open-frame underwater vehicle using the system identification approach. Trials with the vehicle in a test tank have been performed. Using the vehicle on-board sensor information, the methodology is based on the utilisation of an uncoupled 1-DOF (degree of freedom) dynamic system equation of an underwater vehicle and the application of the integral method, which is the classical least squares algorithm, applied to the integral form of the system dynamic equations. An assessment of the feasibility of the method is presented.

17:30-17:50 WeC22.4

Telediagnosis of Transmission Channel and Actuators Faults on a Mobile Robot, pp. 10510-10515

Fawaz, Khaled LAGIS, UMR-CNRS 8146, Pol. Lille
Merzouki, Rochdi Ec. Pol. de Lille
Ould bouamama, Belkacem LAIL

This paper deals with a model based fault detection and isolation (FDI) approach in order to detect and to isolate the transmission channel fault from the actuators faults of a mobile robot. A Co-simulation with virtual robot is developed, allowing to understand the faults influences on the synthesized residuals. Simulation and experimental results show clearly the isolability between the studied faults.

17:50-18:10 WeC22.5

Monitoring Ability Analysis and Qualitative Fault Diagnosis Using Hybrid Bond Graph, pp. 10516-10521

Low, Chang Boon — Nanyang Tech. Univ.
Wang, Danwei — Nanyang Tech. Univ.
Arogeti, Shai — Nanyang Tech. Univ.
Zhang, Jing Bing — Singapore Inst. of Manufacturing Tech.

In part I of this work, we lay a foundation for quantitative bond graph-based FDI design of hybrid systems using hybrid bond graph (HBG). We discussed the causality properties of HBG from FDI perspectives, and proposed the concept of Diagnostic Hybrid Bond graph (DHBG) which is advantageous for efficient and effective FDI applications. Part II presents a continuation of our previous paper [1]. In this part II of our work, we exploit the DHBG to analyze the system's fault monitoring ability. Additionally, we proposed a quantitative FDI framework for effective fault diagnosis for hybrid systems.

18:10-18:30 WeC22.6

Causality Assignment and Model Approximation for Quantitative Hybrid Bond Graph-Based Fault Diagnosis, pp. 10522-10527

Low, Chang Boon — Nanyang Tech. Univ.
Wang, Danwei — Nanyang Tech. Univ.
Arogeti, Shai — Nanyang Tech. Univ.
Zhang, Jing Bing — Singapore Inst. of Manufacturing Tech.

Bond graph (BG) is an effective tool for modeling complex systems and it has been proven to be useful for fault detection and isolation (FDI) purposes for large continuous systems. BG provides causality between system's variables which allows FDI algorithms to be developed systematically from the graph. Similarly, Hybrid bond graph (HBG) is a bond graph-based modeling approach which provides an avenue to model complex hybrid systems; however, due to the lack of understanding, HBG has not been well-utilized for fault diagnosis. This is the first of a two-part paper that investigates the feasibility of utilizing HBG for quantitative FDI applications for hybrid systems. In this first paper, we present an analysis on the causality properties of the HBG where useful properties and insights associated with FDI applications are gained. Based on these properties, a causality assignment procedure and modeling approximation techniques are developed to achieve a HBG with a causality that facilitates efficient and effective FDI design for hybrid systems.

WeC23 323

Discrete Event Systems in Manufacturing (Regular Session)

Chair: Silva, José Reinaldo — Univ. of São Paulo
Co-Chair: Nishi, Tatsushi — Osaka Univ.

16:30-16:50 WeC23.1

Lagrangian Relaxation Technique for Solving Scheduling Problems by Decomposition of Timed Petri Nets, pp. 10528-10533

Nishi, Tatsushi — Osaka Univ.
Shimatani, Kenichi — Osaka Univ.
Inuiguchi, Masahiro — Osaka Univ.

In this paper, we propose Lagrangian relaxation technique for solving scheduling problems by decomposition of timed Petri nets. The scheduling problem is represented by the transition firing sequence problem to minimize a given objective function. The timed Petri net is decomposed into several subnets so that the subproblem for each subnet can be easily solved by a shortest path algorithm. The optimality of solution can be evaluated by the duality gap derived by Lagrangian relaxation method. The performance of the proposed method is compared with the conventional optimization algorithm with penalty function method. The results show that the duality gap within 1.5% can be derived for AGVs routing problems. The effectiveness of the proposed method is demonstrated by comparing the performance between the conventional method.

16:50-17:10 WeC23.2

A Procedure to Compute a Probabilistic Bound for the Maximum Tardiness Using Stochastic Simulation, pp. 10534-10539

Mebarki, Nasser — IUT de Nantes
Shahzad, Muhammad Atif — Univ. of Nantes

Dispatching rules are widely used to dynamically schedule the operations in a shop. Their efficiency depends on the performance criteria of interest. One of the most important objectives to deal with in a manufacturing system is the tardiness which can be measured through several performance measures. This paper proposes an effective procedure to estimate the first two central moments (i.e., the mean and the variance) of the conditional tardiness and from this to compute a probabilistic bound for the maximum tardiness. These estimates are computed from the evaluation of the total tardiness, the number of tardy jobs and the root mean square tardiness obtained through a stochastic simulation. Different evaluations done by simulation show the effectiveness of the bound obtained.

17:10-17:30 WeC23.3

Simulation As a Support of Design and Validation of a Product Driven Control System, pp. 10540-10545

El Haouzi, Hind — Nancy Univ.
Petin, Jean-Francois — Nancy Univ.
Thomas, André — Nancy Univ.

This work is part of a research project on product-driven automation that makes the product active for business and manufacturing purposes. The paper focuses on the design and the simulation of a product-driven control system to ensure better synchronization between informational and physical flows. Feasability of the product-driven concept is evaluated by the development of an industrial test-bed from Trane Company. Main results show benefits for product traceability and cost & time reduction thanks to a better synchronization and anticipation between the manufacturing, assembly and supplying lines of the Trane plant.

17:30-17:50 WeC23.4

Modeling of Programs and Its Verification for Programmable Logic Controllers, pp. 10546-10551

Sarmento, Cleber Alves — Univ. of São Paulo (USP) - Escola Pol.
Silva, José Reinaldo — Univ. of São Paulo
Miyagi, Paulo Eigi — Univ. of Sao Paulo, Escola Pol.
Santos Filho, Diolino José — Escola Pol. - Univ. of São Paulo (USP)

Programmable logic controller is still the main device used for control of productive systems, which can be approached as discrete event dynamic systems. For programming these controllers, five languages were standardized by IEC 61131, and the LD (ladder diagram) language is distinguished among the others, i.e., it has been widely applied in productive systems, even with studies that confirm the restrictions and problems regarding the use of this language, such as the difficulties for errors identification in developed control programs. Therefore, this work presents a proposal for the modeling of extended finite state machines from control programs written in LD. These models are verified through a computational tool, aiming the identification of possible errors in the control program.

17:50-18:10 WeC23.5

An Implementation Environment for Automated Manufacturing Systems, pp. 10552-10557

Diogo, Ricardo Alexandre — Pontifical Catholic Univ. of Parana
Vicari, Carlos Alberto — Pontifical Catholic Univ. of Parana
Rocha Loures, Eduardo — Pontifical Catholic Univ. of Paraná
Busetti, Marco Antonio — Pontifical Catholic Univ. of Parana
Santos, Eduardo Alves Portela — Pontifical Catholic Univ. of Parana

This paper presents an implementation environment applied to reconfigurable processes in automated manufacturing systems. This environment is based on a methodology which consists of a cyclic three-stage development – modeling, synthesis and implementation – until the real system accomplishes the required specification, resulting in the project of the automated system. This kind of development allows a continuous result revision of each stage. The present paper describes the methodology and details of components of the proposed environment.

18:10-18:30 WeC23.6

A Hybrid Control Architecture Applied to Flexible Manufacturing Systems, pp. 10558-10563

Cantillo, Jairo — Pontifical Catholic Univ. of Parana
Busetti, Marco Antonio — Pontifical Catholic Univ. of Parana
Santos, Eduardo Alves Portela — Pontifical Catholic Univ. of Parana
Rocha Loures, Eduardo — Pontifical Catholic Univ. of Paraná

The introduction of advanced information systems and machinery with communication capability and operational versatility provide the manufacturing systems with the capacity of material modification and transport, changes in material processing routes, different product insertion in the production line and plant layout reconfiguration. These characteristics give the production process great flexibility. Supervisory Control Theory (SCT) and Colored Petri Nets provide a formal tool for developing controllers for Discrete Event Systems, e.g., Flexible Manufacturing Systems (FMS). One of the problems for implementing this approach is the difficulty that the modeling of the subsystems and specifications represent in today's modern manufacturing systems. In Flexible Manufacturing Systems the transport mechanism is identified as the subsystem that provides these functionalities. This paper describes the modeling of the subsystems and specifications for a large Flexible Manufacturing System using a hybrid integrated framework.

WeC24 324

Supply and Logistics Networks (Regular Session)

Chair: Shimizu, Yoshiaki — Toyohashi Univ. of Tech.
Co-Chair: Grunder, Olivier — Systems and Transports Lab. SeT/UTBM

16:30-16:50 WeC24.1

A Hybrid Meta-Heuristic Method for Multimodal Logistic Network Design Over Planning Horizon, pp. 10564-10569

Shimizu, Yoshiaki — Toyohashi Univ. of Tech.
Yamazaki, Yoshihiro — Toyohashi Univ. of Tech.
Wada, Takeshi — Osaka Prefectural Coll. of Tech.

Logistics optimization has been acknowledged increasingly as a key issue of supply chain management to improve the business efficiency under global competition and diversified customer demands. Concerning a multimodal logistics optimization problem under multiperiods, in this paper, we have extended a method termed hybrid tabu search that was developed previously by the authors. The attempt aims at deploying a strategic planning more concretely so that it can link to an operational decision making. It is a two-level iterative method composed of tabu search to solve the location problem in the upper level while graph algorithm to solve the transformed minimum cost flow problem for the route selection in the lower level. Through numerical experiments, we have verified the effectiveness of the proposed method in comparison with the commercial software.

16:50-17:10 WeC24.2

Supply Chain Planning under Uncertainty: A Chance Constrained Programming Approach, pp. 10570-10575

Mitra, Kishalay — Tata Consultancy Services Limited
Gudi, Ravindra — IIT Bombay
Patwardhan, Sachin — IIT Bombay
Sardar, Gautam — Tata Consultancy Services

Uncertainty issues associated with a multi-site, multi-product supply chain planning problem has been analyzed in this paper using the chance constraint programming approach. In literature, such problems have been addressed using the two stage stochastic programming approach. While this approach has merits in terms of decomposition, computational complexity even for small size planning problem is large. This problem is overcome in our paper by adopting the chance constraint programming approach for solving the mid term planning problem. It is seen that this approach is generic, relatively simple to use, and can be adapted for bigger size planning problems as well. We demonstrate the proposed approach on a relatively moderate size planning problem taken from the work of McDonald and Karimi (1997) and discuss various aspects of uncertainty in context of this problem.

17:10-17:30 WeC24.3

A Differential Evolution &Genetic Algorithm for Vehicle Routing Problem with Simultaneous Delivery and Pick-Up and Time Windows, pp. 10576-10581

Cao, Erbao — Hunan Univ. P.R.China

The vehicle routing problem with simultaneous delivery and pick-up and time windows (VRPSDPTW) is presented from the point of strategic view that combines the logistics and reverse logistics (bidirectional logistics). A general mixed integer programming mathematic model of VRP-SDPTW is constructed, it can transform into other classical vehicle routing problems by setting different parameters. A hybrid optimization algorithm (HOA) is proposed, which is based principally on the combination of the differential evolution (DE) theory and genetic algorithm (GA). In operation process, we firstly adopted the novel decimal coding to construct the chromosome, and then the differential evolution operator is adopted as the main optimizing scheme, while such techniques of the genetic algorithm, as the novel crossoveroperator mutation-operator are designed to improve the result. Therefore it is expected that advantages of both the differential evolution and the genetic algorithm are kept so that the hybrid optimum algorithm can optimize large scale highly nonlinear problems well and improve the efficiency of the optimization process, and can avoid effectively the common defects of early convergence and the diversity of population in traditional genetic algorithm. The computer simulations are used to compare the performance of the proposed method with GA and DE, and numerical results show that the performance of the proposed method is better than the other method.

17:30-17:50 WeC24.4

A Proposal on Agent-Based Production Planning in Integrated Supply Network, pp. 10582-10587

Opadiji, Jayeola Femi — Kobe Univ.
Kaihara, Toshiya — Kobe Univ.

We propose models that focus on the improvement of flexibility in manufacturing supply networks by enabling a tighter information coupling between the various planning levels without tampering with the autonomy of enterprises which are geographically distributed. The problem is approached from the perspective of social network planning using a community of agents. These agents have unique properties which they exhibit at different planning levels. Characterization of agents in the models is discussed.

17:50-18:10 WeC24.5

Entropy Based Optimization of Decentralized Supply Chain Networks, pp. 10588-10593

Thangavelu, Sundar Raj — NUS
Samavedham, Lakshminarayanan — National Univ. of Singapore

Supply chain is an organized combination of inbound logistics, production plants and multi-echelon distribution network. Decentralized distribution networks are common and prone to exogenous and endogenous uncertainties. Information uncertainty from the downstream customer and material uncertainty from the upstream supplier makes the supply chain behavior more complex. Previous attempts made to enhance the supply chain performance by optimizing the replenishment strategy do not pay attention to the issue of increasing uncertainty (and consequently operational complexity) in the system. Complexity generates unpredictability in supply chain behavior, affects customer satisfaction, and increases cost. This work aims to improve supply chain performance by quantifying and minimizing the complexity associated with the distribution system through entropy calculations in accordance with the business goal and demand pattern faced by the network.

18:10-18:30 WeC24.6

The Holding and the Transportation Costs Optimization in a Simple Supply Chain : The Multiple Transporters Case, pp. 10594-10599

Grunder, Olivier — Systems and Transports Lab. SeT/UTBM

In this paper, we consider the optimization of the physical flows along a simple supply chain in a single-product and multiple transporters context. The studied problem can be assimilated to the lot-sizing problem (LSP) while having its own specificities. A mathematical formulation of the problem is given and a just in time policy is applied to calculate the different dates at each entity of the supply chain. Then, we propose to generalize the Branch and Bound Procedure (BBP) developed in previous work for the single transporter case to the multiple transporters case. The aim is to find both the optimal sequence of lots size and the optimal sequence of

the transporters that have to deliver these lots from the supplier to the customer. These sequences have on the one hand to satisfy all system constraints including the final customer due dates, and on the other hand, to minimize the total cost induced by the various operations of production, holding and transportation.

WeC25 328

Industrial Application of Process Control (Invited Session)

Chair: Han, Chonghun — Seoul National Univ.
Co-Chair: Yu, Cheng-Ching — National Taiwan Univ.
Organizer: Han, Chonghun — Seoul National Univ.
Organizer: Yu, Cheng-Ching — National Taiwan Univ.

16:30-16:50 WeC25.1

A Step-By-Step Approach Toward Advanced Process Control System in Petrochemical Industry (I), pp. 10600-10601

Lee, Jinsuk — Samsung Total

APC (advanced process control) system was successfully applied to aromatics, ethylene and PP (polypropylene) processes of STC (Samsung Total Petrochemicals). The plant performance such as production rate and energy consumption was highly improved by several percent and quality consistency was secured especially for PP process. This implementation will be a base of future plant intelligence system constructed by connecting with ERP (enterprise resource planning) and SCM (supply chain management) systems.

16:50-17:10 WeC25.2

Development of Adaptive Soft Sensor Based on Statistical Identification of Key Variables (I), pp. 10602-10607

Ma, Mingda — Harbin Inst. of Tech.
Ko, Jing-Wei — CPC Petroleum Corp.
Wang, San-Jang — Ta Hwa Inst. of Tech.
Wu, Ming-Feng — National Tsing-Hua Univ.
Jang, Shi-Shang — National Tsing-Hua Univ.
Shieh, Shien-Shu — Chang Jung Univ.
Wong, David, S.H. — National Tsing-Hua Univ.

An adaptive data-driven soft sensor is derived based on systematic dynamic key variables selection of a process system. The key variables are captured using statistical approaches. The on-line plant measurements can be directly selected as key features to estimate the tardily-detected quality variables. The statistical method adopted is the standard stepwise linear regression. The linear model is adapted as the on-line/off-line quality data becomes available. The adaptation of the model is implemented by standard Kalman filtering theory. The key variables are re-selected in case of new scenarios arrive and are detected by the soft senor. The real time data from an industrial O-xylene purification column is implemented to demonstrate the validity of the approach. Many different scenarios are simulated through an industrial standard dynamic simulator. The simulation results also showed the approach is adequate for the industrial applications.

17:10-17:30 WeC25.3

Practice and Challenges in Chemical Process Control Applications in Japan (I), pp. 10608-10613

Ogawa, Morimasa — Yamatake Corp.
Kano, Manabu — Kyoto Univ.

This paper surveys how the three central pillars of process control - PID control, conventional advanced control, and model predictive control - have been used and how they have contributed to production activity from the viewpoint of the process control section in the Japanese chemical industry. In addition to introducing practical methods and their application results, the authors point out challenging problems, which include the development of a general medel-based control technique to enhance batch process control.

17:30-17:50 WeC25.4

Process Automation Development in China (I), pp. 10614-10616

Wang, Shuqing — Zhejiang Univ.
Chu, Jian — Zhejiang Univ.
Su, Hongye — Zhejiang Univ.
Rong, Gang — Zhejiang Univ.
Gu, Yong — Zhejiang Univ.
Jin, Xiaoming — Zhejiang Univ.
Zhang, Jianming — Zhejiang Univ.
Xie, Lei — Zhejiang Univ.

A short historical view of process automation in China is provided. The development of essential aspects of process automation, including Distributed Control System (DCS), Advanced Process Control (APC) and Manufacturing Execution System (MES), are discussed in detail. The contribution of local process automation companies, i.e. SUPCON, and HOLLYSYS are highlighted.

17:50-18:10 WeC25.5

Control and Optimization of a Large Scale Refinery Hydrogen Network (I), pp. 10617-10619

Lee, Youngkoun — SK Energy
Park, Hurnkyoun — SK Energy
Jeong, Changho — SK energy

Modern refineries must produce large quantities of high quality low sulphur fuels for today's market. A significant input to the low sulphur fuels manufacturing process is hydrogen, which is both produced and consumed within the refinery. When insufficient hydrogen is available, production rates will fall, having significant financial penalties on refinery operation. If excess hydrogen is produced then it must be downgraded to fuel or potentially flared, having a negative environmental impact. Balancing hydrogen production and distribution in the refinery to match rapidly changing demands represents a significant benefit in terms of cost of operation.

18:10-18:30 WeC25.6

Nonlinear Model Predictive Control of a Run-Of-Mine Ore Milling Circuit, pp. 10620-10625

Coetzee, Lodewicus Charl — Univ. of Pretoria
Kerrigan, Eric C. — Imperial Coll. London
Craig, Ian — Univ. of Pretoria

In this article a nonlinear model predictive controller is presented for a run-of-mine ore milling circuit. The aim is to determine the feasibility of applying nonlinear MPC to such a circuit. The objective of the controller is to reduce the variability in the product particle size which leads to increased recovery of gold from downstream processes. The controller design is evaluated through a simulation study.

WeC26 327

Control of Power Systems III (Regular Session)

Chair: Maciejowski, Jan — Univ. of Cambridge
Co-Chair: Odgaard, Peter Fogh — KK electronic a/s

16:30-16:50 WeC26.1

Hybrid Model Predictive Control Applied to Switching Control of Burner Load for a Compact Marine Boiler Design, pp. 10626-10633

Solberg, Brian — Aalborg Industries A/S
Andersen, Palle — Aalborg Univ.
Maciejowski, Jan — Univ. of Cambridge
Stoustrup, Jakob — Aalborg Univ.

This paper discusses the application of hybrid model predictive control to control switching between different burner modes in a novel compact marine boiler design. A further purpose of the present work is to point out problems with finite horizon model predictive control applied to systems for which the optimal solution is a limit cycle. Regarding the marine boiler control the aim is to find an optimal control strategy which minimizes a trade-off between deviations in boiler pressure and water level from their respective setpoints while limiting burner switches.The approach taken is based on the Mixed Logic Dynamical framework. The whole boiler systems is modelled in this framework and a model predictive controller is designed. However to facilitate on-line implementation only a small part of the search tree in the mixed integer optimization is evaluated to find out whether a switch should occur or not. The strategy is verified on a simulation model of the compact marine boiler for control of low/high burner load switches. It is shown that even though performance is adequate for some disturbance levels it becomes deteriorated when the optimal solution is a limit cycle.

16:50-17:10 WeC26.2

Constrained Control of a Once-Through Boiler with Recirculation, pp. 10634-10639

Trangbaek, Klaus — Aalborg Univ.

There is an increasing need to operate power plants at low load for longer periods of time. When a once-through boiler operates at a sufficiently low load, recirculation is introduced, significantly altering the control structure. This paper illustrates the possibilities for using constrained control to obtain optimal load gradients in the recirculation mode. A model predictive controller is designed for a simulation model with good results. It is also shown how the feed water flow can be used as an extra control signal.

17:10-17:30 WeC26.3

Identification of the Primary Circuit Dynamics in a Pressurized Water Nuclear Power Plant, pp. 10640-10645

Fazekas, Csaba — Computer and Automation Res. Inst.
Szederkenyi, Gabor — Computer and Automation Res. Inst. Hungarian
Hangos, Katalin M. — Computer & Automation Rsrch. Inst. of the Hungarian

This paper presents the results of the parameter estimation procedure for the primary circuit dynamics of a VVER-type nuclear power plant. The model structure is a low dimensional lumped nonlinear model published previously in Fazekas et al. [2007a]. The parameter estimation method uses the modular decomposition of the system model for obtaining physically meaningful initial parameter estimates. The final parameter estimates are computed using the integrated model.

17:30-17:50 WeC26.4

On-Line Estimation of Wind Turbine Power Coefficients Using Unknown Input Observers, pp. 10646-10651

Odgaard, Peter Fogh — KK electronic a/s
Nielsen, Rasmus — KK-electronic a/s
Damgaard, Chris — KK-electronic a/s

As installed wind turbine energy generation capacity increases, the interest in optimizing these wind turbines increases as well. The optimal operating points for the power and speed control of the turbines depends on a mapping to the power conversion ratio (Cp) from tip speed ratio and blade pitch angles. This mapping changes slowly with time, which can lead to a non-optimal operation of the turbine with time. Another issue is quality of the initial mapping. It might be correct but it can be uncertain. This paper introduces a scheme to estimate this power conversion ratio. The estimated values can subsequently be used to calculate a new operating point. The estimation is based on an optimal unknown input observer.

17:50-18:10 WeC26.5

Real-Time Moisture Content Monitoring of Solid Biomass in Grate Combustion, pp. 10652-10656

Ruusunen, Mika — Univ. of Oulu

A novel method for real-time moisture level monitoring of the solid biomass fuel in grate combustion is presented. The measurement principle is based on temperature sensor information from both flame and a fuel bed. Based on the combustion theory and data analysis, selected features have been extracted from the fused sensor information and estimate of the fuel quality is then made continuously with calculated features. The monitoring approach has been tested in a 300 kW stoker combustion unit intended for decentralized heat production, over a wide range of different process conditions and wood fuel moistures, giving satisfactory accuracy for control purposes. The availability of moisture information made possible to adjust primary/secondary air ratio, leading to reduction of emissions and excess air. Based on the results, the method has capability to give new possibilities for cost effective control and more energy efficient use of solid biomass as a fuel in small-scale energy production.

18:10-18:30 WeC26.6

Possibilities of Fault Tolerant Control in Thermal Power Plants, pp. 10657-10661

Majanne, Yrjö — Tampere Univ. of Tech.

Fault diagnosis and fault tolerant control applications require that the structure of the target process contains certain redundancy in system observability and controllability. Usually the analysis of the existence of these properties is based on the laborious state space model of the process. However, the state space model is not necessary needed for the analysis. In this paper a structural analysis based on oriented bi-partite graphs is applied to analyze the properties of a thermal power plant process to show the redundant structures required for diagnostics and fault tolerant control. The analysis method is demonstrated by analyzing the structure of the secondary and tertiary air system of the boiler.

WeC27 326

Real-Time Systems (Regular Session)

Chair: de la Puente, Juan Antonio — Univ. Pol. de Madrid
Co-Chair: Marcos, Marga — Univ. del País Vasco

16:30-16:50 WeC27.1

The Fault-Tolerant Extension of System Area Networks of Multiprocessor System, pp. 10662-10667

Podlazov, Viktor — Trapeznikov Inst. of Control Sciences RAS
Nikolaev, Artem — The Lab. of Newest Information Tech. - LANIT

The method is proposed for building a fault-tolerant system area network (SAN) as a flat network comprised of several copies of the source network. This flat network is based on a theory of balanced incomplete block designs (BIBD)

16:50-17:10 WeC27.2

Control Performance Evaluation of Selected Methods of Feedback Scheduling of Real-Time Control Tasks, pp. 10668-10673

Lozoya Gamez, Rafael Camilo — Tech. Univ. of Catalonia
Marti, Pau — Tech. Univ. of Catalonia
Velasco, Manel — Tech. Univ. of Catalonia
Fuertes, Josep M. — Tech. Univ. of Catalonia

Feedback scheduling (FS) often refers to the problem of sampling period selection for real-time control tasks that compete for limited computing resources such as processor, network, or battery power. Its goal is to optimize the aggregated control performance achieved by all tasks by efficiently using the scarce resources. In this paper representative existing FS methods are selected, their main features are identified, and a simple control performance evaluation is performed. The latter shows that a) jitters in job executions hide the true performance that can be achieved by the analyzed FS methods, b) after completely removing the degrading effects of jitters, the performance of each FS method dramatically changes, and c) the relative benefit provided by each method depends on the type of perturbations affecting the plants.

17:10-17:30 WeC27.3

Real-Time Monitoring and Diagnosis Platform for a Machining Process, pp. 10674-10679

Portillo Perez, Eva — Univ. of the Basque Country
Marcos, Marga — Univ. del País Vasco
Cabanes, Itziar — Univ. of the Basque Country
Orive, Dario — Univ. del País Vasco
Sánchez, José Antonio — Univ. of the Basque Country

This paper presents the design and development of a real-time monitoring and diagnosis system for diagnosing degraded cutting regimes in Wire Electrical Discharge Machining (WEDM). The detection in advance of the degradation of the cutting process is crucial since this can lead to the breakage of the cutting tool (the wire), reducing the process productivity and the required accuracy. This work presents the design and development of a real-time monitoring system that alerts of degraded operation. Unlike other works found in the literature review, which are focused on proprietary hardware, the present paper proposes a flexible real-time platform based on a commercial data acquisition board that can be easily configured for different purposes. It has been applied to develop a real-time monitoring and diagnosis system that uses virtual sensors to diagnose the process degradation. The results of this work show a satisfactory performance of the presented approach.

17:30-17:50 WeC27.4

The ASSERT Virtual Machine: A Predictable Platform for Real-Time Systems, pp. 10680-10685

de la Puente, Juan Antonio — Univ. Pol. de Madrid
Zamorano, Juan — Univ. Pol. de Madrid
Pulido, José A. — Univ. Pol. de Madrid
Urueńa, Santiago — Univ. Pol. de Madrid

The development of real-time control systems is a complex process which has to face often con_;icting requirements, especially those related to the performance of the control methods and the real-time behaviour of the system. The ASSERT Virtual Machine provides a reliable execution platform for such systems, which allows developers to cope with functional and real-time aspects separately. In order to guarantee the required real-time properties, the virtual machine only accepts software components which have a predictable temporal behaviour which can be analysed at system design time. Such components can be automatically generated from a high-level description of a system which embodies the functional components (e.g. control algorithms) into a set of containers providing the appropriate concurrent and real-time behaviour. The ASSERT Virtual Machine has been implemented in Ada 2005, using a predictable tasking subset of the language known as the Ravenscar pro_;le. A prototype has been validated on several pilot-scale spacecraft control systems, with good results.

17:50-18:10 WeC27.5

Real-Time Obstacle Avoidance by Visually Recognizing Laser Patterns, pp. 10686-10691

Chang, Wen-Chung — National Taipei Univ. of Tech.
Cho, Chih-Wei — National Taipei Univ. of Tech.

This paper presents a 3-D local map building approach for real-time obstacle avoidance using visually-recognized laser patterns. Precise estimate of the local map provides essential information for navigation and control of a mobile robot in unknown environments. Existing navigation and control approaches typically require expensive sensing devices, such as sonar or laser range finder. In this paper, a mobile robot mounted with a CCD camera and a laser line projector is proposed for the considered control tasks.The idea is to reconstruct the actively-projected laser line in Cartesian space from its observed image based on known geometrical relation between the laser line projector and the CCD camera. The position of the obstacle can thus be estimated based on the reconstructed laser line for effective and efficient navigation of mobile robot. The proposed system has been effectively validated in laboratory environments by performing experiments with a custom-made wheeled robot.

18:10-18:30 WeC27.6

Hierarchical and Distributed Embedded Control Kernel, pp. 10692-10697

Simarro, Raul — Univ. Pol. de Valencia.
Coronel, Javier O. — Univ. Pol. de Valencia
Simo, Jose — Univ. Pol. de Valencia
Blanes, Juan F. — Univ. Pol. de Valencia

This paper presents how to get a high control performance and a reliable operation, by means of a suitable combination of several Embedded Control Systems. For this purpose, a hierarchical and distributed control model is proposed. The model holds a set of activities that should be executed on it, such as change, switch and delegate new code of controllers into embedded nodes. All of these activities are managed by a middleware component following the control kernel concept. This model was tested on real processors interconnected in a CAN network, using a XScale microcomputer with a real time operating system (RTLinux) running a high level controller (GPC) and a dsPIC microcontroller for signal acquisition and delivering of control actions.

WeC28 330A

Powertrain Control (Regular Session)

Chair: Del Re, Luigi — Johannes Kepler Univ.
Co-Chair: Sunwoo, Myoungho — Hanyang Univ.

16:30-16:50 WeC28.1

Electromechanical Valve Actuator with Hybrid MMF for Camless Engine, pp. 10698-10703

Liu, Jieng-Jang — National Taiwan Univ.
Yang, Yee-Pien — National Taiwan Univ.
Xu, Jia-Hong — National Taiwan Univ.

As one of variable valve timing (VVT) approaches, the electromechanical valve actuator (EMVA) uses solenoid to actuate valve movement independently for the application of internal combustion engine. This paper proposed an EMVA structure by incorporating the hybrid magneto-motive force (MMF) implementation in which the magnetic flux is combined by the coil excitation and permanent magnets. Making use of the dedicated flux arrangement, the proposed device can be used to fulfill the VVT features with reduced power source requirement and less electric device components. A dual flux channels EMVA is detailed and the design procedures are presented. Comparing with the conventional EMV, the proposed prototype shows a lot of advantages such as compactness, high temperature tolerance, fast response, relieve of starting current, and variable current actuating timing.

16:50-17:10 WeC28.2

Optimal Selection of Control Inputs for Diesel Engines, pp. 10704-10709

Alberer, Daniel — Johannes Kepler Univ. Linz
Hirsch, Markus — Johannes Kepler Univ. Linz Center of Mechatronics
Del Re, Luigi — Johannes Kepler Univ.

Diesel engine NOx and PM emissions are characterized by a combination of many system inputs. Since more than one combination of inputs leads to the same output and the high number of degrees of freedom, it is an ill-posed problem to determine the optimal input combination. In this paper the introduction of a two dimensional coordinate system is addressed, with the target of a separate and independent control of NOx and PM. Finally, a validation on testbench data is presented.

17:10-17:30 WeC28.3

Modelling of a Fuel Supply System for Model-Based Calibration, pp. 10710-10711

Tomforde, Michael — IAV GmbH
Jeinsch, Torsten — IAV GmbH
Blath, Jan P. — IAV GmbH
Dünow, Hans P. — IAV GmbH

The amount of functions and calibration parameters contained in engine management systems has increased dramatically in recent years, leading to high effort and time for the calibration process. Model- based calibration methods using physical models can significantly improve the efficiency of the calibration process. In this contribution a model of the high pressure part of a fuel supply system implemented in a gasoline direct injection engine is presented. The proposed model captures the basic dynamics of the fuel pressure inside the rail and is successfully used to reduce the large amount of measurements necessary for the calibration of a rail pressure controller, due to the high nonlinearity of the process.

17:30-17:50 WeC28.4

Development of SILS and RCP for OSEK-OS Based ECU, pp. 10712-10718

Sunwoo, Myoungho — Hanyang Univ.

This paper presents the Matlab/Simulink-based Software-in-the-Loop Simulation (SILS) tool for OSEK-OS based ECU. The SILS tool has the capability for temporal and functional simulations of control systems.The temporal behavior of a control system is mainly dependent on the implemented software and hardware such as the real-time operating system (OSEK-OS), the target CPU, and the communication protocol. The SILS components with temporal attributes are specified as tasks, task executions, real-time schedulers (OSEK-OS scheduler), and real-time networks. Methods to realize these components in graphical block representations are investigated with Matlab/Simulink. Furthermore, in order to achieve a seamless development process from SILS to Rapid Control Prototyping (RCP), the SILS block set is designed to support automatic code generation in C codes without tool changes and block modifications.

17:50-18:10 WeC28.5

Fuel Economy Improvement Strategy for Light Duty Hybrid Truck Based on Fuel Consumption Computational Model Using Neural Network, pp. 10719-10725

Suzuki, Masahiro — Hino Motors, Ltd.
Raksincharoensak, Pongsathorn — Tokyo Univ. of Agriculture and Tech.
Nagai, Masao — Tokyo Univ. of Agriculture and Tech.

This paper describes a strategy for fuel economy improvement of light duty truck with parallel hybrid system. The main objective of this paper is to develop a new hybrid controller which optimizes the torque distribution among various running situations and driver's characteristics with on-line simulation, computing fuel and electric current consumption by using neural network models of the hybrid ECU. Then, fuel and battery current consumption computational models with respect to battery state of charge (SOC), engine and motor torque and engine speed are synthesized by using neural network, and the models are based on experimental data. Finally, the new hybrid controller including the above mentioned models is developed, and its effectiveness on fuel economy improvement is verified by using computer simulation.

18:10-18:30 WeC28.6

Estimating the Maneuver Quality of an Automatic Motion Inverter for

End-Of-Line Tuning in Agricultural Tractors, pp. 10726-10731

Tanelli, Mara	Pol. di Milano
Savaresi, Sergio	Pol. di Milano
Manzoni, Vincenzo	Pol. di Milano
Monizza, Federico	Univ. degli Studi di Bergamo
Taroni, Francesco	none
Mangili, Alberto	Same Deutz-FAhr Group SpA

End-of line tuning is a crucial step for any mass-produced system endowed with automatic controllers. As a matter of fact, due to components tolerances and spreads in the production line, the controller tuning performed on a prototype system in never optimal on the final product. In many industrial applications, though, the end-of-line tuning is performed by human testers, and this does not always guarantee an objective assessment of the controlled system quality. This paper proposes a way to estimate the maneuver quality from measured data for an automatic motion-inverter in agricultural tractors. The final goal is to automatically classify the performed maneuver and label it with a quality attribute matching that assigned by the driver. This is the initial step necessary to implement an automatic tuning system which can change the controller parameters until a predefined quality on the motion inversion is achieved.

WeC29 330B

Chassis Control and Supervision (Regular Session)

Chair: Akar, Mehmet	Bogazici Univ.
Co-Chair: Scalzi, Stefano	Univ. of Rome Tor Vergata

16:30-16:50 WeC29.1

Integrated Active Front Steering and Semiactive Rear Differential Control in Rear Wheel Drive Vehicles, pp. 10732-10737

Scalzi, Stefano	Univ. of Rome Tor Vergata
Marino, Riccardo	Univ. di Roma Tor Vergata

Many vehicle control systems are based on the yaw rate error to help the driver during oversteer and understeer conditions. The control systems usually operate on brake pressures distributions such as ESP and/or on active front and rear steering control. Recently many papers are focused on the design of integrated global chassis control systems. The main contribution of this paper is to show for a CarSim small SUV model the stability of a proportional-integral active front steering control from the yaw rate tracking error integrated with an electronically controlled semiactive rear differential from the rear wheel speed measurements; the stability analysis is based on Lyapunov techniques. The integrated controlled system shows increased performances: new stable cornering manoeuvres and increased safety especially in emergency conditions. Several simulations are carried out on a standard CarSim small SUV model to confirm the analysis and to explore the robustness with respect to unmodelled combined lateral and longitudinal tire forces according to combined slip theory and unmodelled dynamics such pitch and roll. The simulations on CarSim vehicle show the benefits of using the proposed integrated control with respect to the case in which only active front steering is employed.

16:50-17:10 WeC29.2

Active Coordination of the Individually Actuated Wheel Braking and Steering to Enhance Vehicle Lateral Stability and Handling, pp. 10738-10743

Dincmen, Erkin	Istanbul Tech. Univ.
Acarman, Tankut	Galatasaray Univ.

In this paper, a novel vehicle dynamics controller is proposed by combining two control loops which are formed by the individually actuated wheel braking and steering regulator. The inner braking loop regulates the individual tire force generation and prevents tire force saturation with respect to tire slip. When the tire forces are regulated to operate in the linear region of their nonlinear characteristics, the drive ability and manageability of the vehicle motion dynamics is enhanced in terms of handling and cornering capability. In the outer loop of the proposed control scheme, Linear Quadratic (LQ) optimal controller is introduced in order to assure the overall lateral stability, the driver's desired yaw rate and the desired trajectory's tracking with the capability of rejecting the disturbance moment acting on the vehicle model in the lateral direction. Simulation results are presented to illustrate the effectiveness of the proposed approach.

17:10-17:30 WeC29.3

An Integrated Chassis Controller for Automotive Vehicle Emulation, pp. 10744-10749

Akar, Mehmet	Bogazici Univ.
Kalkkuhl, Jens Christian	DaimlerChrysler AG

This paper discusses an integrated chassis controller for vehicle emulation. The proposed scheme consists of 4-wheel automatic steering for lateral dynamics tracking, and a suspension controller for emulating desired vertical motion. The lateral controller is designed based on the observation that the coupling from vertical to lateral dynamics is weak in the linear operating regime of interest (i.e., for lateral accelerations below 4 m/s/s), whereas the suspension controller compensates for the coupling from lateral to vertical dynamics. The efficacy of the proposed method is demonstrated by realistic experiments in an advanced nonlinear simulator.

17:30-17:50 WeC29.4

GL_2 Estimation of Front Wheel Disturbance, pp. 10750-10755

Akbari, Ahmad	Tech. Univ. of Munich
Lohmann, Boris	Tech. Univ. München
Salimbahrami, Behnam	Tech. Univ. Munich

This paper concerns with the generalized L_2 estimation of the disturbance applied to a vehicle steer wheel. The study is specially useful for active vehicle suspensions utilizing wheelbase preview information. To design an estimator to perform satisfactorily for a wide range of road irregularities and to care for system structured (parametric) uncertainties, a generalized L_2 gain based scheme is proposed to design the estimator. The problem is formulated using LMI's and to ensure desired transient dynamics for the system, some pole location constraints are considered. To evaluate the effectiveness of the proposed controller it is compared with a Kalman estimator designed under similar conditions. The results demonstrate effectiveness of the proposed estimator.

17:50-18:10 WeC29.5

Control of Electric Power Steering Systems - from State of Art to Future Challenges, pp. 10756-10757

Grüner, Stefan	ZF-Lenksysteme GmbH
Gaedke, Alexander	ZF-Lenksysteme GmbH
Karch, Gerald	ZF-Lenksysteme GmbH

Electric power steering (EPS) systems are about to find their way into premium cars. As a result not only the hardware requirements but also functional requirements for EPS systems are increasing. These functional requirements concern performance in conjunction with vehicle level control algorithms as well as road feedback. The paper summarizes the essential functional requirements for state of the art steering systems. It gives an overview of control concepts as implemented in typical EPS systems today and outlines challenges of future approaches from an industrial point of view. These challenges cut down to practical design of controllers and estimators with coarsely quantized measurements and short-word-length on the target hardware.

18:10-18:30 WeC29.6

Explicit Nonlinear MPC of an Automotive Electromechanical Brake, pp. 10758-10763

Lee, Chih Feng	The Univ. of Melbourne
Manzie, Chris	The Univ. of Melbourne
Line, Chris	The Univ. of Melbourne

Electromechanical brakes (EMB) have great potential for automotive applications due to performance, manufacturing and environmental benefits. One key performance criterion is the ability to track brake clamp forces requested by higher level controllers such as antilock braking and electronic stability systems. Prior EMB controllers have utilised architectures including cascaded proportional-integral (PI) control and linear model predictive control (MPC), although only with suboptimal results. In this paper, an explicit nonlinear constrained MPC is proposed for the EMB. The explicit control law is obtained by minimising a quadratic performance criterion. The solution is computed offline and saved to memory to avoid the computational expense of online optimisation. The control law is implemented in simulation using a lookup table and its effectiveness is demonstrated. The effect of model parameter variation on control performance is discussed, and its impact on the controller implementation is investigated with a view to determining the most suitable parameters for online adaptation. Model parameter adaptation within the explicit MPC framework is also investigated.

WeC30	330C

Multi-Vehicle Systems I (Regular Session)

Chair: Zheng, Yu Fan — East China Normal Univ.
Co-Chair: Hsu, Liu — COPPE - Federal Univ. of Rio de Janeiro

16:30-16:50 WeC30.1

Consensus in Networks with Diverse Input and Communication Delays, pp. 10764-10769

Tian, Yu-Ping — Southeast Univ.
Liu, Cheng-Lin — Southeast Univ.

This paper studies the consensus problem for multi-agent systems with diverse input and communication delays. Decentralized consensus conditions are obtained based on the frequency-domain analysis and matrix theory. By these conditions, to achieve consensus under large input delays, one should use small interconnection gains or have small numbers of neighbors when the graph is kept connected. For systems with diverse communication delays, a consensus protocol with unified self-delay is proposed. The obtained consensus conditions are dependent on the self-introduced delay but independent of communication delays when the digraph contains a globally reachable node.

16:50-17:10 WeC30.2

Consensus of Dynamical Agents in Time-Varying Networks, pp. 10770-10775

Zheng, Yu Fan — East China Normal Univ.

Consensus problems in time-varying networks are studied in this paper. We consider two cases. In the first case, the networks are basically connected and the conditions for reaching consensus are described by means of the algebraic properties of connectivity for network graph. In the second case, the networks are possibly disconnected all time. A concept called integral connectivity of networks is used and by means of its algebraic characterization we study the consensus problems with variant time-varying network cases. Necessary and sufficient conditions of consensus over periodic time-varying networks are presented. For aperiodic time-varying network cases some sufficient conditions are given. The estimations of convergence rate are given in terms of the integral connectivity.

17:10-17:30 WeC30.3

Collective Behavior of Multi-Agent Systems under Digital Communication Network, pp. 10776-10781

Yu, Hongwang — Shanghai Univ.
Zheng, Yu Fan — East China Normal Univ.

This paper works on the collective behavior of multi-agent systems under digital networks. It is assumed that the agents are distributed on a plane and communicate through a digital network. The location coordinates of each agent are measured by some remote sensor and transmitted digitally to its neighbors. The topology of communication network is described by an undirected graph and control protocol is designed by a linear decentralized law. In our setting the whole dynamics of the multi-agent system is described by a hybrid system. We explore the relationship between the collective behavior of agents and the properties of agent and network. It is shown that the agents under digital communication network may display different collective behaviors: aggregation, divergence, and periodic oscillation, under different conditions. Examples show the effectiveness of our theoretical results.

17:30-17:50 WeC30.4

Coordination of Multi-Agent Systems with Communication Delays, pp. 10782-10787

Liu, Cheng-Lin — Southeast Univ.
Tian, Yu-Ping — Southeast Univ.

In this paper, we investigate coordination of a network of second-order dynamic agents under communication delays. Based on the frequency-domain analysis and matrix theory, the necessary and sufficient conditions for the system converging to stationary consensus and dynamic consensus are obtained, respectively. The conditions depend on the communication delay, the eigenvalues of the Laplacian matrix, and the interconnection topology of the network. Moreover, we apply the consensus algorithm to the formation control of the multi-agent system with communication delays. The agents in the system can achieve arbitrary desired formation pattern, and the formation moves in a desired velocity. Simulation results illustrate the correctness of the results.

17:50-18:10 WeC30.5

Adaptive Formation Control Using Artificial Potentials for Euler-Lagrange Agents, pp. 10788-10793

Pereira, Ademir Rodrigues — COPPE/ Federal Univ. of Rio de Janeiro
Hsu, Liu — COPPE - Federal Univ. of Rio de Janeiro

In this paper, we present a formation control strategy for a group of agents modeled as Euler-Lagrange systems. The formation is achieved by means of a desired kinematic model generated by artificial potentials. The system uncertainties are compensated by binary adaptive control which combines the good transient properties and robustness of Sliding Mode Control with the desirable steady-state properties of parameter adaptive systems. Furthermore, an important advantage with respect to sliding mode control is that the proposed controller generates a continuous signal so that control chattering is avoided. A simplified version of the controller is also proposed, which does not require the knowledge of the velocities of the neighboring vehicles.

18:10-18:30 WeC30.6

Stability Investigation of a Robotic Swarm with Limited Field of View, pp. 10794-10799

Etemadi, Shahram — Sharif Univ. of Tech.
Alasty, Aria — Sharif Univ. of Tech.
Vossoughi, Gholamreza — Sharif Univ. of Tech.

This paper presents an analytical study of swarm motion in a quasi static environment, in which, motion of each member is being affected by interactive forces and agents. Interactive effects on each member could be attractive or repulsive due to being far from or close to other members respectively. An agent also can be attractive or repulsive. The method is based on Lyapunov analysis. The aim is to preserve the unity of swarm i.e. not losing any member through motion, while being under influence of an agent. It is also considered that field of view of swarm members is limited; which is the most important characteristic of this work.

WeCCC	401

Milestone Report by IFAC Coordinating Committee on Mechatronics, Robotics and Components (CC4) (Milestone Session)

Chair: Boverie, Serge — Continental Automotive France

16:30-18:30 WeCCC.1

Mechatronics, Robotics and Components for Automation and Control - IFAC Milestone Report, pp. 10800-10809

Boverie, Serge — Continental Automotive France
Cho, Dong-il Dan — Seoul National Univ.
Hashimoto, Hideki — Univ. of Tokyo
Tomizuka, Masayoshi — Univ. of California, Berkeley
Wang, Wei — Dalian Univ. of Tech.
Zuehlke, Detlef — TU Kaiserslautern

This paper presents a general overview of the technological fields of mechatronic, robotic, components for automation and control. Five technical areas are considered: component and instruments, mechatronic, robotics, cost oriented automation and human-machine systems. The paper addresses their current key problems and the recent major accomplishments. At last the most promising forecasted development and applications are considered.

ThPL1	Auditorium (301)

A Control-Theoretic Approach to Model-Based Medicine by Hidenori Kimura (Plenary Session)

Chair: Jämsä-Jounela, Sirkka-Liisa — Helsinki Univ. of Tech.

08:00-09:00 ThPL1.1

A Control-Theoretic Approach to Model-Based Medicine, pp. 10810-10821

Kimura, Hidenori — The Inst. of Physical and Chemical Res. (RIKEN)

Advances in medical science and technology inevitably have generated the increasing ramification of disciplines of clinical medicine. Each medical professional tends to be restricted in his/her own specialty, in terms of knowledge, methodology and viewpoint, and often leads to the destruction of the harmonious balance of human body through excessive concentration of a local situation. Human body must be in balance as a complicated system whose behaviors are regulated though huge network of control mechanisms. The medical treatments must be re-considered from this point of view of the totality of human body in face of coming aged society. The integration must be emphasized instead of ramification. The so-called systems medicine is regarded as a methodology of clinical science of the next generation to overcome various bottlenecks of the modern medicine, as well as medical care systems. A core of the system medicine lies in digital technology, particularly modeling and control of human viscera and their protection systems. We propose the notion of model-based medicine as a concrete discipline of system medicine which is based on the well-known internal model control. The methodology of constructing integrative model of human body for model-based medicine is proposed. A preliminary example of model-based medicine for use in ICU(intensive care unit) is shown. As a more realistic example, a new model of glucose-insulin-glucagon dynamics which involves the allostatic effect of neuronal-hormonal regulation is derived, based on which a treatment strategy of model-base medicine is proposed. Some theoretical issues of systems medicine will be discussed.

ThPL2 Auditorium (301)
BigDog, the Rough-Terrain Robot by Marc Raibert (Plenary Session)

Chair: Cho, Hyung Suck — KAIST

09:00-10:00 ThPL2.1
BigDog, the Rough-Terrain Quadruped Robot, pp. 10822-10825

Raibert, Marc — Boston Dynamics

Less than half the Earth's landmass is accessible to existing wheeled and tracked vehicles. But people and animals using their legs can go almost anywhere on Earth. Our mission at Boston Dynamics is to develop a new breed of rough-terrain robots that capture the mobility, autonomy and speed of living creatures. Such robots will travel in outdoor terrain that is too steep, rutted, rocky, wet, muddy, and snowy for conventional vehicles. They will also travel in cities and in our homes, doing chores and providing care, where steps, stairways and household clutter limit the utility of wheeled vehicles. Robots meeting these goals will have terrain sensors, sophisticated computing and power systems, advanced actuators and dynamic controls. I will give a status report on BigDog, an example of such rough-terrain robots. It is a 100 kg quadruped robot that balances actively as it operates on a variety of outdoor terrains, carries a 65 kg load, runs travels at up to 11 kph.

ThA01 Atlantic Hall
Industrial Control Systems (Poster Session)

Chair: Dochain, Denis — Univ. Catholique de Louvain
Co-Chair: Marquardt, Wolfgang — RWTH Aachen Univ.

10:30-12:30 ThA01.1
On-Line Fault Detection and Classification for a Compressor Process in the Oxygen Plant, pp. 10826-10831

Liu, Jialin — Fortune Inst. of Tech.
Chen, Ding-Sou — China Steel Corp.

In this paper, a data-driven model is proposed for on-line monitoring a process with highdimensional variables, outliers, and time-varying characteristics. In this research, principal component analysis (PCA) is used to eliminate collinearity between process variables. After that, fuzzy rules are generated by using the compressed data and an outlier rejection clustering algorithm, named distancedbased fuzzy c-means (DFCM), from which a feasible solution can be obtained to reflect the actual data gatherings. When new event emerge, the data are collected for next model update. An adaptive PCA algorithm is utilized to accommodate the new event data without recalculating the trained data. The known event rules can be transferred to the new PCA subspace by rotating and shifting coordinates of the subspace. Therefore, only new event data need to be clustered on the new subspace. The proposed approach has been applied to monitor a compressor process of the steel plant. Results show the challenges of process monitoring can be effectively dealt with.

10:30-12:30 ThA01.2
Linear Analysis and Control of a Boiler-Turbine Unit, pp. 10832-10837

Tan, Wen — North China Electric Power Univ.
Fang, Fang — North China Electric Power Univ.

Boiler-turbine units are multivariable nonlinear systems. The control of such systems is not easy considering the practical tuning, implementing and maintaining problems. In this paper, the design of a linear controller for the Dalate No.4 unit is reported. Based on a nonlinear model of the unit, we analyze the nonlinearity of the unit and propose to choose the appropriate operating points so that a linear controller can achieve wide-range performance. Simulation results and field tests show that the designed controller works well for the specific range of load variations.

10:30-12:30 ThA01.3
Industrial Temperature PID Controller for Pb-Free Soldering Iron, pp. 10838-10843

Hamane, Hiroto — kogakuin Univ.
Miyazaki, Kazuyoshi — TOHO Electrical Inc.

This paper presents a Pb-free soldering iron temperature controller in consideration of the use of an embedded micro-processor (MPU) with a low memory capacity. The proposed method is suitable for a wide use type commercial controller due to only a variable set point is applied to a PID controller. The proposed controller could solve the Pb-free soldering problem. The proposed method could be successfully applied to a commercial digital temperature controller.The controller has been commercialized.

10:30-12:30 ThA01.4
Hybrid Model Based Optimal Control for a Metallurgy Process, pp. 10844-10850

Qiu, Zhifeng — Katholieke Univ. Leuven
Deconinck, Geert — Katholieke Univ. Leuven
Gui, Weihua — Central South Univ.
Yang, Chunhua — Central South Univ.

This paper applies hybrid modeling method based optimal control in industrial process. Hybrid modeling method combines a priori information with a nonlinear residual compensation technique to build a global model which predicts alumina raw pulp slurry quality. Process control is accomplished based on blending expert knowledge with multi-objective hierarchy reasoning approach. Through the coordination of model and controller, the optimal control of blending process is achieved. Application results show that the proposed method can resolve optimization problems of a kind of industrial processes characterized by time delay and multi-constraints.

10:30-12:30 ThA01.5
Development of Integrated Alstom Gasification Simulator for Implementation Using DCS CS3000, pp. 10851-10856

Haryanto, Ade — Pusan National Univ.
Siregar, Parsaulian — Bandung Inst. of Tech.
Kurniadi, Deddy — Bandung Inst. of Tech.
Hong, Keum-Shik — Pusan National Univ.

In this paper we explore the development of integrated plant simulator that integrates MATLAB as an engine and DCS CS3000 as an industrial controller. It works realtime and online like real industrial control plant scheme. For industrial practicians like operator and engineer, this simulator is very useful as an operator training or control educational tools and can be used to implement loop pairing selection and tune the controller parameters. As a requirement of controlling using DCS, this paper provides integrated analysis tools for loop pairing by implementation relative gain array (RGA) method and decentralized relative gain (DRG). Plant case for this simulator is Alstom gasification.

10:30-12:30 ThA01.6
Cascaded Parameter Estimation for a Water Treatment Plant Using Particle Filters, pp. 10857-10862

Lendek, Zsofia — Delft Univ. of Tech.
van Schagen, K.M. — Delft Univ. of Tech.
Babuska, Robert — Delft Univ. of Tech.
Veersma, A. — Waternet
De Schutter, Bart — Delft Univ. of Tech.

Advanced online control of drinking water treatment plants requires reliable models. These models in general involve temperature-dependent, uncertain parameters, which can only be measured in laboratory conditions.We propose to estimate these parameters online, using the available pH quality measurements. Since the pH measurements are a nonlinear combination of the system's states, a particle filter is used. Thanks to the cascaded nature of the plant, the estimation is also performed in a cascaded setting. The performance is evaluated both for simulated and real-world data. Results indicate that the filter can be effectively used to improve the model accuracy.

10:30-12:30 ThA01.7

Predictive Ratio Control of Multizone Thermal Processing System in Lithography, pp. 10863-10868

Tay, Arthur National Univ. of Singapore
Tan, Kok Kiong National Univ. of Singapore
Zhao, Shao National Univ. of Singapore
Lee, Tong Heng National Univ. of Singapore

Baking of semiconductor substrate is common and critical to photoresist processing in the lithography sequence. Temperature uniformity control is an important issue in photoresist processing with stringent specifications and has a significant impact on the linewidth or critical dimension (CD). In this work, we present the development of a ratio control strategy for controlling temperature uniformity of a silicon wafer substrate. Traditional approach in ratio control does not consider interaction among the different input, our approach takes into consideration the interaction between the different heating zone of the novel multizone thermal system developed by us. The resultant model-based GPC PID controller is designed and tested on the multizone thermal system. Simulation results shows that spatial temperature uniformity can be controlled to within 1degC and 0.1degC during transient and steady-state operating condition respectively.

10:30-12:30 ThA01.8

Centralized & Decentralized Temperature Generalized Predictive Control of a Passive-HVAC Process, pp. 10869-10874

Riadi, Riad Univ. Angers
Tawegoum, Rousseau Univ. Angers
Rachid, Ahmed Univ. de Picardie-Jules Verne
Chassériaux, Gérard Univ. Angers

In this work, an application of conventional generalized predictive control (GPC) to a new HVAC (Heating, Ventilation, Air Conditioning) design is presented. As the process is composed of three nonlinear subsystems, two approaches for temperature control are compared; the centralized one, which solves the global control problem as a full MISO (Multi-Input Single-Output) problem, and the decentralized approach, which decomposes the global control problem into manageable subproblems. In this studied case, the system nonlinearities are seen as additive parametric uncertainties affecting the output, which appears as load disturbances to be rejected by the GPC regulator. For this purpose, both a nominal MISO discrete-time linear model of the global system and two nominal SISO discrete-time linear submodels for the principal local-systems are identified. The performances of the proposed control architectures are experimentally evaluated for a wide range of operating conditions.

10:30-12:30 ThA01.9

IEC 61499 Component Based Approach for Batch Control Systems, pp. 10875-10880

Dimitrova, Desislava Univ. of Chemical Tech. and Metallurgy
Panjaitan, Seno Univ. of Kaiserslautern
Batchkova, Idilia Univ. of Chemical Tech. and Metallurgy
Frey, Georg Univ. of Kaiserslautern

In process automation batch processes play a dominant role. With ISA SP88 and its IEC standard equivalent IEC 61512, there is a standard available covering the description of batch processes and plants over several hierarchical layers. For the instrumentation and automation components in all industrial systems there is a trend towards distributed solutions. The function block oriented IEC 61499 standard describes models to implement distributed control systems. In this contribution a new way to combine the concepts of SP88 for design with the models of IEC 61499 for implementation is proposed. To describe the control sequences Signal Interpreted Petri Nets (SIPN) are used to get a more formal model of the control than it is possible with the Procedure Function Chart (PFC) proposed in SP88. Based on this description basic functions for the control as well as the corresponding activation sequences are determined. The basic components are implemented by function blocks according to IEC 61499. The interconnection of the function blocks according to the required sequences is implemented using a scheduler concept. This concept allows re-configuration of the control without altering the function block diagram. Hence the proposed approach offers analyzable formal models, re-usable basic components, and easy re-configurability. The approach is illustrated using the Festo Mini Pulp Process (MPP).

10:30-12:30 ThA01.10

Feedback Linearization –Based Control for a Class of Chemical Processes in Non-Standard Nonlinear Singular Perturbation Form, pp. 10881-10885

Sarabi-Jamab, Atiye Tehran Univ.
Yazdanpanah, Mohammad Javad Univ. of Tehran

This paper deals with a class of chemical process with measurable time-varying disturbances, which is modeled within the framework of singular perturbation in non-standard form. The results in singular perturbation theory consider the systems in a standard form, therefore, a transformation to change a system representation from non-standard to standard form should be found. After this transformation is made, a systematic approach to control this class of systems and disturbance rejection using feedback linearization is proposed. The application of the developed method is illustrated through a catalytic continuous stirred tank reactor.

10:30-12:30 ThA01.11

An Improved Off-Line Approach for Output Feedback Robust Model Predictive Control, pp. 10886-10891

Zibaee Nejad, Mohammad Hadi Tarbiat Modares Univ.
Asemani, Mohammad Hassan Tarbiat Modares Univ.
Majd, Vahid Johari Tarbiat Modares Univ.

In this paper, we present a new off-line formulation of output feedback robust model predictive control for systems with polytopic uncertainty. The method is based on the use of several Lyapunov functions for each different vertex of the polytope. First we construct nested invariant ellipsoids and their corresponding state feedback gains off-line, therefore we are able to analyze closed-loop robust stability, and guarantee it by adjusting design parameters. On-line, we calculate control law by bisection search regarding to estimator state position between two adjacent ellipsoids in state space. Proposed algorithm reduces conservatism of available off-line methods due to using several Lyapunov functions and novel estimator design method. Moreover proposed technique is very efficient. The algorithm is illustrated with an example.

10:30-12:30 ThA01.12

Disturbance Rejection and Set-Point Following of Periodic Signals Using Predictive Control with Constraints, pp. 10892-10897

Wang, Liuping RMIT Univ.
Gawthrop, Peter Univ. of Glasgow

This paper proposes a continuous-time model predictive control design for disturbance rejection and set-point following of periodic signals. By assuming input disturbance in the form of sinusoid, the periodic frequency is embedded into the design model. Hence, from internal model principle, the steady-state error of the model predictive control system is ensured to be zero for both disturbance rejection and set-point following. Furthermore, with the design framework of model predictive control, hard constraints on the derivative and amplitude of the control signals are imposed as part of the performance specification. Simulation studies have been used to show the efficacy of the design with or without hard constraints.

10:30-12:30 ThA01.13

Adaptive Predictive Control Strategy Using Wavenet Based Plant Modeling, pp. 10898-10903

Nazaruddin, Yul Yunazwin Inst. Teknologi Bandung (ITB)
Cahyadi, Ferdian Inst. Teknologi Bandung (ITB)

An alternative control strategy for nonlinear processes which is an integration between the generalized predictive control and wavelet network (wavenet) approach is proposed in this paper. The wavenet is used for modeling the process as it has learning capability from the numerical data obtained from the measurements and subsequently used as process model in the generalized predictive control scheme. The process model is represented in a Nonlinear AutoRegressive with eXogeneous variables (NARX) model. The modeling process is implemented on-line at each control action and this allows the control to be done adaptively. The proposed adaptive control scheme with its wavenet based modeling is applied to

control an ammonia stripper which is basically an aqueous ammonia binary distillation column of a fertilizer plant in Gresik, East Java, Indonesia. The results show how the proposed control scheme has satisfactorily tracking capability as well as performance with respect to changes in process dynamics

10:30-12:30 ThA01.14

Model Predictive Control of Linear Induction Motor Drive, pp. 10904-10909

Hassan, Ahmad Univ.
Thomas, Jean Beni-Sueif Univ.

This paper investigates the application of the Model Predictive Control (MPC) technique in order to control the speed and/or position of the Linear Induction Motor (LIM) drive. The main goal of this controller is to provide the optimal 3-phase primary voltages necessary for tracking a certain speed reference trajectory. Moreover, constraints over the flux and current could be imposed to keep them within permissible values. The main idea is to tighten the future output error to zero, with minimum input effort. The MPC controller produces its optimal output derived from a quadratic cost function minimization based on the linearized machine model. A PI controller may be used in order to eliminate the steady state error completely. Simulation results show that the MPC controller succeeded in well tracking all given speed reference trajectories at high speed as well as at low speed with almost no current and force ripples. It has been proved that the proposed controller has faster response than any traditional controller. Moreover, it shows more robustness against parameter uncertainty and load disturbance.

10:30-12:30 ThA01.15

Model-Based Predictive Control for the Exhaust Gas Cycle of an Oxyfuel-Process, pp. 10910-10915

Nötges, Thomas RWTH Aachen Univ.
Hölemann, Sebastian RWTH Aachen Univ.
Abel, Dirk RWTH-Aachen Univ.

The global environmental warming which is discussed these days is, at the opinion of many experts, amongst other things scribed to human induced carbon dioxide emissions which intensify the greenhouse effect. To face and overcome the negative consequences like environmental disasters, the rising mean sea level and other, new power plant concepts are researched and developed. In this article a novel, zero emission, oxyfuel power plant concept is discussed. Due to the novelty of the process it is examined in calculations, simulations and laboratory tests by a research group at RWTH Aachen university and does not exist in reality by now. Besides a conventional water cycle, an exhaust gas cycle has a major function in the process. The operation of the exhaust gas cycle requires an automation concept. In this paper an object-oriented model is used as a basis for examining the process behaviour and developing a controller for the multivariable and strongly coupled system. For the sliced exhaust gas cycle a model-based predictive controller is introduced. A parameter study presents the impact of selected controller parameters.

10:30-12:30 ThA01.16

Hybrid Predictive Control of Supermarket Refrigeration Systems: An Optimal Time Switching Strategy, pp. 10916-10922

Sarabia, Daniel Univ. of Valladolid
de Prada, Cesar Univ. of Valladolid

This paper presents a NMPC of a supermarket refrigeration system. This is a hybrid process involving switched nonlinear dynamics and discrete events, on/off manipulated variables (valves and compressors), continuous controlled variables (goods temperatures) and finally, several operation constraints. The hybrid controller is based on a parameterization of the on/off control signals in terms of time of occurrence of events instead of using directly binary values, in this way, we can re-formulate the optimization problem as a NLP problem. Results of the hybrid controller operation are given.

10:30-12:30 ThA01.17

Optimization of Operating Procedure of LNG Storage Facilities Using Rigorous BOR Model, pp. 10923-10926

Kim, Ho Soo Seoul National Univ.
Shin, Myung-wook Seoul National Univ.
Yoon, En Sup Seoul National Univ.

In this study, in order to improve the efficiency and the safety of the LNG storage facilities, the rigorous hybrid dynamical model is proposed. This model is composed of continuous state dynamics which estimate the boil-off rate (BOR) based on understanding of the energy and mass transfer between the stratified cells of LNG storage tanks and discrete state dynamics which describe the operational procedure of the boil-off gas (BOG) compressors. By using this model, an optimal operational procedure can be obtained as a dynamic optimization problem with considering the discrete nature of compressors.

10:30-12:30 ThA01.18

Reliable Multi-Objective On-Line Re-Optimisation Control of Batch Processes Based on Bootstrap Aggregated Neural Networks, pp. 10927-10932

Mukherjee, Ankur Newcastle Univ.
Zhang, Jie Newcastle Univ.

The paper presents a reliable multi-objective re-optimisation control strategy for batch processes based on bootstrap aggregated neural networks. Bootstrap aggregated neural networks not only give better generalisation performance than single neural networks but also provide model prediction confidence bounds. In order to overcome the problem of unknown disturbances, on-line re-optimisation is carried out to amend the control policy for the remaining batch duration. In addition to the process operation objectives, the reliability of model prediction is incorporated in multi-objective optimisation in order to improve the reliability of the obtained optimal control policy. The standard error of the individual neural network predictions is taken as the indication of model prediction reliability. The proposed method is demonstrated on a simulated fed-batch process.

10:30-12:30 ThA01.19

Relay-Based Autotuning of PID Controller for Improved Load Disturbance Rejection, pp. 10933-10938

Liu, Tao Hong Kong Univ. of Science & Tech.
Gao, Furong Hong Kong Univ. of Sci & Tech.

To overcome sluggish load disturbance response for industrial/chemical processes with slow time constant(s), an improved design for on-line autotuning of proportional-integral-derivative (PID) controller is proposed in this paper, based on relay identification of the widely used first-order-plus-dead-time (FOPDT) process model. Using the fitting conditions established for process response at the oscillation frequency under a relay test, the identification algorithm is transparently developed. An analytical controller tuning method is then developed using an asymptotic constraint established thereby for reducing the influence of the slow process time constant on load disturbance rejection. Illustrative examples are given to show the effectiveness and merits of the proposed algorithms.

10:30-12:30 ThA01.20

Design of Uniform Temperature Controller Based on Temperature Difference Model, pp. 10939-10944

Matsunaga, Nobutomo Kumamoto Univ.
Kawaji, Shigeyasu Kumamoto Univ.

Thermal distribution in manufacturing processes, which is observed in both steady and transient states, causes inferior quality. Thus, uniform temperature control is extremely required in many industrial application fields for quality improvement. Conventional control based on black box model is cheap for the control of thermal plant with strong interference. To deal with these problems, we have proposed the temperature difference model (TDM) for thermal process. In this paper, the design method of uniform temperature controller for two-dimensional heat plate is proposed. And the effectiveness of the proposed system is clarified by experiments.

10:30-12:30 ThA01.21

Iterative Feedback Tuning of Cross-Directional Processes Controller, pp. 10945-10950

Yan, Jun Univ. of British Columbia
Dumont, Guy Univ. of British Columbia
Loewen, Philip D. Univ. of British Columbia

This paper studies the possible application of Iterative Feedback Tuning (IFT) to the paper machine cross-directional (CD) control. Although the CD control is naturally a multi-input-multi-output (MIMO) problem, by enforcing the circulant assumption, IFT for CD control is as simple as the single-input-single-output (SISO) case, i.e. only one gradient experiment is needed for estimating the gradient. Simulation of a simple disturbance rejection problem is included to demonstrate the main ideas.

10:30-12:30 ThA01.22

A Comparative Analysis of Nonlinear Control Approaches for Non-Minimum Phase Processes, pp. 10951-10956

Ramírez Estay, Héctor Miguel — Univ. de Concepción
Sbarbaro, Daniel G. — Univ. de Concepcion

The control of nonlinear non-minimum phase processes by using traditional geometric approaches has lead to the development of specific design methods, such as the statically equivalent output approach. On the other hand, alternative design methods based on physical models, energy and mass balances, and the concept of passivity have been applied to a wide range of electrical and electromechanical systems. However, their application to process control has been limited. In this work, a comparative analysis of both design control approaches is presented. A standard continuous stirred tank reactor example is used to illustrate the differences among the approaches and the performances attained in both cases.

10:30-12:30 ThA01.23

A Detection Algorithm for Bifurcations in Dynamical Systems Using Reduced Order Models, pp. 10957-10962

Wattamwar, Satyajit — Tech. Univ. of Eindhoven
Weiland, Siep — Eindhoven Univ. of Tech.
Backx, Ton — Eindhoven Univ. of Tech.

Finite element or finite volume discretizations of distributed parameter systems (DPS) typically lead to high order finite dimensional systems. Model approximation is then an important first step towards the construction of optimal controllers. However, model reduction methods hardly take model uncertainties and parameter variations into account. As such, reduced order models are not well equipped when uncertain system parameters vary in time. This is particularly true when system behavior does not depend continuously on the parameters. It is shown in this paper that the performance of reduced order models inferred from Galerkin projections and proper orthogonal decompositions can deteriorate considerable when system parameters vary over bifurcation points. Motivated by these observations, we propose a detection mechanism based on reduced order models and proper orthogonal decompositions that allows to characterize the influence of parameter variations around a bifurcation value. for this, a hybrud model structure is proposed. The ideas are applied on the example of a tubular reactor. In particular, this paper discusses the difficulties in approximating the transition from extinction to ignited state in a tubular reactor.

10:30-12:30 ThA01.24

Towards Clean-Coal Control Technologies: Modelling Conversion of Carbon Oxide into Hydrogen by a Shift Reactor, pp. 10963-10970

Bittanti, Sergio — Pol. di Milano
Canevese, Silvia — CESI RICERCA
De Marco, Antonio — Consultant
Prandoni, Valter — CESI RICERCA
Serrau, Daniela — Pol. di Milano

The operating behaviour of a catalytic reactor converting carbon oxide into hydrogen by water gas shift is analysed. Such a device can be used in coal gasification plants for hydrogen production. A dynamical model of the reactor is presented, based on a description of the kinetic-chemical mechanisms of adsorption and desorption in the porous catalyst and on mass, energy and momentum conservation equations. Chemical-kinetic parameters have been identified. The complete model has been validated against steady-state data gathered from a laboratory-scale reactor. Dynamical simulation results are shown as well.

10:30-12:30 ThA01.25

Modeling Waste Heat Recovery System of Industrial Ammonia Process Plant Using LPV Identification, pp. 10971-10976

Bambang, Riyanto — Bandung Inst. of Tech.
Subagio, Heri — Bandung Inst. of Tech.
Praharso, Praharso — PT Pupuk Kaltim

This paper presents modeling of Waste Heat System of an industrial ammonia process plant. Linear Parameter Varying (LPV) identification is utilized to cover changes in process operating conditions, such as start-up, normal operation and shut-down. Recursive Least Square (RLS) based algorithm is employed in the LPV identification process. Experimental input-output signals required for identification process are taken from DCS historian data of the ammonia process plant during plant operations. The resulting LPV model is simulated and validated with respect to the measured data. Promising results are obtained in applying advanced LPV identification to cover variations of process operating conditions in an industrial process plant.

10:30-12:30 ThA01.26

Qualitative and Quantitative Synthetic Methodology for Blending Optimization in Lead-Zinc Sintering, pp. 10977-10982

Wang, Chun-Sheng — Central South Univ.
Wu, Min — Central South Univ.
She, Jin-Hua — Tokyo Univ. of Tech.
Cao, Weihua — Central South Univ.
He, Yong — Central South Univ.

To deal with the problem of high cost and low accuracy existed in conventional methods for the lead-zinc sintering blending, a qualitative and quantitative synthetic methodology for sintering blending optimization is presented in this paper. First, two prediction models are built based on a process neural network and the improved grey system theory. Next, these two models are integrated into one prediction model by using the concept of entropy. It guarantees the prediction precision of the Pb and Zn components in the agglomerate. Then, a blending optimization model is established to minimize the costs. Finally, the component ratios are optimized by using the expert reasoning strategy and an integrated synthesis methodology.

10:30-12:30 ThA01.27

A Dynamic Soft-Sensing Method Based on Impulses Response Template and Parameter Estimation with Modified DE Optimization, pp. 10983-10988

Lu, Wenxiang — Tsinghua Univ.
Yang, Qing — Tsinghua Univ.
Huang, Dexian — Tsinghua Univ.
Jin, Yihui — Tsinghua Univ.

As major experimental modeling methods, static soft-sensing methods have been widely used in modern chemical production process now. In fact, for the sampling frequency to output variable by laboratory analyzer off-line is rather low and uniform, the computed results, which gained from those methods or the existed major dynamic methods such as neural networks, are difficult to satisfy the requirements of dynamic control on-line. A dynamic soft-sensing method (DSSM) based on impulse response template (IRT) and parameter estimation using differential evolution (DE) optimization is presented in this paper. However, for a multi-variables system, learning of template parameters still takes large computational cost, and is not only slow in the con- vergence speed but also easy to be trapped into local optima so as to enlarge the modeling errors. To account for these problems, the original DE (ODE) is modified in the aspects of scaling factor and crossover rate, which could dynamically change with iterative loops. Subsequently, a complete implementation of the modified DE (MDE) is presented. Experiment based on hysys simulation of a primary tower system to build a two-inputs- single-output model is carried out, under various impulse response length and noise standard, and the final comparison results demonstrate the effectiveness and robustness of this method.

10:30-12:30 ThA01.28

Network Structure and Robustness of Intracellular Oscillators, pp. 10989-10994

Jacobsen, Elling W. — KTH
Trane, Camilla — KTH

Sustained oscillations play a key role in many intracellular functions, such as circadian time keeping, cell cycle control and calcium signalling. The oscillations are in all cases driven by feedback interactions taking place in biochemical reaction networks. While a single feedback loop in principle is sufficient to generate such oscillations, experimental evidence reveal that more complex network structures, involving multiple feedback loops, underly intracellular oscillations. One hypothesis frequently set forth is that a multi-loop structure is motivated by the need for robustness to internal and external perturbations. We here consider robustness analysis of several recently published models of circadian clocks to determine the role of the underlying network structure in providing robust stability of the oscillators. The robustness analysis is based on adding dynamic perturbations to the network interactions, similar to that used in robust control theory. To elucidate the role of various interactions in providing robust oscillations, we consider blocking specific interactions. Biologically, this contrasts the often considered

gene knockouts and implies that genes are persistently expressed. We find that different models have highly different active structures and also differ significantly in their robustness. While some models essentially rely on a single loop in generating robust oscillations, other models have more intricate structures in which some loops provide oscillations and other serve to increase the robustness. Other models again have redundant loops that provide failure tolerance in the face of large perturbations, such as gene knockouts.

10:30-12:30 ThA01.29

Multivariable LQG Control of a Proton Exchange Membrane Fuel Cell System, pp. 10995-11000

Wang, Fu-Cheng National Taiwan Univ.
Hsuan-Tsung, Chen National Taiwan Univ.
Yen, Jia-Yush National Taiwan Univ.

This paper applies multivariable linear quadratic Gaussian (LQG) control strategies to a proton exchange membrane fuel cell (PEMFC) system. From the system point of view, a PEMFC can be modeled as a two-input-two-output system, where the inputs are air and hydrogen flow rates and the outputs are cell voltage and current. By fixing the output resistance, we aimed to control the cell voltage output by regulating the air and hydrogen flow rates. Due to the nonlinear characteristics of this system, multivariable LQG controllers were designed to provide steady voltage output and to reduce the hydrogen consumption of this system. The study was carried out in three parts. Firstly, the PEMFC system was modelled as multivariable transfer function matrices using identification techniques. Secondly, LQG control algorithms were utilized to design a multivariable controller. Finally, the designed controller was implemented to control the air and hydrogen flow rates. From the experimental results, multivariable LQG control is deemed effective in providing steady output responses and significantly reducing hydrogen consumption.

10:30-12:30 ThA01.30

Visualization of Dynamic Parameters of a Multivariable System Using Self-Organizing Maps, pp. 11001-11006

Fuertes Martinez, Juan Jose Univ. de Leon
Prada, Miguel Angel Univ. de Leon
Dominguez Gonzalez, Manuel Univ. de Leon
Reguera Acevedo, Perfecto Univ. de Leon
Diaz Blanco, Ignacio Univ. de Oviedo
Diez Gonzalez, Alberto Benjamin Univ. de Oviedo

Self-organizing maps are excellent tools for information visualization. In this paper, they are used to extract information about the dynamic behavior of a multivariable system in several operating points. The input space of the SOM is constituted by extended vectors composed of the state of the process and the coefficients of the transfer functions that represent the dynamic behavior of the system for each operating point. New tools of visualization, such as maps of multivariable zeros or maps of relative gain, have been defined in order to explore the system so that suitable control strategies can be selected. The proposed method has been tested on a real multivariable system (a Quadruple-tank industrial scale model).

10:30-12:30 ThA01.31

Greedy Kernel Components Acting on ANFIS to Predict BOF Steelmaking Endpoint, pp. 11007-11012

Han, Min Dalian Univ. of Tech.
Huang, Xiaoqing Dalian Univ. of Tech.

In order to make overall consideration of the information from the original variables in the basic oxygen furnace (BOF) steelmaking dynamic process, an adaptive neural network fuzzy inference system (ANFIS) model based on kernel and greedy components is proposed. This kind of model can improve the endpoint predicting precision of the steel carbon contents and temperature. After hidden information is exposed in the high feature space through the kernel function transformation, greedy algorithm is used to remove redundant information and reduce the dimensions. The extracted components are used as the new inputs of ANFIS, and the implication relation among the inputs is reflected by rules, which simulate the operators experience, and consequently reduce the influence resulted from different operators. When the practical data are simulated, the simulated results are close to the practical values. The method is effective.

10:30-12:30 ThA01.32

Power Transformer Fault Diagnosis Based on Data Fusion, pp. 11013-11017

Lv, Feng Hebei Normal Univ.
Du, Hai-lian He Bei Normal Univ.
Sun, Hao North China Electric Power Univ.
Wang, Zhanfeng Shijiazhuang Univ. of Ec.
Li, Yuan Shenyang Inst. Chemical Tech.

As the fault information of power transformers has characteristics such as complementarities, redundancy and uncertainty, the diagnosis task can't be finished by the simple fault characteristic vector and the diagnosis method. The basic ideas of information fusion are introduced, and DGA (the Dissolved Gas Analysis) is combined tightly with other information such as the results of conventional electrical test of power transformer. The power transformer fault diagnosis model based on information fusion is built. The models can diagnose both fault property and fault spot, which can improve reliability and lower uncertainty in fault diagnosis.

10:30-12:30 ThA01.33

A Two Level Hierarchical Control Structure for Optimizing a Rougher Flotation Circui, pp. 11018-11022

Sbarbaro, Daniel G. Univ. de Concepcion
Maldonado, Miguel Laval Univ.
Cipriano, Aldo Pontificia Univ. Catolica de Chile

The control of rougher flotation circuits represents a challenging control problem due to the non linearities, multiple inputs-multiple outputs and the wide variety of disturbances acting on the system. Many concentrators rely on regulatory control loops to maintain a stable operation and on the plant operators to find the best operational results. As a mean of using the operator's knowledge in a consistent manner Expert Systems have been proposed to emulate the current practices in flotation plants. In this work, an algorithmic supervisory system, as opposed to rule-based systems, is proposed and analyzed using simulations of an industrial rougher flotation circuit.

10:30-12:30 ThA01.34

Modern Algorithms and Systems for Monitoring and Control of Milling and Flotation Process, pp. 11023-11027

Morozov, Valery Moscow state Univ. of mining
Avdokhin, Viktor Moscow state Univ. of mining
Ulitenko, Konstantin JSC Souscvetmetavtomatika
Topchaev, Vladimir JSC Souscvetmetavtomatika
Stoliarov, Valeri JSC Elscort
Ganbaatar, Zorigtyn Erdenet Mining Corp.
Delgerbat, Lodoy Erdenet Mining Corp.

The main reason of milling and flotation process fluctuations is a mixing of ores in various proportions from various sections of a deposit. According to estimates, instability and non-optimized parameters of flotation take 3% to 6% of losses of valuable component. Without ore averaging systems, milling and flotation process are characterized by considerable fluctuations of all input, output and intermediate parameters. In these conditions, applying various mathematic models does not allow controlling the process by action on input parameters with further precise reaching required values of output parameters of the process. Criteria of milling process control are formed to provide required productivity at keeping preset quality. Solution of a task of improving effectiveness of flotation process control requires application of multi-level schemes, providing for regulation of both physico-chemical and technological parameters of the process. Stabilizing and optimizing the main technological parameters allows increasing effectiveness of milling and flotation process.

10:30-12:30 ThA01.35

Advanced Control System of the Steam Pressure in a Fire-Tube Boiler, pp. 11028-11033

Rodriguez Vazquez, Renato Pontificia Univ. Católica del Peru
Rivas Perez, Raul Havana Pol. Univ.
Sotomayor Moriano, Javier Pontificia Univ. Católica del Perú
Perán, J. Ramón Univ. of Valladolid

The urgent requirement to optimize the consumption of energetic resources justifies the application of advanced control strategies to automate equipment that consumes higher amounts of fossil fuels, among them the fire-tube boilers. From a control engineering point of view, these systems are characterized by a difficult dynamic behavior, multiple inputs and outputs, time delay and several uncertainties. In this work an advanced control system with an

Adaptive-GPC algorithm of the steam pressure inside a fire-tube boiler is presented. System identification techniques were employed to obtain a mathematical model that characterizes the dynamic behavior of the process under study. Simulation results evidenced that this model describes with high exactitude the process of steam pressure variation inside the boiler. The model obtained was subsequently used to design the advanced control system. The system was implemented in a utility fire-tube boiler and the results showed its efficiency to deal with variations of the dynamic parameters of the process arisen at different operating conditions. It also showed its superiority against a control system using a PID algorithm.

10:30-12:30 ThA01.36

Research of Large-Scale Reduced SQP Algorithm for Chemical Process System Optimization, pp. 11034-11040

Jiang, Aipeng Hangzhou Dianzi Univ.

Abstract: In chemical process system optimization, it is common that problem has large number of equality constraints and bound constraints, and relatively few degrees of freedom. Reduced space algorithms are well suited for this category of problem. In this paper, a new version of RSQP algorithm coded and implemented in Matlab language was developed. In the RSQP algorithm, the rule of basis selection was revised, and basis selection was realized by Matlab subroutine. Also, an integrated line search of filter method was performed to obtained steplengh. The method combines the advantages of filter line search and that of traditional line search, and was validated by some benchmark examples. The RSQP was applied to some chemical process optimization problems; computational results demonstrate its effectiveness and efficiency.

10:30-12:30 ThA01.37

Robust Control for Output Voltage across Load of DC-DC Converter Matching with Remote Sensing, pp. 11041-11046

Takegami, Eiji DENSEI-LAMBDA K.K.
Higuchi, Kohji The Univ. of Electro-Communications
Nakano, Kazushi the Univ. of Electro-Communications
Kajikawa, Tatsuyoshi The Univ. of Electro-Communications

If the lines which connect the output terminal of DC-DC converter and the load are long, the voltage actually across load will be changed largely to produce the voltage drops by the impedances of the lines. Then, the terminal which senses the voltage across load is prepared apart from the output terminal of DC-DC converter, and it leads to the load, and the voltage across load is adjusted so that it is not changed largely. This method is called remote sensing. When the lines becomes long, the usual method of adjusting the voltage across load cannot suppress enough the change of it. In this paper, the robust digital controller for suppressing the change of the voltage across load is proposed. Experimental studies using DSP demonstrate that this type of digital controller is effective to suppress it.

10:30-12:30 ThA01.38

An Improved Nonlinear Speed Controller for Series DC Motors, pp. 11047-11052

Zhao, Dongbo Tsinghua Univ.
Zhang, Ning Tsinghua Univ.
Zhao, Jun The Australian National Univ.

The issue of speed tracking control for series DC motors is addressed. Based on the classic backstepping design technique, an improved recursive nonlinear controller is proposed to improve the transient response. In the design, two additional class K functions as design functions are adopted to achieve desirable varying decay rate. Application of this strategy substantially improves the transient response and convergence rate without remarkably increasing the controller “gains”. Series DC motors with jumping load torques are also studied. The dynamics of such a motor with jumping load torques are modeled as a switched system. A switching controller based on the improved nonlinear design method is presented. Simulation results demonstrate the effectiveness of the proposed method.

10:30-12:30 ThA01.39

A Market-Based MAS Framework for Microgrids, pp. 11053-11058

Qiu, Zhifeng Katholieke Univ. Leuven
Deconinck, Geert Katholieke Univ. Leuven
Gui, Ning Univ. Antwerpen
Duan, Rui Katholieke Univ. Leuven
Belmans, Ronnie Katholieke Univ. Leuven

This paper proposes a distributed multi-agent system (MAS) framework for market-based control in Microgrids. The proposed system consists of two main entities, Energy Selling Agents (ESAs) and Energy Buying Agents (EBAs). In order to alleviate the internal complexity of the agent, three kinds of delegate mobile agents are designed. They are issued by the corresponding agents according to their different functions assumed in the BDI (belief, desire, intention) architecture, such as one kind of delegate mobile agent fulfills the function for building and maintaining the environment information. Through the coordination and interaction of the agents and the delegate mobile agents, the energy exchange between the power resource units and the local loads is realized dynamically.

10:30-12:30 ThA01.40

Sliding Mode Indicator Model’s at Thermal Control System for Furnace, pp. 11059-11063

Mkrttchian, Vardan All Armenian Internet Univ. - HHH Univ.
Simonyan, Sargis State Enginering Univ. of Armenia
Khachaturova, Anna Inst. of Physical Res. of National Acad. of
Yeranosyan, Hasmik All Armenian Internet Univ.

This paper discusses and deals the development of the Sliding Mode Control Indicator with the using technique of Discontinuous Control for furnace in Laser Physics. To improve efficiency of practical implementation, the furnace control system is regarded as electronic elements having a discontinuity-switching mode where the sliding modes are the basic motions. Implementation of this approach implies the knowledge of the conditions of the occurrence of sliding mode, for which purpose a sliding mode indicator hardware and model has been developed by means the Lab View graphical programming language under Windows environment

10:30-12:30 ThA01.41

A Global Solution to Economic Dispatch with Multiple Fuel Units Using a Function Merger, pp. 11064-11069

Min, Kyung-Il Yonsei Univ.
Moon, Young-Hyun Yonsei Univ.
Lee, Su-Won Inst. of TMS Information Tech.

This paper presents a new systematic approach to find a global solution to economic dispatch (ED) with multiple fuel units using a function merger (FM). Currently, no systematic approach has been developed to find a global solution to economic dispatch with multiple fuel units. Various heuristic methods have been proposed, however it is almost impossible to guarantee a global solution by those methods yet. The proposed method uses the FM and »;-P functions. A FM merges several fuel cost functions into one that satisfies the optimal conditions of an ED. The FM procedures are described in detail with illustrative examples. The global optimality of the proposed method is checked with the ACM (All-Combination Method). The proposed method is tested with a 10-generator system. The results show that the global optimality is achievable by the proposed method.

10:30-12:30 ThA01.42

IMPLEMENTATION OF a PC-BASED SIMULATOR FOR TARASHT POWER PLANT (Turbine Case Study), pp. 11070-11075

Yazdizadeh, Alireza Power and Water Univ. of Tech.

Abstract: Economical operation of large scale systems like a power plant depends on the plant operators and their skills. There are some specific training courses which are presented by experts for the operators, but the operators need to experience in their own way. A methodology for increasing skills of the operators with less cost is to use power system simulators. The TARASHT power plant simulator has been designed and manufactured by Mitsubishi Heavy Industry Group based on a DEC VAX 4000 mini-computer. In a research work supported by the industry, a pc-based simulator was redesigned by Power and Water University of Technology (PWUT). In this paper the result of the project is presented.

10:30-12:30 ThA01.43

Advanced Tuning of POD Controllers for Electric Power Systems Using FACTS Devices, pp. 11076-11077

Korba, Petr ABB Corp. Res. Ltd.
Segundo, Rafael ABB Corp. Res. Ltd.

Chaudhuri, Balarko Imperial Coll. London

In this work, real-time evaluation and steps towards implementation of three different types of power oscillation damping controllers (POD) for fast power electronic devices such as FACTS (flexible AC transmission systems) have been done. The performance of classical POD controllers (lead-lags and phasor estimators) are compared with an advanced adaptive approach. The prerequisite for achieving optimal results in damping of electromechanical oscillations is the availability of remote signals through wide-area monitoring and control (WAMC) platforms discussed here. Achieved results are demonstrated on a dedicated real-time hardware platform.

10:30-12:30 ThA01.44

Architecture of Embedded Human-Machine Interface for Intelligent Electronics Devices, pp. 11078-11079

Kim, Byung-Jin Hyundai Heavy Industries Co., LTD.
Kim, Hyunsung Hyundai Heavy Industries Co., LTD.
Kim, Joon Gyo Inha Univ.
Kim, Jiyoon Inha Univ.
Park, Jaehyun Inha Univ.

Emerging IT technologies, specially high performance micro-controllers enable an intelligent electronics device (IED) for a power-delievery system. Since range of applications can be developed with these intelligent devices, Human-Manchine Interface (HMI) should be very flexible for these diverse applications. This paper introudces our approaches to develop an embedded Human-Machine Interface in our intelligent Electronics Devices.

10:30-12:30 ThA01.45

Trajectory Planning for Flatness-Based Two-Degree-Of-Freedom Control of a Pumped Storage Power Station, pp. 11080-11085

Treuer, Michael Univ. Stuttgart
Weissbach, Tobias Univ. Stuttgart
Scheffknecht, Günter Univ. Stuttgart
Hagenmeyer, Veit BASF Aktiengesellschaft

A pumped storage plant is one of the fastest reacting types of power generating units within power systems. Typically, the desired value curves for the power output during set point changes are provided in form of non-smooth ramp shaped curves. These cannot be followed exactly by the plant process due to its physical limitations. Resulting oscillations of the water pressure with potentially high pressure peaks can cause severe damage to the plant. Therefore, the gradients of set point changes of the power output have to be carefully limited.

In order to improve the control performance, a flatness-based two-degree-of-freedom control concept is applied: smooth trajectories for set point changes of the generator output are provided, which take the plant dynamics into account. The matter of trajectory planning is thereby addressed in detail. The improved control performance is shown by simulations, also in comparison with the widespread conventional PID control concept.

10:30-12:30 ThA01.46

Design of Robust Power System Stabilizer Using Genetic Algorithm-Based Fixed-Structure H_; Loop Shaping Control, pp. 11086-11091

Ngamroo, Issarachai King Mongkut's Inst. of Tech. Ladkrabang
Goda, Tadahiro Kyushu Univ.
Ali nandar, Cuk Supriyadi KMITL
Kunakorn, Anantawat KMITL
Kaitwanidvilai, Somyot King Mongkut's Inst. of Tech. Ladkrabang
Hashiguchi, T Kyushu Univ.

This paper proposes a genetic algorithm (GA)-based fixed-structure H_; loop shaping technique to design a robust power system stabilizer (PSS). The fixed-structure of designed PSS is a 2nd-order leadlag compensator. In the design, system uncertainties are modeled by a normalized coprime factor. The performance and robust stability conditions of the designed system satisfying the H_; loop shaping are formulated as the objective function in the optimization problem. The GA is applied to solve an optimization problem and to achieve control parameters of PSS. The performance and robustness against system uncertainties of the designed PSS are investigated in the single-machine infinite bus system in comparison with a conventional PSS and a PSS designed by H_; loop shaping. Simulation results show that the robustness and damping effect of the proposed PSS are almost the same as those of the PSS with highorder controller designed by H_; loop shaping method.

10:30-12:30 ThA01.47

Preventing Refrigerated Foodstuffs in Supermarkets from Being Discarded on Hot Days by MPC, pp. 11092-11097

Cai, Junping Aalborg Univ.
Stoustrup, Jakob Aalborg Univ.
Jorgensen, John Bagterp Tech. Univ. of Denmark

This paper presents an optimization strategy for supermarket refrigeration systems. It deals with one special condition when the extremely high outdoor temperature causes the compressor to saturate, and work at its maximum capacity. In a traditional control, refrigerated foodstuffs inside display cabinets will suffer from a consequential higher temperature storage, which is detrimental to the food quality, and in worst cases they have to be discarded according to the regulation from authorities. This will cause a big economic loss to the shop owner. By utilizing the thermal mass of foodstuffs and their relative slow temperature change, Model Predictive Control (MPC), foreseeing this situation, it will use more compressor power to cool down the foodstuffs in advance, preventing the high temperature storage from happening, thus saving them from being discarded.

10:30-12:30 ThA01.48

Reducing the Energy Consumption of Space Heating in Buildings: Design of an Optimal Controller., pp. 11098-11105

Raffenel, Yoann Ec. Centrale de Lyon
Blanco, Eric AMPERE Lab.
Virgone, Joseph Univ. Lyon 1, IUTA
Neveux, Philippe Univ. d'Avignon et des Pays de Vaucluse
Thomas, Gerard Ec. Centrale de Lyon
Scorletti, Gerard Ec. Centrale de Lyon

The reduction of the energy consumption in buildings has become a priority in every developed country. Automatic control is one of the latest techniques introduced to this purpose. This paper describes the design of a new controller which controls the internal temperature of an individual dwelling by adjusting of the heating power. First, considering the intermittency the occupation, an optimal temperature trajectory in term of control cost has been computed. Second, introducing an augmented state representation, a state feedback law has been calculated. Third, since this law required an inaccessible state, a Kalman estimator has been introduced to estimate this state. Introducing a deconvolution problematic in its design, a “virtual feed forward” based on estimation has been introduced to balance the external disturbances. Fourth, in order to take into account the control saturation of the heating system, an anti-windup compensator has been introduced to the controller. Finally, the controller has been tested in simulation on an experimental building and the interest of the virtual feed forward has been illustrated.

10:30-12:30 ThA01.49

Power System Stabilization Using Swarm Tuned Fuzzy Controller, pp. 11106-11111

El-Metwally, K.A Cairo Univ.

This paper proposes a swarm optimized fuzzy logic based power system stabilizer (SFLPSS). The fuzzy logic stabilizer membership functions parameters, inputs and outputs gains and fuzzy rules are tuned and optimized using particle swarm optimization (PSO) technique. Optimization parameters were subject to realistic constraint. The optimization is done using a seventh order nonlinear model of a single synchronous machine connected to infinite bus bar. A Guided simulation technique using stability limits check is used to accelerate the PSO algorithm search for optimized parameters. Optimization results in reduction of fuzzy rules. Transient tests of the optimized controller performance showed better performance over conventional controllers.

10:30-12:30 ThA01.50

Fault-Tolerant MPC Control of PEM Fuel Cells, pp. 11112-11117

Puig, Vicenc Univ. Pol. de Catalunya
Feroldi, Diego Univ. Pol. de Catalunya

Serra,, Maria — Univ. Pol. de Catalunya
Quevedo, Joseba — Tech. Univ. of Catalonia
Riera, Jordi — Univ. Pol. de Catalunya

In this paper, fault-tolerant MPC control of PEM fuel cells is addressed. MPC is a suitable control methodology to control fuel cell systems because of their multivariable and complex behaviour. Additionally, MPC is one of the control methodologies that can introduce more easily fault-tolerance. However, the problem of including actuator fault-tolerance in the control loops of these systems has not already been addressed in the literature. This work is focused on the air feeding control. A new control structure that not only uses the compressor voltage as a control variable but also the air valve opening area at the cathode output is considered to improve the fault-tolerance of the air feeding subsystem. It is shown that using this additional control permits to introduce fault-tolerance against compressor faults at the same time that allows to improve control performance. Finally, the proposed approach is assessed on a known test bench PEM fuel cell through simulation.

10:30-12:30 — ThA01.51
Novel Causal Digraph Reasoning for Fault Diagnosis with Application on the Paper Machine Short Circulation Process, pp. 11118-11123
Cheng, Hui — Helsinki Univ. of Tech.
Nikus, Mats — Helsinki Univ. of Tech.
Jämsä-Jounela, Sirkka-Liisa — Helsinki Univ. of Tech.

This paper presents an enhanced dynamic causal digraph reasoning method for fault diagnosis and its application to the short circulation process of a paper machine. In order to improve the isolation capability of the original method, an inference mechanism between the arcs of the graph is proposed to locate process faults on the arcs. Application of the proposed method to the paper machine short circulation process is presented at the end of the paper. The results show that the proposed method is able to identify the responsible arcs when the system is affected by a process fault.

10:30-12:30 — ThA01.52
A Method to Improve Human Prognosis in Supervision of Complex Systems, pp. 11124-11129
Delepine, Olivier — Univ. of Valenciennes
Caulier, Patrice — Univ. of Valenciennes
Vanderhaegen, Frédéric — Univ. of Valenciennes

Human-machine supervision is a fundamental research and applicative axis to contribute to the dependability of complex systems. A recent and promising way to optimize means and performances of supervision is to provide human operators with prognosis activity support tools. Many methods are currently developed or adapted. This paper focuses on the fuzzy treatment and read-out of residuals. After their specification, their application for benchmark supervision provides experimental results which are analyzed in order to discuss on their real impact for human prognosis.

10:30-12:30 — ThA01.53
Control System Diagnosis Algorithm Optimization - the Combinatorial Entropy Approach, pp. 11130-11135
Borowczyk, Henryk — Air Force Inst. of Tech.

The paper presents combinatorial measures of the system condition uncertainty (diagnostic entropy) and the diagnostic symptoms information. The multi-valued diagnostic model has been assumed. Proposed measures can be used for the diagnostic model analysis and the diagnosis algorithm optimization. Optimization method exploits indispensable symptoms at every stage of the optimization process providing minimum number of symptoms in diagnosis algorithm.

10:30-12:30 — ThA01.54
Real-Time Implementation of Fault-Tolerant Control Using Model Predictive Control, pp. 11136-11141
Miksch, Tobias — Univ. of Heidelberg
Gambier, Adrian — Univ. of Heidelberg
Badreddin, Essam — Univ. of Heidelberg

Fault-tolerant control using model predictive control with online accommodation to recover from faults is investigated. A framework for this purpose is presented and problems that one encounters by changing the control law online like error-free tracking, feasibility and computational effort are addressed. In a real-time implementation, the model predictive controller is tested under actuator faults like saturation, freezing and total loss as well as under a structural fault.

10:30-12:30 — ThA01.55
Case-Based Detection of Operating Conditions in Complex Nonlinear Systems, pp. 11142-11147
Juuso, Esko Kalevi — Univ. of Oulu
Timo, Ahola — Outokumpu

The case-based reasoning (CBR) system was developed for the identification of different operating situations in paper machines. Because similar break sensitivities can result from a multitude of dissimilar cases, the case base system is based on a division into categories which correspond to different levels of break sensitivity. The system is based on the linguistic equations (LE) approach and basic fuzzy logic, and it combines expert knowledge and on-line measurements from the wet-end of the paper machine. Nonlinear interactions are handled with a special scaling functions and linear equations. Each equation provides a new fact with a degree of membership, and the resulting set of facts is used in the fuzzy reasoning of process cases and break categories. The LE models are essential in compacting the system since each equation corresponds to a rule set in the fuzzy set systems. The application operates as a case retrieval and reuse application, predicting web break sensitivity in paper machine. Similarity measures based on model errors in the scaled range represent the importance of the models in activating the cases. The break category is defined by the case with the highest degree of membership. Although, the case base is fairly small the results from the on-line tests were relatively good compared to real break sensitivity. The predicted break sensitivity is an indirect measurement, which provides an early indication of process changes. The list of variables in the active cases can be used to avoid harmful operating conditions.

10:30-12:30 — ThA01.56
Linear Dynamic Modeling of Spacecraft with Various Flexible Appendages, pp. 11148-11153
Tantawi, Khalid — SUPAERO
Alazard, Daniel — Univ. de Toulouse - ISAE
Cumer, Christelle — ONERA

We present here a method and some tools developed to build linear models of multi-body systems for space applications (typically satellites). The multi-body system is composed of a main body (hub) fitted with rigid and flexible appendages (solar panels, antennas, propellant tanks, ...etc). Each appendage can be connected to the hub by a cantilever joint or a pivot joint. More generally, our method can be applied to any open mechanical chain. In our approach, the rigid six degrees of freedom (d.o.f) (three translational and three rotational) are treated all together. That is very convenient to build linear models of complex multi-body systems. Then, the dynamics model used to design AOCS, i.e. the model between forces and torques (applied on the hub) and angular and linear position and velocity of the hub, can be derived very easily. This model can be interpreted using block diagram representation.

ThA02 — 304A
Faults and Estimation (Regular Session)
Chair: Kinnaert, Michel — Univ. Libre de Bruxelles
Co-Chair: Chakraborty, Debraj — Indian Inst. of Tech. Bombay

10:30-10:50 — ThA02.1
Fault Diagnosis in Nonlinear Systems Using Interconnected Sliding Mode Observers, pp. 11154-11159
Sharma, Rahul — The Univ. of Melbourne
Aldeen, Mohammad — The Univ. of Melbourne

This paper presents a new technique for fault diagnosis and estimation of unknown inputs in a class of nonlinear systems. The novelty of the approach is governed by the use of two interconnected sliding mode observers. The first of the two observers is used for fault diagnosis and the second is used for the reconstruction of unknown inputs. The two observers exchange their respective reconstructed signals online and in real time. Conditions for the convergence are derived. The design is such that the state trajectories do not leave the sliding manifold even in presence of unknown inputs and faults. This allows for faults and unknown inputs to be reconstructed based on information retrieved from the equivalent output error injection signals.

10:50-11:10 — ThA02.2

Actuator Fault Compensation Control for Nonlinear Systems, pp. 11160-11165

Zhang, Yingwei — Northeastern Univ.
Qin, S. Joe — Univ. of Southern California

The partial loss of actuator effectiveness is considered for the control of a class of nonlinear processes in the presence of a fault. Not only unmatched uncertainties, but also matched uncertainties are discussed in Lyapunov stability sense. The partial loss of actuator effectiveness is approximated by high order neural networks. Application of the proposed design indicates that the fault compensation control law is effective for a nonlinear fermentation system.

11:10-11:30 ThA02.3

Fault Detection for Non-Gaussian Stochastic Systems Via Augmented Lyapunov Functional Approach, pp. 11166-11171

Li, Tao — Southeast Univ.
Sun, Changyin — Southeast Univ.
Wei, Xinjiang — Southeast Univ. Yantai Normal Univ.

In this paper, a new fault detection (FD) scheme is studied for non-Gaussian stochastic dynamic systems using output probability density functions (PDFs). Different from the classical FD problems, the measured information is the PDFs of system output rather than its value, where the B-spline expansion technique is applied so that the considered FD problem is transformed into a nonlinear FD problem. In this context, feasible FD method is presented by combining linear matrix inequality (LMI) technique with augmented Lyapunov functional, which involves a tuning parameter and a slack variable. Furthermore, in order to improve the detection sensitivity performance, an optimal algorithm is applied to minimize the threshold by tuning the parameter. Simulation for a model in the paper-making process is given to demonstrate the efficiency of the proposed approach.

11:30-11:50 ThA02.4

Preserving System Performance During Feedback Failure, pp. 11172-11177

Chakraborty, Debraj — Indian Inst. of Tech. Bombay
Hammer, Jacob — Univ. of Florida

The problem of maintaining acceptable performance of a perturbed control system under conditions of feedback failure is considered. The objective is to maximize the time during which performance remains within desirable bounds without feedback, given that the parameters of the controlled system are within a specified neighborhood of their nominal values. It is shown that there is an optimal open-loop controller that achieves this objective. The performance of this controller can be approximated by a bang-bang controller.

11:50-12:10 ThA02.5

Estimation and Control for Systems with Nonlinearly Parameterized Perturbations, pp. 11178-11183

Grip, Hĺvard Fjćr — Norwegian Univ. of Science and Tech.
Johansen, Tor Arne — Norwegian Univ. of Science and Tech.
Imsland, Lars — SINTEF ICT

A class of systems influenced by nonlinearly parameterized perturbations is considered. An estimation scheme is developed whereby exponentially stable estimates of the unknown parameters can be obtained with an arbitrarily large region of attraction. The method applies to systems where the states are available for measurement, and perturbations with the property that an exponentially stable estimate of the unknown parameters can be obtained if the whole perturbation is known. Compensation for the perturbations in the system equations is considered for a class of systems which have uniformly globally bounded solutions and for which the origin is globally asymptotically stable when no perturbations are present. Examples with simulations are given in order to illustrate the results.

12:10-12:30 ThA02.6

On the State and Parameter Simultaneous Estimation Problem in Induction Motors, pp. 11184-11189

Ticlea, Alexandru — Pol. Univ. of Bucharest
Besancon, Gildas — ENSIEG-INPG

In the context of parameter estimation through state observers, we revisit the transformation of the induction motor model into a state-affine structure with respect to the unknown variables, then we compare in simulation the performances obtained through available adaptive and exponential forgetting factor observer designs.

ThA03 304B
Predictive Control (Regular Session)

Chair: Alamir, Mazen — Gipsa-Lab. (CNRS-Univ. of Grenoble)
Co-Chair: Mosca, Edoardo — Univ. of Florence

10:30-10:50 ThA03.1

Least Restrictive Move-Blocking Model Predictive Control, pp. 11190-11195

Gondhalekar, Ravi — Tokyo Inst. of Tech.
Imura, Jun-ichi — Tokyo Inst. of Tech.

The authors recently proposed an approach to enforce strong feasibility in move-blocking model predictive control problems. In this paper the approach is utilized to design strong model predictive control problems which generate least restrictive controllers. The domains of different move-blocking regimes are thus equal and the same as the non-move-blocking maximum. This allows comparison of different move-blocking regimes based on cost performance only, without considering domain size also. A numerical example and case study demonstrate that between input- and offset-move-blocking, the latter is generally superior.

10:50-11:10 ThA03.2

Predictive Control of Hybrid Systems: Stability Results for Sub-Optimal Solutions, pp. 11196-11201

Lazar, Mircea — Eindhoven Univ. of Tech.
Heemels, Maurice — Tech. Univ. Eindhoven

This article presents a novel model predictive control (MPC) scheme that achieves input-to-state stabilization of constrained discontinuous nonlinear and hybrid systems. Input-to-state stability (ISS) is guaranteed when an optimal solution of the MPC optimization problem is attained. Special attention is paid to the effect that sub-optimal solutions have on ISS of the closed-loop system. This issue is of interest as firstly, the infimum of MPC optimization problems does not have to be attained and secondly, numerical solvers usually provide only sub-optimal solutions. An explicit relation is established between the deviation of the predictive control law from the optimum (called the optimality margin) and the resulting deterioration of the ISS property of the closed-loop system (called the ISS margin).

11:10-11:30 ThA03.3

Model Predictive Control Using Hybrid Feedback, pp. 11202-11207

Gerard, Mathieu — Delft Univ. of Tech.
Verhaegen, Michel — Delft Univ. of Tech.

Traditional Model Predictive Controllers make use of computation expensive optimization methods. The challenge of this research is to take advantage of properties of MPC and use a hybrid gradient descent method to replace the on-line optimization by a simple set of differential equations. Continuous- and discrete-time controllers are presented. Promising results are provided for the control of linear systems with smooth convex constraints with different controller tunings. This technique, even if slightly suboptimal, has a clear interpretation, is efficient and is suitable for implementation on limited embedded microcontrollers.

11:30-11:50 ThA03.4

Predictive Control for Linear Systems with Delayed Input Subject to Constraints, pp. 11208-11213

Olaru, Sorin — Supelec
Niculescu, Silviu-Iulian — Lab. of Signals and Systems (L2S), UMR CNRS 8506,CNRS-SUPE

The paper deals with the moving horizon control of systems subject to input delays and affected by input and state and/or output constraints. The robustness of the control law with respect to the uncertainties introduced by the discretization is considered. The stability of the closed-loop system is guaranteed by forcing the state trajectories to attain a robust positively invariant terminal set on the prediction horizon. Illustrative examples complete the paper.

11:50-12:10 ThA03.5

Horizon-Switching Predictive Set-Point Tracking under Mixed Control Saturations and Persistent Disturbances, pp. 11214-11219

Mosca, Edoardo Univ. of Florence
Tesi, Pietro Univ. degli Studi di Firenze
Zhang, Jingxin Monash Univ.

This paper extends of the horizon-switching predictive control approach, so far restricted to positional input saturation and the pure regulation problem, to the case of set-point tracking. It is proved a basic feasibility property which makes it possible to extend this approach so as to achieve offset-free asymptotic tracking under joint positional and incremental input saturations and constant disturbances. It is also addressed the same problem in the presence of time-varying disturbances. In such a case it is proved that, whenever the system is subject only to incremental input saturations, the goal is achieved with the property of bounded-noise bounded-state l_;-stability.

12:10-12:30 ThA03.6

Computation and Bounding of Robust Invariant Sets for Uncertain Systems, pp. 11220-11225

Benlaoukli, Hichem Supélec
Olaru, Sorin Supelec
Boucher, Patrick Ec. Superieure d'Electricite

This paper deals with the computational issues encountered in the construction of invariant sets of uncertainty LTI systems, the presented results being useful in the more general framework of piecewise linear systems affected by parametric uncertainty. The main contribution is the efficient computation of upper and lower bounds of the maximal positively invariant (MPI) set. These turn to be meaningful approximations when iterative construction procedures are employed, especially if no finite-time algorithms exists to construct the exact MPI set. In order to decrease the computational complexity, the interval search procedures are used to avoid the treatment of the regions which do not meet the neighboring properties.

ThA04 308
Tracking Control (Regular Session)

Chair: Kim, H. Jin Seoul National Univ.
Co-Chair: Schmid, Robert The Univ. of Melbourne

10:30-10:50 ThA04.1

PI Tracking Control with Mixed H2 and H-Infinite Performance of Descriptor Time Delay System for Output PDFs Based on B-Spline Neural Networks, pp. 11226-11231

Sun, Hai qin Southeast Univ. Nanjing, P.R. China
Zhang, Kan_Jian Southeast Univ.
Guo, Lei UMIST

This paper presents a robust PI tracking control strategy with mixed H2 and H-infinite performance for general non-Gaussian systems based on the square root B-spline model for the probability density functions (PDFs).The main objective is to design a generalized proportional-integral (PI) control strategy such that the PDF can follow a target one with the enhanced robustness. Di_erent form the previous models, a descriptor time delay system model based on square root B-spline approximation is first established. To enhance the robust performance for the tracking problem, the mixed H2 and H-infinite performance is applied instead of the only H-infinite performance. The novel mixed H2 and H-infinite tracking problem is formulated as a optimization problem. Instead of the non-convex design algorithms, the improved linear-matrix-inequality (LMI) based convex algorithms are also proved for controller design. Furthermore, simulations on particle distribution control problems are given to demonstrate the efficiency of the proposed approach and encouraging results have obtained.

10:50-11:10 ThA04.2

Setpoint Servo Problem for Symmetric Affine Systems -Asymptotical Stabilizaton by PI Control, pp. 11232-11237

Shimizu, Kiyotaka Keio Univ.
Tamura, Kenichi Keio Univ.

This paper is concerned with control of nonholonomic systems. As is well known, symmetric affine system is unable to control with continuous time-invariant state feedback. In this paper we apply PI Control to a setpoint servo problem for the symmetric affine system. PI control possesses two adjustable parameters KP,KI , and in addition the so-called manual reset quantity m0. It is remarked that adjusting m0 is equivalent to adjusting an initial condition z0 of integrator zŮ; = e. By the PI control with the manual reset m0 appropriately chosen, not only controllable part of symmetric affine system is asymptotically stabilized but also uncontrollable part can be made to converge to the desired value. Applying the PI control with m0, we can control the symmetric affine system without transforming into the "chained form". The effectiveness of the method was confirmed by the simulation results for various plants.

11:10-11:30 ThA04.3

Implementation of Plug-In Type Repetitive Controller for Position-Base Periodic Control Systems, pp. 11238-11243

Hsu, Ge-Liang National Cheng Kung Univ.
Yao, Wu-Sung National Cheng Kung Univ.
Tsai, Mi-Ching National Cheng Kung Univ.

Position-based periodic motions have appeared in many industrial processes such as cam-followers. The period of the output motion driven by the cam varies in the time-domain but is fixed in the angular position-domain, which is called time-varying periodic motion. This paper presents a plug-in type repetitive control scheme for reducing tracking errors via position-based periodic reference signals and/or disturbances. Two kinds of control strategies, namely disturbance feed-forward and disturbance rejection control, are proposed to investigate control performance with time-varying periodic disturbances. The implementation technique utilized in this position-based repetitive controller is discussed in detail, and an anti-vibration control system with position-base load disturbances generated by a cam is realized. Experimental results are given to demonstrate that the repetitive control can effectively eliminate the steady-state errors within a few cycles caused by time-varying periodic disturbances. This study offers an alternative method for realizing a repetitive controller to track and/or reject periodic signals under variable periods.

11:30-11:50 ThA04.4

Real-Time Visual Predictive Controller for Image-Based Trajectory Tracking of a Mobile Robot, pp. 11244-11249

Allibert, Guillaume Pol.
Courtial, Estelle Pol. Univ. d'Orléans
Toure, Y. Univ. d'orléans- IUT de Bourges

This paper deals with the design of a real-time controller for trajectory tracking in the image plane. The Image-Based Visual Servoing (IBVS) task is addressed by a visual predictive approach. The trajectory tracking is formulated into a nonlinear optimization problem in the image plane. The unavoidable constraints in experiments are easily taken into account in the design of the predictive control law. The global model, combining the mobile robot and camera model, is used to predict the behavior of the process. The flatness property of this global model is proved in the general case, that is whatever the camera posture. The flat model permits to reduce the computational time by a factor 2. Experiments are performed on a non holonomic mobile robot with a deported perspective camera. Experimental results show the efficiency and the robustness of the real-time control approach. Visibility constraints are added to point out the capability of the control to avoid obstacles.

11:50-12:10 ThA04.5

An Effective Algorithm for Analytical Computation of Flat Outputs Over the Weyl Algebra, pp. 11250-11256

Morio, Vincent Univ. Bordeaux I
Cazaurang, Franck Univ. Bordeaux I
Zolghadri, Ali Univ. Bordeaux I

This paper presents a new and effective algorithm to compute a set of flat outputs for nonlinear implicit systems described in the differential geometric framework of jets of infinite order. The proposed methodology is based on the necessary and sufficient conditions for differential flatness introduced in L´evine [2006]. A procedure is set up to manage the degrees of freedom involved by the polynomial matrix approach. First, a reduced-order basis of the ideal of differential forms generated by the differentials of all possible Lie-B¨acklund isomorphisms is obtained by computing reduced order bases of the left nullspace of Ore polynomial matrices and the weak Popov form over a Weyl algebra. Then, the generalized Cartan moving frame, including additional structural constraints, is used in order to characterize the strong closedness of the latter ideal.

12:10-12:30 ThA04.6

Nonovershooting Linear Multivariable State Feedback Tracking Controllers, pp. 11257-11262

Schmid, Robert — The Univ. of Melbourne
Ntogramatzidis, Lorenzo — The Univ. of Melbourne

We consider the use of linear multivariable feedback control to achieve a nonovershooting step response. A method is given for designing an LTI state feedback controller to asymptotically track a constant step reference with no overshoot and arbitrarily small rise time. Results are given for both minimum phase and nonminimum phase multivariable LTI systems.

ThA05 307
Adaptive Control I (Regular Session)

Chair: Tomei, Patrizio — Univ. of Roma Tor Vergata
Co-Chair: Costa, Ramon R. — COPPE - Federal Univ. of Rio de Janeiro

10:30-10:50 ThA05.1
Functional Adaptive Control for Multi-Input Multi-Output Systems, pp. 11263-11268

Kral, Ladislav — Univ. of West Bohemia in Pilsen
Simandl, Miroslav — Univ. of West Bohemia

A functional adaptive control for nonlinear stochastic systems with Multi-Input Multi-Output is suggested. The systems are modelled using a multilayer perceptron networks. Parameters of the model are estimated by the Gaussian sum method which allows to determine conditional probability density functions of the network weights. Control design is based on bicriterial dual approach that use two separate criterions to introduce one of opposing aspects between estimation and control; caution and probing. The proposed approach is compared with two adaptive non-dual controllers. The quality of the proposed functional adaptive controller is illustrated in a numerical example.

10:50-11:10 ThA05.2
Intelligent Adaptive Dynamic Matrix Control, pp. 11269-11274

Posada Aguilar, José David — Univ. del Norte
Sanjuan, Marco — Univ. del Norte

This paper presents an approach to adapt the suppression and scaling factor from a single input single output (SISO) dynamic matrix controller (DMC) thought a multiobjective optimization algorithm. To optimize, a nonlinear neural network (NN) process model is used, combined with a multiobjective evolutionary algorithm called SPEA II (Strength Pareto Evolutionary Algorithm) to find better controller parameters for the plant each sample time. Also every sample time, a decision over the resultant pareto front from the multiobjective optimization process are taken using a simple decision approach.

11:10-11:30 ThA05.3
Improving Transient Behavior of MIMO Adaptive Systems, pp. 11275-11280

Pinto, Marcos Ferreira Duarte — Federal Univ. of Rio de Janeiro
Costa, Ramon R. — COPPE - Federal Univ. of Rio de Janeiro

This paper presents a model-reference adaptive control algorithm with improved transient behavior for MIMO uncertain plants with relative degree one. The algorithm employs the control parametrization based on the SDU factorization of the high frequency gain matrix and introduces a lead filter in the adaptive law. Using the singular perturbation method, it is shown that for a sufficiently high adaptation gain and a sufficiently small time constant of the filter, the output error decreases exponentially. Simulations illustrate the transient improvement attained with the algorithm.

11:30-11:50 ThA05.4
Output Feedback Strict Passivity of Discrete-Time Nonlinear Systems and Adaptive Control System Design, pp. 11281-11286

Mizumoto, Ikuro — Kumamoto Univ.
Ohdaira, Satoshi — Kumamoto Univ.
Iwai, Zenta — Kumamoto Univ.

In this paper, a necessary and sufficient condition for a discrete-time nonlinear system to be strictly passive is derived and OFSP (Output Feedback Strictly Passive) conditions will be established. Based on the obtained OFSP conditions, an adaptive output feedback controller design method which can solve causality problems will be proposed for a discrete-time nonlinear system.

11:50-12:10 ThA05.5
Self-Tuning Type-2 PID Control System and Its Application, pp. 11287-11292

Sato, Takao — Univ. of Hyogo
Kameoka, Koichi — Univ. of Hyogo

This study proposes an adaptive control method of a weigh feeder. A weigh feeder dispenses material into a process at a precise rate, and it has been employed in industries, e.g., process control, cement manufactur ing plants, food industry equipment, and so on. To introduce advanced control into industries, self-tuning controllers are designed for controlling a weigh feeder. Three difference controllers are designed; one degree-of-freedom (1DOF) PID, 1DOF PD, and two degree-of-freedom (2DOF) PD controllers, and these control methods are compared through experimental results. Because discharged mass is measured by employing loss-in-weight method, a reference input followed by a plant output is ramp-type, and a type-2 control system has to be designed. Since the controlled object includes an integrator, a type-2 control system can be obtained by using 1DOF PID controller. In design of 2DOF PD control, a pre-compensator is designed to eliminate steady-state velocity error. Further, to be compared with 1DOF PID and 2DOF PD control, a 1DOF PD controller is designed.In this paper, PID and PD controllers are designed on the basis of generalized minimum variance control (GMVC) to obtain useful control methods adopted in industries. In design of the proposed control methods, GMVC can be replaced precisely with a simple PID or PD controller, and advanced control performance can be obtained. Experimental results are shown and compared, and the effectiveness of the proposed design method is shown.

12:10-12:30 ThA05.6
Adaptive Regulator for Uncertain Linear Minimum Phase Systems with Unknown Undermodeled Exosystems, pp. 11293-11298

Marino, Riccardo — Univ. di Roma Tor Vergata
Tomei, Patrizio — Univ. of Roma Tor Vergata

The design of regulators is addressed for uncertain minimum phase linear systems with known bounds, known upper bound on system order, known relative degree, known high frequency gain sign and for exosystems with unknown order and unknown frequencies with known upper bound. A new adaptive output error feedback control algorithm is proposed which guarantees exponential convergence of the output error into a region which decreases with the order of the unmodeled exosystem dynamics. Exponential regulation is obtained when the regulator exactly models all of the exosystem excited frequencies, while asymptotic regulation is achieved when the regulator overmodels the actual exosystem.

ThA06 310A
Disturbance Rejection and Control (Regular Session)

Chair: Guo, Bao-Zhu — The Chinese Acad. of Sciences
Co-Chair: Dion, Jean-Michel — Univ. de Grenoble

10:30-10:50 ThA06.1
Sensor Classification for the Disturbance Rejection by Measurement Feedback Problem, pp. 11299-11303

Dion, Jean-Michel — Univ. de Grenoble
Commault, Christian. — GIPSA-Lab.
Trinh, Do Hieu — Gipsa Lab.

In this paper, we consider dynamical models and we study the preservation of solvability for the Disturbance Rejection by Measurement Feedback (DRMF) problem under sensor failure in a structural framework. We consider a linear structured system and we wonder if the DRMF problem remains solvable in case of some sensor failure. More precisely we will characterize among the sensors some of those which are critical emph{i.e.} which failure leads to solvability loss, and some of those which are useless for solvability purpose.

10:50-11:10 ThA06.2
Disturbance Decoupling with Preview for Two-Dimensional Systems, pp. 11304-11309

Ntogramatzidis, Lorenzo — The Univ. of Melbourne
Cantoni, Michael — Univ. of Melbourne
Yang, Ran — Sun Yat-Sen Univ.

In this paper a solution is given to the exact disturbance decoupling problem for two-dimensional (2-D) systems, whereby the control action consists of a static local state feedback and a preview function of the signal to be rejected. Importantly, stability of the closed loop is taken into account.

11:10-11:30 ThA06.3

Disturbance Compensation on Uncertain Systems: Feedforward Control Design for Stable Systems, pp. 11310-11315

Vilanova, Ramon	Univ. Autňnoma de Barcelona
Arrieta, Orlando	Univ. Autonoma de Barcelona
Ibeas, Asier	Univ. Autónoma de Barcelona
Balaguer, Pedro	Univ. Autonoma de Barcelona
Pedret, Carles	Univ. Autňnoma de Barcelona

This paper considers the design of feedforward controllers when model uncertainty is present. The main contribution is an alternative approach to the generation of the feedorward control action on the basis of the Internal Model Control formulation. This new structure allows for completely independent tuning of the feedback and feedforward controllers and provides an explicit expression for the achieved nominal performance degradation when the uncertain case is considered. The formulation of the feedforward controller as an Internal Model Controller allows existing design approaches to be applied and uncertainty effect taken into account by means of the corresponding analysis equation.

11:30-11:50 ThA06.4

Almost Self-Bounded Controlled Invariant Subspaces and Almost Disturbance Decoupling, pp. 11316-11321

Malabre, Michel	UMR CNRS 6597
Zou, Runmin	Ec. Centrale de Nantes,France

The objective of this contribution is to characterize the so-called finite fixed poles of the Almost Disturbance Decoupling Problem by state feedback (ADDP)0 . The most important step towards this result relies on the extension to almost invariant subspaces of the key notion of self-boundedness, as initially introduced by Basile and Marro for perfect controlled-invariants, namely, we introduce the Almost Self-Bounded Controlled-Invariant subspaces. We recall the pole placement flexibilities and constraints that both exist when using a particular almost invariant subspace as a support for the construction of specific (including high gain) feedbacks, and we show, when (ADDP)0 is solvable, what is the “best” almost invariant subspace to choose, in order to achieve (ADDP)0 and simultaneously place the “largest possible” set of finite poles for the closed loop solution. We finally characterize the set of fixed finite poles for (ADDP)0 , in terms of some finite zero structures.

11:50-12:10 ThA06.5

Stability Analysis for an Euler-Bernoulli Beam under Local Internal Control and Boundary Observation, pp. 11322-11327

Wang, Jun-Min	Beijing Inst. of Tech.
Guo, Bao-Zhu	Acad. of Math. and Syst. Sciences

In this paper, an Euler-Bernoulli beam system under the local internal distributed control and a boundary point observation is studied. We design an infinite-dimensional observer for the open-loop system. The closed loop-system that is non-dissipative is obtained by estimated state feedback. By a detailed spectral analysis, it is shown that there is a set of generalized eigenfunctions, which forms a Riesz basis for the state space. As consequences, both the spectrum-determined growth condition and exponential stability are concluded.

12:10-12:30 ThA06.6

Stabilization of Multidimensional Wave Equations under Non-Collocated Controls and Observations, pp. 11328-11333

Shao, Zhi-Chao	Univ. of the Witwatersrand
Guo, Bao-Zhu	Acad. of Math. and Syst. Sciences
Yao, Cui-Zhen	Beijing Inst. of Tech.

The objective of this paper is to deal with the stabilization of multi-dimensional wave equations under non-collocated control and observation with the following cases: a) internal distributed control and boundary observation; b) boundary control and internal distributed observation; c) locally internal distributed control and boundary observation.

ThA07 310B

Control Problems for Dynamical Systems under Conflict and Uncertainty (Invited Session)

Chair: Tarasyev, Alexander	Inst. of Mathematics and Mechanics of Ural Branch ofRAS
Co-Chair: Glad, Torkel	Linkoping Univ.
Organizer: Ushakov, Vladimir	Inst. of Mathematics and Mechanics of Ural Branch ofthe Russian
Organizer: Subbotina, Nina	Inst. of Mathematics and Mechanics of UralBranchoftheRussian Aca

10:30-10:50 ThA07.1

Positional Procedures for Solving Dynamical Optimization Problems of Prescribed Duration (I), pp. 11334-11339

Subbotina, Nina	Inst. of Mathematics and Mechanics of UralBranchoftheRussian
Tarasyev, Alexander	Inst. of Mathematics and Mechanics of Ural Branch ofRAS
Ushakov, Vladimir	Inst. of Mathematics and Mechanics of Ural Branch ofthe Russ

Optimal control problems under conflict or uncertainties are considered on a finite time interval. Resolving dynamical procedures are suggested. They are based either on constructions of stable bridges produced with the help of step-by-step programmed absorptions or on applications of the backward dynamic programming method. Results of simulations illustrating the suggested methods are exposed.

10:50-11:10 ThA07.2

Rational Approximation of Nonlinear Optimal Control Problems, pp. 11340-11345

Sjöberg, Johan	Linköpings Univ.
Glad, Torkel	Linkoping Univ.

In this paper rational approximation of solutions to nonlinear optimal control problems is considered. A computational procedure is presented that makes it possible to compute a rational function that approximates the true optimal cost function. It is shown that the rational function has the same series expansion around the origin as the true solution. Finally, two examples are given that compares the new method with the power series approximation, which is a rather well-known method to find approximative solutions.

11:10-11:30 ThA07.3

Nonlinear H_; Robust Control for Six DOF Equations of Motion of Rigid Body with Mass Uncertainty, pp. 11346-11351

Kung, Chien-Chun	National Defense Univ.

This paper derives the analytic solution of nonlinear H_; robust controller for a system with mass and moments of inertia uncertainties and investigates the implementation using control surface inverse algorithm. A special Lyapunov function with mass and moments of inertia uncertainties is introduced to solve the associated Hamilton-Jacobi partial differential inequality (HJPDI). The HJPDI is solved analytically, resulting in a nonlinear H_; robust controller with simple proportional feedback structure. The control surface inverse algorithm (CSIA) is employed to determine the angles of control surface deflection from the nonlinear H_; control command. The ranges that guarantee stability and robustness of nonlinear H_; flight control system implemented by vehicle actuators are derived. Numerical simulation is carried out and the results show that the responses still show good convergence for large initial perturbation.

11:30-11:50 ThA07.4

Numerical Solution of the Isaacs Equation for Differential Games with State Constraints (I), pp. 11352-11356

Falcone, Maurizio	SAPIENZA - Univ. di Roma
Cristiani, Emiliano	ENSTA

We present a numerical approximation for differential games with state constraints. The scheme is based on dynamic programming and on the discretization of the Isaacs equation which describes the value function of the game. Once the approximate value function has been computed we can construct a numerical synthesis of feedback controls in order to reconstruct the corresponding optimal trajectories. Some numerical tests are presented and discussed.

11:50-12:10 ThA07.5

On Dynamical Optimization of Conflict Hereditary Systems (I), pp. 11357-11362

Lukoyanov, Nikolay	Inst. of Mathematics and Mechanics of the Ural Branch of the

For dynamical systems with aftereffect, the problem of control under disturbances is considered within the game-theoretic approach of

N.N. Krasovskii and A.I. Subbotin. The problem is posed in the class of strategies with memory (functions of the motion history). The value of optimal guaranteed result (OGR) depends here on an initial history. An appropriate functional equation of the Hamilton-Jacobi-Bellman-Isaacs (HJBI) type with co-invariant (ci-) derivatives is presented. It is shown that if the functional of OGR is ci-smooth then it is the classical solution of this equation, and the optimal strategy can be constructed by aiming in the direction of its ci-gradient. In the nonsmooth case, a generalization of the presented HJBI equation is obtained by using an appropriate directional derivatives. Here, for constructing the optimal control strategy, the method of aiming in the direction of ci-gradients of auxiliary Lyapunov type functionals is elaborated.

12:10-12:30 ThA07.6

On the Characterization of the Discrete Mode Uncertainty in Hybrid State Estimation, pp. 11363-11368

Pina, Luís — Inst. Superior Técnico, Tech. Univ. of Lisbon
Botto, Miguel Ayala — Tech. Univ. of Lisbon

This paper addresses the problem of state estimation for hybrid systems, with special emphasis on the uncertainty associated with the discrete mode estimates. The nature of hybrid systems, which are composed by both discrete modes and continuous states, requires a specific description of the uncertainty associated with the computed estimates. The estimation uncertainty is shown to depend both on the estimation algorithm and on the actual trajectory followed by the system. A new definition of observability for the discrete mode of an hybrid system is proposed determining the best accuracy obtainable when estimating the discrete mode. A simple numerical example with a PWA system clarifies the presented concepts.

ThA08 310C

Robust Linear Matrix Inequalities (Regular Session)

Chair: Ebihara, Yoshio — Kyoto Univ.
Co-Chair: Shcherbakov, P.S. — Moscow Inst. of Control Sciences

10:30-10:50 ThA08.1

Semidefinite Programs with Interval Uncertainty: Reduced Vertex Results, pp. 11369-11374

Calafiore, Giuseppe — Pol. di Torino
Dabbene, Fabrizio — Pol. di Torino

In this paper, we derive a reduced vertex result for robust solution of uncertain semidefinite optimization problems subject to interval uncertainty. If the number of decision variables is m and the size of the coefficient matrices in the linear matrix inequality constraints is n times n, a direct vertex approach would require satisfaction of 2^{n(m+1)(n+1)/2} vertex constraints: a huge number, even for small values of n and m. The conditionsobtained here are instead based on the introduction of m slack variables and a subset of vertex coefficient matrices of cardinality 2^{n-1}, thus reducing the problem to a practically manageable size, at least for small n. A similar size reduction is also obtained for a class of problems with affinely dependent interval uncertainty.

10:50-11:10 ThA08.2

Robust Stability of Nonlinear Systems, pp. 11375-11378

Schwenk, Sebastian — Univ. of Wuppertal
Tibken, Bernd — Univ. of Wuppertal

In recent years the main focus of research in the area of robust stability of systems was on linear systems. In this paper the question of robust stability for nonlinear systems is adressed. We are mainly interested in global asymptotic stability and the main tools to solve these problems are methods based on Lyapunov functions. Using an appropriate Lyapunov function and an exact linearization of the system we are able to derive a sufficient condition for global asymptotic stability of a nonlinear system. This sufficient condition is known in the literature as robust linear matrix inequality. The main contribution of this paper is a new relaxation for robust linear matrix inequalities which avoids vertexization and leads to a computationally efficient procedure.

11:10-11:30 ThA08.3

Extracting Worst Case Perturbations for Robustness Analysis of Parameter-Dependent LTI Systems, pp. 11379-11384

Onishi, Yusuke — Kyoto Univ.
Ebihara, Yoshio — Kyoto Univ.
Hagiwara, Tomomichi — Kyoto Univ.

In this paper, we deal with robust performance analysis problems of LTI systems depending on uncertain parameters. By following existing scaling-based approaches, we firstly derive computationally tractable parameter-independent LMI conditions to assess the robust performance, which are conservative in general. What makes the present approach novel is to take the dual of those LMIs so that we can conclude the exactness of the analysis results. More precisely, we clarify that if the computed dual solution satisfies a certain rank condition, then we can ensure that the robust performance is never attained. In particular, we can extract the worst case perturbation that violates the underlying performance. Thus we provide viable tests for the exactness verification of LMI-based robust performance analysis.

11:30-11:50 ThA08.4

Extensions of Petersen's Lemma on Matrix Uncertainty, pp. 11385-11390

Shcherbakov, P.S. — Moscow Inst. of Control Sciences
Topunov, Michael — Inst. for Control Science

Proposed are generalizations and refinements of a well-known result on robust matrix sign-definiteness, which is extensively exploited in quadratic stability, design of robust quadratically stabilizing controllers, robust LQR-problem, etc. The main emphasis is put on formulating the results in terms of linear matrix inequalities.

11:50-12:10 ThA08.5

Robust Stability/Performance Analysis for Polytopic Systems Via Multiple Slack Variable Approach, pp. 11391-11396

Sato, Masayuki — Japan Aerospace Exploration Agency

This paper investigates robust stability, H_2 performance, and H_{infty} performance analysis for polytopic systems, i.e. Linear Time-Invariant Parameter-Dependent (LTIPD) systems in which the parameters lie in the unit simplex. Our results are derived via multiple ``slack variable'' approach, which has previously been proposed for the non-negativity check of polynomial functions, using Polynomially Parameter-Dependent Lyapunov Functions (PPDLFs). Our derived conditions are only sufficient conditions for our addressed problems; however, they encompass existing methods via single slack variable approach. Numerical examples are included to demonstrate the effectiveness of our methods.

12:10-12:30 ThA08.6

A Descriptor System Approach to Robust Control for Polytopic Systems with Time Delay and Its Application to Flight Control, pp. 11397-11402

Shen, Chao — Northeastern Univ.
Jing, Yuanwei — Northeastern Univ.
Wang, Qingli — Shenyang Inst. of Engineering
Ban, Ying — Northeastern Univ.

This paper investigates the problem of stability analysis for a polytopic system with time-varying delay via parameter-dependent Lyapunov functions. By a relaxation approach with slack matrices and a descriptor model transformation, a new robust delay-dependent stability criterion is expressed as a set of linear matrix inequalities (LMIs) with less computational burden. This criterion combined with fault tolerant techniques can be employed for robust reliable controller synthesis for an aircraft dynamic system with multiple operating points. The resulting flight control system remains stable when actuator faults occur. The simulation results illustrate the effectiveness of the proposed approach.

ThA09 311C

Grey Box System Identification (Regular Session)

Chair: Bittanti, Sergio — Pol. di Milano
Co-Chair: Bobtsov, Alexey — Saint-PetersburgStateUniversityofInformationTechnologiesMechanics andOptics

10:30-10:50 ThA09.1

Frequency Identification of Biased Harmonic Disturbance, pp. 11403-11408

Bobtsov, Alexey — Saint-PetersburgStateUniversityofInformationTechnologiesMechani
Nikolaev, Nikolay — Saint-Petersburg State Univ. of InformationTechnologies Me
Slita, Olga — Baltic State Tech. Univ.

The paper is dedicated to problem of unknown frequency identification of an unmeasured biased harmonic disturbance y(t) = Ă;_o +Ă;*sin(w*t+¦;) affecting a nonlinear system. Unlike known analogues, this approach allows to regulate time of estimation of unknown frequency w.

10:50-11:10 ThA09.2

Estimation of White-Box Model Parameters Via Artificial Data Generation: A Two-Stage Approach, pp. 11409-11414

Garatti, Simone — Pol. di Milano
Bittanti, Sergio — Pol. di Milano

A main problem encountered in control engineering is the estimation of unknown parameters appearing in the plant equations. In this paper, a new off-line method to perform such estimation is proposed. The method is based on the use of the plant simulator and on the generation of artificial data from which the relationship between the unknown parameter vector and available measurements is estimated. A simple example is used to illustrate how effective the method is in comparison to those methods based on the Kalman filtering techniques (Extended Kalman Filter and Unscented Kalman filter).

11:10-11:30 ThA09.3

Grey Box Modelling – Branches and Experiences, pp. 11415-11420

Sohlberg, Björn — Dalarna Univ.
Jacobsen, Elling — Automatic Control

This paper deals with methods and experiences of incorporating a priori knowledge into mathematical models of industrial processes and systems. Grey box modelling has been developed in several directions and can be grouped into branches depending on the way a priori knowledge is handled. In this paper we divide grey box modelling into the following branches; constrained black box identification, semi-physical modelling, mechanistic modelling, hybrid modelling and distributed parameter modelling. Experiences from case studies demonstrate the different branches of grey box modelling procedures. In the applications, the grey box models have been used for model based control, soft sensors, process supervision and failure detection. Further, distributed parameter modelling presents a specific challenge in that it is difficult to distinguish model reduction errors from model-data discrepancies. By estimating the model reduction error and forming hypothesis tests based on the estimate, the problem can be dealt with effectively.

11:30-11:50 ThA09.4

Determining Identifiable Parameterizations for Large-Scale Physical Models in Reservoir Engineering, pp. 11421-11426

Van Doren, Jorn F.M. — Delft Univ. of Tech.
Van den Hof, Paul M.J. — Delft Univ. of Tech.
Jansen, Jan Dirk — Delft Univ. of Tech.
Bosgra, Okko H. — Eindhoven Univ. of Tech.

In this paper identifiable parameterizations are determined for models of flow in porous media as applied in the field of petroleum reservoir engineering. Starting from a large-scale, physics-based model parameterization with an extensive parameter space, the best identifiable reduced dimensional parameterization is constructed. This is achieved through the development of an analytical expression for the (finite-time) information matrix of the problem. It is shown that the information matrix can be expressed in terms of controllability and observability properties of the model and the sensitivity of the state space matrices w.r.t. the parameter vector. A reduced dimensional subspace is then obtained after a singular value decomposition of the information matrix, leading to the use of basis functions (spatial patterns) in the original parameter space. The approach is applied to two reservoir models: a siso model with 49 parameters and a mimo model with 441 parameters.

11:50-12:10 ThA09.5

A Novel Hybrid Neural Network for Modeling Rare-Earth Extraction Process, pp. 11427-11432

Jia, Wenjun — Northeastern Univ.
Chai, Tianyou — Northeastern Univ.
Yu, Wen — CINVESTAV-IPN

Although neural networks are universal approximators, they are black-box models and it is difficult to obtain a suitable neural structure for a special unknown nonlinear system. Since many physical systems can be modeled by mechanistic models, we use these information to modify the normal neural identifiers and propose a novel neural modeling approach in this paper. This model includes a linear model which is linearized from the mechanistic model and a multilayer neural network. By Lyapunov stability approach, we prove that this hybrid neuro is stable in present of parameter and structure uncertainties. Then we apply these theory results on rare-earth extraction process. The results of application show that this new method can be used as soft-sensor of complex nonlinear systems.

12:10-12:30 ThA09.6

Multirate Data Assimilation in a Cultivation Process, pp. 11433-11438

Barrero Mendoza, Oscar — Univ. de Ibague
Petersen, Jorgen — Novo Nordisk A/S
Jřrgensen, Sten Bay — Tech. Univ. of Denmark

Infrequent and delayed output measurements are a commonly found in industrial processes.Hence, multirate estimation has gained some attention from researchers in the past decades to provide solutions to receiving data with widely differing sampling intervals. In this paper we present a discrete-time multirate estimator which combines ideas from Data Assimilation and the Extended Kalman filter. The performance of the estimator is demonstrated through a cultivation process study.

ThA10 311B

Excitation and Experiment Design (Regular Session)

Chair: Hjalmarsson, HĺKan — KTH
Co-Chair: Bombois, Xavier — Delft Univ. of Tech.

10:30-10:50 ThA10.1

Persistency of Excitation in Subspace Predictive Control, pp. 11439-11444

Hallouzi, Redouane — Delft Univ. of Tech.
Verhaegen, Michel — Delft Univ. of Tech.

This paper presents a method that ensures persistency of excitation for subspace predictive control. This control method is characterized by the combination of a predictive control law with a subspace predictor. The subspace predictor is continuously being adapted to the controlled system by using input-output data from this system. For this purpose the input-output data should be persistently exciting. In this paper a method is proposed to ensure persistency of excitation by adding a term to the cost function used by the predictive control law. This term is designed such that only the least excited directions of the input space are additionally excited. An advantage of the method is that the optimization problem that needs to be solved for the predictive controller can still be solved by using quadratic programming. The proposed excitation method is evaluated in simulation on a detailed nonlinear model of a transport aircraft. The simulation results clearly show the usefulness of the proposed method.

10:50-11:10 ThA10.2

Finite-Time Experiment Design with Multisines, pp. 11445-11450

Bombois, Xavier — Delft Univ. of Tech.
Barenthin, Märta — KTH
Van den Hof, Paul M.J. — Delft Univ. of Tech.

When the number of data used for an identification experiment is small, the data contain transient effects and these effects contribute to the accuracy of the identified model. Consequently, when designing the optimal input signal for an identification experiment in the case of small data set, these transient effects have to be taken into account. In this paper, we present a methodology for optimal experiment design which, unlike other approaches such as the asymptotic approach, takes explicitly the transient effects into account. This paper is restricted to model structures that are linear in the parameter and to multisine input signals.

11:10-11:30 ThA10.3

The Cost of Complexity in Identification of FIR Systems, pp. 11451-11456

Rojas, Cristian — The Univ. of Newcastle
Barenthin, Märta — KTH
Welsh, James — Univ. of Newcastle
Hjalmarsson, HĺKan — KTH

In this paper we investigate the minimum amount of input power required to estimate a given linear system with a prescribed degree of accuracy, as a function of the model complexity. This quantity is defined to be the ‘cost of complexity’. The degree of accuracy considered is the maximum variance of the discrete-time transfer function estimator over a frequency range [_;É;B, É;B]. It is commonly believed that the cost increases as the model complexity increases. The objective of this paper is to quantify this dependence. In particular, we establish several properties of the cost of complexity. We find, for example, a lower bound for the cost asymptotic in the model order. For simplicity, we consider only systems described by FIR models and assume that there is no undermodelling.

11:30-11:50 ThA10.4

Optimal Input Design for On-Line Identification: A Coupled Observer-MPC Approach, pp. 11457-11462

Flila, Saida	Univ. Lyon1
Dufour, Pascal	Univ. Lyon 1
Hammouri, Hassan	Univ. Claude Bernard

This paper presents a parametric sensitivity based controller for on line optimal model parameter identification using constrained closed loop control tools and an observer. In optimal input design problem, analytical solution exists for few particular cases based on a relatively simple model. The approach proposed here may be used for a process based on a continuous model in the time domain, with two assumptions on the observability and the general structure of the model. The new proposed approach is to solve a model predictive control problem coupled with an on line process parameter estimation at each time using an observer. A dynamic parametric sensitivity model (derived from the process model) is also used on line to get the parametric sensitivity that has to be optimized. Both optimal input and estimated model parameter are therefore obtained on line. The case study presented here is a powder coating curing process where the main thermal parameter to identify influences the powder curing. First simulation results show here the efficiency of the approach in the control software (MPC@CB) developed under Matlab.

11:50-12:10 ThA10.5

Optimal Input Design for Model Discrimination Based on Kullback Divergence, pp. 11463-11467

Uosaki, Katsuji	Fukui Univ. of Tech.
Hatanaka, Toshiharu	Osaka Univ.

The optimal input design problem has been discussed for efficient order determination of autoregressive models under the input power constraint. By solving a mathematical programming problem, auto-caovariance sequence of the optimal input is derived, which maximizes the time-average of the Kullback divergence to make difference of the models bigger without making much effect on the original system behavior. The proposed approach is based on the sequential comparison of the AIC, and it can be applied to find the structure of general linear time-invariant discrete-time systems.

12:10-12:30 ThA10.6

State and Input Observability for Structured Bilinear Systems: A Graph-Theoretic Approach, pp. 11468-11473

Boukhobza, Taha	Univ. Henri Poincaré Nancy 1
Hamelin, Hamelin	Nancy Univ.

This paper deals with the state and input observability analysis for structured bilinear systems with unknown inputs. More precisely, we provide two groups of conditions, the first ones are necessary and the second ones are sufficient, to check whether or not a structured bilinear system is generically state and input observable. These conditions, which are far to be trivial, are expressed in quite simple graphic-terms. Moreover,the proposed method is assumes only the knowledge of the system's structure andall the given conditions are easy to check because they deal with finding paths in a digraph. This makes the suggested approach particularly well suited to study large scale systems or systems with unknown parameters, as it may be the case during a conception stage.

ThA11 311A

Linear Parametrically Varying (LPV) Methodologies (Regular Session)

Chair: Park, PooGyeon	Pohang Univ. of Sci. & Tech.
Co-Chair: Zenger, Kai	Helsinki Univ. of Tech.

10:30-10:50 ThA11.1

Frequency Domain Identification of Linear, Deterministically Time-Varying Systems, pp. 11474-11479

Lataire, John	Vrije Univ. Brussel
Pintelon, Rik	Vrije Univ. Brussel

This paper proposes an extension of the framework of linear time invariant system identification to linear slowly time-varying system identification. The class of systems considered is described by ordinary differential equations with coefficients varying piecewise polynomially with time. The estimation is performed in the frequency domain using multisine excitation signals within an errors-in-variables framework. It is also discussed how multisine excitations provide estimates of, on the one hand, the speed of variation of the system and, on the other hand, an estimation of a non-parametric noise model.

10:50-11:10 ThA11.2

Linear Parameter Varying Control for Sampled-Data Multi-Rate Systems, pp. 11480-11485

Antunes, Duarte	Inst. Superior Tecnico, Inst. forSystemsandRobotics
Silvestre, Carlos	Inst. Superior Tecnico
Cunha, Rita	Inst. Superior Técnico, Inst. for Systems and

A new methodology for the design and implementation of linear parameter varying (LVP) controllers for multi-rate sampled-data systems is presented and its stability properties are analyzed. A controller structure is first proposed for the regulation of multi-rate systems with more measured outputs than inputs. This structure is specially suited for a gain-scheduling implementation that verifies an important property known as the linearization property. The proposed solution guarantees local stability of the feedback interconnection of the nonlinear multi-rate system and the LPV controller about individual equilibria, and ultimate boundedness of a conveniently defined closed-loop error in response to slowly varying exogenous inputs. An example is presented that illustrates the applicability of the proposed solution.

11:10-11:30 ThA11.3

Representations with Constant System Matrices of Linear Time-Periodic Dynamical Systems, pp. 11486-11490

Zenger, Kai	Helsinki Univ. of Tech.
Ylinen, Raimo	Helsinki Univ. of Tech.

In the paper it is investigated, under which conditions a time variable state transformation can be used to change a periodic autonomous system realization into a form with constant real coefficients. Conditions for the transformation to be periodic are further considered, and it is shown that the necessary and sufficient condition to meet the conditions is in that two specific matrices must be similar to each other. The properties of the matrices and the transformation are studied, and the discussion is then extended to input-output systems.An approach to design stabilizing control laws for these kinds of periodic systems is outlined.

11:30-11:50 ThA11.4

Brockett Problem for Systems with Feedback Delay, pp. 11491-11496

Insperger, Tamas	Budapest Univ. of Tech. and Ec.
Stepan, Gabor	Budapest Univ. of Tech. and Ec.

The Brockett problem is posed for systems with feedback delay in the form: what kind of time-varying controllers should be used to obtain asymptotic stability? Stabilization of delayed systems is a challenging task in control theory, since these systems usually have infinitely many poles. In this paper, the act-and-wait control concept is investigated as a possible technique to reduce the number of poles of systems with feedback delay. The Brockett problem is rephrased for the act-and-wait control system.

11:50-12:10 ThA11.5

LPV APPROACH FOR Hinfinity FILTER DESIGN FOR a CLASS OF NONLINEAR SYSTEMS, pp. 11497-11502

Gérard, Benjamin Francis	Nancy Univ.
Souley Ali, Harouna	Univ. Henri Poincaré
Zasadzinski, Michel	Cran
Darouach, Mohamed	Univ. Henri Poincare-Nancy

This paper deals with the H-infinity filtering problem for a class of nonlinear systems. This class of nonlinear systems is composed of a bilinear part and of a lipschitzian one. Using an unbiasedness condition for the bilinear part permits to parameterize the filter matrices through a single gain. Two LPV extensions of the bounded real lemma are used to solve the H-infinity filtering problem. This approach reduces the conservatism inherent to the boundedness of the inputs. Then the filtering solution is expressed in terms of LMI

(Linear Matrix Inequalitiy) to be verified at the vertices of a polytope.

12:10-12:30 ThA11.6

Stabilization of 2-D Linear Parameter-Varying Systems Using Parameter-Dependent Lyapunov Function: An LMI Approach, pp. 11503-11507

Yun, Sung Wook — POSTECH
Choi, Yun Jong — POSTECH
Park, PooGyeon — Pohang Univ. of Sci. & Tech.

This paper proposes a parameter-dependent state-feedback controller for the 2-D discrete linear parameter-varying (LPV) system with the Fornasini-Machesini (FM) first model. To find the stabilizing conditions of the system, we first transform the closed-loop system to a Roesser-type model, and then derive the conditions to linear matrix inequalities (LMIs) using a parameter-dependent Lyapunov function (PDLF) and a relaxation technique. The simulation results show that the designed controller is valid and the system asymptotically converges to the origin.

ThA12 313

Stability of Hybrid and Switched Systems (Regular Session)

Chair: Li, Guang — The Univ. of Bristol
Co-Chair: Efimov, Denis — Liege Univ.

10:30-10:50 ThA12.1

Switched Mutual--Master-Slave Synchronisation: Application to Mechanical Systems, pp. 11508-11513

Efimov, Denis — Inst. for Problems of Mechanical Eng.
Panteley, Elena V. — CNRS
Loria, Antonio — CNRS
Fradkov, Alexander L. — Acad. of Sciences of Russia

We show that the problems of mutual, master-slave synchronisation are equivalent (up to a transformation) to a classical output tracking control for certain nonlinear time-varying systems. Therefore, solving any of these problems solves the others however, in the presence of disturbances such an over-simplification of the tracking/synchronisation problem may lead to loss of performance and increase of control efforts. Then, we propose a supervisor controller that ensures asymptotic tracking while keeping synchronisation errors ``small''. Further, in the presence of disturbances, we establish input-output-to-state stability. In particular, we address the simultaneous tracking and synchronisation problems for mechanical systems.

10:50-11:10 ThA12.2

Stability and Control of Systems with Uncertain Time-Varying Sampling Period and Time Delay, pp. 11514-11519

Izák, Michal — Univ. of Kaiserslautern
Görges, Daniel — Univ. of Kaiserslautern
Liu, Steven — Tech. Univ. Kaiserslautern

This paper addresses stability and control issues of systems with uncertain and time-varying sampling period and time-delay. These arise e.g. in embedded or networked control applications where limited computation or communication resources have to be scheduled. The uncertain and time-varying sampling period and time delay are transformed into polytopic and additive norm-bounded uncertainties in the discretized system description. Control design and stability analysis methods are given in the form of LMIs applying switched parameter-dependent quadratic Lyapunov functions. A reduction algorithm is proposed in order to decrease the amount of LMIs necessary for stability analysis. The control design and stability analysis methods as well as the reduction algorithm are illustrated by an example.

11:10-11:30 ThA12.3

Stability of Discrete Impulsive Hybrid Systems Via Comparison Principle, pp. 11520-11525

Liu, Bin — The Australian National Univ.
Hill, David J. — The Australian National Univ.

This paper studies discrete impulsive hybrid systems. The comparison principle and uniform stability are established for such hybrid systems. Moreover, the attraction region is estimated. As applications, the comparison principle is used to study the robust stability problem for linear interval discrete impulsive hybrid systems and a class of nonlinear uncertain discrete impulsive hybrid systems.

11:30-11:50 ThA12.4

Robust Switching of Switched Linear Systems, pp. 11526-11529

Sun, Zhendong — South China Univ. of Tech.

For switched dynamical systems, switching signals usually undergo perturbations and disturbances due to various reasons. A well-behaved switched system might not work properly when its switching signal is perturbed. In this work, we investigate the switching robustness for a class of switched linear systems. For this, we firstdefine the distance between two switching signals by means of their switching matrices chains. Then, we prove that, if a periodic switching path steers the switched system exponentially stable, then any slightly perturbed switching signal also makes the system stable.

11:50-12:10 ThA12.5

Performance and Stability Analysis of Discontinuous PWA Systems by Piecing Together PWQ Functions, pp. 11530-11535

Gondhalekar, Ravi — Tokyo Inst. of Tech.
Imura, Jun-ichi — Tokyo Inst. of Tech.

An algorithm for evaluating the cost performance of discontinuous autonomous discrete-time piecewise affine systems is presented. The algorithm performs reverse reachability analysis and constructs a piecewise quadratic trajectory cost function over the entire region of attraction of the origin while explicitly taking into account the exact spatial evolution of the trajectories and the exact switching structure of the system as a whole. Available explicitly, this cost function can be integrated in order to evaluate the cost performance of the entire system. The reverse reachability algorithm is applied to the problem of constructing Lyapunov functions. The resulting Lyapunov functions are less conservative than other forms of Lyapunov function commonly used for stability analysis of autonomous discrete-time piecewise affine systems.

12:10-12:30 ThA12.6

On a Generalization of the Kalman-Yakubovich-Popov Lemma, pp. 11536-11541

Curran, Paul — NUI Dublin

The purpose of this note is to develop a generalization of the K-Y-P lemma and to apply this result to the absolute stability of single-variable Lur'e systems with sector-restricted nonlinearities.

ThA13 314

Learning and Estimation (Regular Session)

Chair: Horn, Joachim — Helmut-Schmidt-Univ. / Univ. of the Federal Armed
Co-Chair: Chang, Hyeong Soo — Sogang Univ.

10:30-10:50 ThA13.1

SPLL: Simultaneous Probabilistic Localization and Learning, pp. 11542-11547

Betoni Parodi, Bruno — Siemens AG
Szabo, Andrei — Siemens AG
Horn, Joachim — Helmut-Schmidt-Univ. / Univ. of the Federal Armed
Bamberger, Joachim — Siemens AG

Indoor localisation systems based on existent radio communication networks often make use of received signal strength (RSS) as measured feature. In order to achieve a good accuracy such systems have a huge payload in the called calibration phase, where many labelled measurements are collected and used to build a representative feature map. The present paper introduces a new algorithm based on previous works from the same authors, where the calibration phase is avoided by unsupervised online learning, during the operational phase of the system. Using probabilistic localisation and non-parametric density estimation, the new approach uses unlabelled measurements to learn a feature map, having as start only a rough initial model. Simulations with artificial generated data and with real measurements validate the introduced algorithm.

10:50-11:10 ThA13.2

Randomized Algorithm: A Viability Computation, pp. 11548-11553

Djeridane, Badis — ETH Zurich
Crück, Eva — Ec. Pol. / CNRS
Lygeros, John — ETH Zurich

We deal with the problem of computing maximal viability sets for nonlinear continuous or hybrid systems. Our main objective is to beat the curse of dimensionality, that is, we wan to avoid the exponential growth of required computational resource with respect to the dimension of the system. We propose a randomized approach for viability computation: we avoid griding the state-space, and use random extraction of points instead. This algorithm was implemented successfully to linear and nonlinear examples. We provide comparison of our results with results of other method.

11:10-11:30 ThA13.3

Design and Real Time Implementation of a Fuzzy Tuned H_; Estimator in a Low Cost AHRS, pp. 11554-11559

Keighobadi, Jafar — Amirkabir Univ. of Tech. (Tehran Pol.

Kabganian, Mansour — Amirkabir Univ. of Tech. (Tehran Pol.

Yazdanpanah, M. J. — Univ. of Tehran

In this paper a Fuzzy Tuned extended H_; (FTH_;) estimator is designed and implemented in an Attitude Heading Reference System (AHRS), which is specialized to vehicular applications. In AHRS, 3- axis accelerometers are allotted to measure the earth's gravity field vector and then to update the roll and pitch angles obtained from gyros' dynamic. Therefore, the AHRS on an accelerated vehicle will be affected by large disturbances. Additionally, in ground vehicles, the measurements of 3-axis magnetometers are corrupted by both soft and hard iron time varying disturbances. The FTH_; estimator is an extended H_; ;filter in which only noise and attenuation bounds are tuned based on fuzzy linguistic ifthen rules. The mentioned features make the estimator more reliable and suitable for hardware implementation. FTH_; estimator relies on a consistent fuzzy combination of two change detection tests; namely, likelihood ratio and averaged norm error. Real-time implementation of new attitude-heading estimator is performed on a TMS320VC5416 Digital Signal Processor (DSP). Incorporating this powerful and small size DSP with micro electro mechanical inertial and resistive magnetic sensors leads to a low cost, small size and low power consumption AHRS. Performance of the AHRS was evaluated in Monte Carlo simulations of vehicle's attitude-headings. The FTH_; estimator results in a superior performance compared to that of the extended H_; estimator in simulation and real tests.

11:30-11:50 ThA13.4

Gap-Free Bounds for Stochastic Multi-Armed Bandit, pp. 11560-11563

Juditsky, Anatoly — Univ. Grenoble I

Nazin, Alexander V. — Inst. of Control Sciences RAS

Tsybakov, Alexander — CREST

Vayatis, Nicolas — ENS de Cachan, Univ. CNRS

We consider the stochastic multi-armed bandit problem with unknown horizon. We present a randomized decision strategy which is based on updating a probability distribution through a stochastic mirror descent/exponentiated gradient type algorithm. We consider separately two assumptions: nonnegative losses or arbitrary losses with an exponential moment condition. We prove optimal (up to logarithmic factors) gap-free bounds on the excess risk of the average over time of the instantaneous losses induced by the choice of a specific action.

11:50-12:10 ThA13.5

Statistic Tracking Control for Non-Gaussian Systems Using T-S Fuzzy Model, pp. 11564-11569

Yi, Yang — Southeast Univ.

Li, Tao — Southeast Univ.

Guo, Lei — UMIST

This paper studies a new type of control framework for dynamical stochastic systems, called statistic tracking control. Non-Gaussian systems are considered and the tracked objective is the statistical information of a given target probability density function (PDF). Following neural network approximation to the performance function, the concerned problem is transferred into the tracking of given weights. Different from the previous related works, the time delay T-S fuzzy models with the exogenous disturbances are applied to represent the nonlinear weighting dynamics. Meanwhile, the generalized PI controller structure and the improved convex LMI algorithms are proposed to fulfil the tracking problem. Furthermore, in order to enhance the robust performance, the peak-to-peak measure is applied to optimize the tracking performance.

12:10-12:30 ThA13.6

Robust Fault Detection Linear Interval Observers Avoiding the Wrapping Effect, pp. 11570-11575

Meseguer, Jordi — Univ. Pol. de Catalunya (UPC)

Puig, Vicenc — Univ. Pol. de Catalunya

Escobet, Teresa — Univ. Pol. de Catalunya

In model based fault detection it is very important to analyze how the effect of model uncertainty is considered when determining the optimal threshold to be used in residual evaluation. When using model parameter uncertainty (interval model), an interval observer has been shown to be a suitable strategy to generate this adaptive threshold. However, interval observers can be affected by the wrapping effect when low computational algorithms, as such region-based approaches coming from the interval community, are used to determine the predicted output interval. As a novelty, this paper shows that the wrapping effect might be avoided forcing the observer gain to satisfy the isotonicity condition. Then, the effect of this observer condition on the time evolution of the residual sensitivity to a fault and the minimum detectable fault is analyzed in order to see whether the fault detection performance is enhanced or not. Finally, an example based on an industrial servo actuator will be used to illustrate the derived results.

ThA14 318

Networks and Control (Invited Session)

Co-Chair: Fraisse, Philippe — LIRMM, Univ. de Montpellier 2

Organizer: Andreu, David — LIRMM-CNRS, Univ. of Montpellier 2

Organizer: Fraisse, Philippe — LIRMM, Univ. de Montpellier 2

10:30-10:50 ThA14.1

Proposition and Validation of an Original MAC Layer with Simultaneous Accesses for Low Latency Wireless Control/command Applications (I), pp. 11576-11581

Van Den Bossche, Adrien — Univ. of Toulouse

Val, Thierry — Univ. of Toulouse

Campo, Eric — Univ. of Toulouse

Control/command processes require a transmission system with some characteristics like high reliability, low latency and strong guarantees on messages delivery. Concerning wire networks, field buses technologies like FIP offer this kind of service (periodic tasks, real time constraints…). Unfortunately, few wireless technologies can propose a communication system which respects such constraints. Indeed, wireless transmissions must deal with medium characteristics which make impossible the direct translation of mechanisms used with wire networks. The purpose of this paper is to present an original Medium Access Control (MAC) layer for a real time Low Power-Wireless Personal Area Network (LP-WPAN). The proposed MAC-layer has been validated by several complementary methods; in this paper, we focus on the specific Simultaneous Guaranteed Time Slot (SGTS) part.

10:50-11:10 ThA14.2

On the Implementation of One Process Control Application Type through a Network. Considering Three LANs: CAN, WiFi, ZigBee (I), pp. 11582-11587

Mouney, Gérard — Univ. Toulouse 3

Juanole, Guy — Univ. Toulouse

Calmettes, Christophe — Centre Univ. JF Champollion

This paper wants to present the first reasoning in order to implement on a network a process control application type which is, in a first time, specified with a continuous model (transfer function in the Laplace domain). The network is a local area network and we only consider the MAC layer (frame scheduling) and the physical layer (serial frame transmission). By first reasoning, we mean that, we study the case of a network which is dedicated to the process control application type, and we want to link the stability and the reactivity that the application can get from the service provided by the network (link between the parameters of the open loop transfer function and the network characteristics (frame transfer, frame format, bit rate)). Three networks are considered: CAN, WiFi, ZigBee. This work is a basic work which wants to emphasize the necessary interplay between Automatic Control theory and Networks mechanisms.

11:10-11:30 ThA14.3

Wireless Distributed Architecture for Therapeutic FES: Metrology for Muscle Control (I), pp. 11588-11593

Toussaint, Mickael — LIRMM, Univ. de Montpellier 2

Andreu, David — LIRMM-CNRS, Univ. of

Montpellier 2
Fraisse, Philippe — LIRMM, Univ. de Montpellier 2

This paper presents a Functional Electro-Stimulation distributed architecture based on a wireless network, for therapeutic training of disabled patients. On this distributed architecture, the movement (of disabled members) is artificially controlled by means of a global controller which pilots a set of stimulation units. The closed loop control system we developed for controlling muscle is based on a high order sliding mode method. In such wireless network-based control, the variable delay introduced by the network must be taken into account to ensure the stability of the closed loop. Thus, in order to characterize the medium on which the control is performed, we carried out accurate measurements of the architecture performances (stack-crossing, round-trip time, etc.). We then propose the use of a Kalman filter to predict the communication delay evolution, with the aim to exploit it within the closed loop control.

11:30-11:50 — ThA14.4
Sampled-Data Networked Control Systems with Random Time Delay, pp. 11594-11599
Chen, Chih-Chung — Tech. Univ. Munich
Hirche, Sandra — Tech. Univ. Muenchen
Buss, Martin — Tech. Univ. Muenchen

The stability and performance of a networked control system (NCS) strongly depends on the transmission delay. However, the randomness of the transmission delay is an intrinsic property in the network communication, e.g. Ethernet. Aiming at NCS with random transmission delay, a novel control approach is proposed. The transmission delays from sensorto- controller (SC) and controller-to-actuator (CA) are modelled by two independent Markovian processes. A controller, which is able to monitor the SC delay and synchronously switches according to it, is considered. The resulting closed-loop system is a Markovian jump linear system with randomly piecewise continuous delay. The exponential mean square stability for the given model is established by using a Lyapunov-Krasovskii functional. The performance benefits of the proposed approach are demonstrated in a numerical example.

11:50-12:10 — ThA14.5
Constrained Control of Event-Driven Networked Systems, pp. 11600-11605
Dritsas, Leonidas — Univ. of Patras
Tzes, Anthony — Univ. of Patras

This article focuses on the control of Networked Systems in which the packets are time-stamped and suffer from long (more than one sampling period) transmission delays. The inner sample arrival of the packet, coupled with other constraints posed by the system's characteristics such as control and/or state saturation impedes the system's performance. A constrained finite time optimal controller is designed for this system that is robust against the inner sample delays. The presented simulation studies investigate on the performance of the suggested controller.

12:10-12:30 — ThA14.6
The Motion Message Estimator in Networked Control Systems, pp. 11606-11611
Hsieh, Chen-Chou — National Chiao-Tung Univ.
Hsu, Pau-Lo — National Chiao Tung Univ.
Wang, Bor-Chyun — China Univ. of Tchnology

The networked control system (NCS) in industrial applications, such as computerized numerical control (CNC) machine tools and robots, possess advantages of simple wiring, expansion flexibility, and easy maintenance. However, the introduced network delay is unavoidable. Moreover, in real-time synchronized multi-axis NCS, all motion messages transmitted through the network are required to be received in time to meet specifications of the deadline. However, the data dropout may occur in NCS due to its time delay in a stochastic nature, and it also may results in degradation of motion accuracy. In this paper, a motion message estimator is proposed to construct the real-time networked industrial applications to reduce the data-dropout effect. Analytical results indicate that a 3rd-order message estimator based on the Taylor expansion successfully suppresses the uncertainties in NCS due to the dropout effect. Furthermore, this paper also proposes the networked cross-coupled control (CCC) structure to improve the contouring accuracy of the multi-axis NCS. Results indicate that the variation of the contouring error in the multi-axis NCS is suppressed greatly by applying the proposed networked CCC. Finally, experimental results indicate the proposed motion message estimator leads to improved accuracy on an industrial CNC machine tool with the NCS implementation.

ThA15 — 317
Control and Regulation in Biological Systems (Regular Session)
Chair: Schrempf, Andreas — Univ. of Applied Sciences, Upper Austria
Co-Chair: Wen, Lingfeng — Univ. of Sydney

10:30-10:50 — ThA15.1
Towards Model-Based Continuous-Time Identification of the Human Balance Controller, pp. 11612-11617
Gawthrop, Peter — Univ. of Glasgow
Wang, Liuping — RMIT Univ.

There are a number of competing scientific hypotheses about the structure and parameters of the human control system concerned with balance. System identification techniques have potential to distinguish between such competing hypotheses.

As a step towards this goal, the data from an initial series of experiments involving balancing an inverted pendulum by a human via a joystick was analysed using a recently-developed two-stage continuous-time identification method.

10:50-11:10 — ThA15.2
Heart Rate Regulation During Exercise with Various Loads: Identification and Nonlinear H_{infty} Control, pp. 11618-11623
Cheng, Teddy M. — Univ. of New South Wales
Savkin, Andrey V. — Univ. of New South Wales
Celler, Branko G. — The Univ. of New South Wales
Su, Steven W. — Univ. of Tech. Sydney
Wang, Lu — The Univ. of New South Wales

A model for the heart rate response to treadmill walking exercise is proposed in this paper. The parameters of the model were experimentally identified which involved subjects walking at different speeds. A 2-degree-of-freedom controller was then developed for the regulation of the heart rate response during treadmill exercise. The controller consists of a piecewise LQ and an H_{infty} sub-controllers. Experimental results demonstrated that the heart rate of the subjects were regulated by the proposed controller.

11:10-11:30 — ThA15.3
Adaptive Feedback Control in Deep Brain Stimulation: A Simulation Study, pp. 11624-11629
Santaniello, Sabato — Univ. degli Studi del Sannio
Fiengo, Giovanni — Univ. degli Studi del Sannio
Glielmo, Luigi — Univ. of Sannio

Deep brain stimulation (DBS) is an effective electric therapy to treat movement disorders associated with chronical neural diseases like essential tremor, dystonia and Parkinson’s disease. In spite of a long clinical experience, the cellular effects of the DBS are still partially unknown because of the lack of information about the target sites. Recent studies, however, have proposed the local field potentials (LFPs) in the targets as a useful tool to study the behavior before and after stimulation [Priori et al., 2006]. Our work investigates the relationship between DBS settings and LFPs in a detailed simulator of the electric activity in the Vim (one of the preferred surgical targets) under tremor conditions. A least-square approach is adopted to identify a functional, input-output ARX model structure for the Vim and evaluate the effects of the stimulation on its electric patterns. Based on it, an adaptive minimum variance control scheme is then proposed to restore the spectral features of the Vim’s LFPs to reference values, i.e., as in subjects not affected by movement disorders. Results indicate good performances in tracking the reference spectral features through selective changes in the low (2-7 Hz), ±; (7-13 Hz) and ¸; (13-35 Hz) ranges.

11:30-11:50 — ThA15.4
Application of a Novel Optimization-Based Approach to Characterize Integrated Signalling, Regulatory, and Metabolic Biochemical Networks, pp. 11630-11635
Lee, Jong Min — Univ. of Alberta
Gianchandani, Erwin P. — Univ. of Virginia
Eddy, James A. — Univ. of Virginia
Papin, Jason A. — Univ. of Virginia

Extracellular cues affect signaling, metabolic, and regulatory processes to elicit cellular responses. Although intracellular signaling, metabolic, and regulatory networks are highly integrated, previous analyses have largely focused on independent processes (e.g., metabolism) without considering the interplay that exists among them. In this paper, we present the recent development of a flux balance analysis (FBA)-based strategy, referred to as integrated dynamic FBA (idFBA), that dynamically simulates cellular phenotypes arising from integrated networks [Lee et al., 2007]. The idFBA framework solves a linear program to find the optimal fluxes of biochemical reactions in an integrated network. It assumes quasi-steady-state conditions for "fast" reactions and incorporates "slow" reactions into the stoichiometric relationships to confine the feasible solution space. We also describe its recent application to a prototypic integrated system to assess the efficacy of idFBA [Lee et al., 2007].

11:50-12:10 ThA15.5

Advanced Regulatory Controller for Automatic Control of Anesthesia, pp. 11636-11641

Yelneedi, Sreenivas — NUS
Samavedham, Lakshminarayanan — National Univ. of Singapore
Rangaiah, Gade Pandu — National Univ. of Singapore

Anesthesia process is to maintain a triad of hypnosis, analgesia and neuromuscular blockade by infusing several drugs which are specific for each state. This work focuses on controlling the hypnosis with RTDA (Robustness, Set-point tracking, Disturbance rejection, Aggressiveness) controller by regulation of propofol using Bispectral Index (BIS) as primary controlled variable. One of the main advantages of RTDA controller is its intuitive tuning parameters when compared to PID and MPC controllers. For the controller design, a fourthorder nonlinear pharmacokinetic - pharmacodynamic representation is used for the hypnosis dynamics of patients. Nominal values for pharmacokinetics and pharmacodynamics were taken from the literature. Then the performance of the RTDA controller is compared with the performances of the PID and MPC controllers. Robust performance of these controllers is tested for a selected range of patients by considering variability in parameters of the patient model. Also studied are the relative performances with respect to different set-points in BIS, and disturbances in BIS signal. Numerical simulations show that the RTDA controller provides better performance compared to the other two controllers.

12:10-12:30 ThA15.6

Active Cardiac Stabilization Using H Infinity Control Methodology, pp. 11642-11647

Bachta, Wael — LSIIT
Laroche, Edouard — LSIIT
Renaud, Pierre — LGeCo-INSA STARSOURG
Gangloff, Jacques — LSIIT

Beating heart surgery is an important milestone in cardiac surgery. This technique is currently made possible thanks to the use of passive mechanical stabilizers. Nevertheless, the commercially available stabilizers exhibit significant residual motion, which is inherent to their geometry. Recently, a novel active stabilizer based on a compliant structure has been designed. High-speed visual feedback is used to compensate for the residual cardiac motion with a piezo actuator. In this paper three H_infinity control strategies with different levels of a priori knowledge on the disturbance are tested and compared. First, a classical feedback strategy without any assumption on the disturbance is designed. Second, a feedback control law with a resonant filter centered at the cardiac fundamental frequency is synthetized. Finally, a 2 degrees-of-freedom controller fed with a prediction of the heart motion is proposed. The prediction is obtained with an original method provided in this article.

ThA17 320A

Control Education: Teaching Tools and Methods (Regular Session)

Chair: Dzielinski, Andrzej — Warsaw Univ. of Tech.
Co-Chair: Morales-Menendez, Ruben — Tecnologico de Monterrey, Campus Monterrey

10:30-10:50 ThA17.1

Testing of Control Programs in Distant Education, pp. 11648-11653

Susta, Richard — Faculty of Electrical Eng., CTU of Prague
Burget, Pavel — Czech Tech. Univ. in Prague, FEE

The paper deals with automatic testing of programmable logical controller (PLC) programs in a distant education. Students control a physical model, which that has also its virtual counterpart. While one user is connected to the physical model, others debug programs with the aid of the virtual model. We discuss the structure of models, the organization of education, and the testing process of student's programs. Finally, we present a new theory of delta-graphs used for conversion programs into a timed abstraction of PLC suitable for testing, as the main contribution of this paper.

10:50-11:10 ThA17.2

Simulation and Experimental Tools for Fractional Order Control Education, pp. 11654-11659

Dzielinski, Andrzej — Warsaw Univ. of Tech.
Sierociuk, Dominik — Warsaw Univ. of Tech. (ISEP)

The paper presents the simulation toolkit in MATLAB/Simulink for the fractional order discrete, state-space system education. The toolkit has been written as a set of C-MEX S-functions which simulate several fractional order blocks - e.g. fractional order difference, fractional order discrete state-space representation, fractional order Kalman filter. This way the C code generation capability (using Real Time Workshop) has been provided. This allowed to easily implement the control algorithms in the experimental setup. For analysis of fractional order systems the ultracapacitor has been chosen. It represents the real-life system which is inherently of fractional order. Altogether the simulation toolkit and the experimental testbed form the basis for the advanced fractional order control lab at Institute of Control and Industrial Electronics, Warsaw University of Technology.

11:10-11:30 ThA17.3

Control Education within a Multidisciplinary Summer Course on Applied Mobile Robotics, pp. 11660-11665

Pacheco, Lluís — Univ. of Girona
Luo, Ningsu — Univ. de Girona
Ferrer-Mallorquí, Inčs — Univ. de Girona
Cufi, Xavier — Univ. of Girona

This paper presents our teaching experience in control educational issues through a summer course ”Applied Mobile Robotics”. The main aim is to integrate different knowledge related to control and computer science through an adequate robotic framework that acts as an educational multidisciplinary tool in the course. As a practical approach, the majority of educational activities of the course are carried out at our university labs. The students are greatly motivated by working on such a robotic platform, which permits them to consolidate the acquired knowledge and to extend their complementary curricula.

11:30-11:50 ThA17.4

Teaching Digital Controllers for Finite Settling Time by Using Model-Based Control Education (MBCE) in a Constructivist Framework, pp. 11666-11671

Gambier, Adrian — Univ. of Heidelberg

In this contribution, a new approach for teaching digital controllers for finite settling time and deadbeat response is proposed. Essential concepts of deadbeat control are revised and shorted in order to simplify the teaching. The approach is base on a constructivist instructional model, which is supported by well-known pedagogical tools as the learning cycle, the sandwich structure and the portfolio assessment. Finally, the lecture is designed in details and CACSD tools are introduced by mean of an illustrative example.

11:50-12:10 ThA17.5

Simplifying the Practical Approach of the Process Control Teaching, pp. 11672-11677

Morales-Menendez, Ruben — Tecnologico de Monterrey, Campus Monterrey
Lopez-Lauterio, Tomas — Tecnologico de Monterrey, campus Monterrey
Ramírez-Mendoza, Ricardo A. — ITESM Campus Monterrey
Guedea, Federico — Univ. of Waterloo, ITESM

Process control teaching at Tecnologico de Monterrey combines advanced didactic techniques, software systems and industrial equipment as instructional tools to achieve educational objectives. A software tool was designed to assist students in achieving deeper understanding on process control with practical experience. This software tool has the capability to exploit several real-time process control strategies implemented in Matlab/Simulink or compiled on ANSI C scripts. Early results showed that students can learn faster.

12:10-12:30 ThA17.6

Corrected Mathematical Model of Quadruple Tank Process, pp. 11678-11683

Roinila, Tomi	Tampere Univ. of Tech.
Jaatinen, Antti	Tampere Univ. of Tech.
Vilkko, Matti Kalervo	Tampere Univ. of Tech.

A quadruple tank apparatus has been developed in many universities for use in undergraduate chemical engineering laboratories. The control experiment illustrates the performance limitations for multivariable systems posed by ill-conditioning, right half plane transmission zeros, and model uncertainties. The experiment is suitable for teaching how to select among multiloop, decoupling, and fully multivariable control structures. A number of these reports are, however, based on erroneous mathematical modeling and thus resulting incorrect results. Obviously all these reports refer originally to the one and same paper which includes this incorrect part of modeling. The error is significant if the pumps used in the experiment are not identical. If they are identical the error is, however, negligible. Mathematical derivation and simulation results are provided to give a corrected model and illustrate the effect of the widespread incorrect modeling.

ThA18 320B

Control Methods in Robotics (Regular Session)

Chair: de la Puente, Juan Antonio	Univ. Pol. de Madrid
Co-Chair: Santibanez, Victor	Inst. Tecnologico De La Laguna

10:30-10:50 ThA18.1

PID Controllers for Robots Equipped with Brushed DC-Motors Revisited, pp. 11684-11689

Hernandez-Guzman, Victor M.	Univ. Autonoma De Queretaro
Santibanez, Victor	Inst. Tecnologico De La Laguna
Carrillo-Serrano, Roberto Valentin	Univ. Autonoma de Queretaro

In this note we are concerned with controller design for robot manipulators equipped with brushed DC-motors in the case when the electric dynamics of these actuators is not neglected. We present, for the first time, stability proofs which show that PD control with desired gravity compensation and the classical PID controller presented previously in the literature under the assumption that no actuator dynamics exists can also be designed in this case. In the case of the classical PID controller we show that design can be done without the exact knowledge of neither robot nor actuator parameters. We present, for the first time, a theoretical justification for use of torque control, a strategy commonly used in industrial practice to control brushed DC-motors.

10:50-11:10 ThA18.2

A New Saturated Nonlinear PID Global Regulator for Robot Manipulators, pp. 11690-11695

Santibanez, Victor	Inst. Tecnologico De La Laguna
Kelly, Rafael	CICESE
Zavala-Rio, Arturo	Inst. Potosino de Investigacion Cientifica y Tecnologica
Parada, Ricardo Pavel	Inst. tecnologico de La Laguna

It is well known that industrial robots use the classical PID for positioning tasks. To the authors' knowledge, so far, there is not a proof of global regulation for such a controller. In the search of a practical PID regulator that be global, this paper proposes a new saturated nonlinear PID regulator for solving the problem of global regulation in robot manipulators with bounded torques. An approach based on Lyapunov theory is used for analyzing the global asymptotic stability. In this sense this proposal gives a step ahead in the search of a global asymptotic stability analysis for the practical PID.

11:10-11:30 ThA18.3

Nonlinear Adaptive H-Infinity Output Feedback Tracking Control for Robotic Systems, pp. 11696-11701

Levi, Itzhak	Ben Gurion Univ. of the Negev, Israel
Berman, Nadav	Ben Gurion Univ. of The Negev
Ailon, Amit	Ben Gurion Univ. of The Negev

This paper presents a solution to the tracking control problem of robotic systems in the presence of exogenous disturbances and model uncertainty with partial state information. The solution yields a Linear Matrix Inequalities (LMIs) based tracking output feedback controller. The main contribution of this paper lies in its particular approach which facilitates an application of the linear H infinity control theory without linearizing the underlying system. This yields a relatively simple and elegant design procedure. In addition, a relatively low gain controller is achieved. Simulation results of application this control algorithm in a two-degree of freedom robot demonstrates the design procedure feasibility.

11:30-11:50 ThA18.4

Neural Network Adaptive Robust Tracking Control for Uncertain Robotic Systems with Delays, pp. 11702-11707

Wang, Yaonan	Hunan Univ.
Zuo, Yi	Hunan Univ.
Huang, Lihong	Hunan Univ.
Li, Chunsheng	Guangdong Commercial Coll.

In this paper, the problem of the robust tracking for a class of uncertain robotic systems with delays is investigated. The uncertainty is nonlinear time-varying and does not require a matching condition. A reference model with the desired amplitude and phase properties is given to construct and error model. A neural network system is used to approximate an unknown controlled system from the strategic manipulation of the model following tracking errors. Based on the Lyapunov method and the linear matrix inequality (LMI) approach, several sufficient conditions, which guarantee the state variables of the closed loop system to converge, globally, uniformly and exponentially, to a ball in the state space with any pre-specified convergence rate, are derived. Numerical examples are given to illustrate the proposed method.

11:50-12:10 ThA18.5

Neural Network Robot Control with Noisy Learning, pp. 11708-11713

Ishihara, Abraham K.	Stanford Univ.
van Doornik, Johan	Stanford Univ.
Ben-Menahem, Shahar	stanford

Neural network based control of a serial-link robotic manipulator is considered subject to a signal dependent noise (SDN) model corrupting the training signal. A radial basis function (RBF) network is utilized in the feedforward control to approximate the unknown inverse dynamics. The weights are adaptively adjusted according to a gradient descent plus a regulation term (Narendra's e-modification). A typical quadratic stochastic Lyapunov function is constructed which shows under certain noise models it is not necessary to employ quartic Lyapunov functions as is typically carried out in stochastic adaptive backstepping designs. Bounds on the feedback gains, and learning rate parameters are derived that guarantee the origin of the closed loop system is semi-globally, uniformly bounded in expectation (SGUBE).

12:10-12:30 ThA18.6

Hybrid Input Shaping and Feedback Control Schemes of a Flexible Robot Manipulator, pp. 11714-11719

Mohamed, Zaharuddin	Faculty of Electrical Engineering
Ahmad, Mohd Ashraf	Univ. Malaysia Pahang

This paper presents investigations into the development of hybrid control schemes for input tracking and vibration control of a flexible robot manipulator. A constrained planar single-link flexible manipulator is considered and the dynamic model of the system is derived using the assume mode method. To study the effectiveness of the controllers, initially a collocated PD control is developed for control of rigid body motion. This is then extended to incorporate input shaper control schemes for vibration control of the system. The positive and modified specified negative amplitude input shapers are designed based on the properties of the system. Simulation results of the response of the manipulator with the controllers are presented in time and frequency domains. The performances of the hybrid control schemes are examined in terms of level of input tracking capability, vibration reduction, time response specifications and robustness to parameters uncertainty in comparison to the PD control. Finally, a comparative assessment of the amplitude polarities of the input shapers to the system performance is presented and discussed.

ThA19 320C

Recent Advances in Intelligent Autonomous Systems (Invited Session)

Chair: Ahn, Hyo-Sung — Gwangju Inst. of Science and Tech. (GIST)
Co-Chair: Moore, Kevin L. — Colorado School of Mines
Organizer: Ahn, Hyo-Sung — Gwangju Inst. of Science and Tech. (GIST)

10:30-10:50 ThA19.1
A Tutorial Introduction to Autonomous Systems (I), pp. 11720-11731
Moore, Kevin L. — Colorado School of Mines

This paper presents a tutorial-level introduction to the technical aspects of unmanned autonomous systems. We emphasize a system engineering perspective on the conceptual design and integration of both the components used in unmanned systems, including the locomotion, sensors, and computing systems needed to provide inherent autonomy capability, and the algorithms and architectures needed to enable control and autonomy, including path-tracking control and high-level planning strategies. Concepts are illustrated using case study examples from robotic and unmanned system developed by the author and his colleagues.

10:50-11:10 ThA19.2
Reference Tag-Based Indoor Localization Techniques (I), pp. 11732-11737
Ahn, Hyo-Sung — Gwangju Inst. of Science and Tech. (GIST)
Yu, Wonpil — ETRI

In WSN-based localization, there are many challenging points. The difficulty lies in the fact that communication signals in a space-limited indoor office environment are interfered and attenuated by multi-path, reflection, channel fading, deflection, diffraction, etc. In fact, it is quite difficult to develop a reliable signal propagation model in an office environment because it is challenging to accurately estimate the signal path loss parameter. This paper proposes using reference tags for online estimation of signal propagation model and for the reliable calculation of the time of flight of radio signals. Thus main contribution of this paper is to suggest localization schemes based on reference tag, which is so-called reference tag-based indoor localization (RTIL).

11:10-11:30 ThA19.3
A Steward Robot to Help Daily Activities in a Smart House Environment (I), pp. 11738-11743
Park, Kwang-Hyun — Kwangwoon Univ.
Lee, Hyong-Euk Lee — KAIST
Bien, Zeungnam — Korea Advanced Inst. of Science and Tech.

Independence of the people in need in their activities of daily living becomes a matter of vital importance to any society in the years to come. As an approach to achieve independence, this paper addresses the problem of controlling assistive home environment emphasizing human-friendly human-machine interaction. To provide inhabitants with easily accessible, convenient, and cost-effective environment for independent living, we introduce a new service robot categorized into a steward robot as an intermediate agent between inhabitants and complex smart house environment. The learning capability and emotional interaction of the robot can enhance human-friendliness in various tasks. A learning system enables the robot to provide customized services by accumulating knowledge of the user's behavior patterns in daily activities. An emotional interaction system generates facial expressions to communicate with the user in a human-friendly manner. We have developed two types of steward robots: a software type to use everywhere by personal computing devices such as a PDA and a cellular phone, and a hardware type to provide tangible services with physical interaction by two robotic arms and a mobile base.

11:30-11:50 ThA19.4
Band-Reconfigurable Multi-UAV-Based Cooperative Remote Sensing for Real-Time Water Management and Distributed Irrigation Control (I), pp. 11744-11749
Chao, Haiyang — Utah State Univ.
Baumann, Marc — Utah State Univ.
Jensens, Austin — Utah State Univ.
Chen, YangQuan — Utah State Univ.
Cao, Yongcan — Utah State Univ.
Ren, Wei — Utah State Univ.
McKee, Mac — Utah State Univ.

This paper presents an overview of ongoing research on small unmanned autonomous vehicles (UAVs) for cooperative remote sensing for real-time water management and irrigation control. Small UAVs can carry embedded cameras with different wavelength bands, which are low-cost but have high spatial-resolution. These imagers mounted on UAVs can form a camera array to perform multispectral imaging with reconfigurable bands dependent on mission. Development of essential subsystems, such as the UAV platforms, embedded multispectral imagers, and image stitching and registration, is introduced together with real UAV flight test results of one typical example mission.

11:50-12:10 ThA19.5
Non-Cooperative Outcomes for Stochastic Multi-Player Nash Games: Decision Strategies towards Multi-Attribute Performance Robustness, pp. 11750-11756
Pham, Khanh D. — AIR FORCE Res. Lab.

The advantages of compactness from logic of state-space model description and quantitativity from probabilistic knowledge of stochastic disturbances have been exploited to construct a situational awareness which then provides essential common knowledge to non-cooperative decision makers about the adverse and dynamic environment within a linear-quadratic class of nonzero-sum stochastic games. It incorporates the perception of relevant attributes of the decision problem, comprehension of the meaning of the shared interaction model in combination with and in relation to various goals of non-cooperative decision makers so that future projection of higher-order characteristics of the Chi-squared random measures of performance is obtained with high confidence. New solution concepts, called the multi-cumulant Nash strategies are proposed to directly influence respective performance distributions and to effectively guarantee performance robustness for non-cooperative decision makers.

12:10-12:30 ThA19.6
Robust Landmark Detection and Localization; a Multisensor Approach, pp. 11757-11762
Amarasinghe, Dilan — Memorial Univ. of Newfoundland
Mann, George K. I. — Memorial Univ. of Newfoundland
Gosine, Raymond G. — Memorial Univ. of Newfoundland

This paper describes a landmark position measurement system using an integrated laser-camera sensor. Laser range finder can be used to detect landmarks that are direction invariant in the laser data such as protruding edges in walls, edges of tables, chairs. When such features are unavailable the processes that depend on landmarks such as navigation and simultaneous localization and mapping (SLAM) algorithms will not be able to perform at the best accuracy. However, in many instances larger number of landmarks can be detected using computer vision. In the proposed method camera is used to detect landmarks while the location of the landmark is measured by the laser range finder using laser-camera calibration information. Thus, the proposed method exploits the beneficial aspects of each sensor to overcome the disadvantages of the other sensor. Experimental results with important statistics are provided and an application in SLAM is presented.

ThA20 321C
Flexible Robots (Regular Session)
Chair: Sasiadek, Jurek Z — Carleton Univ.
Co-Chair: Pieri, Edson Roberto De — Federal Univ. of Santa Catarina

10:30-10:50 ThA20.1
Reference Tracking versus Path-Following for One-Link Manipulator Flexible Robot, pp. 11763-11768
Pires, Pedro — IST, TULisbon
Martins, Jorge — IST, TULisbon
Sa da Costa, Jose — IST, TULisbon

This paper details two control approaches for a flexible manipulator system, where the non-minimum phase problem is treated. In the first approach, we use the motion planning technique. It searches for proper output trajectories with polynomial form, in order to cancel the effects of the unstable zeros. The second approach is called Path-Following with internal model control. Its primary objective is to steer a physical object to converge to a geometric path, and its secondary objective is to ensure that an object's motion along the path satisfies a given dynamic specification.

10:50-11:10 ThA20.2

Practical Robust Control for Flexible Joint Robot Manipulators, pp. 11769-11774

Yeon, Je Sung — Hanyang Univ.
Park, Jong Hyeon — Hanyang Univ.
Lee, Sang-Hun — Hyundai Heavy Industries Co., Ltd.

In this paper we proposed a practical robust control using transformed dynamics. The dynamic model of the flexible manipulator can be split up into two subsystems, however the transformed dynamics is made into one with the singular perturbation standard form. The proposed controller has simple structure, more easy tuning factor, and control forms having direct relation with control performance. The design procedure consists of two parts. A model based computed torque control part, and robust control part to maintain the tracking performance using the nonlinear H-infinity control. The designed robust control is applied to a 6-DOF robot manipulator with joint flexibilities. The proposed robust controller has better tracking performance and advantage in its application.

11:10-11:30 ThA20.3

Backstepping Control Design of a Single-Link Flexible Robotic Manipulator, pp. 11775-11780

Huang, Jhih-Wei — National Chi Nan Univ.
Lin, Jung-Shan — National Chi Nan Univ.

In this paper, the backstepping design scheme is developed for the tip-position trajectory tracking control of single-link flexible robotic manipulator systems. An infinite dimensional dynamic model of a single-link flexible manipulator is derived through the assumed modes method associated with Lagrange approach. For simplicity, a linearized system model would be analyzed and investigated for our tracking control design with elimination of tip vibration. That is to say, the proposed backstepping controller is not only to stabilize the flexible robotic manipulator, but also to drive the trajectory tracking error and tip-deflection to converge to zero asymptotically. Furthermore, some simulation results are given to illustrate the excellent performance of the backstepping control design applied to a single-link flexible robotic manipulator.

11:30-11:50 ThA20.4

Control of a Flexible Robot Using Fuzzy Logic and a Noncollocated Sensor, pp. 11781-11786

Green, Anthony — Carleton Univ.
Sasiadek, Jurek Z — Carleton Univ.

Inverse flexible dynamics control (IFDC) and fuzzy logic system adaptive control (FLSAC) strategies are used to track the end effector of a flexible space robot with sensors collocated at the joints, noncollocated at the end effector and 0.5m from the elbow joint on link 2. Collocated joint sensors satisfy hyperstability conditions but fail to capture nonminimum phase (NMP) response that generates time-delays causing asynchronous control action. Noncollocated sensors capture NMP response but require time delay compensation to achieve synchronous control action. Results for IFDC are insignificant compared to those achieved with FLSAC.

11:50-12:10 ThA20.5

Vibration Control of a Flexible Link Manipulator Using Smart Structures, pp. 11787-11792

Salmasi, Hamid — Univ. of Saskatchewan
Fotouhi, Reza — Univ. of Saskatchewan
Nikiforuk, Peter — Univ. of Saskatchewan

The active vibration suppression of a flexible link manipulator using a smart structure (piezoelectric actuator) is investigated. For this purpose, a Finite Element (FE) model is developed for the modal and transient analysis of a cantilever beam and a flexible link manipulator. The novelty of this work is in the development of an accurate finite element model of a piezoelectric and beam/manipulator. Also, the effect of the placement of the piezoelectric actuator along the beam, based on the controllability of the system states and using FE analysis, is investigated. To avoid system instability, a collocated sensor-actuator pair is used and a proportional control strategy is employed to adjust the voltage applied to the piezoelectric actuator so as to control vibrations. For the flexible link manipulator, it is shown that the vibration is well suppressed during and at the end of a manoeuvre by locating the piezoelectric actuator at the optimum location. The effect of the controller gain on the vibration behaviour of the system is investigated and the optimum controller gain is found using two main evaluation criteria; these are the contribution of the dominant frequencies in the response and the error norms of the vibration amplitudes.

12:10-12:30 ThA20.6

Friction Compensation in Flexible Joints Robot with GMS Model: Identification, Control and Experimental Results, pp. 11793-11798

Casanova, Christiano Correa — UFSC - Univ. Federal de Santa Catarina
Pieri, Edson Roberto De — Federal Univ. of Santa Catarina
Moreno, Ubirajara F. — Federal Univ. of Santa Catarina
Castelan, Eugenio B. — Univ. Federal de Santa Catarina

In this paper the position control of robot manipulators considering joint flexibilities and friction compensation is presented. For the control purposes a cascade control strategy is presented and the friction compensation is described using the Generalized Maxwell-Slip (GMS) model. The GMS parameters are identified and a friction observer based on this model is proposed and incorporated to the cascade strategy so that the stability and performance can be improved. An experimental setup was constructed to validate the proposed control and friction compensation strategy: a planar two degrees of freedom robot with joint flexibilities prototype. The behavior of the cascade control with GMS model was tested in simulation and it was validated in the experimental setup.

ThA21 321B

Dynamics and Control of Micro and Nano-Scale Systems IV
(Invited Session)

Chair: Moheimani, S.O. Reza — Univ. of Newcastle
Co-Chair: Sebastian, Abu — IBM Res.
Organizer: Moheimani, S.O. Reza — Univ. of Newcastle
Organizer: Sebastian, Abu — IBM Res.

10:30-10:50 ThA21.1

A Closed-Loop Approach to Reducing Scan Errors in Nanopositioning Platforms (I), pp. 11799-11804

Aphale, Sumeet — Univ. of Newcastle, Australia
Bhikkaji, Bharath — Newcastle Univ.
Moheimani, S.O. Reza — Univ. of Newcastle

Piezoelectric stack-actuated parallel-kinematic nanopositioning platforms have their first resonant mode at relatively low frequencies and also suffer from nonlinearities such as hysteresis and creep, resulting in a typically low-grade positioning performance. Closed-loop control algorithms have shown the potential to eliminate these problems and achieve robust, repeatable nanopositioning. In this work, the performance of three commonly used damping controllers is compared based on their closed-loop noise characteristics. The best one is combined with an integrator to produce accurate raster scans of large areas while imparting substantial damping to the system and minimizing inherent nonlinearities. A scanning resolution of approximately 8nm, over a 100Ľ;m × 100Ľ;m area is achieved.

10:50-11:10 ThA21.2

Optimal Input Signals for Bandlimited Scanning Systems (I), pp. 11805-11810

Fleming, Andrew John — Univ. of Newcastle
Wills, Adrian George — Univ. of Newcastle

Periodic scanning trajectories are designed with minimal harmonic content and fixed linear regions. While minimum harmonic content reduces vibration in mechanical scanners, fixed linear regions eliminate curvature in the scan area. Simulated and experimental results demonstrate less induced vibration than presently used techniques.

11:10-11:30 ThA21.3

Physical-Model-Based Control of a Piezoelectric Tube Scanner (I), pp. 11811-11816

Gawthrop, Peter — Univ. of Glasgow
Bhikkaji, Bharath — Newcastle Univ.
Moheimani, S.O. Reza — Univ. of Newcastle

A piezoelectric tube is shown to have linear, but non-minimum phase dynamics. The main impediment to the actuation of this piezoelectric tube is the presence of a low-frequency resonant mode which causes mechanical vibrations. A physical-model-based control method is extended to non-minimum phase systems in general and successfully applied to damp the resonant mode; leading to a vibration-free actuation of the piezoelectric tube.

11:30-11:50 ThA21.4

Control of a Five-Degrees-Of-Freedom Nanopositioner, pp. 11817-11822

Shen, Jing-Chung National Formosa Univ.

This paper presents the tracking control of a five-degrees-of-freedom nanopositioner. This nanopositioner is actuated by piezoelectric actuators. Capacitive gap sensors are used for position feedback. Firstly, the modified Prandtl-Ishlinskii (MPI) model is used to model the hysteresis nonlinearity of piezoelectric actuator, then its inverse is used to cancel out the hysteresis nonlinearity. In order to design the feedback controller, the linearized open-loop characteristics of this nanopositioner are investigated. Based on the results of investigation, each pair of piezoelectric actuator and corresponding gap sensor are treated as independent systems and modeled as a uncertain first order linear model. When the model is identified, the linear system model with uncertainty is used to design the controller. The sliding-mode disturbance (uncertainty) estimation and compensation scheme is used in this study. Experimental results are given to show the effectiveness of the proposed method.

11:50-12:10 ThA21.5

Design Methodology for Robust and Fault-Tolerant Control of a Microprehensile Microrobot-On-Chip (I), pp. 11823-11828

Boukhnifer, Moussa ENSI de Bourges-Univ. d'Orléans
Ferreira, Antoine Univ. d'Orléans- ENSI de Bourges
Kratz, Frederic ENSIB

Recently, the evolution of microfabrication technologies and component integration at microscale led to the development of integrated Microrobot-On-Chip (MOC) where on- chip control refers to integrated miniaturized systems where the control algorithms, sensors and actuators are included as part of the system. Enabling these types of micromechatronic systems requires research in methods to deal with sensor and actuator robustness with fault-tolerant control against micromechanical failures, microphysical uncertainties (adhesive effects, object repulsion/attraction) and noise spikes in sensing instruments. This paper presents a general architecture for fault tolerant control using Youla parametrization for a piezoelectric microrobotic gripper. The distinguished feature of our controller architecture is that it shows structurally how the controller design for performance and robustness may be done separately which has the potential to overcome the conflict between performance and robustness in the traditional feedback framework. The controller architecture includes two parts: one part for performance and the other part for robustness. The controller architecture works in such a way that the feedback control system will be solely controlled by the PI performance controller for a nominal model and the H_; robustification controller will only be active in the presence of the uncertainties or external disturbances.

ThA22 321A

Vibration Control and Flexible Systems (Regular Session)

Chair: Savaresi, Sergio Pol. di Milano
Co-Chair: Visioli, Antonio Univ. of Brescia

10:30-10:50 ThA22.1

Iterative Feedforward Tuning for Residual Vibration Reduction, pp. 11829-11834

Visioli, Antonio Univ. of Brescia
Piazzi, Aurelio Univ. of Parma

An iterative approach for the determination of an input-output inversion feedforward control law for residual vibration reduction is proposed in this paper. In particular, point-to-point motion planning of vibratory servosystems is considered. The method aims at estimating recursively the parameters of the system in order to determine the exact command input to be applied to the control system in order to achieve a predefined motion without oscillations. In this context, a gradient based minimisation of the integrated square error cost function is performed. Simulation results show the effectiveness of the methodology.

10:50-11:10 ThA22.2

Vibration Reduction in a Washing Machine Via Damping Control, pp. 11835-11840

Spelta, Cristiano Univ. degli studi di Bergamo
Savaresi, Sergio Pol. di Milano
Fraternale, Giuseppe Indesit company
Gaudiano, Nicola Indesit Company

The aim of this work is the analysis and design of a control system for the reduction of the mechanical vibration and the perceived acoustic noise in a washing machine. The control system is implemented via a semi-active magnetorheological damper located on the suspension that links the drum to the cabinet. The entire design procedure is outlined. The semi-active actuator is accurately described. An experimental protocol is proposed and tested on a sensored machine to highlight the system dynamical behavior. On this basis a simple adaptation control strategy is proposed, designed and tested. Finally some experiments are held in anechoic chamber: the reported results show the effectiveness of the proposed control system.

11:10-11:30 ThA22.3

An Advanced System for Vibration Control of Flexible Structures, pp. 11841-11846

Cavallo, Alberto Seconda Univ. degli Studi di Napoli
De Maria, G. Seconda Univ. degli Studi di Napoli SUN
Natale, Ciro Seconda Univ. degli Studi di Napoli
Pirozzi, Salvatore Seconda Univ. di Napoli

The objective of the research work here presented is the rejection of a broadband disturbance in a vibrating flexible structure. From a technological point of view, the problem is tackled using an advanced lightweight magnetostrictive resonant actuator with an integrated optical strain sensor. The adopted control strategy consists of a two-levels controller. Usefully exploiting the measurement of the integrated sensor, a low-level feedback loop, aimed at linearizing the actuator behaviour, is designed by resorting to a model-following approach. An optimal control law is specifically implemented as the high-level feedback loop providing a H infinity strongly stabilizing controller with bandpass capability for both low- and high-frequencies measurement disturbances affecting the accelerometer used as control sensor. The advanced control system has been experimentally tested on an aeronautical stiffened panel.

11:30-11:50 ThA22.4

Boundary Control of a Vibrating Composite Laminated Rectangular Plate, pp. 11847-11852

Rastgoftar, Hossein Shiraz Univ.
Eghtesad, Mohammad Shiraz Univ.
Khayatian, Alireza Shiraz Univ.

This paper presents a solution to the boundary stabilization of a symmetric composite laminated plate in free transverse vibration. The symmetric composite laminated plate dynamics is presented by a linear fourth order partial differential equation (PDE). A linear control law is constructed to stabilize the plate. The control force consists of feedback of the velocity at the boundary of the plate. The novelty of this article is that it is possible to stabilize asymptotically a free transversely vibrating symmetric composite laminated plate with simply supported boundary condition via boundary control without resorting to truncation of the model.

11:50-12:10 ThA22.5

Robust Control of a Bending-Torsion Coupled Flexible Arm with Uncertainties, pp. 11853-11858

Watanabe, Toru Coll. of science and Tech. Nihon Univ.

This paper presents a design procedure of H-infinity robust controller of a three-dimensional two links flexible robot arm taking account of posture change and uncertain payload. Two-degree-of freedom model is identified experimentally by utilizing Seto's modeling method. An H-infinity controller is obtained by using a generalized plant including error matrices and two filters; Error matrices represent the fluctuation of parameters between nominal and fluctuated model. Besides, A high-pass and a low-pass filter are introduced to avoid spilover or to realize pseudo-integrator, respectively. The effectiveness of the obtained controller are verified by the simulation and the control experiment.

12:10-12:30 ThA22.6

Influence of Actuator Size and Location on Robust Stability of Actively Controlled Flexible Beams, pp. 11859-11864

Benatzky, Christian — Vienna Univ. of Tech.
Kozek, Martin — Vienna Univ. of Tech.

This paper addresses the influence of the actuator size on the closed loop stability of collocated and non-collocated transfer functions utilized in the structural control of flexible beams. Besides the well known robustness advantages of collocated transfer functions it is shown, that if the actuator is small compared to the flexible structure, a non-collocated actuator/sensor configuration provides larger stability margins. It is shown, that this effect arises from the uncertainty associated with the steady state gain of collocated transfer functions. The applicability to other types of boundary conditions and limitations due to length and spatial frequencies of the beam are also addressed.

ThA23 — 323
R2R System Technology for Printed Electronics (Invited Session)

Chair: Lee, Sangyoon — Konkuk Univ.
Co-Chair: Kang, Chul-Goo — Konkuk Univ.
Organizer: Lee, Sangyoon — Konkuk Univ.

10:30-10:50 — ThA23.1
A Feed-Forward Tension Control in Drying Section of Roll to Roll E-Printing System (I), pp. 11865-11870

Lee, Chang Woo — Konkuk Univ.
Lee, Jang Won — Konkuk Univ.
Kim, Ho Joon — Konkuk Univ.
Shin, KeeHyun — Konkuk Univ.

The mathematical model for tension behaviors of a moving web by Shin (Shin, 2000) is extended to the tension model considering the thermal strain due to temperature variation in dryer of roll to roll system. The extended model includes the terms that take into account the effect of the change of the Young`s Modulus, the thermal coefficient, and the thermal strain on the variation of tension. By using the extended tension model, a new tension control method is suggested in this paper. The key factors of suggested in this paper. The key factors of suggested tension control method include that the thermal strain of web could be compensated by using the velocity adjustment. The computer simulation and experiment validation was carried out to confirm the performance of the proposed tension control method. The results show that the suggested tension control logic not only overcomes the problem of the traditional tension control logic, but also improves the performance of tension control in a dryer section of roll to roll system.

10:50-11:10 — ThA23.2
Development of a Lateral Control Simulation Software for Roll-To-Roll Systems (I), pp. 11871-11876

Lee, Sangyoon — Konkuk Univ.
Ho, Thanhtam — Konkuk Univ.
Shin, Hyeunhun — Konkuk Univ.

This paper presents the development and simulation results of a computer simulation software for the lateral position control of a moving web in roll-to-roll (R2R) systems. Mathematical models of the web dynamics are described first to explain the lateral motion of a moving web. Based on the models, a controller that employs the PID control method is developed, and embedded in simulation software named LACOSIM. The software is for simulating the lateral dynamics of a moving web and controlling a lateral position error in R2R systems. Simulation results show that the software can be a useful tool for the development of a web guide system for R2R systems.

11:10-11:30 — ThA23.3
MIMO Tension Modelling and Control for Roll-To-Roll Converting Machines (I), pp. 11877-11882

Kang, Chul-Goo — Konkuk Univ.
Lee, Bong-Ju — Konkuk Univ.

Roll-to-roll converting machines have significant interactions in tensions and speeds among web spans. A reasonable MIMO model for web tension plays an important role for high-performance converting machines. In this paper, we derive a nonlinear MIMO web-tension model of a high-speed gravure printing machine considering span length to be time-varying instead of considering it to be fixed. Then a feedback control system is constructed and web-tension control performance is analyzed at transient and steady-state condition via simulation studies using Simulink software.

11:30-11:50 — ThA23.4
Design Parameter Analysis of a Roll-To-Roll Printing Machine (I), pp. 11883-11888

Kang, Chul-Goo — Konkuk Univ.
Lee, Bong-Ju — Konkuk Univ.

The stability of multi-input and multi-output web-tension systems is an important factor that is required for the roll-to-roll printing machines. This paper analyzes stability for design parameters of a web-tension system of a high-speed gravure printing machine. Analyzed parameters include moment of inertia of the passive dancer, viscous friction coefficient of the dancer system, distances from hinge to dancer roller and cylinder, and proportional gains of the tension control system. The validity of the analysis is demonstrated by simulation study.

11:50-12:10 — ThA23.5
Tension Estimation by Using Register Error in Roll to Roll E-Printing System (I), pp. 11889-11894

Lee, Jang Won — Konkuk Univ.
Lee, Chang Woo — Konkuk Univ.
Shin, KeeHyun — Konkuk Univ.

The focus of this study is on development of mathematical model and experimental verification of a tension estimation using the register error in R2R (roll to roll) e-Printing systems. In a printing section of conventional R2R printing systems, the tension is generally measured not for controlling but for monitoring because the tension control causes the occurrence of a register error. But the tension in the R2R e-Printing system must be controlled as well as measured for more precise control of the register error. The tension can be measured by the loadcells in the conventional R2R systems. But installing loadcell on the R2R systems causes extra economic burden. In addition, the space for the loadcells on the R2R systems is limited due to many components including dryers and cooling units. In this study, a new tension estimation model is proposed. The proposed model is based on the register error model, the equivalent torque equation, and the tension model. Numerical simulations and experimental results showed that the proposed model was effective to estimate the tension in a printing section.

ThA24 — 324
Semantic-Based Solutions for Enterprise Integration and Networking (Invited Session)

Chair: Boudjlida, Nacer — Nancy-Univ. LORIA, INRIA, CNRS
Co-Chair: Panetto, Hervé — Nancy-Univ.
Organizer: Boudjlida, Nacer — Nancy-Univ. LORIA, INRIA, CNRS
Organizer: Panetto, Hervé — ESIAL - Nancy-Univ.
Organizer: Krogstie, John — NTNU

10:30-11:10 — ThA24.1
The Unified Enterprise Modelling Language – Overview and Further Work (I), pp. 11895-11906

Anaya, Victor — Univ. Pol. de Valencia
Berio, Giuseppe — Univ. of Torino
Harzallah, Mounira — LINA -Univ. of Nantes
Heymans, Patrick — Univ. of Namur (FUNDP)
Matulevicius, Raimundas — Univ. of Namur
Opdahl, Andreas L — Univ. of Bergen
Panetto, Hervé — Nancy-Univ.
Verdecho, Maria Jose — Univ. Pol. de Valencia

The Unified Enterprise Modelling Language (UEML) aims to support integrated use of enterprise and IS models expressed in a variety of languages. To achieve this aim, UEML provides a hub through which different languages can be connected, thereby paving the way for connecting the models expressed in those languages. UEML offers a structured approach to describing enterprise and IS modelling constructs, a common ontology to interrelate construct descriptions at the semantic level, a correspondence analysis approach to estimate semantic construct similarity, a quality framework to aid selection of languages, a meta-meta model to organise the UEML and a set of tools to aid its use and evolution. This paper presents an overview of UEML and points to paths for further work.

11:10-11:30 — ThA24.2
Enterprise Modelling and Ontology (I), pp. 11907-11912

Zouggar, Nabila | Univ. de Bordeaux
Chen, David | Univ. Bordeaux I
Vallespir, Bruno | Univ. of Bordeaux 1

Generally speaking, Enterprise model is used during the system engineering life cycle by other stakeholders rather than those who developed it. They do not necessarily know the context in which the model was built and quite often are not familiar with the language used for the modelling. This situation makes that the model loses its semantic during its exploitation and creates ambiguities and difficulties in its use. We will propose in this paper a methodological approach to be followed in the creation of models which would make it possible to keep their semantics during their life cycle by the use of ontologies and semantic annotations. A simplified application example is presented to illustrate the use of the proposed approach.

11:30-11:50 ThA24.3

Preparation of Papers for IFAC Conferences & Symposia: Ontology-Based Methodology for Collaborative Process Definition of Enterprise Networks (I), pp. 11913-11918

Rajsiri, Vatcharaphun | Ec. des Mines d'Albi-Carmaux
Lorre, Jean-Pierre | EBM WebSourcing
Benaben, Frederick | Ec. des Mines d'Albi-Carmaux
Pingaud, Hervé | ENSTIMAC

This paper presents a knowledge-based methodology dedicated to automate the specification of virtual organization collaborative processes. Our approach takes as input knowledge concerning collaboration coming from involved organizations and produces as output a BPMN compliant process. The collaborative network ontology consists of (i) collaboration attributes, (ii) description of participants and (iii) collaborative processes inspired from the enterprise Process Handbook (MIT). This OWL ontology coupled with a reasoning engine will be used by a collaboration aided design tool (CDT) provided by EBM WebSourcing.

11:50-12:10 ThA24.4

Components Selection Methods for Enterprise Interoperability in Multi Domain Models (I), pp. 11919-11924

Feng, Ke | Southeast Univ.
Li, Xiaoping | Southeast Univ.
Wang, Qian | Southeast Univ.
Shan, Jingjing | Southeast Univ.

Component-based development is gradually showing its advantages in building complex systems with shorter time and less cost than traditional methods. However, mismatching and semantic are key problems in component searching process. In this paper, a function description model is proposed to precisely and completely describe the user requirements and component function based on domain models. In the component selection process, a sophisticated matching algorithm is introduced for semantic problems in matching two activity profiles derived from different domain models. A component selection method is also presented to improve interoperability for multi domain models, followed by the implemented prototype of the proposed methods.

12:10-12:30 ThA24.5

A Systemic Approach to Interoperability Formalization (I), pp. 11925-11930

Naudet, Yannick | Henri Tudor Public Res. Center
Latour, Thibaud | Henri Tudor Public Res. Center
Chen, David | Univ. Bordeaux I

With a first version developed last year, the Ontology of Interoperability (OoI) aims at formally describing concepts relating to problems and solutions in the domain of interoperability. From the beginning, the OoI has its foundations in the systemic theory and addresses interoperability from the general point of view of a system, whether it is composed by other systems (systems-of-systems) or not. In this paper, we present the last OoI focusing on the systemic approach. We then integrate a classification of interoperability knowledge provided by the Framework for Enterprise Interoperability. This way, we contextualize the OoI with a specific vocabulary to the enterprise domain, where solutions to interoperability problems are characterized according to interoperability approaches defined in the ISO 14258 and both solutions and problems can be localized into enterprises levels and characterized by interoperability levels, as defined in the European Interoperability Framework.

Applied Process Control (Regular Session)

Chair: Yu, Cheng-Ching | National Taiwan Univ.
Co-Chair: Aksikas, Ilyasse | Univ. of Alberta

10:30-10:50 ThA25.1

Implementation of Optimal Decisions in the Presence of Uncertainty, pp. 11931-11936

Barz, Tilman | TU-Berlin
Arellano-Garcia, Harvey | TU Berlin
Wozny, Günter | TU-Berlin

In this work, the implementation of optimal and robust decisions in the presence of various uncertainties comprising the model parameters, external conditions and the closed loop behavior of basic controllers is presented. In order to compute optimal and reliable decisions, a chance constrained optimization problem is formulated. The efficient solution approach is based on the relaxation of the original stochastic problem formulation to a standard NLP problem. By this means, nominal optimal solutions are relocated in order to guarantee both feasibility and process operation as close to the true optimum as possible. The solution implicates the minimization of additional costs which result from conservative strategies so as to compensate for uncertainty. The experimental verification of the developed approach is carried out on a distillation pilot plant for the separation of an azeotropic mixture.

10:50-11:10 ThA25.2

Robust Multivariable PI Control: Applications to Process Control, pp. 11937-11942

Seshagiri, Sridhar | San Diego State Univ.

The control of the longitudinal flight dynamics of an F-16 aircraft is challenging because the system is highly nonlinear, and also non-affine in the input. We consider a sliding mode control design based on linearization of the aircraft, with the the altitude h and velocity V (Mach number) as the trim variables. The design further exploits the modal decomposition of the dynamics into its short-period and phugoid approximations. The primary design objective is model-following of the pitch rate q, which is the preferred system for aircraft approach and landing. Regulation of the aircraft velocity V (or the Mach-hold autopilot) is also considered, but as a secondary objective. It is shown that the inherent robustness of the SMC design provides a convenient way to design controllers without gain scheduling, with a steady-state response that is comparable to that of a conventional gain-scheduled approach with integral control, but with improved transient performance. Finally, we apply the recently developed technique of “conditional integrators” to achieve asymptotic regulation with constant exogenous signals, without degrading the transient response. Through extensive simulation on the nonlinear multiple-input multiple-output (MIMO) longitudinal model of the F-16 aircraft, we show that the conditional integrator design outperforms the one based on the conventional approach, without requiring any scheduling.

11:10-11:30 ThA25.3

Estimation of Distillation Compositions Using Sensitivity Matrix Analysis and Kernel Ridge Regression, pp. 11943-11948

Li, Qi | Dalian Univ. of Tech.
Shao, Cheng | Dalian Univ. of Tech.

The stringent quality requirement of petroleum products in highly competitive markets makes on-line controlling of distillation composition essential. In this paper, a novel method using sensitivity matrix analysis and kernel ridge regression to implement on-line estimation of distillation compositions is proposed. In the approach, the sensitivity matrix analysis is presented to select the most suitable secondary variables to be used as the estimator’s inputs. The kernel ridge regression is used to build the composition estimator. The influence of measurement noise on the estimator’s performance is also investigated. Application to a simulated distillation column demonstrates the effectiveness of the method.

11:30-11:50 ThA25.4

Context-Based State Estimation in Semiconductor Manufacturing: Reference Path Based State Transformation Approach, pp. 11949-11954

Su, An-Jhih | National Taiwan Univ.
Yu, Cheng-Ching | National Taiwan Univ.
Jeng, Jyh-Cheng | National Taipei Univ. of Tech.
Huang, Hsiao-Ping | National Taiwan Univ.
Yang, Cheng-Jer | ProMOS Tech. Inc.

Chiou, Hung-Wen — ProMOS Tech. Inc.
Yang, Shu-Ching — ProMOS Tech. Inc.

There are many possible factors in semiconductor manufacturing processes such as metrology tool bias, product type, or chamber that may induce disturbance to the process output. To account for all these types, a context-based model is often used. The most important feature of a context-based system is rank deficiency, and therefore we propose a method that unbiasedly estimates the relative status of each context and process output by state transformation. The transformed states are straightforward and physically meaningful. Furthermore, a solution of planning paths with a guarantee of output performance is also investigated. The other application of particle count estimation for data from a real fab is also demonstrated.

11:50-12:10 ThA25.5

Control of Time-Varying Distributed Parameter Plug Flow Reactor by LQR, pp. 11955-11960

Aksikas, Ilyasse — Univ. of Alberta
Fuxman, Adrian Matias — Univ. of Alberta
Forbes, J. Fraser — Univ. of Alberta

The linear quadratic (LQ) optimal control problem is studied for a partial differential equation model of a time-varying plug flow tubular reactor. First some properties of the linearized model around a specific equilibrium profile are studied. Next, an LQ-control feedback is computed by using the corresponding operator Riccati differential equation, whose solution can be obtained via a related matrix Riccati partial differential equation. The controller is applied to the nonlinear reactor system and tested numerically.

12:10-12:30 ThA25.6

Researches on Load Balancing Control Problem for the Systems with Multiple Parallel Entities Using Differences Control Technique, pp. 11961-11966

Wang, Xingxuan — Fudan Univ.
Zheng, Da-Zhong — Tsinghua Univ.

Load-balancing problem, which covers a large area in engineering fields where several parallel entities share the same load on the systems, is studied. A control technique for solving such problem, called differences control technique (DsCT), is investigated. Two types of systems whose parallel entities can be approximated respectively as an integral and a first-order-plus-dead-time (FOPDT) model are examined. The issue of system balanceability is elaborately addressed, and a sufficient condition for the systems to be balanceable is given. An application example is presented to demonstrate the effectiveness of the DsCT technique for solving the load-balancing problem.

ThA26 — 327

Dynamic Interaction of Power Plants (Regular Session)

Chair: Xu, Tao — Univ. of Durham
Co-Chair: Moon, Un-Chul — ChungAng Univ.

10:30-11:10 ThA26.1

Voltage Control Techniques for Electrical Distribution Networks Including Distributed Generation, pp. 11967-11971

Xu, Tao — Univ. of Durham
Taylor, Philip — Univ. of Durham

For the last three decades, a large scale integration of distributed generation (DG) is beginning to change the electrical distribution network from passive to active. Consequently, technical difficulties are created by significant impacts generated by DGs with voltage variation being the dominant effect. This paper presents a comprehensive review of voltage control techniques on electrical distribution networks connected with DG, recommendations are provided in terms of enhancing network voltage stability and maximising the DG utilisation.

11:10-11:30 ThA26.2

Improvement of the Performance of Scheduled Stepwise Power Programme Changes within the European Power System, pp. 11972-11977

Weissbach, Tobias — Univ. Stuttgart
Welfonder, Ernst — Univ. Stuttgart

Since the deregulation of the electrical energy market, the technical realisation of power transactions based on energy market contracts often effects large stepwise power programme changes – especially at the change of the hour. Originating from mainly economic reasons, these stepwise power programme changes lead to remarkable power imbalances within the European Power System causing large unintended frequency deviations with a negative impact on the control performance of power plants and power system. Within the framework of this paper, possible causes for the resulting poor control performance are analysed. Subsequently, measures for an improvement of the performance of scheduled stepwise power programme changes are proposed.

11:30-11:50 ThA26.3

Application of Model Predictive Control to a Cascade of River Power Plants, pp. 11978-11983

Setz, Cornelia — ETH Zurich
Heinrich, Adrienne — Philips
Rostalski, Philipp — ETH Zurich
Papafotiou, Georgios — ABB Corp. Res.
Morari, Manfred — Swiss Federal Inst. of Tech.

River power plants are important contributors to the over 19% of world electricity produced by hydro-electric plants. Built in the natural course of a river, they produce energy by manipulating the water discharge through their facilities. They therefore introduce fluctuations in the river's natural water level and flow, which might conflict with various constraints imposed for environmental and operational purposes. Motivated by these issues, we present in this paper the application of Model Predictive Control for regulating the turbine discharge of river power plants, taking into account environmental, navigational and economical constraints and limitations. Large disturbances caused by the operation of locks are particularly investigated, as well as the issue of reducing abrasion by keeping the frequency of turbine discharge adjustments modest.

11:50-12:10 ThA26.4

An Adaptive Dynamic Matrix Control of a Boiler-Turbine System, pp. 11984-11989

Lee, Kwang Y. — Baylor Univ.
Lee, Jae-Du — ChungAng Univ.
Moon, Un-Chul — ChungAng Univ.
Lee, Seung-Chul — ChungAng Univ.

This paper proposes an adaptive Dynamic Matrix Control (DMC) and its application to boiler-turbine system. In a conventional DMC, object system is described as a Step Response Model (SRM). However, a nonlinear system is not effectively described as a single SRM. In this paper, nine SRMs at various operating points are prepared. On-line interpolation is performed at every sampling step to find the suitable SRM. Therefore, the proposed adaptive DMC can consider the nonlinearity of boiler-turbine system. The simulation results show satisfactory results with a wide range operation of the boiler-turbine system.

12:10-12:30 ThA26.5

Design and Simulation on Improved Repetitive Controller for Inverted Power Supply, pp. 11990-11994

Jia, Deli — Harbin Univ. of Science and Tech.
You, Bo — Harbin Univ. of Science and Tech.
Zhang, Fengjing — Harbin Univ. of Science and Tech.

Aimed at the inverted power supply control system, an improved repetitive control method has been proposed. It combines repetitive controller with proportion and integral controllers, which improves the inverted power supply's output power performance when the load is nonlinear. Based on this control scheme, a detailed program parameters design for each part of the repetitive controller is proposed and the special Notch function is also introduced. The improved repetitive controller design method was verified by simulation and results showed that improved system has good dynamic and static characteristics, stable voltage accuracy is high; the content of output waveform harmonic dropped to 1.07%, the rate of convergence speed was greatly enhanced.

ThA27 — 326

Flow Control in Internet (Regular Session)

Chair: Roth, Hubert — Univ. Siegen
Co-Chair: Pavel, Lacra — Univ. of Toronto

10:30-10:50 ThA27.1

Metropolis Criterion Based Q-Learning Flow Control for High-Speed Networks, pp. 11995-12000

Li, Xin — Northeastern Univ.
Jing, Yuanwei — Northeastern Univ.
Dimirovski, Georgi Marko — Dogus Univ. of Istanbul

Zhang, Siying — Northeastern Univ.

For the congestion problems in high-speed networks, a Metropolis criterion based Q-learning flow controller is proposed. Because of the uncertainties and highly time-varying, it is not easy to accurately obtain the complete information for high-speed networks. The Q-learning algorithm, which is independent of mathematic model, shows the particular superiority in high-speed networks. It obtains the optimal Q-values through interaction with the environment to improve its behavior policy. The Metropolis criterion of simulated annealing algorithm can cope with the balance between exploration and exploitation in Q-learning. By means of learning procedures, the proposed controller can learn to take the best action to regulate source flow with the features of high throughput and low packet loss ratio. Simulation results show that the proposed method can promote the performance of the networks and avoid the occurrence of congestion effectively.

10:50-11:10 — ThA27.2

State-Space Approach to Pricing Design in OSNR Nash Game, pp. 12001-12006

Zhu, Quanyan — Univ. of Toronto
Pavel, Lacra — Univ. of Toronto

The static nature of the noncooperative power control game model in optical networks makes it difficult to study and design an appropriate pricing scheme. In this paper, we derive a first-order best response dynamics from the game-theoretical model and formulate a general multi-input and multi-output (MIMO) state-space model. We use classical linear system theory to explain the controllability of the pricing and the observability of the power states. We use the output regulator theory to design a pricing policy for the network for a given optical signal-to-noise ratio (OSNR) target.

11:10-11:30 — ThA27.3

Observer-Based Robust Controller Design for Active Queue Management, pp. 12007-12012

Zhou, Yucheng — Department of Res. Inst. of Wood Industry Chinese
Wang, Hongwei — Northeastern Univ.
Jing, Yuanwei — Northeastern Univ.
Liu, Xiaoping — Northeastern Univ.

In this paper, an observer–based controller is designed for the problem of congestion control . In TCP/IP networks, the packets-dropping probability function is considered as a control input. Therefore, the work described here is to design robust observer controller, which is aimed at robust stabilization of network system with uncertainties, input delay and a saturated input. The controller is used to estimate online the average trasmission window and achieve the desired queue length. By applying the Lyapunov-Krasovskii function approach and the linear matrix inequality technique, control law is derived. Simulation experiments have been carrier out and the results demonstrate this scheme can achieve transient and steady-state responses. The results also show that this scheme outperformance the tradition PI controller.

11:30-11:50 — ThA27.4

Sliding Mode Control for Uncertain Time-Delay TCP/AQM Network Systems, pp. 12013-12018

Wang, Hongwei — Northeastern Univ.
Jing, Yuanwei — Northeastern Univ.
Zhou, Yucheng — Department of Res. Inst. of Wood Industry Chinese
Chen, Zhaona — Northeastern Univ.
Liu, Xiaoping — Northeastern Univ.

For TCP linear dynamic systems with input time-varying and mismatched uncertainties, we propose an active queue management (AQM) scheme based on sliding mode control (SMC), which is aimed at robust stabilization of delay and uncertainties network system .The original uncertain time-delay system was first transformed into a delay-free system. Then based on the transformed system, an improved sliding mode control (ISMC) strategy is proposed; the robust sliding hyperplane is constructed from LMI with stability. The simulation experiments indicate that this scheme can track queue length very quickly under various network conditions, the system have strong robustness .The results also that this scheme outperformance the known ones with the traditional either proportional-plus-intergral or sliding mode controls.

11:50-12:10 — ThA27.5

A Passive Network Measurement-Based Traffic Control Algorithm in Gateway of P2P Systems, pp. 12019-12023

Jiang, Yibo — Zhejiang Univ. of Tech.
Chen, Weijie — Zhejiang Univ. of Tech.
Wang, Wanliang — Zhejiang Univ. of Tech.
Zheng, Jianwei — Zhejiang Univ. of Tech.
Zhao, Yanwei — Zhejiang Univ. of Tech.

With the progress of peer-to-peer technology, P2P applications have evolved and established themselves as the leading ‘growth app’ of Internet traffic workload. In order to reserve enough bandwidth for other applications, gateway of P2P systems must control P2P's traffic. In this paper, passive network measurement of P2P traffic is introduced, and network behaviors of some P2P applications are discussed. Then, one model of receiving and forwarding P2P packets is constructed. One algorithm of traffic control in P2P is designed, which includes two important factors: rejection probability of P2P request and disconnection probability of P2P channel. The results of two parallel experiments show that control algorithm of P2P traffic based on network measurement can reserve enough network resource without disabling all P2P packets.

ThA28 — 330A

Flexible Structure Diagnosis and Health Monitoring (Regular Session)

Chair: Agrawal, Brij — Naval Postgraduate School
Co-Chair: Alazard, Daniel — ONERA-CERT / SUPAERO

10:30-10:50 — ThA28.1

An Adaptive Statistical Approach to Flutter Monitoring, pp. 12024-12029

Zouari, Rafik — IRISA/INRIA
Mevel, Laurent — IRISA/INRIA
Basseville, Michele — IRISA/CNRS

Flutter is a critical instability phenomenon for aircrafts. In previous investigations, the authors have proposed several online statistical subspace-based algorithms for flutter monitoring. Each algorithm monitors some stability criterion (damping, flutter margin...) w.r.t. a fixed reference flight point using the online Cusum test. The drawback of this technique is that the flutter detection corresponds to a light trend of the criterion toward instability and thus the estimated flutter airspeed is conservative. In this paper, a new moving reference version is proposed which intends to give a better estimation of the flutter airspeed. Application on simulation data shows the relevance of the new algorithm

10:50-11:10 — ThA28.2

Fault-Tolerant Control Using Dynamic Inversion and Model Predictive Control Applied to an Aerospace Benchmark, pp. 12030-12035

Joosten, Diederick — Delft Univ. of Tech.
van den Boom, Ton J. J. — Delft Univ. of Tech.
Lombaerts, Thomas — Delft Univ. of Tech.

This paper features the combination of model-based predictive control and dynamic inversion into a constrained and globally valid control method for fault-tolerant flight-control purposes. The fact that the approach is both constrained and model-based creates the possibility to incorporate additional constraints, or even a new model, in case of a failure. Both of these properties lead to the fault-tolerant qualities of the method. Efficient distribution of the desired control moves over the control effectors creates the possibility to separate the input allocation problem from the inversion loop when redundant actuators are available. An important part of this paper consists of the application of the proposed theory to an aerospace benchmark of high complexity. It is shown through an example that the theory is well-suited to the task, provided that fault-detection and isolation information is available continuously.

11:10-11:30 — ThA28.3

Development of a Robust Model-Based Fault Diagnosis Technique for Reusable Launch Vehicles. a Case Study, pp. 12036-12041

Falcoz, Alexandre — Univ. of Bordeaux1, IMS Lab.
Henry, David — Univ. Bordeaux I
Zolghadri, Ali — Univ. Bordeaux I

This paper deals with the design of robust Fault Detection and Isolation (FDI) filters for atmospheric re-entry vehicles subjected to actuator faults. The FDI technique is based on carefully chosen linear models of the controlled vehicle about the available on-board reference trajectories. The modelling process allows for both Lateral/directional and longitudinal motions. Design trade-offs are formulated and managed as H_infinity/H_minus specifcations. Nonlinear simulations show the effectiveness of the proposed scheme despite atmospheric disturbances and measurement noises.

11:30-11:50 ThA28.4

On Learning Compressed Diagnosis Classifiers, pp. 12042-12047

Provan, Gregory — Univ. Coll. Cork

We address the problem of embedding a model-based diagnostic system representation within a processor with limited memory (as is typical of most real-world aerospace systems). Given a Boolean diagnostic model f in which we have a probability distribution over fault likelihoods, we describe a method for approximately generating an embedded representation of f by learning a decision tree that encodes only the probabilistically most-likely diagnoses. If the set of possible diagnoses follows a power-law distribution, we show that we can create decision trees that contain the vast majority of the probability mass of the full decision tree, but require significantly less memory than the full decision tree.

11:50-12:10 ThA28.5

Digital Filters for Gain Stabilization of Flexible Vehicle Dynamics, pp. 12048-12053

Samar, Raza — National Engineering & Scientific Commission

The necessity of having low-cost aerospace vehicles with short development times means that control designers need to work with simplified and approximate dynamic models. Aerospace vehicles typically being light and slender, exhibit body bending and flexibility effects at relatively lower frequencies. It may not be possible or practical in every case to carry out detailed test and analyses exercises to determine the structural dynamic characteristics of a vehicle. So, body bending shapes and slopes may not be precisely known; the mode frequencies can however be roughly estimated through simplified analysis. Here it will be assumed that the flexible mode frequencies are approximately known, and are sufficiently high so that gain stabilization is possible. This paper discusses different digital filters for gain stabilization of flexible vehicles, and elaborates their advantages and drawbacks. Various filters are compared; Butterworth, Bessel, Chebychev, Elliptical and simple quadratic filters of various orders are discussed. The filter selection is based on having desirable magnitude attenuation characteristics while at the same time leading to minimum phase lag near the closed-loop bandwidth. The filter design and selection process is illustrated by an example of a sounding rocket stabilization problem. Two flights of the vehicle have been conducted, the first with no consideration of the body-bending dynamics and hence no filters. Serious problems were observed, hence Elliptic filters were used to provide gain stabilization in the second flight. Flight test results are presented and discussed.

12:10-12:30 ThA28.6

Rest-To-Rest Slew Maneuver of Three-Axis Rotational Flexible Spacecraft, pp. 12054-12060

Kim, Jae Jun — Naval Postgraduate School
Agrawal, Brij — Naval Postgraduate School

This paper presents a slew maneuver control design of three-axis rotational flexible spacecraft. The focus of the work is to investigate the nonlinear effect of the three axis maneuver for a flexible spacecraft when a vibration suppression technique for linear systems such as input shaping is used in the control design. A simple method of slewing three-axis rotational spacecraft using input shaping is proposed and the proposed technique is implemented on an experimental three-axis spacecraft simulator.

ThA29 330B

Automotive Systems Control (Regular Session)

Chair: Liu, Li — Department of Mechanical System Engineering,TokyoUniversity of Agriculture and Tech.
Co-Chair: Chang, Jae Kyun — CARNES Co. Ltd.

10:30-10:50 ThA29.1

Automotive Systems Engineering, pp. 12061-12064

Chang, Jae Kyun — CARNES Co. Ltd.

Automotive Systems engineering is the key technology for many innovations in vehicle construction. In Vehicle development, quality control, risk and cost management is an important precondition for successful and on-time projects, in addition to expertise in increasing complexity. To realize increasing demands concerning safety, economic impact, fuel consumption, comfort and high quality a coordinated and systematic development process is essential in this contribution. Based on functional and non functional requirements, an open and modular system architecture must be designed. This system architecture, as the basis for the system design and implementation, support aspects like re-use, function partitioning, scalability and distributed development with well defined system interfaces. Furthermore, a hierarchical decomposition of the system into sub system and the necessity to realize a system by using different technical and physical principles will be the main topics out of system engineering and architecture design.

10:50-11:10 ThA29.2

NCGPC with Dynamic Extension Applied to a Turbocharged Diesel Engine, pp. 12065-12070

Dabo, Marcelin — Univ. de Rouen
Langlois, Nicolas — IRSEEM / ESIGELEC
Respondek, Witold — Inst. National des Sciences Appliquees
Chafouk, Houcine — IRSEEM / ESIGELEC

This paper presents a control design method applied to diesel engines equipped with a Variable Geometry Turbocharger (VGT) and an Exhaust Gas Recirculation (EGR) valve. The objective of this control is to reduce gas pollution to the fixed rate norms imposed by Euro v and Euro vi, Arnold et al. [2006] (Transport and E. E. Federation [2004] and Umweltbundesamt [2003]) without loosing the torque power of the controlled Turbocharged Diesel Engine (shortly, TDE). To achieve this, we propose to control Air Fuel Ratio (AFR) and EGR Fraction. But these variables are not accessible for measurements, Jankovic et al. [2000]. Therefore the gas pressure in the intake manifold and the compressor mass flow rate are preferred. Those outputs, however, lead to a non-minimum phase system. To avoid this, another choice of outputs is proposed which, together with a dynamic extension, yields a linearizable system with trivial zero dynamics, to which we apply Nonlinear Continuous-time Generalized Predictive Control. Simulation results are presented to highlight efficiency of the controller.

11:10-11:30 ThA29.3

A Study of Predicting Model of an Electrical Energy Balance for a Conventional Vehicle, pp. 12071-12072

Kim, Sungtae — Hyundai Motor Co.
Chung, Seungmyun — Hyundai Motor Co.
Shin, Wanjae — Hyundai Motor Company
Lee, Je Been — HMC

To the automobile the various electricity and electronic devices are increasing recently, it is difficult for predicting the electric energy balance. This paper is for a simulation program of electrical power system for a conventional vehicle. The electrical power system of vehicle is composed of battery, alternator and electric loads. Major components of the vehicle electrical power system are battery and alternator. The battery modeling is applied by an equivalent circuit method on a basis of lab test data. The simulation results are verified by the experimental data from the vehicle and this simulation program can be applied to other kinds of vehicles by obtaining of extensive test data.

11:30-11:50 ThA29.4

On Torque Control of Handling and Steering Feel for Avoidance Maneuver with Electric Power Steering, pp. 12073-12078

Liu, Li — Department of Mechanical System Engineering,TokyoUniversity of A
Nagai, Masao — Tokyo Univ. of Agriculture and Tech.
Raksincharoensak, Pongsathorn — Tokyo Univ. of Agriculture and Tech.

This paper evaluates EPS control strategies for improving vehicle handling and steering feel during high speed avoidance maneuver. Theoretical analysis of frequency response of steering angle and vehicle lateral acceleration relative to steering torque input is performed. Closed-loop simulation studies are also conducted by adopting a driver model to describe the human steering behavior. Based on the study, EPS control strategies of steering torque assistance and damping compensation are investigated. The results show the effectiveness of EPS to improve vehicle responsiveness and stability, to reduce steering effort, and to realize comfortable steering feel for high speed avoidance maneuver.

11:50-12:10 ThA29.5

FlexRay Communication for the High Speed Distributed Control System, pp. 12079-12080

Kim, Seunghoon — Hyundai-Kia Motors

The FlexRay communication has been developed by FlexRay consortium which is consisted of more than 120 automotive industry companies to fulfill the requirement for the high speed communication for high performance distributed control system in vehicle. In this paper we explain the FlexRay communication and compare the FlexRay with CAN protocol. Then we will discuss the requirement for the high speed distributed control system and consider the FlexRay protocol for this system.

12:10-12:30 ThA29.6

A Reliable Gateway for In-Vehicle Networks, pp. 12081-12086

Seo, Suk-Hyun — Sungkyunkwan Univ.
Kim, Jin-Ho — Sungkyunkwan Univ.
Moon, Tae-Youn — Sungkyunkwan Univ.
Kwon, Key Ho — Sungkyunkwan Univ.
Hwang, Sung-Ho — Sungkyunkwan Univ.
Jeon, Jae Wook — Sungkyunkwan Univ.

This paper presents a reliable gateway for communication between the LIN, CAN, FlexRay protocols. A gateway is indispensable device for constructing in-vehicle networks. Networks with different protocols have to include an additional gateway in order to exchange information among different networks. The main function of the gateway is translation. However, there is some latency when a message is transferred from one node (source) to another (destination); further, there is a high probability of error due to different protocol specifications such as baudrates, message frame formats, and so on. Therefore the implementation of a reliable gateway is a challenging task. In this paper, we propose a reliable gateway based on OSEK OS and OSEK NM for in-vehicle networks. We develop a gateway embedded system and implement a reliable gateway mechanism. We then examine the developed gateway system and present the results of experiments with several trials.

ThA30 — 330C

Multi-Vehicle Systems II (Regular Session)

Chair: Pagilla, Prabhakar R. — Oklahoma State Univ.
Co-Chair: Fidan, Baris — National ICT Australia

10:30-10:50 ThA30.1

Hierarchical UAV Formation Control for Cooperative Surveillance, pp. 12087-12092

Sutton, Andrew — ANU
Fidan, Baris — National ICT Australia
van der Walle, Dirk — ANU

In this paper, we analyze the problem of rigidly maintaining a formation of three unmanned aerial vehicles (UAVs), whilst surveying a region of interest following, as a team, a particular pre-defined (spiral) trajectory. The UAVs in the formation are constrained to fly at constant speeds and to maintain certain pre-defined inter-agent distances. A decentralized proportional-integral (PI) control scheme (involving certain nonlinear switching terms) is developed for the surveillance and formation maintenance tasks above, based on a hierarchical (i.e. leader-first follower-second follower) sensing and control structure.

10:50-11:10 ThA30.2

Multi-UAV Cooperative Fault Detection Employing Vision Based Relative Position Estimation, pp. 12093-12098

Heredia, Guillermo — Univ. of Seville
Caballero, Fernando — Univ. of Seville
Maza, Ivan — Univ. of Seville
Merino, Luis — Pablo de Olavide Univ.
Viguria, Antidio — Univ. of Seville
Ollero, Anibal Ollero — Escuela Superior de Ingenieros - Univ. de Sevilla

This paper presents a method to increase the reliability of UAV sensor fault detection in a multi-UAV context. The method uses additional position estimations that augment individual UAV fault detection system. These additional estimations are obtained using images from the same planar scene taken from two different UAVs. Since accuracy and noise level of the estimation depends on several factors, dynamic replanning of the multiUAV team can be used to obtain a better estimation in case of faults caused by slow growing errors of absolute position estimation that cannot be detected by using local FDI in the UAVs. Experimental results with data from two real UAVs are also presented.

11:10-11:30 ThA30.3

Leader-Following Formation Navigation for Multiple Robots with Collision Avoidance, pp. 12099-12104

Sakurama, Kazunori — The Univ. of Electro-Communications
Nakano, Kazushi — the Univ. of Electro-Communications

This paper deals with a collision avoidance problem in leader-following formation navigation for multiple mobile robots. Because followers should move along a leader's trajectory, we first try to avoid collisions by adjusting their velocities on the trajectory. This strategy causes delays of the followers from the leader, which is often problematic because we cannot predict how late the followers will be from the leader. Moreover, there are situations that the robots cannot avoid collisions only with this strategy. If the leader goes straight and turns back toward the followers suddenly, the followers have to move back along the trajectory where the leader just moved. In this case, the followers would be better off moving around to the back of the leader and recover their delays even if they go away from the specified trajectory. From these viewpoints, this paper proposes a collision avoidance method for leader-following formation navigation taking into account both the tracking errors and the delays of the followers from the leader. This method adjusts the velocity of each follower, as well as modifies the shape of the trajectory if a delay becomes too large. The effectiveness of the proposed method is demonstrated by a simulation with three mobile robots.

11:30-11:50 ThA30.4

A Distributed Constraint Force Approach for Coordination of Multiple Mobile Robots, pp. 12105-12110

Zou, Yunfei — Oklahoma State Univ.
Pagilla, Prabhakar R. — Oklahoma State Univ.

A new approach to coordination of multiple mobile robots is presented in this paper. The approach relies on the notion of constraint forces which are used in the development of the dynamics of a system of constrained particles with inertia. A familiar class of dynamic, nonholonomic robots are considered. The goal is to design a distributed coordination control algorithm for each robot in the group to achieve, and maintain, a particular formation while ensuring navigation of the group. The theory of constraint forces is used to generate a stable control algorithm for each mobile robot that will achieve, and maintain, a given formation. The advantage of the proposed method is that the formation keeping forces (constraint forces) cancel only those applied forces which act against the constraints. Another feature of the proposed distributed control algorithm is that it allows to add/remove other mobile robots into/from the formation gracefully with simple modifications of the control input. Further, the algorithm is scalable. To corroborate the theoretical approach, simulation results on a group of six robots are shown and discussed.

11:50-12:10 ThA30.5

LMI-Based Control of Vehicle Platoons for Robust Longitudinal Guidance, pp. 12111-12116

Maschuw, Jan Philipp — RWTH Aachen Univ.
Kessler, Guenter C. — RWTH Aachen Univ.
Abel, Dirk — RWTH-Aachen Univ.

This paper presents a novel approach to control layout for longitudinal guidance of platoons with a limited number of vehicles. It accounts for both the reduction of spacing errors and a limitation in velocities and accelerations of following vehicles to avoid saturations. All criteria can be expressed using a mixed H-2/H-infinity problem formulation. The objectives are formulated as one set of linear matrix inequalities that are solved for the controller. The optimization is presented for different control structures and the effectiveness of reducing overshoots in velocities or accelerations is shown through simulation results. This work also considers structural constraints concerning the information available to the controller and evaluates a sequential control algorithm applying the same layout method. Finally, the effects of changing parameters of the vehicle's drivetrain are analyzed and robustness of the presented controllers is investigated.

12:10-12:30 ThA30.6

Optimal Trajectories for Homing Navigation with Bearing Measurements, pp. 12117-12123

Bishop, Adrian — Deakin Univ.
Pathirana, Pubudu N. — Deakin Univ.

In this paper we examine the geometry of a number of navigation schemes for guiding a pursuer from a fixed initial position to a final target position. We explicitly characterize the optimal pursuer trajectories for the given problems in terms of minimizing the error in an unbiased estimate of the target position from successive bearing measurements made along the trajectory.

ThB02 304A

Nonlinear Output Regulation (Regular Session)

Chair: Ding, Zhengtao — The Univ. of Manchester
Co-Chair: Oguchi, Toshiki — Tokyo Metropolitan Univ.

14:00-14:20 ThB02.1

Solvability of the Regulator Equation: L^2-Space Approach, pp. 12124-12128

Rehak, Branislav — Inst. of Information Theory and Automation, Acad. of Scien

An alternative method for the proof of solvability of the differential equation that is a part of the Regulator Equation which arises from the solution of the Output Regulation Problem. The proof uses the standard Hilbert-space based theory of solutions of elliptic partial differential equations for the case of the linear Output Regulation Problem. In the nonlinear case, a sequence of linear equations is defined so that their solution converges to the solution of the nonlinear problem. This is proved using the Banach Contraction Theorem.

14:20-14:40 ThB02.2

Design of Continuous and Discontinuous Output Regulators for a MAGLEV System, pp. 12129-12134

Rivera, Jorge — Univ. de Guadalajara
Loukianov, Alexander G. — CINVESTAV IPN GDl
Castillo-Toledo, Bernardino — CINVESTAV-GDL, Mexico

This work presents the design of continuous and discontinuous output regulators for a magnetic levitation (MAGLEV) system, for asymptotic output trajectory tracking and disturbance rejection. The nonlinear full information case is considered for both regulators. Then by numerical simulations one compares the performance of both control strategies, under criteria as transient response, steady-state accuracy, feasibility of control implementation and parameter sensitivity. The superior performance of the discontinuous regulator is then put in evidence by the obtained results.

14:40-15:00 ThB02.3

Global Robust Output Regulation of Nonlinear Strict Feedforward Systems, pp. 12135-12140

Chen, Tianshi — The Chinese Univ. of Hong Kong
Huang, Jie — The Chinese Univ. of Hong Kong

This paper studies the global robust output regulation of nonlinear strict feedforward systems. By utilizing the general framework for tackling the output regulation problem [Huang and Chen, 2004], the output regulation problem is converted into a global robust stabilization problem for a general class of nonlinear feedforward systems that is subject to both dynamic uncertainty and time-varying static uncertainty.

15:00-15:20 ThB02.4

Global Output Regulation of Nonlinear Time-Delay Output Feedback Systems with Unknown Exosystems, pp. 12141-12146

Chen, Cailian — The Univ. of Manchester
Ding, Zhengtao — The Univ. of Manchester

The output regulation problem for nonlinear time-delay systems can be solved under the assumptions that certain integral regulator equations are solvable and the full information of exosystems is available. This paper shows that these two assumptions can be removed for a class of nonlinear time-delay output feedback systems by introducing a transfer matrix dependent on the system delays. Based on a filtered transformation and an adaptive control, a global output regulation method is developed in this paper for a class of nonlinear time-delay output feedback systems under disturbances generated from unknown exosystems.

15:20-15:40 ThB02.5

Certainty Equivalence in Nonlinear Output Regulation with Unmeasurable Regulated Error, pp. 12147-12152

Celani, Fabio — Sapienza Univ. of Rome

In the present paper we consider a general nonlinear output regulation problem in which the regulated error is unmeasurable. It is assumed that the interconnection of the controlled plant with the exosystem observed through the measured output satisfies some appropriate observability conditions that allow the design of an asymptotic observer. Then, the contribution of this paper consists in showing that in the latter scenario, a design based on certainty equivalence is effective for determining a controller that achieves semiglobal output regulation.

15:40-16:00 ThB02.6

Synchronization of Four Identical Nonlinear Systems with Time-Delay, pp. 12153-12158

Oguchi, Toshiki — Tokyo Metropolitan Univ.
Nijmeijer, Hendrik — Eindhoven Univ. of Tech.
Yamamoto, Takashi — Tokyo Metropolitan Univ.
Kniknie, Thijs — Eindhoven Univ. of Tech.

This paper considers the synchronization problem for four identical nonlinear systems coupled with time-delay. We have already studied the synchronization problem for bidirectional two coupled systems with delays and derived sufficient conditions to synchronize the systems. In this paper, these approaches are extended for four identical chaotic systems unidirectionally or bidirectionally coupled using state or output feedback with time-delays. Firstly, we show, using the small-gain theorem, that trajectories of coupled strictly semi-passive systems converge to a bounded region. Then we derive sufficient conditions for synchronization of coupled systems. The derived conditions are based on the delay-dependent Lyapunov-Krasovskii approach, and the criteria are obtained in the form of linear matrix inequalities (LMIs). The effectiveness of the derived conditions is illustrated by numerical examples.

ThB03 304B

Nonlinear Predictive Control (Regular Session)

Chair: Kouvaritakis, Basil — Oxford Univ.
Co-Chair: Nagy, Zoltan K. — Loughborough Univ.

14:00-14:20 ThB03.1

A Dual Mode MPC Scheme for Nonlinear Processes, pp. 12159-12164

Gutiérrez González, Luisa Paulina — National Univ. of Colombia
Odloak, Darci — Univ. of São Paulo - Brazil
Sotomayor, Oscar — Pol. School of the Univ. of Sao Paulo
Alvarez, Hernan — National Univ. of Colombia

This paper presents a new dual mode nonlinear model predictive controller (NMPC) that is based on the combination of the finite horizon NMPC with the infinite horizon predictive controller (IHMPC). The resulting nonlinear controller is shown to be stable when the IHMPC is globally stabilizing. The main advantage of the proposed controller in comparison to the IHMPC is a better performance as the model nonlinearities are taken into account in the computation of the control law. The advantage of the proposed controller compared to the existing dual mode NMPC is that constraints are also considered in the linear controller that is supposed to control the system when the state enters the terminal set. The performance of the proposed controller is compared to the stable IHMPC through simulation of an industrial styrene polymerization reactor.

14:20-14:40 ThB03.2

Fast Nonlinear Model Predictive Control Using Set Membership Approximation, pp. 12165-12170

Canale, Massimo — Pol. di Torino
Fagiano, Lorenzo — Pol. di Torino
Milanese, Mario — Pol. di Torino

Set Membership function estimation methodologies under the Nearest Point approach are employed to compute an approximating function for a nonlinear model predictive controller (NMPC). The method is based on the off-line computation of a finite number nu of exact NMPC control solutions. The obtained approximating functions fulfill input constraints, have computational time which is independent on the control horizon and guarantee a level of accuracy which tends to zero by increasing nu. A nonlinear oscillator example is used to demonstrate the effectiveness of the presented results.

14:40-15:00 ThB03.3

A New Nonlinear Predictive Control Approach Using Hammerstein Models with Compensation Term, pp. 12171-12176

Casillo, Danielle Simone S. — Federal Univ. of Rio Grande do Norte
Maitelli, André Laurindo — Federal Univ. of Rio Grande do Norte
Barros Fontes, Adhemar — Federal Univ. of Bahia

In this paper is presented a contribution for development and implementation of nonlinear predictive control based on Hammerstein models as well as to make properties evaluation. In this work, nonlinear predictive control development has been used the time-step linearity method and a compensation term is used with an objective to make better the controller performance. An example demonstrating the viability of the proposed methodology is presented.

15:00-15:20 ThB03.4

Nonlinear Model Predictive Control of an Industrial Batch Reactor Subject to Swelling Constraint, pp. 12177-12182

Simon, Levente — ETH Zurich
Nagy, Zoltan K. — Loughborough Univ.
Hungerbuehler, Konrad — ETH Zurich

This paper presents the application of nonlinear model predictive control (NMPC) to a simulated industrial batch reactor subject to safety and productivity constraints due to swelling. The catalyst used in the chemical process decomposes in the reactor; therefore it is fed in discrete time steps during the batch. Although the optimal reactor temperature profile, using a fixed catalyst dosing policy, is optimized off-line an on-line control solution is needed in order to accommodate the reaction rate and level disturbances which arise due to catalyst dosing uncertainty (feeding time, mass and purity). The on-line control method is based on the shrinking horizon optimal control methodology and it uses a reaction and hydrodynamic model. It is concluded that the implemented shrinking horizon on-line optimization strategy is able to calculate the optimal temperature profile without causing level swelling.

15:20-15:40 ThB03.5

Nonlinear One-Step Predictive Control of an Active Magnetic Bearing, pp. 12183-12188

Bonnet, Stéphane — Univ. de Tech. de Compiegne
De Miras, Jérôme — UMR HeuDiaSyC CNRS 6599
Vidolov, Boris — Univ. de Tech. de Compiegne

This paper deals with the stabilization of a five degree-of-freedom active magnetic bearing using a novel predictive nonlinear control approach. That approach is based on using a simplified nonlinear model of the bearing axes without considering couplings to synthesize a discrete-time controller. The controller is then able to stabilize the load with predetermined linear dynamics that form the control design parameters. Simulations and experimental results obtained from a laboratory bearing show the robustness of the proposed controller, both in terms of modeling errors and perturbation rejection.

15:40-16:00 ThB03.6

Periodic Use of Time-Varying State Feedbacks for the Receding Horizon Control of Bilinear Systems, pp. 12189-12193

Lee, Young Il — Seoul National Univ. of Tech.
Kouvaritakis, Basil — Oxford Univ.
Cannon, Mark — Univ. of Oxford

This paper provides a receding horizon control method for bilinear systems in the presence of input constraints. Periodically-invariant sets are derived for a bilinear system with respect to a series of time-varying state feedback gains. The dual-mode control strategy is adopted and the periodically-invariant sets are used as target invariant sets. The state feedback gains used to define the target invariant sets are also used to render degrees of freedom to steer the current state into the target set.

The region of attraction for the proposed algorithm is enlarged significantly with an extension of the horizon of periodicity while the on-line computation remains easy to handle.

ThB04 308

Tracking Control Applications (Regular Session)

Chair: Bensoussan, David — École de Tech. supérieure - Univ. of Quebec
Co-Chair: Li, Shihua — Southeast Univ.

14:00-14:20 ThB04.1

Adaptive Tracking Control for an Overhead Crane System, pp. 12194-12199

Ma, Bojun — Nankai Univ.
Fang, Yongchun — Nankai Univ.
Zhang, Xuebo — Nankai Univ.

This paper proposes an adaptive control method for an underactuated overhead crane system. To improve the transferring efficiency and enhance the security of the crane system, the trolley is required to reach the desired position as fast as possible, while the swing of payload needs to be within an acceptable domain. To achieve these objectives, a novel two-step design strategy consisting of a trajectory planning stage and an adaptive tracking control design stage, is proposed to attack such an underactuated system as overhead crane. In the first step this paper proposes a new S curve as the desired trajectory for trolley tracking, and in the second step, it constructs an adaptive control law to make the trolley track the planned trajectory. As shown by Lyapunov Techniques, the proposed adaptive controller guarantees an asymptotical tracking result even in the presence of uncertainties including system parameters and various disturbances. Simulation results demonstrate that he new S trajectory and the tracking controller achieves a superior performance for the underactuated cranes.

14:20-14:40 ThB04.2

Arbitrarily Fast Tracking Feedback Systems for a Class of Nonlinear Plants, pp. 12200-12205

Bensoussan, David — École de Tech. supérieure - Univ. of Quebec
Hammami, Maher — faculté des sciences

Abstract: In the present article it is proved that stability can be ensured by quasi-linear compensators for plants with global Lipschitz nonlinearity. In the present article, it is shown that arbitrarily fast tracking can be obtained achieved using quasi-linear feedback are explored for various numbers of poles in excess of zeros in a given plant. This is a study of the intrinsic capability of feedback systems to achieve arbitrarily high per¬formance because in industrial applications the raise of the gain is limited by hardware protection.

14:40-15:00 ThB04.3

Trajectory Tracking Controller Design for an Unmanned Air Vehicle, pp. 12206-12211

Natesan, Kannan — Univ. of Leicester
Gu, Dawei — Univ. of Leicester
Postlethwaite, Ian — the Univ. of Leicester

This paper presents a complete trajectory tracking controller design for an Unmanned Air Vehicle using Linear Parameter Varying design methods. The longitudinal and lateral controllers are designed using an inner loop – outer loop structure with the inner loop LPV controller designed using Ŀ;-synthesis. The inner-loop is then approximated with a reference model and the outer loop is designed using loop-shaping techniques. Full scale nonlinear simulations are used to test the efficiency of the designed controller and of the proposed design approach.

15:00-15:20 ThB04.4

Finite-Time Tracking Control of a Nonholonomic Mobile Robot, pp. 12212-12217

Wang, Zhao — Southeast Univ.
Li, Shihua — Southeast Univ.
Fei, Shumin — Southeast Univ.

In this paper, the finite-time tracking problem is investigated for a nonholonomic wheeled mobile robot in a fifth-order dynamic model. We consider the whole tracking error system as a cascaded system. Two continuous global finite-time stabilizing controllers are designed for a second-order subsystem and a third-order subsystem respectively. Then finite-time stability results for cascaded systems are employed to prove that the closed-loop system satisfies the finite-time stability. Thus the closed-loop system can track the reference trajectory in finite-time when the desired velocities satisfy some conditions. In particular, we discuss the control gains selection for the third-order finite-time controller and give sufficient conditions by using Lyapunov and backstepping techniques. Simulation results demonstrate the effectiveness of our method.

15:20-15:40 ThB04.5

On Feedback Linearization for Robust Tracking Control of Flexible Joint Robots, pp. 12218-12223

Moberg, Stig — ABB AB - Robotics
Hanssen, Sven — ABB Automation Tech.

Feedback linearization is one of the major academic approaches for controlling flexible joint robots. This contribution investigates the discrete-time implementation of the feedback linearization approach for a realistic three-axis robot model. A simulation study of high speed tracking with model uncertainty is performed. It is assumed that full state measurements of the linearizing states are available. The feedback linearization approach is compared to a feedforward approach.

15:40-16:00 ThB04.6

Tracking Control of a Induction Motor: An Output Feedback Approach, pp. 12224-12229

Araujo, Gustavo — Univ. de Los Andes
Ríos-Bolívar, Miguel — Univ. de Los Andes
Lischinsky, Pablo — Univ. de Los Andes

In this work the output feedback tracking problem for the angular position of a induction motor driving a mechanical load is addressed. It is assumed that the two rotor flux variables are not measured whilst the two stator current variables and also the angular position and velocity are available for feedback. The employed approach consists of the asymptotic reconstruction of a full state feedback stabilizing control law, without using a Lyapunov function and by applying a separation principle. Firstly, a Backstepping tracking controller is considered, then, a dynamic output feedback is synthesized for the two voltage control inputs, which asymptotically recovers the Backstepping control law.

ThB05 307

Adaptive Control II (Regular Session)

Chair: Leva, Alberto — Pol. di Milano
Co-Chair: Chen, Xinkai — Shibaura Inst. of Tech.

14:00-14:20 ThB05.1

An ILC-Based Minimum Entropy PI Controller for Unknown and Non-Gaussian Stochastic Systems, pp. 12230-12235

Ghasemi Afshar, Puya — The Univ. of Manchester
Wang, Hong — the Univ. of Manchester

In this paper, a new adaptive control algorithm is presented for unknown nonlinear and non-Gaussian stochastic systems. The method combines the minimum entropy control with an Iterative Learning Control (ILC) framework, where the control horizon is divided into a number of time-domain intervals called Batches. Within each batch a PI controller is used to control the plant so as to achieve the required tracking performance, where a neural network is used to learn the dynamics of the unknown plant. Between any two adjacent batches, a D-type ILC law is applied to tune the PI control coe±cients so that the tracking error entropy for the closed loop system is reduced batch by batch. The analysis on the ILC convergence is made and a set of demonstrable experiment results on a test rig are also provided to show the effectiveness of the obtained adaptive control algorithm.

14:20-14:40 ThB05.2

Direct Fuzzy Tracking Control of a Class of Nonaffine Stochastic Nonlinear Systems with Unknown Dead-Zone Input, pp. 12236-12241

Yu, Jian Jiang — Southeast Univ.
Zhang, Kan_Jian — Southeast Univ.
Fei, Shumin — Southeast Univ.

In this paper, a direct adaptive fuzzy tracking control scheme is presented for a class of stochastic nonaffine uncertain nonlinear systems with unknown dead-zone input. Based on the first-type fuzzy logic system's online approximation capability, a direct adaptive fuzzy tracking controller is developed by using the backstepping approach. It is proved that the design scheme ensures that all the error variables are bounded in probability while the mean square tracking error becomes semiglobally uniformly ultimately bounded(SGUUB) in an arbitrarily small area around the origin. Simulation results show the effectiveness of the control scheme.

14:40-15:00 ThB05.3

Parallel Disturbance Force Compensator for Electrical Machines, pp. 12242-12247

Zenger, Kai — Helsinki Univ. of Tech.
Sinervo, Anssi — Helsinki Univ. of Tech.
Orivuori, Juha — Helsinki Univ. of Tech.
Laiho, Antti — VTT Tech. Res. Centre of Finland
Tammi, Kari — VTT Tech. Res. Centre of Finland

The objective of the research is to diminish unwanted forces generated by rotation and unbalanced rotor mass on the rotor of an electrical machine. These forces, dependent on rotational speed, cause vibration that, when occurring in the machine's natural frequency, causes severe problems. Extra windings are built in the stator of the machine, and they are supplied with current to create an opposite force to the vibration. The main task is to develop a new controller to the system, in order to continuously provide the needed voltage input to the new actuator. The system was first modeled for finite element model (FEM) software, and based on FEM simulations a simplified state-space model was identified. Separate models for the rotor mechanics and for the actuator were created for convenience. Input to the actuator model was voltage given by the controller, and the output was the compensating force to the rotor. The rotor model mapped total input force of rotor to displacement, vibration. There was an internal feedback from rotor displacement to actuator, which was taken into account in the actuator model. Because the source of vibration is well known, the problem was attacked at the very source. A compensator was designed for balancing the forces in the rotor. The forces were not measured and remained thus unknown, but they could be estimated. The adaptive compensator was designed so that other controllers can be used parallel, without having to make any changes to the compensator.

15:00-15:20 ThB05.4

Adaptive Control of Unknown Dynamic Hysteretic Systems, pp. 12248-12253

Chen, Xinkai — Shibaura Inst. of Tech.
Hisayama, Takeshi — Shibaura Inst. of Tech.
Su, Chun-Yi — Concordia Univ.

This paper first discusses the adaptive control for the hysteresis described by Prandtl-Ishlinskii model. Then, the adaptive control for the continuous-time linear dynamical systems preceded with hysteresis described by Prandtl-Ishlinskii model is considered. The relative degree and the upper bound of the order of the linear dynamical system are assumed to be known. The contribution of the paper is the fusion of the hysteresis model with the adaptive control techniques. Only the parameters (which are generated from the parameters of the linear system and the density function of the hysteresis) directly needed in the formulation of the controller are adaptively estimated online. The output tracking error can be controlled to approach to zero. Simulation results show the effectiveness of the proposed algorithm.

15:20-15:40 ThB05.5

Bayesian Paradigm and Fully Probabilistic Design, pp. 12254-12259

Karny, Miroslav — Inst. of Information Theory And Automation, A V C R

The paper provides background of fully probabilistic design of decision-making strategies and finds its position with respect to the standard Bayesian decision making.

15:40-16:00 ThB05.6

Normalised Expression and Evaluation of PI Tuning Rules, pp. 12260-12265

Leva, Alberto — Pol. di Milano
Donida, Filippo — Pol. di Milano

This manuscript addresses the problem of casting the heterogeneous panorama of model-based PI tuning rules into some uniform framework. By adopting convenient normalisations, different rules can be expressed in such a way to allow objectively grounded comparisons. The presented work is part of a larger research project, the ultimate goal of which is to allow qualifying the contribution of newly introduced rules with respect to existing ones, and possibly to design PI autotuners encompassing more than one rule, and capable of selecting the `best' one for each particular tuning problem. The extension of the idea to the PID case will be treated in future works.

ThB06 310A

Modeling and Control in the Behavioral Framework (Invited Session)

Chair: Rapisarda, Paolo — Univ. of Southampton
Co-Chair: Takaba, Kiyotsugu — Kyoto Univ.
Organizer: Rapisarda, Paolo — Univ. of Southampton
Organizer: Takaba, Kiyotsugu — Kyoto Univ.

14:00-14:40 ThB06.1

Linear Differential Behaviors Described by Rational Symbols (I), pp. 12266-12272

Willems, Jan C. — K.U. Leuven
Yamamoto, Yutaka — Kyoto Univ.

We present a behavioral theory of linear systems described by differential equations involving matrices of rational functions. Representations of controllable and stabilizable systems that are left coprime over the ring of proper, stable, or proper stable rational functions are discussed. These representations lead to effective parametrizations of the set of stabilizing controllers for a plant.

14:40-15:00 ThB06.2

Output Regulation in the Behavioral Framework (I), pp. 12273-12278

Takaba, Kiyotsugu — Kyoto Univ.

This paper considers a behavioral approach to the output regulation of a linear differential system subject to a class of exogenous inputs. We first derive a necessary and sufficient condition for the output regulation of a linear system represented by a kernel representation.Based on this condition, a method for synthesizing a controller that achieves the output regulation is developed. It turns out that the controller synthesis results in solving a certain polynomial matrix equation. It is also shown that the present method provides a wider class of controllers including improper ones such as a PID controller. A numerical example is included to demonstrate the applicability of the present method.

15:00-15:20 ThB06.3

On Linear Canonical Controllers within the Unfalsified Control Framework (I), pp. 12279-12284

Kaneko, Osamu — Osaka Univ.

A canonical controller (cf. van der Schaft [2002]), which was proposed by van der Schaft, is a controller yielding a given specification with a plant behavior. In this paper, for a given data of a plant and a specification, we provide a synthesis of linear canonical controllers without using mathematical models of a plant. A desired canonical controller can be obtained by solving linear algebraic equations which consist of a data and a specification. We also see that a canonical controller designed by proposed method also unfalsifies the actual data and a specification, so our result is also regarded as one of synthesis of unfalsified controllers (cf. Safonov and Tsao [1997]).

15:20-15:40 ThB06.4

Why "state" Feedback? (I), pp. 12285-12290

Rapisarda, Paolo — Univ. of Southampton
Markovsky, Ivan — Katholieke Univ. Leuven

We study the linear quadratic control problem from a representation-free point of view, and we show that this formulation brings forth two self-contained and original proofs of the optimality of state feedback control laws; these proofs which do not depend on an a priori state-space representation. Moreover, we show an orthogonality property characterizing the set of optimal trajectory of a LQ-control problem.

15:40-16:00 ThB06.5

Model Reduction of Dissipative Systems by Balanced Truncation (I), pp. 12291-12296

Minh, Ha Binh — Univ. of Groningen
Trentelman, Harry L. — Univ. of Groningen
Rapisarda, Paolo — Univ. of Southampton

Given a dissipative system behavior with general supply rate, say a _-dissipative system, we propose a balanced truncation method to obtain a reduced-order system behavior which is again _-dissipative. This methods applies to driving variable representations of systems. A one-step error bound formula is discussed.

ThB07 310B

Evolutionary Algorithms (Regular Session)

Chair: Chang, Hyeong Soo — Sogang Univ.
Co-Chair: Chen, Jie — Beijing Inst. of Tech.

14:00-14:20 ThB07.1

Fuzzy Controller Design by Clustering-Aided Ant Colony Optimization, pp. 12297-12302

Juang, Chia-Feng — National Chung Hsing Univ.
Kang, Yu-Ping — ChungChou Inst. of Tech.
Chiang, Lo — National Chung-Hsing Univ.

This paper proposes a Clustering-aided Ant Colony Optimization (ACO) algorithm (CACO) for fuzzy controller design. The objective of CACO is to improve both the design efficiency of a fuzzy controllers and its performance. In CACO, the number of rules in CACO is created on-line by a newly proposed fuzzy clustering. Once a new rule is generated, the consequence is selected from a list of candidate control actions by ACO. In ACO, the tour of an ant is regarded as a combination of consequent actions selected from every rule. Searching for the best one among all consequence combinations involves using a proposed pheromone matrix and a new heuristic value assignment method. To verify the performance of CACO on fuzzy control, simulations on water bath temperature control are performed.

14:20-14:40 ThB07.2

A Unifed Approach to Control Design Using a Cooperative Co-Evolutionary Bisection Algorithm, pp. 12303-12311

Farag, Adel Omran — El Fateh Univ.

This paper proposes a novel algorithm named as a Co-evolutionary Cooperative Bisection (CCB) algorithm as a master tool for solving variety of control problems. The proposed algorithm is computationally attractive and has very favorable convergence properties. The numerical superiority of the CCB-algorithm is back to two main factors, the numerical efficiency of gamma-Bisection algorithm, and the multi-population evolutionary algorithm proposed in this paper (Cooperation + Parallelism). To demonstrate the potential of the proposed algorithm a method for designing fixed-structure controllers that minimize an upper bound on the singular value mu is presented. The problem considered here is of significant practical interest, since many industrial controllers are constrained in order/structure and required to meet high robustness demands. Moreover, even if the controller order or structure are not restricted, the proposed algorithm has the advantage of being able to optimize over for stability multipliers and controllers simultaneously, thereby improving the chances of converging to the global minimum. Numerical examples given here confirm the computational efficiency and the excellent convergence properties of the proposed CCB-algorithm.

14:40-15:00 ThB07.3

Quantum Particle Swarm Optimization Based Network Intrusion Feature Selection and Detection, pp. 12312-12317

Zhang, Hongmei — East China Univ. of Science and Tech.
Gao, Haihua — East China Univ. of Science and Tech.
Wang, Xingyu — East China Univ. of Science and Tech.

Considering the relevance among features, which filter-based feature selection method fails to deal with, a kind of hybrid quantum particle swarm optimization and support vector machines based network intrusion feature selection wrapper algorithm is put forward. The subset of features is represented using quantum superposition characteristic and probability representation, among which superposition characteristic can make a single particle represent several states, thus potentially increases population diversity. Every particle in the quantum particle swarm stands for a selected subset of features. A probabilistic mutation is adopted to avoid local optimal and a taboo search table is used to enlarge particle swarm's search space and avoid repeated computation. The fitness of particle is defined as the correct classification percentage by SVM using a training set whose patterns are represented using only the selected subset of features. The results of experiments demonstrate that the proposed method can be an effective and efficient way for feature selection and detection via using the data sets of KDD cup 99.

15:00-15:20 ThB07.4

Supporting VHDL Design for Air-Conditioning Controller Using Evolutionary Computation, pp. 12318-12323

Kojima, Kazuyuki — Saitama Univ.
Watanuki, Keiichi — Saitama Univ.

In recent years, as part of the remarkable development of electronic techniques, electronic control has been applied to various systems. Many sensors and actuators have been implemented into those systems, and energy efficiency and performance have been greatly improved. However, these systems have been complicated, and much time has been required to develop system controllers. In this paper, a method of automatic controller design for those systems is described. In order to automate the design of an electronic controller, an evolutionary hardware is applied. First, the framework for applying the genetic algorithm to the automation of controller design is described. In particular, the coding of a chromosome is shown in detail. Then, how to make a fitness function is represented, with an air conditioner as an example, and the controller of the air conditioner is developed automatically using our proposed framework. Finally, an evolutionary simulation is performed to confirm our framework.

15:20-15:40 ThB07.5
Solving Multi-Objective Linear Control Design Problems Using Genetic Algorithms, pp. 12324-12329

Sanchez, Gustavo — Univ. Simón Bolívar
Villasana, Minaya — Univ. Simon Bolivar
Strefezza, Miguel — Univ. Simóm Bolívar

Abstract: Two multi-objective genetic algorithms, an elitist version of MOGA and NSGA-II, were applied to solve two linear control design problems. The first was a H2 problem with a PI controller structure, for a first order stable plant. The second was a mixed H2/Hinf control problem. In both cases, three indicators were used to evaluate each algorithm performance: Set coverage, spread and hypervolume. It was found that NSGA-II shows better performance indicators. Moreover, for the second problem, a new controller representation was proposed with corresponding cross-over and mutation operators. This approach was able to find solutions as good as those previously published. The main advantage is that the stability restriction disappears, allowing to deal with an unconstrained optimization problem.

15:40-16:00 ThB07.6
A Multi-Objective Evolutionary Algorithm of Marriage in Honey Bees Optimization Based on the Local Particle Swarm Optimization, pp. 12330-12335

Yang, Chenguang — Beijing Inst. of Tech.
Chen, Jie — Beijing Inst. of Tech.
Tu, Xuyan — Beijing Inst. of Tech.

Marriage in Honey Bees Optimization (MBO) is a new swarm-intelligence method, but existing researches concentrate more on its application in single-objective optimization. In this paper, we focus on improving the algorithm to solve the multi-objective problem and increasing its convergence speed. The proposed algorithm is named as multi-objective Particle Swarm Marriage in Honey Bees Optimization (MOPSMBO). It uses non-dominated sorting strategy and crowded-comparison approach, utilizes the local Particle Swarm Optimization (PSO) to perform the local characteristic, and simpler the structure of MBO. Based on the Markov chain theory, we prove that MOPSMBO can converge with probability one to the entire set of minimal elements. Simulations are done on several multi-objective test functions and multi-objective Traveling Salesman Problem (TSP). By comparing MOPSMBO with MOGA, NPGA, NSGA and NSGA-II, simulation results show that MOPSMBO has better convergence speed and can better converge near the true Pareto-optimal front.

ThB08 310C
Robust Time-Delay Systems I (Regular Session)

Chair: Kao, Chung-Yao — Univ. of Melbourne
Co-Chair: Bhattacharyya, Shankar P. — Texas A & M Univ.

14:00-14:20 ThB08.1
On Robustness of Discrete-Time LTI Systems with Varying Time Delays, pp. 12336-12341

Kao, Chung-Yao — Univ. of Melbourne

This manuscript concerns robust stability analysis of discrete-time LTI systems with varying time delays. The stability problem is treated in the Integral Quadratic Constraint (IQC) framework. The novelty and main contribution of the manuscript is the integral quadratic constraint characterization of the discrete-time time-varying delay operator. The characterization enables the IQC analysis to be applied for studying robustness property in the presence of time-varying delays.

14:20-14:40 ThB08.2
A Full-Block mathcal{S}-Procedure Application to Delay-Dependent mathcal{H}_infty State-Feedback Control of Uncertain Time-Delay Systems, pp. 12342-12347

Briat, Corentin — INPG/ENSIEG
Sename, Olivier — INPG
Lafay, JeanFrancois — Ec. Centrale Nantes

This paper deals about the robust stabilization of uncertain systems with time-varying state delays in the delay dependent framework. The system is represented using LFR and stability is deduced from Lyapunov-Krasovskii theorem and full-block S-procedure. We derive sufficient conditions to the existence of a robust Hinfinity state-feedback control law. As this sufficient condition is expressed in terms of NMI we propose a relaxation based on the cone-complementary algorithm which is known to lead to good results for such problems. We show the efficiency of our method trough an example.

14:40-15:00 ThB08.3
A Delay-Partitioning Projection Approach to Stability Analysis of Neutral Systems, pp. 12348-12353

Du, Baozhu — Univ. of Hong Kong
Lam, James — Univ. of Hong Kong
Shu, Zhan — The Univ. of Hong Kong

This paper introduces a new effective approach to study the stability of neutral systems. By employing a special Lyapunov-Krasovskii functional form based on delay partitioning, delay-dependent stability criteria are established for the nominal and the uncertain case (polytopic type) in terms of linear matrix inequalities (LMI). Numerical examples are employed to illustrate that the delay-partitioning projection approach can be applied to estimate the upper bounds for the delays for the system to maintain stability. Judging from these numerical results, the stability criteria obtained are less conservative than those of existing methods.

15:00-15:20 ThB08.4
Robust Stability of Distributed Delay Systems, pp. 12354-12358

Muenz, Ulrich — Univ. of Stuttgart
Rieber, Jochen M. — Astrium GmbH
Allgower, Frank — Univ. of Stuttgart

We present an LMI condition for robust stability of uncertain distributed delay systems (DDS). It is based on recent results for DDS with rational delay kernels. After the incorporation of uncertain kernels, the new approach is now applicable to any time-varying, uncertain, piecewise continuous delay kernel. The stability analysis is formulated as an LMI and at the same time uses explicitly the information about the nominal delay kernel. This is the main advantage of the new approach compared to existing solutions. The performance of the approach is illustrated in an example.

15:20-15:40 ThB08.5
Finite-Dimensional H_infinity Filter Design for Linear Systems with State Delay, pp. 12359-12364

Basin, Michael V. — Autonomous Univ. of Nuevo Leon
Shi, Peng — Faculty of Advanced Tech.
Calderon Alvarez, Dario — Autonomous Univ. of Nuevo Leon
Wang, Jianfei — Nanjing Univ. of Aeronautics and Astronautics

This paper presents the central finite-dimensional H_infinity filters for linear systems with state delay, that is suboptimal for a given threshold gamma with respect to a modified Bolza-Meyer quadratic criterion including the attenuation control term with the opposite sign. In contrast to the results previously obtained for linear time delay systems, the paper reduces the original H_infinity filtering problems to H_2 (optimal mean-square) filtering problems, using the technique proposed in [1]. The paper first presents the central suboptimal H_infinity filter for linear systems with state delay, based on the optimal H_2 filter from [33], which contains a finite number of the filtering equations for any fixed filtering horizon, but this number grows unboundedly as time goes to infinity. To overcome that difficulty, the alternative central suboptimal H_infinity filter is designed for linear systems with state delay, which is based on the alternative optimal H_2 filter from [34]. Numerical simulations are conducted to verify performance of the designed central suboptimal filters for linear systems with state delay against the central suboptimal H_infinity filter available for linear systems without delays.

15:40-16:00 ThB08.6

Finite-Dimensional H_infinity Filter Design for Linear Systems with Measurement Delay, pp. 12365-12370

Basin, Michael V.	Autonomous Univ. of Nuevo Leon
Shi, Peng	Faculty of Advanced Tech.
Calderon Alvarez, Dario	Autonomous Univ. of Nuevo Leon
Wang, Jianfei	Nanjing Univ. of Aeronautics and Astronautics

This paper presents the central finite-dimensional H_infinity filter for linear systems with measurement delay, that is suboptimal for a given threshold gamma with respect to a modified Bolza-Meyer quadratic criterion including the attenuation control term with the opposite sign. In contrast to the results previously obtained for linear time delay systems, the paper reduces the original H_infinity filtering problem to an H_2 (optimal linear-quadratic) filtering problem, using the technique proposed in [1]. Application of the reduction technique becomes possible, since the optimal filtering equations solving the H_2 (linear-quadratic) filtering problems have been obtained for linear systems with measurement delay. The paper presents the central suboptimal H_infinity filter for linear systems with measurement delay, based on the optimal H_2 filter from [35], where the standard H_infinity filtering conditions of stabilizability, detectability, and noise orthonormality are assumed. Finally, to relax the standard conditions, the paper presents the generalized version of the designed H_infinity filter in the absence of the noise orthonormality. The proposed H_infinity filtering algorithm provides a direct method to calculate the minimum achievable values of the threshold gamma, based on the existence properties for a bounded solution of the gain matrix equation. Numerical simulations are conducted to verify performance of the designed central suboptimal filter for linear systems with state delay against the central suboptimal H_infinity filter available for linear systems without delays. The simulation results show a definite advantage in the values of the noise-output transfer function H_infinity norms in favor of the designed filter.

ThB09 311C
Identification for Control (Regular Session)

Chair: Tsakalis, Kostas	Arizona State Univ.
Co-Chair: Zhang, Lifeng	Univ. of the West of England

14:00-14:20 ThB09.1

A New Robust-Control-Oriented System Identification Method, pp. 12371-12376

Zhan, Charles	Honeywell Inc.
Tsakalis, Kostas	Arizona State Univ.

This paper introduces a new robust-control-oriented system identification method, which consists of the following three steps: 1. High-order ARX model identification; 2. Loop shaping weighting functions design based on the high-order ARX model; 3. Control-oriented model reduction by minimizing the weighted L_2-gap between the high-order ARX model and the low-order model. This method truly integrates the control objective into the identification step. A robust controller can be readily designed as a result of the identification. Simulation examples are given to show that smaller weighted nu-gap can be achieved by using the proposed method.

14:20-14:40 ThB09.2

A New Model Validity Monitoring Method for Nonlinear Recursive Identification, pp. 12377-12382

Zhang, Lifeng	Univ. of the West of England
Zhu, Quanmin	Univ. of the West of England
Longden, Ashley	Univ. of the west of england

In the present study, a new correlation test based model validity monitoring procedure is proposed to online check the quality of nonlinear recursively identified models. The new method provides a simple but effective diagnose of nonlinear recursive models by detecting if the residuals are reduced to uncorrelated noise sequences. In the monitoring procedure, the correlation functions are periodically computed with a specified frequency and a constant data window. The computational time and sensitivity of the correlation tests can be easily modified by adjusting the testing time interval, data length, and maximum lag. A simulated case study is employed to demonstrate the effectiveness and efficiency of the new method.

14:40-15:00 ThB09.3

Parameter Reduction of Nonlinear Least-Squares Estimates Via the Singular Value Decomposition, pp. 12383-12388

Nagamune, Ryozo	Univ. of British Columbia
Choi, Jongeun	Michigan State Univ.

This paper proposes a technique for reducing the number of uncertain parameters in order to simplify robust and adaptive controller design. The system is assumed to have a known structure with parametric uncertainties that represent plant dynamics variation. An original set of parameters is identified by nonlinear least-squares (NLS) optimization using noisy frequency response functions. Using the property of asymptotic normality for NLS estimates, the original parameter set is re-parameterized by an affine function of the smaller number of uncorrelated parameters. The correlation among uncertain parameters over NLS estimates from different plants is detected by the singular value decomposition. A numerical example illustrates the usefulness of the proposed techniques.

15:00-15:20 ThB09.4

PLS and Its Application within Model Predictive Controllers, pp. 12389-12394

Shamekh, Awad	The Univ. of Manchester, UK
Lennox, Barry	Univ. of Manchester
Sandoz, David	Univ. of Manchester
Marjanovic, Ognjen	Univ. of Manchester

Many system identification techniques have been proposed over the last few decades, including ordinary and recursive least squares. Recently, Partial Least Squares (PLS) has become a popular tool in the chemometric community and is beginning to be applied to solve complex industrial process control problems. These studies have tended to ignore the issue of bias with this form of model and it is this issue that is addressed in this article. The paper describes the development of an unbiased recursive PLS algorithm that is successfully applied to two simulated processes.

15:20-15:40 ThB09.5

Bayes Parameter Identification with Polynomial Asymmetrical Loss Function, pp. 12395-12400

Kulczycki, Piotr	Pol. Acad. of Sciences
Mazgaj, Aleksander	Cracow Univ. of Tech.

The parameter identification for problems where losses arising from overestimation and underestimation are different and can be described by an asymmetrical and polynomial function, is investigated here. The Bayes decision rule allowing to minimize potential losses is used. Calculation algorithms are based on the nonparametric methodology of statistical kernel estimators, which frees the method from distribution type. Three basic cases are considered in detail: a linear, a quadratic, and finally a general concept for a higher order polynomial – here the cube-case is described in detail as an example. For each of them the final result constitutes a numerical procedure enabling to effectively calculate the optimal value of a parameter in question.

15:40-16:00 ThB09.6

Intelligent Modelling of MIMO Nonlinear Dynamic Process Plants for Predictive Control Purposes, pp. 12401-12406

Mohammadzaheri, Morteza	Univ. of Adelaide
Chen, Lei	Adelaide Univ.

In this research, the input/output data of a MIMO nonlinear system are used to create intelligent models for nonlinear systems. Multi layer perceptrons and neuro-fuzzy networks are utilized for the intelligent models. To make these models suitable for the predictive control, a variety of subtle points should be considered. Recurrent models and subtractive clustering are used in this research, and a pre-processing is applied to the columns of the raw data. Then the prepared data are used to train models. A reliable checking process is also studied. A Catalytic Continuous Stirred Tank Reactor is used as a case study. A computer model is used to gather the input data rather than a real one. Finally, the simulation is successfully performed to indicate the capabilities of the intelligent modeling method as well as the importance of the design considerations offered in this paper.

ThB10 311B

Stochastic Modelling and Control (Regular Session)

Chair: Pota, Hemanshu — Univ. of New South Wales
Co-Chair: Fuchs, Jean Jacques — Univ. de Rennes

14:00-14:20 ThB10.1

Ship Motion Prediction for Maritime Flight Operations, pp. 12407-12412

Yang, Xilin — Univ. of New South Wales at AustralianDenfenseForceAcademy
Pota, Hemanshu — Univ. of New South Wales
Garratt, Matthew — UNSW@ADFA
Ugrinovskii, Valery — Univ. of New South Wales

This paper presents a novel and feasible prediction procedure for ship motion in the presence of uncertain tendency of ship motion dynamic variations and stochastic sea state disturbances. An appropriate model aiming to feature the characteristics of the dynamic relationship between an observer and a ship deck is constructed, from which an initial algorithm is implemented. The optimal system order based on Bayes Information Criterion (BIC) is derived, resulting in the development of an accurate adaptive multi-step predictor for estimation of ship motion dynamics. Simulation results demonstrate that the proposed prediction approach substantially reduces the model complexity and exhibits excellent prediction performance, making it suitable for integration into ship-helicopter approaches and landing guidance systems.

14:20-14:40 ThB10.2

Feedback Control of Internet Applications Involving the Tracking of Dynamic Data, pp. 12413-12418

Shah, Shweta — Carnegie Mellon Univ.
Moudgalya, Kannan M. — I.I.T. Bombay
Ramamritham, Krithi — IIT Bombay

Control of computing systems is different in many ways from the control of conventional systems. The quality of service problem in internet applications, that is, reducing the network overhead without affecting the quality, has been studied in detail. Network overhead can be measured in terms of the number of refreshes of the dynamic data. Use of randomly generated input vectors allows early use of feedback control, thereby lowering the network overhead. Identification using moving time windows helps obtain locally accurate models, thereby increasing the efficacy of the control scheme. Online tuning of the maximum permissible change in the input, namely maximum time till next refresh, has been shown to improve the control performance. Because this approach is not controller specific, it would be of use to all controllers. Two different ways of formulating the linear quadratic regulator objective function have been studied. Using the reciprocal of TTR (time to refresh) as the control input makes the control weight sensitive over a larger range, compared to using TTR itself as the input.

14:40-15:00 ThB10.3

Fault Detection and Diagnosis in the DAMADICS Benchmark Actuator System – a Hidden Markov Model Approach, pp. 12419-12424

Almeida, Gustavo Matheus de — Federal Univ. of Minas Gerais
Park, Song Won — Univ. of Sao Paulo

Early fault detection and diagnosis in chemical process monitoring represents a challenge to be overcome. Another one concerns the spatial overlapping problem among distinct fault classes, once some events may only be distinguished from the others by taking into account its order of occurrence. The hidden Markov model (HMM) technique is capable of providing information about the tendency of the process and of modelling ordered data. Hence, the goal is to investigate the contribution of this technique to both aspects related to process monitoring activities. The case study is based on the DAMADICS benchmark actuator system. Both abrupt and incipient faulty events were investigated. To the former, detection and diagnosis tasks were immediately satisfied; and to the latter, they were carried out in a progressive and correct course.

15:00-15:20 ThB10.4

A Sparse Representation Criterion: Recovery Conditions and Implementation Issues., pp. 12425-12429

Fuchs, Jean Jacques — Univ. de Rennes

Sparse representations techniques have become an active domain of research in signal processing with numerous applications in compression and coding, for instance. They are mostly based on a combined l_2-l_1 criterion, where l_2- or least-squares-part ensures closeness to the observations and the l_1-part sparsity. We replace the least-squares-part by a l_infinity-part and investigate the recovery conditions of the so-obtained l_infinity-l_1 criterion. We then propose an algorithm, that minimizes the criterion, in a finite number of steps.

15:20-15:40 ThB10.5

Parsimonious Representation of Signals Based on Scattering Transform, pp. 12430-12435

Sorine, Michel — INRIA
Zhang, Qinghua — INRIA
Laleg, Taous-Meriem — The French Inst. on Res. in computer sciencesandcontrol
Crépeau, Emmanuelle — Univ. de Versailles Saint Quentin

A parsimonious representation of signals is a mathematic model parametrized with a small number of parameters. Such models are useful for analysis, interpolation, filtering, feature extraction, and data compression. A new parsimonious model is presented in this paper based on scattering transforms. It is closely related to the eigenvalues and eigenfunctions of the linear Schrödinger equation. The efficiency of this method is illustrated in this paper with examples of both synthetic and real signals.

15:40-16:00 ThB10.6

Non-Parametric Adaptive Estimation of a Multivariate Density, pp. 12436-12441

Vasiliev, Vyacheslav — Univ. of Tomsk

The properties of adaptive non-parametric kernel estimators for the multivariate probability density and its derivatives of identically distributed random vectors at a given point are studied. It is supposed that these vectors form a martingale-difference process. An asymptotic mean square criterion is proposed. The optimality in asymptotically minimax sense of adaptive estimators of density derivatives is proved for a class of the Bartlett kernel estimators with a random data-driven bandwidth.

It's well-known that the optimization of the asymptotic value of the mean squared error for the Bartlett kernel density estimators leads to the optimal bandwidth depending on unknown functions. Therefore it is not quite simple to apply these estimators to practice.

The paper proposes an adaptive approach to this problem, which is based on the idea of changing the unknown functions in optimal bandwidth by a sequence of estimators converging to the unknown values of these functions. It is shown, that the constructed adaptive kernel estimators keep all the asymptotic properties of the sharp-optimal non-adaptive Bartlett estimators.

An example of the adaptive estimator, optimal in the sense of the introduced criterion is considered. This estimator has simple structure and may be easily used in real statistical problems. The proposed estimators possess the property of uniform asymptotic normality and almost sure convergence.

ThB11 311A

Recent Advances in Iterative and Repetitive Learning Control I (Invited Session)

Chair: Ahn, Hyo-Sung — Gwangju Inst. of Science and Tech. (GIST)
Co-Chair: Moore, Kevin L. — Colorado School of Mines
Organizer: Ahn, Hyo-Sung — Gwangju Inst. of Science and Tech. (GIST)

14:00-14:20 ThB11.1

Discrete-Time Intermittent Iterative Learning Controller with Independent Data Dropouts (I), pp. 12442-12447

Ahn, Hyo-Sung — Gwangju Inst. of Science and Tech. (GIST)
Moore, Kevin L. — Colorado School of Mines
Chen, YangQuan — Utah State Univ.

In networked control systems (NCS), it is considered essential to design a robust controller such that the networked-system is stable against data dropouts during the network transfer. It has been shown that there is a critical data dropout rate over which the networkedsystem could be unstable; hence the desired task cannot be achieved. This paper shows that a desired task or trajectories can be still achieved even though there are feedback signal dropouts if the desired task is repetitive, as in the iterative learning control case. Specifically this paper shows how to design stochastic iterative learning control systems such that the networked-system with a repetitive task is robust stable against measurement and process noises and independent, intermittent output channel dropouts.

14:20-14:40 ThB11.2

A Study on the Effect of Variable Initial State Error in Average Operator-Based Iterative Learning Control (I), pp. 12448-12453

Park, Kwang-Hyun — Kwangwoon Univ.
Bien, Zeungnam — Korea Advanced Inst. of Science and Tech.

This paper studies the effect of variable initial state error in iterative learning control (ILC) algorithms for linear time-invariant (LTI) systems. It is first pointed out that the previous result based on an average operator has a restriction due to a specific condition for convergence, even though it shows that the effect of the initial state error can be accurately estimated while the existing algorithms show only the boundness of the error or the convergence from stochastic point of view. To relieve this limitation, a modified ILC algorithm is proposed and a sufficient condition for convergence is presented. In order to show the validity of the proposed algorithm, a numerical example is given.

14:40-15:00 ThB11.3

Frequency Domain Based Design of Iterative Learning Controllers for Monotonic Convergence (I), pp. 12454-12459

Phan, Minh — Dartmouth Coll.
Brown, Hunter — Dartmouth Coll.
Lee, Soo Cheol — Daegu Univ.
Longman, Richard W. — Columbia Univ. MS 4703

This paper presents a frequency domain based method to design iterative learning controllers (ILC) for monotonic convergence. The design is an extension of a repetitive controller (RC) design that achieves monotonic convergence of all frequency components of the tracking error from period to period. The monotonic convergence condition in the RC design requires a steady-state assumption that the ILC problem does not satisfy due to the transient at the beginning of every repetition. Additional fine-tuning of the ILC gains to ensure monotonic convergence is needed and two such techniques (iterative and non-iterative) are developed. Numerical examples are presented to illustrate the design method.

15:00-15:20 ThB11.4

On the Settling Time in Repetitive Control Systems (I), pp. 12460-12467

Yeol, Joe W. — Columbia Univ.
Longman, Richard W. — Columbia Univ. MS 4703
Ryu, Yeong S. — State Univ. of New York at Farmingdale

Repetitive control seeks to converge to zero tracking error when a feedback control system has a periodic command or a periodic disturbance. It is of interest to examine how long one must wait until convergence is reached. Without the repetitive control loop, any feedback system has a settling time often defined as four times the longest time constant in the characteristic polynomial. When a repetitive control loop is put around such a system, there are p additional roots to the characteristic polynomial, where p is the period in time steps, which can be very large. Again one can define the settling time, which might best be measured in units of periods, representing the number of periods needed to essentially complete the convergence process. This paper studies the convergence rate for several general classes of repetitive controller design methods.

15:20-15:40 ThB11.5

Comparison Studies on Anti-Aliasing/Anti-Imaging Filtering and Signal Extension in Multi-Rate ILC (I), pp. 12468-12473

Zhang, Bin — Nanyang Tech. Univ.
Wang, Danwei — Nanyang Tech. Univ.
Wang, Yigang — Nanyang Tech. Univ.
Ye, Yongqiang — Lakehead Univ.
Zhou, Keliang — TUDelft

Multirate iterative learning control (ILC) systems have different sampling rates for feedback online loop and feedforward (or ILC) offline loop. The implementation of multirate ILC requires to downsample the signal first and, after processing, upsample the signal again. In the process of downsampling and upsampling, aliasing and imaging may occur and need to be handled properly. In this paper, the multirate ILC with and without anti-aliasing/anti-imaging filters are compared with different types of low-pass filter. Furthermore, to satisfy the steady state frequency response, the signals are extended and different extension methods are evaluated. A series of simulation results is provided to demonstrate that anti-aliasing and anti-imaging filters signil significantly improve the tracking performance. However, the extension methods have little influence on the tracking accuracy.

15:40-16:00 ThB11.6

A Note on Iterative Learning Control for Nonlinear Systems with Input Uncertainties (I), pp. 12474-12479

Tan, Ying — The Univ. of Melbourne
Xu, Jian-Xin — National Univ. of Singapore

The problem of designing an iterative learning controller in the presence of input uncertainties is of great importance in practicalimplementations. This paper addresses this important issue for a simple scalar nonlinear dynamic system with general input uncertainties. A dual iterative learning loop is applied to systems to ``learn'' both unknown dynamics and static input uncertainties respectively and can ensure that the output of the system converges to the desired trajectory. Two analytic examples show that the proposed dual learning control scheme can work well under input uncertainties such as saturation and dead zone.

ThB12 313

Quantized Systems and Model Predictive Control of Hybrid Systems (Regular Session)

Chair: Sugie, Toshiharu — Kyoto Univ.
Co-Chair: Chiuso, Alessandro — Univ. of Padova

14:00-14:20 ThB12.1

Input-To-State Stabilization of Nonlinear Systems with Quantized Feedback, pp. 12480-12485

Kameneva, Tatiana — Univ. of Melbourne
Nesic, Dragan — Univ. of Melbourne

This paper addresses the stabilization problem of nonlinear feedback systems with quantized measurements in the presence of bounded disturbances. This paper is an extension of Liberzon, Nesic (2007) to nonlinear systems. Using the scheme proposed in Liberzon, Nesic (2007), we show that input-to-state stability with respect to bounded disturbances is achievable for nonlinear systems with quantized feedback.

14:20-14:40 ThB12.2

A Note on Estimation Using Quantized Data, pp. 12486-12491

Chiuso, Alessandro — Univ. of Padova

In this paper we discuss estimation of parameters from quantized data. Extending some recent results appeared in the literature we show that, under a regularity assumption on the parametric model describing the data, the Maximum Likelihood estimator can be found, asymptotically, in closed form in two steps. The first is a non-linear (and invertible) mapping of the observed relative frequencies which makes the dependence on the parameters linear; the second is a linear estimator. Some simulations which demonstrate the results are included.

14:40-15:00 ThB12.3

State Estimation Using Quantized Measurements, pp. 12492-12497

Fu, Minyue — Univ. of Newcastle
de Souza, Carlos E. — Lab. Nac. de Comp. Cientifica - LNCC

In this paper we consider the problem of state estimation for linear dynamic systems using quantized measurements. This problem arises when state estimation needs to be done using information transmitted over a digital communication channel. We investigate how to design the quantizer and the estimator jointly.

15:00-15:20 ThB12.4

Optimal Dynamic Quantizers for 2D Systems with Discrete-Valued Input and Its Application to Generation of Binary Halftone Images, pp. 12498-12503

Minami, Yuki — Kyoto Univ.
Azuma, Shun-ichi — Kyoto Univ.
Sugie, Toshiharu — Kyoto Univ.

This paper addresses an optimal design problem of dynamic quantizers for a class of 2D systems with discrete-valued control input. First, we derive a closed form expression of the performance of a class of dynamic quantizers. Next, based on that, an optimal dynamic quantizer is provided. Finally, we apply the optimal dynamic quantizer to generate binary halftone images.

15:20-15:40 ThB12.5

Robust Output Feedback MPC for Linear Systems Via Interpolation Technique, pp. 12504-12509

Sui, Dan — NUS
Feng, Le — The Norwegian Univ. of Science and Tech.
Hovd, Morten — Norwegian Univ. of Tech. and Science

This paper provides a simple approach to the problem of robust output feedback model predictive control (MPC) for linear discrete-time systems with state and input constraints, subject to bounded state disturbances and output measurement errors. The problem of estimating the state is addressed by using a fixed linear observer. The state estimation error converges and stays in some set of the error dynamics, which is taken into account in the design of MPC controllers. In the MPC optimization where the nominal system is considered, the constraints are tightened in a monotonic sequence such that the satisfaction of input and state constraints for the original system is guaranteed. Robust stability of an invariant set for the closed-loop original system is ensured. Furthermore, in order to reduce the inherent computational complexity of the MPC controller design, interpolation techniques are introduced in the proposed approach, where the resulting controller interpolates among several MPC controllers. This procedure leads to a relatively large domain of attraction even by employing short prediction horizons. Therefore, with short horizons, a low computational complexity is expected.

15:40-16:00 ThB12.6

Control of an Autonomous Hybrid System Using a Nonlinear Model Predictive Controller, pp. 12510-12515

Prakash, Jagadeesan — Madras Inst. of Tech.
Patwardhan, Sachin — IIT Bombay
Shah, Sirish — Univ. of Alberta

State estimation and estimator based predictive control of nonlinear autonomous hybrid systems poses a challenging problem as these systems involve discontinuities that are introduced by switching of the discrete variables. In this paper, we propose a state estimation scheme for an autonomous hybrid system using an ensemble Kalman filter (EnKF), which belongs to the class of particle filters and is a derivative free nonlinear state estimator. We then proceed to develop a novel nonlinear model predictive control scheme that inherits the approach used in EnKF formulation for future trajectory predictions. The efficacy of the proposed state estimation and control scheme is demonstrated by conducting simulation studies on a benchmark three-tank system.

ThB13 314

Kalman Filtering Techniques (Regular Session)

Chair: Guay, Martin — Queen's Univ.
Co-Chair: Oliveira, Paulo Jorge — Inst. Superior Técnico

14:00-14:20 ThB13.1

Applications of Random Parameter Matrices Kalman Filtering in Uncertain Observation and Multi-Model Systems, pp. 12516-12521

Luo, Dandan — Sichuan Univ.
Zhu, Yunmin — Sichuan Univ.

This paper considers two types of practical applications of the Linear Minimum Variance recursive state estimation for the linear discrete time dynamic system with random state transition and measurement matrices. The first type of applications is the Kalman filtering with uncertain observations. The second one is the randomly variant dynamic systems with multiple models.

14:20-14:40 ThB13.2

Kalman Filter Decomposition in the Time Domain Using Observability Index, pp. 12522-12527

Kim, Yuri — Canadian Space Agency

Considering the Kalman–Bucy Filter (KBF) from an engineering point of view it is always important to know in advance, before KBF implementation, which variables are practically "good" and which are "bad" observable and how long it will take to estimate all of them in the presence of measurement noise to some appropriate (not necessarily theoretically optimal) level. This article presents an approach to measuring the observability by a special index that has the physical meaning of signal to nose ratio. This approach leads to the decomposition of the KBF in the time domain into two filters applied consecutively in time: the filter estimating the transitional process caused by the uncertainty in initial conditions and the filter estimating the system steady state. In turn; this results in mitigation of the computational requirements and in a simplification of the filter implementation by the engineers.

14:40-15:00 ThB13.3

Kalman and H Infinity Optimal Filtering for a Class of Kinematic Systems, pp. 12528-12533

Batista, Pedro — Inst. Superior Técnico
Silvestre, Carlos — Inst. Superior Tecnico
Oliveira, Paulo Jorge — Inst. Superior Técnico

This paper presents a set of optimal filtering results for a class of kinematic systems with particular application to the estimation of linear quantities in Integrated Navigation Systems for mobile platforms. At the core of the proposed methodology there is a time varying orthogonal Lyapunov coordinate transformation that renders the overall system dynamics linear time invariant (LTI). The design is based on the Kalman or H Infinity filtering steady state solutions for an equivalent LTI system and allows for the natural use of frequency weights to explicitly achieve adequate disturbance rejection and attenuation of the noise of the sensors on the state estimates. Afterwards, the resulting solution is converted back to the original coordinate space, yielding a globally stable time varying optimal estimator for the problem at hand. A simple example of practical importance in marine systems is provided that demonstrates the applicability of the proposed design methodologies and simulation results are included to illustrate the filtering achievable performance.

15:00-15:20 ThB13.4

Integrating the Utkin Observer with the Unscented Kalman Filter, pp. 12534-12539

Ongkosutjahjo, Martin — Univ. of Reading
Becerra, Victor — Univ. of Reading

This paper describes the integration of an Utkin observer with the unscented Kalman filter, investigates the performance of the combined observer, termed the unscented Utkin observer, and compares it with an unscented Kalman filter. Simulation tests are performed using a model of a single link robot arm with a revolute elastic joint rotating in a vertical plane. The results indicate that the unscented Utkin observer outperforms the unscented Kalman filter.

15:20-15:40 ThB13.5

Stochastic Flow Model Using Kalman Filters for Parameter Estimation, pp. 12540-12545

Graton, Guillaume — Ec. Centrale de Marseille
Guay, Martin — Queen's Univ.
Arinez, Jorge — General Motors Res. & Development Center

Attaining high quality from manufacturing systems requires utilizing appropriate system-level quality performance modeling and analysis tools. This paper describes the application of the stochastic-flow-modeling (SFM) approach to represent the quality output behavior of a manufacturing system. To do this, a basic one-product type SFM is extended to that of a multiple-product manufacturing system. This work also provides a novel addition to the SFM approach through the use of a Kalman filter to estimate quality parameters. After a presentation of the reference manufacturing system, results are given for different examples and the effectiveness of the SFM model is examined in terms of accuracy and convergence.

15:40-16:00 ThB13.6

Stochastic Robust Kalman Filtering for Linear Time-Varying Systems with a Multiplicative Measurement Noise, pp. 12546-12551

Ra, Won-Sang — Agency for Defense Development
Whang, Ick Ho — The Agency For Defense Development

In this paper, a stochastic robust Kalman filtering problem is investigated for timevarying linear systems with stochastic uncertainties in its measurement matrix. The influence of parametric uncertainties on the nominal Kalman filter estimate is analyzed in the sense of classical weighted least-squares criterion. Stochastic approximation of estimation errors due to uncertainties allows us to obtain a recursive stochastic robust Kalman filter. The procedure of the stochastic error compensation is interpreted as the optimization of an indefinite quadratic cost. Considering the single stage estimation problem, the stochastic robust Kalman filter recursion is derived. As well, its existence condition is recursively checked using the estimation error covariance. It is shown that the weighted estimation error of the suggested filter is zero mean, which is the distinct property compared to the previous robust filters.

ThB14 318
Design and Analysis of Networked Control Systems (Invited Session)

Chair: Liu, Guoping — Univ. of Glamorgan
Co-Chair: Rees, David — Univ. of Glamorgan
Organizer: Liu, Guoping — Univ. of Glamorgan
Organizer: Rees, David — Univ. of Glamorgan

14:00-14:20 ThB14.1
Co-Simulation Framework for Networked Control Systems Over Multi-Hop Mobile Ad-Hoc Networks (I), pp. 12552-12557

Hasan, Mohammad Shahidul — Staffordshire Univ.
Yu, Hongnian — Staffordshire Univ.
Griffiths, Alison Louise — STAFFORDSHIRE Univ.
Yang, T. C. — Univ. of Sussex

Networked Control Systems over mobile ad-hoc networks have drawn the attention of the researchers because of its suitability in various ad-hoc applications. This paper presents the investigation of such systems using both real wireless communication and co-simulation of Matlab and OPNET. The plant and the wireless node models are simulated on a computer by Matlab and OPNET, respectively. The controller model is run on a laptop. These two computers communicate using a real wireless link. The interactive co-simulation is applied to a double pendulum plant with two sensors and two actuators. Both the co-simulation technique and the results are presented and discussed.

14:20-14:40 ThB14.2
Predictive Control Strategy for a Wireless Networked System (I), pp. 12558-12563

Chai, Senchun — Univ. of glamorgan
Liu, Guoping — Univ. of Glamorgan
Rees, David — Univ. of Glamorgan

As the technology matures, wireless networks are being widely used in industry and homes providing mobile users with significant benefits. In this paper, a networked recursive predictive control method is proposed for the general packet radio service (GPRS) wireless network. Such an implementation has a long random network delay and high data dropout rates. Practical experiments have been carried out to demonstrate the effectiveness of the proposed predictive control scheme.

14:40-15:00 ThB14.3
Delay-Distribution-Dependent Stability and Stabilization for Wireless Networked Control System with Data Quantization (I), pp. 12564-12569

Yue, Dong — Nanjing Normal Univ.
Tian, Engang — Donghua Univ.
Zhang, Yijun — Donghau Univ.

In this paper, the problem of stability and stabilization is studied for wireless networked control system (WiNCS) with data quantization. Considering the mobile characteristics of wireless network environment, it is assumed in this paper that the network-induced delay is random and its probability distribution is known a prior. In terms of the probability distribution of the delay, a new type of system model with stochastic parameter matrices is proposed. The purpose of this paper is to design the state feedback controller which can guarantee the system is exponentially mean-square stable when considering the effect of both network conditions and data quantizations. By using linear matrix inequality (LMI) technology, sufficient conditions for the solvability of the addressed problem are obtained. It should be noted that, different from the traditional methods in the existing references, the solvability of the derived conditions depends on not only the size of the delay, but also the probability of the delay taking values in some intervals. Finally, a numerical example is provided to demonstrate the effectiveness and applicability of the proposed approach.

15:00-15:20 ThB14.4
Stabilization for Networked Control Systems with Nonlinear Perturbation, pp. 12570-12574

Zhou, Lei — Nantong Univ.
Xiao, Xiaoqing — Nantong Univ.
Lu, Guoping — Nantong Univ.

This paper discusses the stabilization controller designs for a class of networked control systems with nonlinear perturbation. Under consideration of both network-induced delay and the data packet dropout in the transmission, a state feedback controller and a static output feedback controller are constructed, respectively. In addition, the effectiveness of our approach is demonstrated by two numerical examples.

15:20-15:40 ThB14.5
A Simple State Feedback Controller Design Method of Networked Control Systems with Time Delay and Packet Dropout, pp. 12575-12580

Li, HongBo — Tsinghua Univ.
Sun, Zengqi — Tsinghua Univ.
Chow, Mo-Yuen — North Carolina State Univ.
Chen, Badong — Tsinghua Univ.

This paper presents a simple yet e®ective method to design state feedback controller for networked control systems (NCSs). By introducing the lifting technique into NCSs and by considering the balance between e®ectiveness and simplicity, a novel discrete-time switch model is proposed with the consideration of time delay and packet dropout during the transmission of packets. In terms of the given model, we give su±cient conditions for the existence of state feedback controller such that the closed-loop NCSs are asymptotically stable. Based on the obtained stability conditions, a homotopy-based iterative LMI algorithm is developed to get the state feedback gain. Simulation and experimental results are given to demonstrate the e®ectiveness of the proposed approaches.

15:40-16:00 ThB14.6
Stability of Model-Based Networked Control Systems with Intermittent Feedback, pp. 12581-12586

Estrada, Tomas — Univ. of Notre Dame
Antsaklis, Panos J. — Univ. of Notre Dame

In this paper, we apply the concept of Intermittent Feedback to a class of networked control systems known as Model-Based Networked Control Systems (MB-NCS). We begin by introducing the basic architecture for model-based control with intermittent feedback, then address the case with output feedback (through the use of a state observer), providing a full description of the state response of the system, as well as a necessary and sufficient condition for stability in each case. Examples are provided to complement the theoretical results. Extensions of our results to cases with nonlinear plants are also presented. Finally, we investigate the situation where the update times tau and h are time-varying, first addressing the case where they have upper and lower bounds, then moving on to the case where their distributions are i.i.d or driven by a Markov chain.

ThB15 317
Control Issues in Metabolic Engineering (Regular Session)

Chair: Moreno, Jaime A. — Univ. Nacional Autonoma de Mexico-UNAM
Co-Chair: Strmcnik, Stanko — Jozef Stefan Inst.

14:00-14:20 ThB15.1
Optimal Metabolic Pathway Activation, pp. 12587-12592

Oyarzún, Diego A. — National Univ. of Ireland, Maynooth
Ingalls, Brian P. — Univ. of Waterloo
Middleton, Rick — National Univ. of Ireland
Kalamatianos, Dimitrios — National Univ. of Ireland, Maynooth

This paper deals with temporal enzyme distribution in the activation of biochemical pathways. Pathway activation arises when production of a certain biomolecule is required due to changing environmental conditions. Under the premise that biological systems have been optimized through evolutionary processes, a biologically meaningful optimal control problem is posed. In this setup, the enzyme concentrations are assumed to be time dependent and constrained by a limited overall enzyme production capacity, while the optimization criterion accounts for both time and resource usage. Using geometric arguments we establish the bang-bang nature of the solution and reveal that each reaction must be sequentially activated in the same order as they appear in the pathway. The results hold for a broad range of enzyme dynamics which includes, but is not limited to, Mass Action, Michaelis-Menten and Hill Equation kinetics.

14:20-14:40 ThB15.2

An LMI Approach for Robust Stability of Genetic Networks, pp. 12593-12598

Chesi, Graziano — Univ. of Hong Kong
Hung, Yeung Sam — The Univ. of Hong Kong

This paper addresses the problem of establishing robust stability of uncertain genetic networks with SUM regulatory functions. For these networks we derive a sufficient condition for robust stability by introducing a bounding set of the uncertain nonlinearity, and we show that this condition can be formulated as a linear matrix inequality (LMI) optimization obtained via the square matricial representation (SMR) of polynomials by adopting polynomial Lyapunov functions and polynomial descriptions of the bounding set. Then, we propose a method for computing a family of bounding sets by means of convex optimizations. It is worthwhile to remark that these results are derived in spite of the fact that the variable equilibrium point cannot be computed being the solution of a system of parameter-dependent nonlinear equations, and is hence unknown.

14:40-15:00 ThB15.3

Hybrid Approximation of Stochastic Process Algebras for Systems Biology, pp. 12599-12606

Bortolussi, Luca — Univ. of Trieste
Policriti, Alberto — Univ. of Udine

We present a technique to approximate models of biological systems written in a "distilled" version of stochastic Concurrent Constraint Programming (sCCP), a stochastic programming methodology based on logic programming. Our technique automatically associates to a stochastic model an hybrid automaton, i.e. a dynamical system where continuous and discrete dynamics coexist. The hybrid automata generated in this way are, in certain cases, capable of capturing aspects of the dynamics of stochastic processes that are lost in approximations based solely on ordinary differential equations. In particular, they work better for those systems whose sCCP model contains explicit logical mechanisms of control. In the paper we outline the general technique to perform this association and we discuss some issues related to its applicability.

15:00-15:20 ThB15.4

Robustness Analysis of Cellular Systems for in Silico Drug Discovery, pp. 12607-12612

Perumal, Thanneer Malai — National Univ. of Singapore
Wu, Yan — National Univ. of Singapore
Gunawan, Rudiyanto — National Univ. of Singapore

Biological robustness has been recognized as a fundamental organizational principle in cellular behavior. The understanding of robustness trade-off in biology has significant implications in the drug discovery research. Some diseases such as cancer can hijack cellular robustness complicating their treatment. Most of the published robustness analyses in systems biology relate this property to the output parametric sensitivity. A new analysis is proposed in which the sensitivities are evaluated for perturbations on the system states rather than on the model parameters. The result of this analysis can be directly validated in experiments, and further used in the drug discovery research to understand drug effects, to optimize drug dosing and timing, and to identify potential molecules as drug targets. The application to a model of cell death regulation shows the biological insights offered by this analysis.

15:20-15:40 ThB15.5

Control of Overflow Metabolism Via Sliding Mode Reference Conditioning, pp. 12613-12618

Picó, Jesús — Tech. Univ. of Valencia
Garelli, Fabricio — Univ. of La Plata
De Battista, Hernán — Univ. of La Plata

In many biotechnological processes, the optimal productivity corresponds to operating at critical substrate concentration. The problem, then, consists of maximizing the feeding rate compatible with the critical constraint, so as to avoid overflow metabolism. This value may be unknown and may change from experiment to experiment and from strain to strain, and even in the same experiment due to changing environmental and/or process conditions. In previous works different strategies to cope with this problem have been applied to microorganisms of industrial interest, such as E. coli and S. cerevisiae. Thus, probing strategies have been used in fedbatch bioreactors to operate close to their maximum oxygen transfer rate while avoiding acetate accumulation in the first case. In the fed-batch fermentation of S. cerevisiae a small amount of ethanol is allowed to be present in the culture, and the control problem in one of regulating the ethanol concentration a a given low reference value.

Here an approach based on sliding mode reference conditioning is proposed to drive the system to a maximum specific growth rate compatible with a given constraint (e.g. ethanol concentration lower than a given threshold). It is shown how this approach is robust with respect to uncertainties in the process dynamics and with respect to unknown perturbations affecting the critical point.

15:40-16:00 ThB15.6

Neural Networks to Predict Protein Stability Changes Upon Mutation, pp. 12619-12624

Grosfils, Aline — Univ. Libre de Bruxelles
Dehouck, Yves — Univ. Libre de Bruxelles
Gilis, Dimitri — Univ. Libre de Bruxelles
Rooman, Marianne — Univ. Libre de Bruxelles
Bogaerts, Philippe — Univ. Libre de Bruxelles

Black box modelling is used here to improve the performances of the PoPMuSiC program that predicts protein stability changes caused by single-site mutations. For that purpose previously developed statistical energy functions are exploited, which are based on a formalism that highlights the coupling between 4 different protein descriptors (sequence, distance, torsion angles and solvent-accessibility), as well as the volume variation of the mutated amino acid. As the importance of the different types of interactions may depend on the protein region, the stability change is expressed as a linear combination of these energetic functions, whose proportionality coefficients vary with the solvent-accessibility of the mutated residue. Two alternative structures are considered for these coefficients: a Radial Basis Function network, and a MultiLayer Perceptron with sigmoid nodes. These two structures are identified, leading to an improvement of the predictive capabilities of PoPMuSiC, and are discussed in terms of their biophysical interpretation.

ThB17 320A

Control Education: E-Learning (Regular Session)

Chair: Pereira, Carlos Eduardo — Federal Univ. of Rio Grande do Sol
Co-Chair: Dormido, Sebastián — UNED

14:00-14:20 ThB17.1

Educational Games in Control, pp. 12625-12630

Muenz, Ulrich — Univ. of Stuttgart
Schumm, Peter — Univ. Stuttgart
Allgower, Frank — Univ. of Stuttgart

Basic control courses are often attended by students from many different study programs. Many of these students are mainly interested in solving practical problems, whereas the lecturer usually aims at teaching profound knowledge of the analysis and control of dynamical systems. This gap between the application-oriented expectation of the learner and the theory-focused material chosen by the lecturer may end up in a considerable demotivation of the students, which in turn lowers their learning performance. One way to close this gap and to increase both motivation and learning performance are educational games. This is shown in this paper exemplarily for two educational games that were introduced in a basic automatic control course at the University of Stuttgart. Both games are presented in detail and compared based on the course evaluations and feedback from our students.

14:20-14:40 ThB17.2

Student Competition in Multivariable Control Design - Education through E-Game, pp. 12631-12636

Atanasijevic-Kunc, Maja — Univ. of Ljubljana
Karba, Rihard — Univ. of Ljubljana
Logar, Vito — Faculty of Electrical engineering, Univ. of Ljubljana
Papi ;, Marko — Univ. of Ljubljana
Bešter, Janez — Univ. of Ljubljana

In the paper some ideas of studying multivariable control are presented where special attention is devoted to step – by step transition to e-learning. Introduced ideas are realized through design projects between which one is chosen as a competition game and is realized using E-CHO system, Matlab and a pilot plant. All preparation for the game can be realized using remote virtual and actual laboratory device while the competition itself is taking place in the laboratory to preserve personal contacts between the students and the staff.

14:40-15:00 ThB17.3

Blended Learning Using GCAR-EAD Environment: Experiences and Application Results, pp. 12637-12642

Schaf, Frederico Menine — Univ. of Rio Grande do Sul
Pereira, Carlos Eduardo — Federal Univ. of Rio Grande do Sol
Henriques, Renato Ventura Bayan — Univ. of Rio Grande do Sul

This paper presents results and experiences of the application of a educational tool called GCAR-EAD Virtual Learning Environment in control systems lessons at the electrical engineering department of our University. The environment offers besides traditional organized educational material also remote experiments and a preliminary tutoring system that guide the student in order to maximize knowledge transfer and self learning techniques. MOODLE as common virtual learning platform implementation was employed as basis of the environment architecture and several developed tools were integrated to increase the added educational value of the system. Results and students feedback indicate good educational value associated with the system and further development is addressed to enhance the blended learning scenario and effectiveness of the system.

15:00-15:20 ThB17.4

Design of Web-Based Real-Time Control Laboratory for Diversely Located Test Rigs, pp. 12643-12648

Hu, Wenshan — Univ. of Glamorgan
Liu, Guoping — Univ. of Glamorgan
Rees, David — Univ. of Glamorgan
Qiao, Yuliang — Chinese Acad. of Sciences

This paper introduces a four-layer structure for the global scale remote laboratory NCSLab (www.ncslab.net) which provides a unified interface for accessing the test rig diversely located. This structure is good for both expansion and maintenance. All the test rigs are classified into several sublaboratories according to their functions rather than their locations. The user doesn't have to know their geographical locations. The user can use a single user ID and password to access all the test rigs in different locations just as they are all in one place. The remote lab also provides great flexibility for the users including remote tuning, remote monitoring and remote control algorithms. Most of the jobs done in a hands-on laboratory can be carried out in the remote laboratory.

15:20-15:40 ThB17.5

E-Learning System with a Real System and Graphical Simulator for Embedded System, pp. 12649-12654

Yokota, Sho — Tokyo Univ. of Tech.
Kazuya, Hiramatsu — Tokyo Univ. of Tech.
Yasuhiro, Ohyama — Tokyo Univ. of Tech.
She, Jin-Hua — Tokyo Univ. of Tech.
Hashimoto, Hiroshi — Tokyo Univ. of Tech.

This paper describes an e-learning system with a real system and simulator for studying embedded system. Proposed e-learning system provides learners with three items for studying embedded system. First one is on-line textbook. Second one is a graphical simulator, and third one is a real system. The simulator consists of microprocessor and its peripheral circuit. The real system consists of same composition as a simulator and is connected to the internet, namely it is a remote experimental embedded system. The simulator is used for the verifying the programming and for understanding the theory of embedded system operation, namely it is used for exercise The real system is used for the experiment to check the real reaction of the system, namely it is used for experiment. Therefore the leaner can study embedded system regardless of location and time. Moreover they can learn even if they do not have a real system. Thus they do not have to prepare any equipment needed for developing embedded system.

15:40-16:00 ThB17.6

Multitasking Real-Time Control Systems in Easy Java Simulations, pp. 12655-12660

Farias, Gonzalo — U.N.E.D.
Cervin, Anton — Lund Univ.
Arzen, Karl-Erik — Lund Inst. of Tech.
Dormido, Sebastián — UNED
Esquembre, Francisco — Professor, Ph. D

The paper presents the development of interactive real-time control labs using Easy Java Simulations (Ejs). Ejs is a free software tool that allows rapid creation of interactive simulations in Java. A new TrueTime-based kernel has been designed in Ejs in order to create multitasking real-time system simulations as well as soft real-time applications. The main features of these new capabilities are presented.

ThB18 320B

Embedded Component Technology for Network Robot System (Invited Session)

Chair: Cho, Young-Jo — ETRI
Co-Chair: Hamaguchi, Masafumi — Shimane Univ.
Organizer: Cho, Young-Jo — ETRI

14:00-14:20 ThB18.1

A Tele-Operated Gesture Recognition Mobile Robot Using a Stereo Vision (I), pp. 12661-12666

Shin, H.C. — Electronics and Telecommunications Res. Inst.
Kim, Y.G. — Korea Univ. of Science and Tech.
Cho, J.I. — Electronics and Telecommunications Res. Inst.
Cho, Young-Jo — ETRI

In this paper, a tele-operated gesture recognition mobile robot using a stereo vision is represented. We propose a real-time face and hand classification and 3D position extraction using a stereo vision embedded system. To obtain the disparity image, we used the stereo vision process on FPGA and developed the embedded system to obtain the image sequence for basic image processing. Then we applied the simple and reliable algorithm we developed to detect and classify the head and hand in real-time on Tele-operation server. The arm posture and hand trajectory were used for gesture recognition. We also show the experimental result to support validity of the system and the algorithm

14:20-14:40 ThB18.2

Damping Path Design for Liquid Container Transferred with Wheeled Mobile Robot Along Multiple Turn Sections, pp. 12667-12672

Yoshida, Yu — Shimane Univ.
Hamaguchi, Masafumi — Shimane Univ.
Taniguchi, Takao — Shimane Univ.

This paper proposes a design method of a damping path for a cylindrical liquid container transferred with a wheeled mobile robot. The damping path is constructed from the acceleration using the principle of an input shaping method. Although a positional error is occurred by using the input shaping method, it is easy to correct the error with the proposed method. The proposed design method can be applied to a complex reference path including multiple turn sections. In addition, a constraint condition of maximum amplitude of sloshing in the container can be taken into consideration. The effectiveness of the proposed method is clarified through simulations and experiments.

14:40-15:00 ThB18.3

Automated Bayesian Network Integration Based on Ontology for Reasoning Object Existence of Service Robot (I), pp. 12673-12678

Song, Youn-Suk — LG Electronics
Cho, Sung-Bae — Yonsei Univ.

Object detection of service robots is very important for their service. Most of services such as delivery, errand of users are related to objects. Conventional methods are based on the geometric models in static industrial environments, but they have limitations in uncertain and dynamic indoor environments, because interest object can be occluded or small in the image according to the robot's location or angle. For solving these uncertain situations, it is helpful to predict the probability of target object, because it can give important information for their next action. Our idea is to use observed objects as context information for predicting target one. For this, we adopt Bayesian networks and ontology together for modeling domain knowledge and reasoning objects in probabilistic frame. We verified the performance and process of our method through the experiments.

15:00-15:20 ThB18.4

Robot System Providing Fault-Tolerant Services: Research of Middleware Supporting Fault-Tolerance (I), pp. 12679-12684

Baek, BumHyeon — student
Choi, HyeongSeob — student
Park, Hong Seong — Kangwon National Univ.
Kim, Joong-Bae — ETRI
Kim, Sunghoon — ETRI

Recently, robot technology is actively going on progress to the field of various services such as medical care, entertainment. These service robots are in use for home management nearby person, and so need to operate safely. Fault tolerance is a performable capacity without influence of fault although fault is occurred hardware or software and guarantees safe operation of systems. This paper proposes a robot system providing fault-tolerant services in distribute environment. The systems are developed to apply to robot middleware for supporting fault-tolerance. The robot middleware is divided into three layers of a Service Layer (SL), Network Adaptation Layer (NAL), Network Interface Layer (NIL) and includes Operating System Abstraction Layer (OSAL), Fault-Tolerant Manager (FTM). Especially, Service-Adaptive Engine (SAE) in SL and Fault-Tolerant Manager provides fault tolerance for this middleware and are easy to dynamic expansion. Also, these systems are component-based structure, and so provide reusability, lightweight to load various robot systems.

15:20-15:40 ThB18.5

The Software Architecture for Module-Based Robot System Supporting Heterogeneous Network Interfaces (I), pp. 12685-12690

Lee, Kwang Koog — Kangwon National Univ.
Kim, Seong Hoon — Kangwon National Univ.
Vitaly, Li — Kangwon National Univ.
Choe, Sun Hee — Kangwon National Univ.
Park, Hong Seong — Kangwon National Univ.
Kim, Sunghoon — ETRI
Kim, Joong-Bae — ETRI

On developing modern robot systems, intellectual robots can be designed as multiple modules, where the module means the autonomous hardware units performing robot specific tasks. Further, each module can be connected with non-unified network interfaces due to a heterogeneous feature of robot system. In this manner, one of technical challenges is interoperability to support stable and effective communication between such disparate devices. Focusing on this issue, this paper proposes a middleware named HERM (Heterogeneous nEtwork-based Robot Middleware). HERM is divided into three layers; (i) Network Interface Layer, which abstracts various heterogeneous network interfaces as logical channels, (ii) Network Adaptation Layer, which provides addressing strategies and routing service for communication between modules, and (iii) Application Support Layer, which manages robot applications and transforms application data into a standard format for transmitting over a network. By this layered design, HERM provides standardized interfaces to control various heterogeneous network devices, supporting transparent and facilitates integration of different module which constitute a robot system. The results of implementation and experiment show that HERM is suitable for a module-based robot.

15:40-16:00 ThB18.6

Emotion Expression and Environment through Affective Interaction (I), pp. 12691-12696

Park, Cheonshu — Electronics and Telecommunications Res. Inst.
Cho, Young-Jo — ETRI

This paper focuses on emotion expressions and environments through affective interaction between a human and a robot. To this end, we develop an emotion expression system includes an emotion engine, an experimental platform and a simulation tool. KOBIE is an experimental robot platform which provides emotional stability and continuous interest to a user through affective interaction. In addition, the simulation tool provides a visualization interface for the emotion engine and expresses emotion through an avatar. The proposed system can be used in the development of cyber characters that use emotions or in the development of an apparatus with emotion in a ubiquitous environment.

ThB19 320C

Tele Robotics (Regular Session)

Chair: Basanez, Luis — Univ. Pol. de Catalunya
Co-Chair: Namerikawa, Toru — Kanazawa Univ.

14:00-14:20 ThB19.1

Bilateral Teleoperation Experiments: Scattering Transformation and Passive Output Synchronization Revisited, pp. 12697-12702

Nuńo, Emmanuel — Tech. Univ. of Catalonia
Basanez, Luis — Univ. Pol. de Catalunya
Rodriguez-Seda, Erick Joel — Univ. of Illinois at Urbana-Champaign
Spong, Mark W. — Univ. of Illinois at Urbana-Champaign

It is well known that the scattering variables transform the transmission delays into a passive virtual transmission line, hence, its interconnection with passive subsystems preserves passivity of the overall system. However, wave reflections may occur. Using a symmetric velocity controller, on the master and the slave, and by matching the impedances, the scattering transformation reduces to a passive output synchronization scheme. In this paper we revisit this relation and perform some experiments on this line.

14:20-14:40 ThB19.2

Predictive PD Control for Teleoperation with Communication Time Delay, pp. 12703-12708

Yoshida, Kouei — Kanazawa Univ.
Namerikawa, Toru — Kanazawa Univ.

This paper deals with a problem of predictive control for nonlinear multi-DOF teleoperation with time varying delay, parametric uncertainties of the robot model and uncertainties of remote environment. The proposed method is combination of the PD control based on the predictors and the adaptive impedance control. Since the predictors are used to simultaneously estimate the master and slave dynamics, the use of the delayed information is avoided. Thus, the performance degradation due to communication time delay can be alleviated. The adaptive impedance control is used to linearize the robot with parametric uncertainties. Proposed predictive PD control method does not require the environmental dynamic model and can achieve the position coordination and the static force reflection in certain conditions. The stability and position coordination are guaranteed by using the Lyapunov theorem. Experimental results show the effectiveness of proposed teleoperation.

14:40-15:00 ThB19.3

Determining Fixturing Points for Complex Objects, pp. 12709-12714

Roa, Maximo — Tech. Univ. of Catalonia
Suarez, Raul — Univ. Pol. de Catalunya

This paper presents a method to design fixtures for complex objects in robotized environments. The object is described with a set of points on its surface. First, an initial form-closure fixture is found with an iterative algorithm. The initial fixture is then improved with an iterative approach relying on a geometrical reasoning that efficiently looks for a locally optimum fixture; the quality of the fixture is measured considering the largest perturbation wrench that the fixture can resist, with independence of its direction. Once a locally optimum fixture has been reached, independent contact regions are computed to provide robustness in front of the locator positioning errors or to allow variations in the locators position. The proposed approach can also be applied to compute fixtures when one or several locators are fixed beforehand. The procedure has been implemented and application examples are included in the paper.

15:00-15:20 ThB19.4

Analysis and Design of Position-Force Teleoperation with Scattering Matrix, pp. 12715-12720

Duong, Minh Duc — Toyohashi Univ. of Tech.
Miyoshi, Takanori — Toyohashi Univ. of Tech.
Terashima, Kazuhiko — Toyohashi Univ. of Tech.
Rodriguez-Seda, Erick Joel — Univ. of Illinois at Urbana-Champaign

This paper presents a design method for a position-force bilateral teleoperation system with scattering matrix by using compensators and wave filters. At first, the compensators and low-pass filters were chosen to guarantee the system's stability based on the small-gain theorem. After that, the effects of wave impedance and time delay on the stiffness and the viscosity of the system were evaluated.

Moreover, the existence of oscillation, and even instability of the local loop caused by properties of remote environment, are recognized and explained. Finally, the conditions for the designed parameters to stabilize the system are given using Popov criterion.

15:20-15:40 ThB19.5

Transparent Bilateral Control Architecture by State Convergence for Telerobotics, pp. 12721-12726

Azorin, Jose M.	Univ. Miguel Hernandez de Elche
Aracil, Rafael	Univ. Pol. de Madrid
Sabater, Jose M.	Univ. Miguel Hernandez
Perez, Carlos	Univ. Miguel Hernández
Garcia, Nicolas M.	Univ. Miguel Hernandez

This paper presents a bilateral control scheme designed to achieve the two main goals of a teleoperation system: stability and transparency. The control scheme allows that the slave follows the master, ant that the force displayed to the operator was exactly the reaction force from the environment. In addition, the interaction force of the slave with the environment is adapted to the master/slave ratio when it is reflected to the operator, improving the transparency of the system. The bilateral control scheme can be used in contact situations or non-contact situations (free motion) of the slave with the environment. Together with the control scheme, the paper describes an analytical design method that allows to obtain the control gains.

15:40-16:00 ThB19.6

Nonlinear H_Infinity Control of a Bilateral Nonlinear Teleoperation System, pp. 12727-12732

Razi, Kamran	Univ. of Tehran
Yazdanpanah, Mohammad Javad	Univ. of Tehran
Shiry Ghidary, Saied	Amirkabir Univ. of Tech.

In this paper, we present a nonlinear H_; control technique for the bilateral teleoperation of a nonlinear master-slave system. The proposed controller guarantees robust stability in the presence of uncertainty in operator and environment impedances. The guidelines to include nonlinear intervening tool between master and slave robot are suggested. The proposed technique enables adjusting weighting of position and force tracking error functions for both amplitude and frequency domain. To solve the corresponding partial differential equation, called HJI, an approximation method based on Taylor series expansion of the solution is used. A numerical simulation demonstrates that the linear controller tends to instability in contact tasks while the third order approximated nonlinear controller yields desired performance.

ThB20 321C

Automation in Micro and Nano-Handling I (Invited Session)

Chair: Fatikow, Sergej	Fak.II, AMiR
Co-Chair: Li, Yangmin	Univ. of Macau
Organizer: Fatikow, Sergej	Fak.II, AMiR

14:00-14:20 ThB20.1

Structure Improvement of an XY Flexure Micromanipulator for Micro/Nano Scale Manipulation (I), pp. 12733-12738

Xu, Qingsong	Univ. of Macau
Li, Yangmin	Univ. of Macau

An effort made towards the performance improvement for an XY micromanipulator featuring parallel architecture and flexure hinges has been presented in this paper. Through the implementation of four steps evolution of the original structure, a new manipulator with decoupled motion is finally obtained, which owns an enlarged workspace and eliminated stiffening and buckling phenomena. The merits of the new manipulator have been illustrated via the finite element analysis performed via ANSYS software package. It is believed that the generated flexure micromanipulator can be adopted in the applications involving manipulation of objects in micro- and nano-meter scales.

14:20-14:40 ThB20.2

Development, Control and Evaluation of a Mobile Platform for Microrobots (I), pp. 12739-12744

Edeler, Christoph	Univ. of Oldenburg
Jasper, Daniel	Univ. of Oldenburg
Fatikow, Sergej	Fak.II, AMiR

This paper describes the development, control and evaluation of a mobile platform for microrobots. The platform uses laser-structured piezoceramic plates equipped with ruby hemispheres in order to continuously rotate three steel spheres using the stick-slip effect. The spheres roll on the working surface and can thus move the platform in two translational and one rotational degrees of freedom. This indirect stick-slip actuation does not stress the working surface and can even operate on surfaces that are not perfectly flat. The exact geometry of the actuators is analyzed and an open-loop control approach is derived. As there are 27 piezo segments moving nine ruby hemispheres and three steel spheres, both the amplification hardware and the software algorithms need to be carefully designed. A prototype was built and evaluated to prove the concept. Basic data about the platform's properties such as step length, resolution and actuation speed was gathered. The results are very promising as the platform can move with nm-resolution and with velocities of up to 10 mm/s.

14:40-15:00 ThB20.3

The SEM-FIB Workbench (I), pp. 12745-12750

Kim, Kyunghwan	NT Res. Inc.
Klocke, Volker	Klocke Nanotechenik

The Nanorobotics series developed by Klocke Nanotechnik extend Scanning Electron or Ion Microscopes to material processing systems. The included automation allows the whole field of handling, assembly and manufacturing like known from a normal desktop system – now with nano-precision, including various kinds of image generation by using different sensors. Applications are in the field of Material Research, Forensics, 3-Dimensional SEM/FIB, Tribology, Semiconductor, e-beam Lithography or X-Ray imaging up to complete NanoFabrication.

15:00-15:20 ThB20.4

Automated Nano-Assembly in the SEM I: Challenges in Setting up a Warehouse (I), pp. 12751-12756

Wich, Thomas	Univ. of Oldenburg
Stolle, Christian	Univ. of Oldenburg
Frick, Oliver	Univ. of Oldenburg
Fatikow, Sergej	Fak.II, AMiR

This paper describes the implementation of setting up a warehouse for automated nano-assembly, i.e. the automated registration of the parts processed during the automated assembly. Starting with a brief description of the goals of the assembly process, the overall process structure and its challenges with respect to the micro- and nanoscale are explained. The warehouse task is used as an example for describing the task planning, the necessity to minimize the number of subtasks taking further constraints from the experimental setup into account. For controlling such a complex assembly process, an intelligent and flexible control and communication structure is necessary, which will be explained in detail. Based on these considerations, the implementation of the warehouse task and its challenges, including the representation of the parts in the control system, object recognition using generalized models and methods for part origin determination will be presented.

15:20-15:40 ThB20.5

Electromagnetic Parallel Microrobot for Micro and Nano-Handling (I), pp. 12757-12762

Büttgenbach, Stephanus	Tech. Univ. of Braunschweig
Feldmann, Marco	Tech. Univ. of Braunschweig

In this paper we report on a novel parallel microrobot driven by Lorentz force actuators. The microrobot consists of three linear microactuators positioned in plane forming a parallel planar kinematic structure. Each actuator is connected by polymer flexural hinges to a triangular frame in the center of the structure serving as the end effector. Advantages of such micro actuators are the facts that their displacement increases with increasing current and that they exhibit good linear characteristics according to the Lorentz force law. Therefore they allow high precision displacements. Due to the freely suspended structure, friction can be disregarded, and first movements occur already at a current of 10 µA, which results in very low thermal effects. For application to micro- and nano-handling the precise measurement of the displacement of each actuator is very important. Therefore, special capacitive micro sensors are integrated into the system, which consist of comb-like structures constituting differential capacitors. Currently, these micro sensors allow controlling the end effector in a closed loop control with high precision of 1.3 nm within a workspace of 400 µm x 400 µm.

ThB21 321B

Soft Computing/Computational Intelligence in Mechatronics (Invited Session)

Chair: Ang Jr, Marcelo H — National Univ. of Singapore
Co-Chair: Lee, Tong Heng — National Univ. of Singapore
Organizer: Ang Jr, Marcelo H — National Univ. of Singapore

14:00-14:20 ThB21.1

Fault Detection and Accommodation Control for a Class of Nonlinear Systems (I), pp. 12763-12768

Huang, Sunan — National Univ. of Singapore
Tan, Kok Kiong — National Univ. of Singapore
Tang, Kok Zuea — National Univ. of Singapore
Lee, Tong Heng — National Univ. of Singapore

In this paper, a fault detection and accommodation scheme is designed, which is applicable to a large class of nonlinear systems. The nonlinear observer is designed to enable the detection of fault occurrences through comparison of observed states with their signatures. Under such circumstances, when a component fails, the fault accommodation control will be activated to compensate the effects of the fault function.

14:20-14:40 ThB21.2

Neural Network Based Control for a Class of Uncertain Robot Manipulator with External Disturbance, pp. 12769-12774

Xian, Bin — Tian Jin Univ.
Cui, Cuijie — Tianjin Univ.
Huang, Mu — TianJin Univ.
Li, Dong — Tianjin Univ.
Yang, Kaiyan — Tianjin Univ.

In this paper, a neural network based continuous control mechanism that can compensate for system uncertainties is developed for a class of robot manipulators under both repeating and non-repeating disturbances. With limited assumptions about the systems' dynamics, Lyapunov techniques are utilized to show that a semi-global asymptotic tracking result is achieved while all the closed-loop states remain bounded. Numerical simulation results are provided to demonstrated that the proposed control design achieves a good tracking performance.

14:40-15:00 ThB21.3

The Operational Space Formulation with Neural-Network Adaptive Motion Control (I), pp. 12775-12780

Soewandito, Dandy — National Univ. of Singapore
Oetomo, Denny Nurjanto — Monash Univ.
Ang Jr, Marcelo H — National Univ. of Singapore

An operational space controller that employs three-layer neural network (NN) adaptive motion control is presented in this paper. It is shown that the trajectory tracking errors and the NN weight errors are bounded and consequently the controller is shown to be stable. Comparative study is made between the performance of the proposed NN adaptive motion control strategy and the conventional inverse-dynamics control and PD plus gravity compensation controller. The simulation results show that the NN adaptive motion control can be as effective as the inverse-dynamics without the need for textit{a priori} knowledge of the system dynamics. Real-time implementation of the strategy was also conducted on a real PUMA 560 robot.

15:00-15:20 ThB21.4

Synchronization of Two Ball and Beam Systems with Neural Compensation, pp. 12781-12786

Jiménez, Saúl — CINVESTAV-IPN
Yu, Wen — CINVESTAV-IPN
Li, Xiaoou — CINVESTAV-IPN

Ball and beam system is one of the most popular and important laboratory models for teaching control systems engineering. There are two problems for ball and beam synchronized control: 1) many laboratories use simple controllers such as PD control, and theory analysis is based on linear models, 2) nonlinear controllers for ball and beam system have good theory results, but they are seldom used in real applications. Almost nobody realize synchronized control for ball and beam systems. In this paper we first use PD control with nonlinear exact compensation for the cross-coupling synchronization. Then a RBF neural network is applied to approximate the nonlinear compensator. Two types of controller are proposed: parallel and serial PD regulators. The synchronization stability of two ball and beam systems are discussed . Real experiments are applied to test our theory results.

15:20-15:40 ThB21.5

Evolutionary Univector Field-Based Navigation with Collision Avoidance for Mobile Robot (I), pp. 12787-12792

Lim, Yusun — KAIST
Choi, Seung-Hwan — Korea Advanced Inst. of Science and Tech.
Kim, Jong-Hwan — Korea Advanced Inst. of Science and Tech.
Kim, Dong-Han — Kyung Hee Univ.

This paper proposes a novel vector field navigation method by using the velocity vector of a robot to avoid obstacles in dynamic environment. Shifting vector and virtual obstacle are proposed to derive the center of repulsive field which makes the robot move away from the obstacle: The shifting vector is derived from the velocity vector of the robot and the obstacle and the virtual obstacle is made by adding the shifting vector to the real obstacle. By considering the velocity vector of an obstacle with a shifting vector and a virtual obstacle, the robot can avoid not only stationary obstacles but also dynamic obstacles, where the fields are optimized by evolutionary programming. The performance of proposed method is demonstrated by simulations and experiments in robot soccer system.

15:40-16:00 ThB21.6

Sliding Mode Algorithm for On-Line Learning in Fuzzy Rule-Based Neural Networks (I), pp. 12793-12798

Topalov, Andon Venelinov — Tech. Univ. Sofia, branch Plovdiv, Bulgaria
Kaynak, Okyay — Bogazici Univ.
Shakev, Nikola Georgiev — Tech. Univ. Sofia, branch Plovdiv
Hong, Suk Kyo — Ajou Univ.

A new, variable structure systems theory based, algorithm has been developed for on-line training of fuzzy-neural networks. Such computationally intelligent structures are widely used for modeling, identification and control of nonlinear dynamic systems. The algorithm is applicable to fuzzy rule-based neural nets of Takagi-Sugeno-Kang type with a scalar output. Its convergence is established and the conditions are given. Differently from other similar approaches which are limited to the adaptation of the parameters of the network defuzzification part only, the proposed algorithm tunes also the parameters of the implemented membership functions. The zero level set of the learning error variable is considered as a sliding surface in the space of network learning parameters. The effectiveness of the proposed algorithm is shown when applied to on-line learning of nonlinear functions approximation.

ThB22 321A

Estimation, Detection and Diagnosis (Regular Session)

Chair: Koivisto, Hannu — Tampere Univ. of Tech.
Co-Chair: Badreddin, Essam — Univ. of Heidelberg

14:00-14:20 ThB22.1

Behavior Based Estimation of Dependability for Autonomous Mobile Systems Using Particle Filter, pp. 12799-12804

Rüdiger, Jan — Univ. of Heidelberg
Wagner, Achim — Univ. of Mannheim
Badreddin, Essam — Univ. of Heidelberg

The dependability of a system is particularly important when dealing with autonomous or semi-autonomous systems. With an increasing degree of autonomy and safety requirements, the requirements for dependability increase. Hence, being able to measure and compare the dependability of a system is more and more inevitable. Since autonomous mobile systems are usually described by their behavior it is straightforward to also define the dependability of such a system in a behavioral context. Thus, in this paper, the approach of a behavioral based definition of dependability is used together with a Particle Filter to predict the dependability of an autonomous mobile system at runtime

14:20-14:40 ThB22.2

Detection of Safe and Harmful Bioaerosols by Means of Fuzzy Classifiers, pp. 12805-12812

Pulkkinen, Pietari — Tampere Univ. of Tech.
Hytönen, Jarmo — Dekati Ltd.
Koivisto, Hannu — Tampere Univ. of Tech.

This paper aims to create a fuzzy classifier (FC) to be used in a recently developed bioaerosol detector. The main requirements for FC are high true positive (TP) rate, low false positive (FP) rate, and interpretability, which is measured by transparency of fuzzy partition. Due to the contradicting nature of the above requirements, FCs are identified by hybrid genetic fuzzy system (GFS), which initializes the population using decision trees (DTs) and simplification operations. Then, a multiobjective evolutionary algorithm (MOEA) is run in order to find a Pareto-optimal set of FCs. During MOEA optimization, heuristic rule and rule condition removal is applied to keep the rule base consistent. Real-world bioaerosol data, collected from Umeĺ trial field, Sweden, and from laboratory of Finnish Defense Forces Technical Research Center, were used to validate the proposed GFS. By means of it, a widely spread set of interpretable and accurate FCs was obtained. Moreover, an FC based on this project was installed into the bioaerosol detector and the preliminary tests proved its capability in distinguishing between safe and harmful bioaerosols.

14:40-15:00 ThB22.3

Energy Based Mode Tracking of Hybrid Systems, pp. 12813-12818

Arogeti, Shai — Nanyang Tech. Univ.
Wang, Danwei — Nanyang Tech. Univ.
Low, Chang Boon — Nanyang Tech. Univ.
Zhang, Jing Bing — Singapore Inst. of Manufacturing Tech.

Hybrid systems consist of continuous and discrete dynamics. These systems can be described with a set of modes, where in each mode the system is governed by a continuous dynamics, and different modes correspond to different continuous models. For hybrid systems, model-based fault detection and isolation (FDI) is a challenging task, since system’s prevailing dynamical model and the system's current mode (discrete state) are mutual dependent and intertwined. This paper introduces a new energy based approach for mode tracking of physical systems with hybrid dynamics. A Hybrid Bond Graph systematic analysis is utilized to characterize each system’s mode with compact energy relations. To track system’s modes, we monitor these energy relations in real time. The result is an energy based mode tracker that is more efficient in terms of computational resources than existing techniques.

15:00-15:20 ThB22.4

Design and Realization of Sensor Nodes for Dense Underwater Wireless Sensor Networks, pp. 12819-12824

Lu, Chao — Chinese Acad. of Sciences
Wang, Shuo — Chinese Acad. of Sciences
Tan, Min — Inst. of Automation, Chinese Acad. of Sciences

High cost and high power consumption of underwater acoustic modem have limited the applications and researches of underwater wireless sensor networks (UWSN). This paper presents a node architecture and its low-cost realization to deal with such problems as high cost, high power consumption, large volume, and relative localization in a dense UWSN. Some fundamental functions like short range underwater acoustic communication, relative range measurement, localization among the nodes are realized. And the experimental results show the nodes can meet the basic requirements of the dense UWSN research.

15:20-15:40 ThB22.5

Diagnostic Fusion for in Vehicle Driver Vigilance Assessment, pp. 12825-12830

Boverie, Serge — Siemens VDO Automotive
Giralt, Alain — Siemens VDO automotive
Le Quellec, Jean-Michel — Siemens VDO Automotive

Driver impairment in broad terms is one of the most common causes for traffic accidents. In the context of impairment, decreased vigilance, fatigue and inattention are major factors accounting for driver errors. The real time detection and assessment of driver impairment through non-intrusive driver monitoring system is a real challenge. Within this paper after an extended state of the art of the existing technologies and systems a Driver vigilance monitoring system based on the fusion of physiological, behavioural and contextual information is described. This system has been implemented on a vehicle and real conditions experiments have been performed on motorway

15:40-16:00 ThB22.6

Driver Vigilance Diagnostic Based on Eyelid Movement Observation, pp. 12831-12836

Boverie, Serge — Siemens VDO Automotive
Giralt, Alain — Siemens VDO automotive

Driver loss of vigilance is an important cause of road fatalities. The improvement of technologies makes now possible the implementation of in-vehicle driver monitoring systems assessing in real time the evolution of the driver state. Within this paper a Driver Vigilance Monitoring (DVM) system developed by SIEMENS VDO Automotive is described. This system includes a compact CMOS camera for observing the driver eyelid movements and a set of algorithms for analyzing in real time the image provided by the camera, to classify this information and at last to provide drowsiness diagnostic.

ThB23 323

Production & Logistics Over Manufacturing Networking

(Regular Session)

Chair: Chai, Tianyou — Northeastern Univ.
Co-Chair: Dolgui, Alexandre — Ec. des Mines de Saint Etienne

14:00-14:20 ThB23.1

Complete Modification Rescheduling Method and Its Application for Steelmaking and Continuous Casting, pp. 12837-12842

Pang, Xinfu — Northeastern Univ.
Yu, Shengping — Northeastern Univ.
Zheng, Binglin — Northeastern Univ.
Chai, Tianyou — Northeastern Univ.

Delayed processing time and machine failures upset the plan in steelmaking-continuous casting (SCC) production, which make production plan infeasible. The manual repairing cannot satisfy objectives of quick response and optimal scheduling. The practical rescheduling with 1-4 refining stages cannot abstract as three stages hybrid flow shop (HFS). A method is presented for the rescheduling problem, which includes two steps. Firstly, the assigning machine strategy and its computing algorithm are given. Secondly, the mathematical models are developed as multi-objective model based on practical production constraints, so as to solve machine conflicts. The dynamic scheduling system for SCC with the rescheduling method has been successfully applied to Shanghai Baoshan steel plant, and realizes rapidly optimal rescheduling.

14:20-14:40 ThB23.2

Particle Swarm Optimization for Open Vehicle Routing Problem with Time Dependent Travel Time, pp. 12843-12848

Zhao, Yanwei — Zhejiang Univ. of Tech.
Wu, Bin — Zhejiang Univ. of Tech.
Wang, Wanliang — Zhejiang Univ. of Tech.
Zhang, Jingling — Zhejiang Univ. of Tech.

Open Vehicle Routing Problem with Time Dependent Travel Time (OVRPTD) is different from most variants of vehilce routing problems from the liteture in that the vehicle dosen’t return to the depot after serving the last customer and the travle time is time dependent. The travle time is presented by a continuous dynamic network time dependent function. Particle Swarm Optimization with self-adaptive inertia weight is presented. Each particle regulates its inertia weight according to the corresponding position with itself and the best particle in the population. Different updating rules are applied to the excellence particles and the inferior particles. For the excellence particles, compute their information entropy after server iterations, and update their position according to the new position updating function. And for the inferior particles, record them in the bulletin board, then after several iteration, use the new particles displace the inferior according the appearance frequency in the board. In the experiment, the influence of the population, iteration, inertia weight for the optimization result is discussed. By the experiment, give the field of the parameter. Compare the particle swarm optimization with other algorithms by the benchmark. The result shows the algorithm in the paper is the efficiency for the OVRPTD.

14:40-15:00 ThB23.3

MRP Parameterization under Lead Time Uncertainties: A Branch and Cut Algorithm, pp. 12849-12854

Dolgui, Alexandre — Ec. des Mines de Saint Etienne
Ould Louly, Aly Mohamed — King Saud Univ.

Inventory control in a Supply chain is crucial for companies who wish to satisfy their customer demands on time as well as controlling costs. A common approach is to use the MRP techniques. However, these techniques are based on the supposition that lead times are known. In a Supply chain the lead times are often random variables. Therefore, an efficient exact approach to aid in MRP parameterization under lead time uncertainties was developed; more precisely the approach has as objective to calculate planned lead times when the component procurement times are random. The aim is to find the values of planned lead times which minimize the sum of the average component holding cost and the average backlogging cost. The developed approach is based on a mathematical model of this problem with discrete decision variables and on a Branch and Cut algorithm.

15:00-15:20 ThB23.4

Towards a Neuro-Fuzzy System for Time Series Forecasting in Maintenance Applications, pp. 12855-12860

El Koujok, Mohamed — FEMTO-ST Inst. UMR CNRS 6174 - UFC / ENSMM / UTBM
Gouriveau, Rafael — FEMTO-ST Inst. UMR CNRS 6174 - UFC / ENSMM / UTBM
Zerhouni, Noureddine — FEMTO-ST Inst. UMR CNRS 6174 - UFC / ENSMM / UTBM

In maintenance field, industrial and research communities take a growing interest in the "understanding of the degradation phenomenon". Within this frame, the general purpose of the paper is to explore the way of defining a prognostic system that is able to approximate and predict the degradation of equipment. Prognostic is defined and the evolution of developments on forecasting methods is studied. A neuro-fuzzy system for failure prediction based on the ANFIS model is closely studied and a pre-treatment of data is proposed to perform short term accurate and mid-term reliable predictions.

15:20-15:40 ThB23.5

New Approach to Prognostic System Failures, pp. 12861-12866

Peysson, Flavien — Univ. Paul Cézanne, Aix-Marseille III
Ouladsine, Mustapha — Univ. d'aix marseille III
Noura, Hassan — United Arab Emirates Univ.
Leger, Jean-Baptiste — PREDICT
Allemand, Claude — DCN

To obtain high availability with reduced life cycle total ownership costs, classical maintenance policies are not sufficient. Indeed these polices do not allow us to thrust in just when its necessary because they are not available to plan the current system state in the future. The paper presents an approach based on the system decomposition in three levels: Environment, Mission and Resources, to predict the system failure by tracking its various degradation and thus to know whether the system is able to accomplish its mission in time by using system current state and its future use.

15:40-16:00 ThB23.6

Online Change Detection and Conditional Maintenance, pp. 12867-12872

Fouladirad, Mitra — Univ. Tech. of Troyes
Grall, Antoine — Univ. de Tech. de Troyes

The aim of this paper is to use the online change detection methods in the framework of the conditional maintenance. The purpose is to propose an adequate conditional maintenance policy to a gradually deteriorating system with change of mode using on-line detection algorithms. The parameters defining the deterioration mode after the change can be unknown. The main purpose is to optimize a global cost criterion.

ThB24 324

Architectures and Software Tools for Enterprise Integration and Networking in Manufacturing (Regular Session)

Chair: Molina, Arturo — Tecnologico de Monterrey
Co-Chair: Pingaud, Hervé — ENSTIMAC

14:00-14:20 ThB24.1

Methodology for Enterprise Interoperability, pp. 12873-12878

Daclin, Nicolas — Univ. d eBordeaux
Chen, David — Univ. Bordeaux I
Vallespir, Bruno — Univ. of Bordeaux 1

This paper aims at presenting a methodology for guiding enterprises to improve interoperability. This methodology consists in (i) a framework of interoperability, which structures specific solutions of interoperability and is composed of barriers, concerns and approaches dimensions; (ii) method to measure interoperability, which takes into consideration interoperability (maturity) before and (operational performances) during a partnership; and (iii) a structured approach defining the steps of the methodology, from the expression of enterprise's needs to implementation of solutions. The relationship which consistently relates these components is highlighted. It enables establishing interoperability in a step-bystep manner. This paper presents each component of the methodology and shows how it operates.

14:20-14:40 ThB24.2

Multi-Screen View and GRAI GRIDS to Model Decisional Process of Manufacturing IS Alignment, pp. 12879-12884

Goepp-Thiebaud, Virginie — Inst. National des Sciences Appliquées de Strasbourg
Kiefer, François — Inst. National des Sciences Appliquées de Strasbourg

Today, manufacturing companies evolve in a competitive and changing environment that drives continual change. These changes and related evolution generally concern the organization as the whole and influence the company strategy, its business processes and its information system (IS). The focus of this paper is on the coherent evolution of the manufacturing IS, that is to say on its alignment with the strategy, the environment and the evolutions. Because of IS manufacturing specificities, one interesting approach consists in using the multi-screen view, which relocates the IS under study on a systemic and a time scale. However the related exploitation procedure is too general to be efficient. Therefore it is proposed to model, with GRAI-GRIDS, the decisional process required to perform these alignments by working out the multi-screen view model of a specific IS. It emphasizes the combination of bottom-up and top-down analysis as well as the relevance of the systemic and time views on the IS.

14:40-15:00 ThB24.3

A UML Profile for Transforming GRAI Extended Actigrams into UML (I), pp. 12885-12890

Grangel Seguer, Reyes — Univ. Jaume I
Cutting-Decelle, Anne-Françoise — Ec. Centrale de Lille
Bourey, Jean-Pierre — Ec. Centrale de Lille

Interoperability is one of the main problems linked to the rapid evolution of Information and Communication Technologies (ICT), and to the need to set up quickly alliances among different kinds of enterprises based on cooperative information systems in order to benefit from market opportunities. Solving this problem at both the Enterprise Modelling level and the Business Process Modelling instead of the code level by using model-driven approaches is a promising proposal. In this context, this paper mainly focuses on transformations of business process models at the Enterprise Modelling level. This kind of transformation is one component of a more general model-driven approach to solve business process integration problems or, more widely, interoperability problems. This describes a UML Profile definition to transform GRAI Extended Actigrams into UML Activity Diagrams, as a mechanism to avoid the semantic losses generated by transformations. The implementation of this Profile with the Atlas Transformation Language (ATL) is finally presented.

15:00-15:20 ThB24.4

Analysis & Design of a Collaboration Opportunity Characterization Tool for Virtual Organisations Creation, pp. 12891-12898

Concha, David — ITESM
Romero, Tania — ITESM
Romero, David — ITESM
Galeano, Nathalie — ITESM
Jimenez, Guillermo — ITESM
Molina, Arturo — Tecnologico de Monterrey

This paper presents the conceptual foundations relevant to the proper design and implementation of a software tool to support a broker or a business integrator in the context of a Virtual Organisation (VO) for partners search and selection for a specific business/collaboration opportunity. The Collaboration Opportunity Characterization tool detailed in this paper provides functionalities for decomposing a collaboration opportunity into items, which can be individually mapped to the specific competencies required for achieving the VO business/collaborative objectives, once the competencies required are specified, this competency-related information can be used for the further selection of proper VO partners to tackle a specific business/collaboration opportunity

15:20-15:40 ThB24.5

An Approach for Evaluating Enterprise Organizational Interoperability Based on Enterprise Model Checking Techniques, pp. 12899-12904

Chapurlat, Vincent — Ec. des Mines d'Alčs
Vallespir, Bruno — Univ. of Bordeaux 1
Pingaud, Hervé — ENSTIMAC

A company manager wanting to choose relevant partners in order to respond rapidly and efficiently to a business opportunity must be confident first on the partners' ability and adequacy, second on their organizational interoperability allowing then to collaborate profitably all along the affair. The aim of this paper is to present an approach allowing this manager to identify potential interoperability problems between partners. This approach is based on the specification of interoperability rules, and on the analysis of these rules on enterprise models by using two complementary formal checking techniques

15:40-16:00 ThB24.6

Development of a Production Management System for Automated and Manual Process Mixed Manufacturing, pp. 12905-12910

Ishii, Yoshikazu, — Hitachi, Ltd.
Morita, Kazunobu, — Hitachi, Ltd.
Shiga, Hiroyuki, — Hitachi Information & Control Solutions, Ltd.

In batch plants of process industries such as medicines, fine chemicals, and foods, it is necessary to have functions executed by computers and operators, such as cooperative management of the plant computers, management of manual operations, and management of dynamic changes for equipment control. To provide such functionality, this report presents twenty-five recipe elements, such as a start element for a control computer program, and a binder for the work procedure, which can be used in a library. Then the report shows the checking function of the master table and its lexicons. Validities of the recipe element are shown through an application in two plant types.

ThB25 328

Design and Control (Regular Session)

Chair: Visioli, Antonio — Univ. of Brescia
Co-Chair: Bao, Jie — The Univ. of New South Wales

14:00-14:20 ThB25.1

Simultaneous Design and Control of the Tennessee Eastman Process, pp. 12911-12916

Ricardez Sandoval, Luis Alberto — Univ. of Waterloo
Budman, Hector M. — Univ. of Waterloo
Douglas, Peter — Univ. of Waterloo

This paper presents a large-scale application of a new approach to simultaneously design and control chemical processes that does not require dynamic programming and a priori assumptions of the disturbance dynamics. The process closed-loop behavior is represented as a state space uncertain model. The robust models are then used to calculate infinite-time horizon bounds on the process stability, worst-case variability and process constraints using a Singular Structured Value (SSV) approach. The proposed methodology was used to simultaneously design and control the Tennessee Eastman Process.

14:20-14:40 ThB25.2

Minimum-Time Feedforward Plus PID Control for MIMO Systems, pp. 12917-12922

Piccagli, Stefano — Univ. degli Studi di Brescia
Visioli, Antonio — Univ. of Brescia

In this paper we propose a technique for the determination of a feedforward control law to be applied to a closed-loop PID-based control system for a multi-input multi-output process in order to achieve a minimum-time transition of the outputs subject to constraints on both the control variables and the system outputs. The optimal command inputs are determined by suitably approximating the state variables and the input signals by means of Chebyshev series and by subsequently solving a constrained optimisation problem. Simulation results demonstrate the effectiveness of the methodology.

14:40-15:00 ThB25.3

Generic Optimal Temperature Profiles for a Class of Jacketed Tubular Reactors, pp. 12923-12928

Logist, Filip — Katholieke Univ. Leuven
Van Erdeghem, Peter M.M. — KU Leuven
Smets, Ilse — Biotec - Bioprocess Tech. And Control
Van Impe, Jan F.M. — Katholieke Univ. Leuven

This paper deals with the optimal and safe operation of jacketed tubular reactors. Despite the existence of advanced distributed controllers, optimal steady-state reference profiles to be tracked are often unknown. In Logist et al. 2007, a procedure which combines analytical and numerical optimal control techniques, has been proposed for deriving optimal analytical (and thus generic) references, and it has been illustrated for plug flow reactors. The aim of this paper is to illustrate the general applicability of this procedure by allowing dispersion. As dispersion significantly complicates a possible solution process (due to second-order derivatives and split boundary conditions), hardly any generic results are known. Nevertheless, the dispersive plug flow reactor model is important for practice, since varying the dispersion level allows to mimic an entire reactor range, i.e., from plug flow to perfectly mixed reactors. As an example a jacketed tubular reactor in which an exothermic irreversible first-order reaction takes place is adopted. It is shown that the procedure yields generic reference solutions for (i) three different cost criteria, and (ii) different dispersion levels.

F. Logist, I.Y. Smets, and J.F. Van Impe. Derivation of generic optimal reference temperature profiles for steady-state exothermic jacketed tubular reactors. J. Process Control, 18, 92-104, 2008

15:00-15:20 ThB25.4

Adaptive LQ Approach Used in Conductivity Control Inside Continuous-Stirred Tank Reactor, pp. 12929-12934

Vojtesek, Jiri — Faculty of Applied Informatics, Tomas Bata Univ. in
Dostal, Petr — Tomas Bata Univ. In Zlin

This paper deals adaptive control of the real model represented by the Continuous-stirred tank reactor (CSTR). This type of reactor belongs to the class of systems with lumped-parameters. The chemical reaction inside the reactor is dilution of the salt with the clean water. The resulted mixture has specific conductivity, which is about to be controlled, depends on the content of the salt inside the reactant. Used adaptive approach is based on recursive identification of the system's parameters during the control. A polynomial approach used for the controller synthesis has satisfied control requirements and moreover, it could be used for systems with negative properties such as nonlinearity, non-minimum phase etc.

15:20-15:40 ThB25.5

Efficient Branch and Bound Methods for Pairing Selection, pp. 12935-12940

Kariwala, Vinay — Nanyang Tech. Univ.
Cao, Yi — Cranfield Univ.

During the past few decades, a number of methods for selection of input-output pairings for decentralized control have been proposed. Most of these available methods require evaluation of every alternative in order to find the optimal pairings. As the number of alternatives grows rapidly with problem size, pairing selection through an exhaustive search can be computationally forbidding for large-scale process. In this paper, we present novel branch and bound (BAB) approaches for pairing selection using relative gain array and mu-interaction measure as the selection criteria to overcome this difficulty. We demonstrate the computational efficiency of the proposed BAB approaches by applying them to randomly generated matrices as well as to the Tennessee Eastman benchmark example.

15:40-16:00 ThB25.6

Operability Analysis for Process Systems with Recycle and Bypass Streams, pp. 12941-12946

Setiawan, Ridwan — The Univ. of New South Wales
Bao, Jie — The Univ. of New South Wales
Rojas, Osvaldo J. — The Univ. of Newcastle
Lee, Peter L. — Curtin Univ. of Tech.

Recycle and bypass streams exist in chemical plants in various configurations. They may lead to plantwide operability problems due to the strong interaction between process units. Based on the concept of dissipative systems, this paper provides a new approach to plantwide operability analysis for processes with bypass and recycle streams, particularly on plantwide stability, stabilizability, and effects of disturbance. By using the topology of process interconnections, this analysis approach is developed from a network perspective and can be used for large scale process systems.

ThB26 327
Constraint and Security Monitoring and Control (Regular Session)

Chair: Malik, O.P. — The Univ. of Calgary
Co-Chair: Paoli, Andrea — Univ. of Bologna

14:00-14:20 ThB26.1
How Topology Affects Security: An Upper Bound of Electric Power Network Security, pp. 12947-12952

Jia, Qing-Shan — Tsinghua Univ.
Zhao, Qianchuan — Tsinghua Univ.

Electric power network is a fundamental facility in modern society. The importance to ensure and enhance the security of the power network can never be over emphasized. In this paper, we study how the topology of a power network restricts the security. By focusing on the power balanced condition which is necessary for the security after line outage contingencies, we show that a practical power network cannot avoid collapse. Using a method based on ordered binary decision diagram (OBDD) that fast enumerates the line outages causing network collapses, we obtain an upper bound for power network security, and indicate the transmission lines that are critical to power network security. This method is demonstrated on an IEEE 30-bus network. We hope this work brings insights to the understanding of why power networks cannot avoid collapse and how to enhance the security of an electric power network.

14:20-14:40 ThB26.2
Monitoring a Gas-Cooled Nuclear Reactor Core Integrity, pp. 12953-12958

Bonivento, Claudio — Univ. of Bologna
Grimble, Michael — Univ. of Strathclyde
Giovanini, Leonardo — Industrial Control Centre
Monari, Mattia — Univ. of Bologna
Paoli, Andrea — Univ. of Bologna

This work concerns with the problem of monitoring an Advanced Gas-cooled Nuclear Reactor (AGR) core. In the world wide context of energy production, the advanced gas-cooled reactor (AGR) nuclear power stations are approaching the end of their predicted operational live. Currently, it has been proposed to extend the operational lifetime of the nuclear plants if the distortions of the reactor cores are not as severe as initially predicted, and if it is possible to prove that the reactors are still safe to operate. The purpose of this work is to present a monitoring system based on analytical redundancy and directional residual generation using measurements obtained during the refueling process. In short this problem consists of building an unknown input observer with the role to estimate the friction force produced by the interaction between the wall of the fuel channel and the fuel assembly. This let to estimate the shape of the graphite bricks that comprise the core and, therefore, monitor any distortion of them.

14:40-15:00 ThB26.3
A New Integrated Fault Diagnosis and Analysis System for Large-Scale Power Grid, pp. 12959-12964

Zhou, Ziguan — China Electric Power Res. Inst.
Bai, Xiaomin — China Electric Power Res. Inst.

This paper describes an efficient methodology that can be used in an integrated fault diagnosis and analysis system (IFDAS) for large-scale power grid. The IFDAS extended from some software tools used in contemporary power grid consists of four main parts: fault information processing, fault diagnosis, power gird vulnerability analysis and prediction contingency analysis. It also has some innovative characteristics. First, the large-scale power system IFDAS in this paper is based on slow successive tripping procedure of cascading failure. Second, the concept of coordination is brought into the cascading failure analysis and defence scheme of IFDAS. Third, it is an on-line cascading failure analysis method which can trace real-time operation conditions. And last it makes full use of data acquisition channels and monitor system dynamic behavior. According to the slow successive tripping procedure character of the cascading failure and blackouts, the concept of a large-scale power system IFDAS is presented. And the features, structure, flow and responding mechanism of the IFDAS are all detailed discussed. Finally, case analysis shows that the IFDAS is a system good at fast identifying cause during cascading failure, supplying optimum dispatching strategy, and avoiding blackouts effectively.

15:00-15:20 ThB26.4
DSA-Visualisation Monitoring and Ranking of System Dynamic Behaviour, pp. 12965-12970

Lerch, Edwin — Siemens AG

The paper presents the application of a software tool to simulate system dynamic behavior together with the possibility to select critical contingencies of an electrical energy system. These cases are visualized and a ranking decision is introduced to support the operators to select critical system states. Insecure operating conditions can be monitored in the time domain using the full system representation in real time or by calculating the eigenvalues of the system to monitored weakly damped system states and stability margins.

15:20-15:40 ThB26.5
Low-Cost Embedded Solution for Measuring Power Quality Parameters, pp. 12971-12976

Tomesc, Liviu — Tech. Univ. of Cluj-Napoca
Duma, Radu — Tech. Univ. of Cluj-Napoca
Abrudean, Mihai — Tech. Univ. of Cluj
Dobra, Petru — Tech. Univ. of Cluj

Power quality issues are becoming a serious concern for the electrical power users considering the negative influence that these phenomena can have on the electrical equipment and the utility bill. That is why more solutions are required for measuring the power quality parameters. This paper presents a low-cost approach based on an inexpensive RISC microprocessor and frequency analysis for constant measuring and monitoring of specific parameters.

ThB27 326
Congestion Control in Internet (Regular Session)

Chair: Hill, David J. — The Australian National Univ.
Co-Chair: Onat, Ahmet — Sabanci Univ.

14:00-14:20 ThB27.1
Internet Congestion Control Subject to Node and Link Constraints, pp. 12977-12982

Xia, Yongxiang — Australian National Univ.
Hill, David J. — The Australian National Univ.

This paper studies the mathematical modelling of Internet congestion control. Differently to previous models, which consider either the link capacity or the node processing capability as the constraints, here we take both of them into account, i.e., the aggregate flow rate on a link cannot exceed the link capacity and the aggregate flow rate at a node is limited by the node processing capability. A decentralized primal-dual algorithm is proposed to solve the congestion control problem and its convergence is proven. Using this algorithm we show the bottleneck of the network performance when these two constraints are unbalanced.

14:20-14:40 ThB27.2
Adaptive Sliding Mode Congestion Control for DiffServ Network, pp. 12983-12987

Zheng, Xiuping — Northeastern Univ.
Zhang, Nannan — Northeastern Univ.
Dimirovski, Georgi Marko — Dogus Univ. of Istanbul
Jing, Yuanwei — Northeastern Univ.

This paper is about the application of adaptive sliding mode control to solving congestion problem for DiffServ Network. A nonlinear fluid flow model which is transformed into a parametric strict feedback form is used to analyze and control. Backstepping design procedure is applied, which leads to a new adaptive sliding mode controller. And by using the adaptive sliding mode controller, we achieve buffer queue length regulation against model uncertainties and disturbances. The simulation results show that the proposed control system is robust to unknown nonlinearities and disturbances.

14:40-15:00 ThB27.3
Quick Kelly Control: A Nonlinear Congestion Control Method for

High Speed Networks, pp. 12988-12993

Xiang, Yanping — Chinese Acad. of Sciences Inst. of Automation
Yi, Jianqiang — Inst. of Automation, Chinese Acad. of Sciences
Zhao, Dongbin — Inst. of Automation, Chinese Acad. of Sciences

The traditional congestion control algorithms exhibit low convergence rate to equilibrium when the network capacity is very large. In this paper, we present a new group of algorithms called Quick Kelly Control (QKC) to accelerate the convergence rate. QKC is scalable to networks operating at very high speeds. The link utilization ratio function is used as feedback signal and a group of novel nonlinear update laws is constructed. We prove the stability of a primal-dual form of QKC (PDQKC) without considering delay. We also compare this algorithm with two classic algorithms and give simulation results. It is shown that PDQKC has powerful bandwidth scalability and offers fast convergence rate without sacrificing proportional fairness.

15:00-15:20 ThB27.4

Hopf Bifurcation and Oscillations in Homogeneous Communication Networks, pp. 12994-12999

Yin, Huibing — Univ. of Illinois at Urbana-Champaign
Wang, Pang Paul — Univ. of Illinois
Alpcan, Tansu — Deutsche Telekom Lab.
Mehta, Prashant G. — Univ. of Illinois at Urbana-Champaign

In this paper, we investigate stability and bifurcation arising in a communication network model with a large number of homogeneous (symmetric) users and a single bottleneck AQM queue. We carry out bifurcation analysis to study the effect of user delay and strength of feedback. It is shown that for any given delay, there exists a critical amount of feedback (due to AQM) at which the equilibrium loses stability and a limit cycling solution develops via a super-critical Hopf bifurcation. The conclusion is verified both numerically and analytically.

15:20-15:40 ThB27.5

Model Based Predictive Networked Control Systems, pp. 13000-13005

Onat, Ahmet — Sabanci Univ.
Naskali, Teoman — Sabanci Univ.
Parlakay, Emrah — Sabanci Univ.

Networked control systems where the sensors, controller and actuators of a digital control system reside on different computer nodes linked by a network, aim to overcome the disadvantages of conventional digital control systems at the application level, such as difficulty of modification, vulnerability to electrical noise, difficulty in maintenance and upgrades. However random communication delay and loss on the network may jeopardize stability since the communication delay decreases the phase margin of the control system and data loss can be considered as noise.

In this project, we propose a novel networked control method where satisfactory control is possible even under random delay and data loss. We keep a model of the plant inside the controller node and use it to predict the plant states into the future to generate corresponding control outputs. At every sampling period the states of the model are reset to the actual or predicted states of the plant. The ambiguity of plant state during periods of total communication loss are also addressed.

The proposed model based predictive networked control system architecture is first verified by simulation on the model of a DC motor under conditions of data loss and noise. Then experiments are repeated on a dedicated test platform using a physical DC motor. Results show that significant amounts of data loss and delay can be tolerated in the system before performance starts to degrade.

15:40-16:00 ThB27.6

State-Space Model Based Generalized Predictive Control for Networked Control Systems, pp. 13006-13011

Tang, Bin — Central South Univ.
Liu, Guoping — Univ. of Glamorgan
Gui, Weihua — Central South Univ.
Wang, Yalin — Central South Univ.

This paper is concerned with generalized predictive control based on state-space model for networked control systems. Both the network-induced time delay and packet loss are taken into account. The networked predictive controller design is discussed with respect to three network cases, which are related to packet loss, network-induced delay, and both packet loss and network-induced delay, respectively. Simulation and experiment results show the effectiveness of our networked predictive control algorithms.

ThB28 330A

Guidance, Navigation and Control of Aerospace Vehicles

(Regular Session)

Chair: Zhang, Shuguang — Beihang Univ.
Co-Chair: Alazard, Daniel — Univ. de Toulouse - ISAE

14:00-14:20 ThB28.1

Visual Servo Motion Control of a Spacecraft Around an Asteroid Using Feature Points, pp. 13012-13015

Yanagi, Naoya — Univ. of Electro-Communications
Terui, Fuyuto — Japan Aerospace Exploration Agency

A visual servo motion controller is developed for maneuvering a planetary exploration spacecraft in proximity to an asteroid. The controller utilizes the positions of feature points in images of the asteroid taken by an onboard camera. These feature points are extracted from images using some metric and are directly fed back for the calculation of 6DOF control inputs (torque and force). The feasibility of the proposed control algorithm is investigated by a numerical simulation.

14:20-14:40 ThB28.2

Nonlinear Model Predictive Spread Acceleration Guidance with Impact Angle Constraint for Stationary Targets, pp. 13016-13021

Das, Priya G. — Indian Inst. of Science
Padhi, Radhakant — Indian Inst. of Science

A new technique named as model predictive spread acceleration guidance (MPSAG) is proposed in this paper. It combines nonlinear model predictive control and spread acceleration guidance philosophies. This technique is then used to design a nonlinear suboptimal guidance law for a constant speed missile against stationary target with impact angle constraint. MPSAG technique can be applied to a class of nonlinear problems, which leads to a closed form solution of the lateral acceleration (latax) history update. Guidance command assumed is the lateral acceleration (latax), applied normal to the velocity vector. The new guidance law is validated by considering the nonlinear kinematics with both lag-free as well as first order autopilot delay. The simulation results show that the proposed technique is quite promising to come up with a nonlinear guidance law that leads to both very small miss distance as well as the desired impact angle.

14:40-15:00 ThB28.3

Rapid Terminal Area Trajectory Planning for Reentry Vehicles (I), pp. 13022-13027

Zhang, Shuguang — Beihang Univ.
Tang, Peng — Beihang Univ.

Achievements of the Space Shuttle experience and recent research activities were analyzed and absorbed, and a rapid generation technique of trajectories was focused on for the terminal area of reentry runway-landing flight vehicles. Based on the present processing capability of onboard computers, the trajectory geometry preset planning can be replaced by logic condition based algorithms which can represent the flight dynamics, so that the accuracy and rapidness can be better compromised. In view of the separation of the variation time scales, a propagation logic without iteration was established for longitudinal variables, combined with lateral effect correction. For the lateral motion, a three-step logic was put forward compromising the flexibility and effectiveness. Testing cases from different initial conditions show that the algorithm is promising for onboard application. It can rapidly generate trajectories with satisfactory accuracy due to the incorporation of the coupling effects in flight dynamics, and the guidance commands can be tracked by basic guidance control law.

15:00-15:20 ThB28.4

Development and Testing of a Real-Time NDGPS/INS Avigation System for Helicopter Based on Artificial Vision, pp. 13028-13033

Kim, JaeHyung — Korean Air
Lyou, Joon — Chungnam National Univ.

An artificial vision aided NDGPS/INS system has been developed and tested in the dynamic environment of a ground and flight vehicle to evaluate the overall system performance. The results show the significant advantages in position accuracy and situation awareness. Accuracy meets the CAT-I precision approach and landing using NDGPS/INS integration. Also we confirm the proposed system is effective to increase situational awareness and improve flight safety by using artificial vision. The system design, software algorithm, and flight test results are presented. We show our efforts of developing the capability of situation awareness in helicopter navigation.

15:20-15:40 ThB28.5

A New Initial Alignment Algorithm for Strapdown Inertial Navigation System Using Sensor Output, pp. 13034-13039

Kim, KwangJin — Doosan Infracore
Park, Chan Gook — Seoul National Univ.

In this paper, a new alignment algorithm that uses simultaneously both open-loop and closed-loop scheme is designed to increase the convergence rate of the Kalman filter in the fine alignment stage. Generally, the initial alignment is divided into coarse and fine alignment. The fine alignment stage with the 10-state Kalman filter refines the initial estimate of the transformation matrix given by the coarse alignment algorithm. This paper derives a convergence theorem of the Kalman filter for analyzing a problem of the 10-state Kalman filter in the fine alignment. In order to resolve the problem, the new alignment algorithm calculates the attitude angles with the open-loop scheme and estimates the accelerometer and gyro biases with the closed-loop scheme at once. The estimated bias errors are used to correct the sensor errors that are utilized to calculate the attitude angles in the open-loop scheme. The computer simulation results illustrate the efficiency of this new alignment algorithm.

ThB29 330B

Modeling and Control of Transportation Systems (Regular Session)

Chair: Hellendoorn, Hans — Delft Univ. of Tech.
Co-Chair: Ozguner, Umit — Ohio State Univ.

14:00-14:20 ThB29.1

Fast Parametric Estimation for Macroscopic Traffic Flow Model, pp. 13040-13045

Abouaďssa, Hassane — Univ. of Artois
Fliess, Michel — Ec. Pol.
Join, Cédric — UHP-Nancy & ALIEN INRIA-Futurs

The main traffic parameters such as the critical density and the free flow speed of a motorway segments are subject to changes over time due to traffic conditions (traffic composition, incidents, . . .) and environmental factors (dense fog, strong wind, snow, . . .). As such parameters have an impact on the performance of the traffic control strategies, they must be estimated on-line. Our approach, which is of algebraic flavor and avoids asymptotic and statistical techniques, yields fast implementable formulae in closed form. Some convincing computer simulations are provided.

14:20-14:40 ThB29.2

Sliding Mode Control and Flatness-Based Concept for Real-Time Ramp Metering, pp. 13046-13051

Iordanova, Violina — Univ. of Artois
Abouaďssa, Hassane — Univ. of Artois
Jolly, Daniel — Univ. of Artois

The aim of this paper is to present an application of a sliding mode control (SMC) and flatness-based concept to real-time ramp metering. Such application is a novel attempt in the field of traffic control. Differentially flat concept provides simple algorithms to generate optimal trajectories, without integration of any differential equation. On the other hand, SMC is known to be a robust control method appropriate for uncertain systems such that the traffic ones. The proposed approach is based on the well-known space discrete first order macroscopic model. A simple case study shows very promising results for further works including traffic control for more complex motorway network.

14:40-15:00 ThB29.3

Influencing Long-Term Route Choice by Traffic Control Measures - a Model Study, pp. 13052-13057

Van Den Berg, Monique — Delft Univ. of Tech.
Hegyi, Andreas — Delft Univ. of Tech.
De Schutter, Bart — Delft Univ. of Tech.
Hellendoorn, Hans — Delft Univ. of Tech.

Currently used traffic control measures, such as traffic signals, variable speed limits, ramp metering installations etc., are often not designed to influence the route choice of drivers. However, traffic control measures do influence the travel times that are experienced in the network. Since route choice is, at least for a part, based on experienced travel times, the control measures thus also influence the long-term route choice. This influence can be seen as a side-effect of the control measures, but in this paper we will investigate the possibilities to explicitly and actively use the influence of the traffic control measures to change the long-term route choice. Using basic traffic flow and route choice models we investigate how outflow and speed limit control can affect the final equilibrium turning fractions. As an example we consider a case study for a simple network with two routes and use a simple linear outflow controller, which makes the analytical investigation of the effects of the controller possible, but the results can be extended to more sophisticated control methods.

15:00-15:20 ThB29.4

A Model Predictive Control Approach for Decentralized Traffic Signal Control, pp. 13058-13063

Yazici, Ahmet — Eskisehir Osmangazi Univ.
Ozguner, Umit — Ohio State Univ.
Seo, Gangdo — Korea Water Res. Corp.

In this paper, a decentralized control is utilized for the traffic signal control problem using model predictive control. A point-queue model is used with red-green signal transition times. A traffic signal controller is designed to minimize the queue lengths with information from the adjacent intersections. After the signal controller gathers the needed information from the adjacent intersections, it makes green time calculation of the next period.

15:20-15:40 ThB29.5

Freeway Traffic Management Using Linear Programming, pp. 13064-13069

Jacquet, Denis — Protoptim

We present in this paper a linear programming framework to address freeway control applications such as ramp metering. After showing the equivalence between the LWR model and a linear optimization problem, several extensions are introduced to model the ramp queues and the capacity drop phenomenon. A wide range of objective functions which are relevant in traffic engineering are then introduced and several optimization-based control strategies are discussed. The effectiveness and versatility of this method is illustrated on a class of objective functions for a ramp metering problem.

15:40-16:00 ThB29.6

A Multimodal Model for an Urban Traffic Control Policy, pp. 13070-13078

Kachroudi, Sofiane — THE FRENCH NATIONAL Inst. FOR TRANSPORT AND SAFETY
Bhouri, Neila — THE FRENCH NATIONAL Inst. FOR TRANSPORT AND SAFETY

The main aim of this paper is to present a multimodal model of urban traffic used as predictive model for a traffic control policy. The traffic control policy is based on Model Predictive Control (MPC). The predictive model focus on the Private vehicle mode and Public transport mode. For the first mode, the model is based essentielly on the store-and-forward model. For the second mode, we present an innovative model based on mean behavior of Public transport vehicles. Simulation tests show that the model of Public transport mode is consistent and worthy to be implemented for a traffic control policy.

ThB30 330C

Transportation Logistics (Regular Session)

Chair: Stathopoulos, Antony — National Tech. Univ. of Athens
Co-Chair: Chi, Ronghu — Qingdao Univ. of Science and Tech.

14:00-14:20 ThB30.1

Modelling Dynamic Urban Road Networks Performance under Congestion Pricing Strategies, pp. 13079-13084

Dimitriou, Loukas — Univ.
Stathopoulos, Antony — National Tech. Univ. of Athens

The development of modern information systems able to process real-time data concerning the traffic state network-wide is making possible the implementation of new forms of strategies concerning urban transportation networks management. The success of the implementation of such strategies is heavily depended on the detailed design of them. In the current study, an evaluation framework of the application of a congestion pricing strategy based on the marginal travel cost is presented, able to identify the dynamic impact of congestion pricing on the performance of the system, by taking into consideration behavioral characteristics of multiple user classes. This framework builds on tactics of variable road congestion pricing, based on theories of stochastic optimal control.

14:20-14:40 ThB30.2

Hybrid Predictive Control for the Vehicle Dynamic Routing Problem Based on Evolutionary Multiobjective Optimization (EMO), pp. 13085-13090

Nuńez, Alfredo — Univ. de Chile
Saez, Doris — Univ. de Chile
Cortés, Cristián — Univ. de Chile

In this paper, a hybrid adaptive predictive control approach (HAPC) to solve a dynamic pickup and delivery problem (DPDP) is presented based on a dynamic objective function that includes two dimensions: user and operator costs. Because these two costs are opposite components, the problem was formulated and solved by using an Evolutionary Multiobjective Optimization (EMO) technique. The idea is to minimize both, user and operator costs. At every instant, the use of genetic algorithms is proposed to find the optimal Pareto front associated with the DPDP, whose Pareto Optimal set is a set of solutions of the problem. Since only one solution has to be applied to the system every time a new request appears, several criteria will be utilized in order to properly use the information provided by the dynamic optimal Pareto front. Illustrative experiments through simulation of the process are presented to show the potential benefits of the new approach. Thus, by using EMO, the trade off between the two conflicting objectives will become clear for the dispatcher when making dynamic routing decisions.

14:40-15:00 ThB30.3

Hybrid Heuristic Approaches for a Multi-Production Forward/reverse Logistics System Design Problem, pp. 13091-13096

Liu, Changshi — Hunan Univ.

We consider a multi-production two-stage forward/reverse logistics system design problem where a fixed number of capacitated distribution/reclaiming centers are to be located with respect to capacitated suppliers and retail locations while minimizing the total costs, and take the random of demand/reclaiming into consideration. We also provide hybrid heuristic procedures for the solution of the problem, and develop transshipment heuristic to improve the duration of the hybrid approaches. Finally we present extensive computational results that show the high performance and effectiveness of the solution approaches.

15:00-15:20 ThB30.4

Model and Algorithm for the Vendor-Warehouse Transportation and Inventory Problem in a Three-Level Distribution System, pp. 13097-13102

Li, Jianxiang — Beijing Inst. of Tech.
Chu, Feng — Univ. of Tech. of Troyes
Chen, Haoxun — Tech. Univ. of Troyes

We consider the inventory-routing problem in a three-level distribution system with a single vendor, a single warehouse and many geographically dispersed retailers. In this problem, each retailer faces a demand at a deterministic, retailer-specific rate. The demand of each retailer is replenished either from the warehouse by a small vehicle or from the vendor bypassing the warehouse by a big vehicle. Inventories are kept not only at the retailers but also at the warehouse. The objective is to find a combined inventory policy and routing pattern minimizing a long-run average system-wide cost while meeting the demand of each retailer without shortage. We present an efficient solution approach based on a fixed partition policy where the retailers are partitioned into disjoint and collectively exhaustive sets and each set of retailers is served on a separate route. Given a fixed partition, the original problem is decomposed into three subproblems. In this paper, we focus on the modelling and resolution of the vendor-warehouse transportation and inventory subproblem. We demonstrate that the subproblem can be reduced to a C/C/C/Z capacitated dynamic lot sizing problem and there exists an algorithm to solve the reduced problem to optimality in O(T2) time.

15:20-15:40 ThB30.5

Freeway Density Control Via Model-Free Adaptive Ramp Metering Approach, pp. 13103-13108

Chi, Ronghu — Qingdao Univ. of Science and Tech.
Sui, Shulin — Qingdao Univ. of Science and Tech.
Yu, Lei — Qingdao Univ. of Science and Tech.

By introducing a new dynamical linearization technology, this paper presents a model-free adaptive control approach for density control of freeway traffic flow via ramp metering, which is consisted with a control input learning law and a parameter updating law. The design and analysis of the presented method just depends on the I/O data of the freeway traffic system without requiring any priori of the controlled system. Furthermore, the control input learning law is extended to a higher-order form by incorporating more control information of previous sampling instants for improving the control performance. Both convergence analysis and simulation results illustrate the validity of the presented methods.

15:40-16:00 ThB30.6

Network Characteristics of Air Traffic in the Continental United States, pp. 13109-13114

Sridhar, Banavar — NASA Ames Res. Center
Sheth, Kapil — NASA

Air traffic is undergoing big changes both in developed and developing countries. The demand for air traffic in the United States is expected to grow to 2 or 3 times the current levels of traffic in the next few decades. This paper models demand for air traffic as a network with several thousand nodes. Recently, methods have been developed to study the network characteristics of large complex systems in many natural and engineering fields. Several networks exhibit the “scale-free” property that as the network grows in size, a small number of components have a disproportionate influence on the successful operation of the network. This paper describes the network properties of the current air traffic system and uses future scenarios of air traffic growth to understand the performance of future air traffic networks. The air traffic network exhibits an exponentially truncated scale-free behavior. It is shown that a three-times growth in the overall traffic may result in a ten-times impact on the density of traffic in certain parts of the United States. Thus, in addition to bottlenecks at major airports, the risk of en route traffic saturation calls for route restructuring and the introduction of new operational concepts, such as automation to increase en route capacity.

ThB31 306

Guidance Navigation and Control (Video Session)

Chair: Chung, Wan Kyun — Pohang Univ. of Science & Tech.
Co-Chair: Song, Jae-Bok — Korea Univ.

14:00-14:20 ThB31.1

Balance and Tracking Control of Ball and Plate Systems, pp. 13115-13115

Liao, Shian-Ching — National Cheng Kung Univ.
Tu, Yi-Wei — National Cheng Kung Univ.
Yang, Kuang-Shine — National Cheng Kung Univ.
Ho, Ming-Tzu — National Cheng Kung Univ.

In this video, the digital signal processor based (DSP-based) ball and plate control system is introduced. The plate is actuated by two DC motors. To sense the position of the ball, a resistive touch panel is utilized. The optical encoder with resolution 1000 pluses/rev attached to the shaft of the DC motor is used to measure the angular displacement of the motor. The system is controlled by a DSP (150MHz/32-bit) board equipped with a 12-bit D/A converter. The sampling frequency of the system is chosen to be 1 kHz. The voltage signals are generated according to the designed control law and are also supplied to power amplifiers that derive the DC motors. The signal from the touch panel is passed through a digital low-pass filter to reduce the effect of sensor noise. The ball and plate system is a highly nonlinear and coupled system. Due to existence of the centrifugal force, the system relative degree is not well defined. Moreover, the centrifugal force provides a strong positive feedback and easily leads to the peaking phenomenon. The system model is approximated as two decoupled systems. The backstepping control design approach is used to design the controller for balance and tracking control. The video shows the effectiveness of the designed control system.

Attachment

14:20-14:40 ThB31.2

Visualization of Air Traffic Flow for Modeling and Control Applications, pp. 13116-13116

Sridhar, Banavar NASA Ames Res. Center
Sheth, Kapil NASA

A safe and efficient aviation industry is vital to the global economy. The growing traffic demand, rise in oil prices, delays in building new runways and security issues are imposing pressures on the system to evolve from the current procedure-based human-centered system to a more flexible system with higher levels of automation. Air Traffic Management (ATM) involves several layers of decision-makers scattered between the service providers (Airports and the Federal Aviation Administration in the United States) and users of airspace (Airlines, General Aviation, Cargo Carriers). Several types of uncertainties are pervasive in the system. ATM needs major overhauling in the United States of America and Europe and traffic demand is growing at a rapid rate in Asia. The transformation of ATM requires both policy and technological changes. The main purpose of Traffic Flow Management (TFM) is to address the imbalance between the supply of available airspace and airport capacity and the demand for it placed by the arrivals and departures of aircraft during a day. In the event demand exceeds capacity, TFM decisions to maintain safety either by delaying aircraft at airports or rerouting them results in delay. In the U.S. airspace, the design of efficient TFM strategies involves the optimization of schedules of 15,000 to 20,000 aircraft under airspace and airport constraints in the presence of weather uncertainty. The problem is hierarchical, stochastic and has several time scales. The tools and decision support systems available to manage this complex task are rapidly evolving but need significant improvement. In addition to aircraft dynamic models, the size and the timescales of the problem require the development of aggregate flow models. NASA has been developing models, metrics and optimization methods to improve the flow of traffic in the National Airspace System (NAS). The aim of this video is to present the complexity and richness of the problems in Traffic Flow Management and engage the Controls Community to become part of the solution. The video is produced using the Future ATM Concepts Evaluation Tool (FACET), an environment for modeling and evaluating system-wide airspace operations over the United States. The video consists of two parts. The first part, “A day in the life of air traffic in the U.S.,” shows the diurnal nature of air traffic, growth in the early morning, heavy demand during the day and early evening and the decay later in the night. The traffic flow shows highlights like the congested northeastern part of United States, forbidden regions for air traffic and general traffic patterns. The second part of the video shows the effect of controls to mitigate the effects of severe weather on traffic flow patterns. The visualization shows traffic in holding patterns due to lack of arrival capacity at New York region airports, traffic avoiding severe weather and the unfolding interaction between demand and capacity. The video has been a highly effective tool to educate specialists and laymen about the air traffic control problem.

Attachment

14:40-15:00 ThB31.3

Multi-Model Based Fault Detection and Diagnosis of a Hydraulic Servo Axis, pp. 13117-13117

Muenchhof, Marco Tech. Univ. Darmstadt

This paper describes the design and implementation of a multi-model based fault detection and diagnosis system for a hydraulic servo axis. Multiple models are operated in parallel to the plant - similar to a bank of observers. Beside one model mimicking the fault free process, there are additional models describing the process behavior in the presence of both actuator and process faults. For each model the squared error between the model output and the plant output is determined. The model which (over a period of time) shows the best match with the process is assumed to currently best describe the process behavior. The fault injected into the model with the best match is thus at the same time the diagnosis, i.e. the fault which is assumed to be present in the real system. This system has been tested exhaustively at a testbed. The result of the tests is shown in the accompanying video.

Attachment

15:00-15:20 ThB31.4

Fault Detection of Actuators and Channel Transmission Using Virtual Simulation, pp. 13118-13118

Fawaz, Khaled LAGIS, UMR-CNRS 8146, Pol. Lille
Merzouki, Rochdi Ec. Pol. de Lille
Ould bouamama, Belkacem LAIL

In this film, a Co-simulation between a virtual and a real mobile robot is presented. It concerns the on line telediagnosis of transmission channel and actuators faults of a mobile robot. Two innovated points are given through this work: the first concerns the transmission channel which is considered as an uncoupled system, modelled separately from the robot model, and concatenated to this latter for the FDI algorithm synthesis. The second point relates to the development of a virtual simulator which can work in parallel with the real robot. The interest of this simulator is its ability to inform the system supervisor of any transmission and/or actuators faults, without being closer to the real system. In this section, the modelling of the transmission channel and the miniature mobile robot is presented.

Attachment

15:20-15:40 ThB31.5

Driver Steering Assistance to Avoid Unintended Lane Departure by Lane Keeping and Steering Suggestions, pp. 13119-13119

Minoiu Enache, Nicoleta INRETS/LCPC - LIVIC Lab.
Netto, Mariana LIVIC - LCPC/INRETS
Mammar, Said LSC-CNRS-FRE2494
Lusetti, Benoit INRETS/LCPC

One of the most frequent causes of highway accidents is the unintended out of lane deviation, due to moments of inattention, sleepiness or drowsiness. The enclosed video shows a driver steering assistance that prevents this type of lane departure. For vehicles with conventional steering columns, there are some difficulties in carrying out this type of steering assistance, in closed loop control. These difficulties consist in sharing vehicle control with the driver. The solution presented in this contribution is based on alternating the steering control of the vehicle between the driver and the steering assistance.

Attachment

15:40-16:00 ThB31.6

Hybrid Conveyance System with Automatic Path Planning and Power Assistance, pp. 13120-13120

Miyoshi, Takanori Toyohashi Univ. of Tech.
Miyashita, Yuuki Toyohashi Univ. of Tech.
Yamamoto, Manabu Toyohashi Univ. of Tech.
Niinuma, Ayumu Toyohashi Univ. of Tech.
Kubo, Kazuya Toyohashi Univ. of Tech.
Terashima, Kazuhiko Toyohashi Univ. of Tech.

The authors have developed a power-assisted system aimed at solving the following problems in a factory; i.e., a common conveyance system such as an overhead crane using pushbutton control can pose difficulties for the operator in positioning an object due to the object’s vibration. As well, workers often suffer physically from directly moving or lifting heavy objects. In light of this, our proposed system is aimed at lessening the worker’s burden while allowing highly precise positioning of an object. We have previously developed a system for automatic path planning involving sequence control. The algorithm of automatic path planning system can be described as follows 1. An environmental map identifying objects is generated by the slide-ray projection method using laser line makers and CCD cameras. 2. The position of a spot produced by a laser pointer is measured by two cameras, and it is used as the target point of the automatic path planning system. 3. An original orbit to the target point is determined by the potential method based on the map of the environment. 4. The original orbit is reconstructed by feedforward control using inverse dynamics calculation in order to achieve sway control. Thus, our path planning system can convey an object from its initial position to a target point without creating residual vibration. However, this automatic conveyance system was found not to be sufficiently accurate to assemble the upper half of a mold on its lower half in an actual factory. Here we propose a hybrid conveyance system which combines automatic path planning and a power-assist function for an overhead crane. The conventional system is unable to both transport an object automatically and to manipulate it directly. However, our proposed system can allow an operator to perform both of these functions. By using this hybrid conveyance system, the system first automatically transports an object, then the operator can assemble the object with a high degree of precision by direct manipulation exerting only slight force, if necessary. This manufacturing technique could be especially useful in situations that involve the movement of an object over long distances. Thus, our proposed system can increase productivity and reduce the operator’s burden, as illustrated in the video.

Attachment

ThC02 304A
Output Feedback Control (Regular Session)

Chair: Yurkevich, Valery D. — Novosibirsk State Tech. Univ.
Co-Chair: Farza, Mondher — Univ. DE CAEN, ENSICAEN

16:30-16:50 ThC02.1

A Modified Design for the VS-MRAC Based on the Indirect Approach: Stability Analysis, pp. 13121-13126

Barbosa, Josenalde, Oliveira — Agricultural School of Jundiaí
Araujo, Aldayr Dantas de — Federal Univ. of Rio Grande do Norte

Recently, an alternative to achieve a robust controller that provides a straightforward and intuitive design and tuning of its parameters named Indirect Variable Structure Model Reference Adaptive Controller (IVS-MRAC) was presented for relative degree one LTI plants, suggesting to be globally asymptotically stable with superior transient behavior and disturbance rejection properties. Its novelty is in the procedure to obtain the bounds for the relay’s amplitudes, used in the switching laws. These bounds are now associated with the plant parameters, instead of the controller parameters. In this paper, a modification is made on the plant high frequency gain switching law, in order to develop a first formal stability analysis, considering the presence of input disturbances and unmodeled dynamics. It is shown that the overall system error is stable with respect to some small residual set.

16:50-17:10 ThC02.2

A LMI-Based Design of Dynamic Output Feedback Controller for T-S Fuzzy Systems, pp. 13127-13132

Asemani, Mohammad Hassan — Tarbiat Modares Univ.
Zibaee Nejad, Mohammad Hadi — Tarbiat Modares Univ.
Majd, Vahid Johari — Tarbiat Modares Univ.

This paper presents a dynamic output feedback controller design for fuzzy dynamic systems based on the concept of dynamic parallel distributed compensation (DPDC). Three types of stabilizing controller design methods are proposed based on state feedback design methods. The controller design involves solving a set of linear matrix inequalities (LMIs), and the control laws are numerically tractable via LMI techniques. Moreover, performance of the fuzzy controller in terms of decay rate and constraint on the control input is studied and LMI conditions for these performance criteria are obtained. An example is given to illustrate validity of the proposed methods, and to compare their performance.

17:10-17:30 ThC02.3

Output Regulation of Uncertain Nonaffine in Control Systems Via Singular Perturbation Technique, pp. 13133-13138

Yurkevich, Valery D. — Novosibirsk State Tech. Univ.
Hwang, Kab-Ju — Univ. of Ulsan

The problem of output regulation for nonlinear control systems with guaranteed transient performances in the presence of uncertainties is discussed, where the nonlinear systems are nonaffine in the control. The fast dynamical controller with the highest output derivative in feedback loop is used, where the controller is proper and can be implemented without ideal differentiation. Two-time-scale motions are induced in the closed-loop system and the method of singular perturbations is used to analyze the closed-loop system properties. Stability conditions imposed on the fast and slow modes and sufficiently large mode separation rate can ensure that the full-order closed-loop system achieves the desired properties in such a way that the output transient performances are desired and insensitive to external disturbances and variations of nonlinear system parameters. The problem of absolute stability analysis of the fast-motion subsystem for nonaffine systems with two-time-scale motions is considered in the presence of a sector-like condition in the control.

17:30-17:50 ThC02.4

Adaptive Output Feedback Controller for a Class of Uncertain Nonlinear Systems, pp. 13139-13144

Maatoug, Tarak — ISET Gabčs
Farza, Mondher — Univ. DE CAEN, ENSICAEN
M'Saad, Mohammed — GREYC CNRS UMR 6072
Kamoun, Mohamed — ENIS, SFAX, TUNISIA
Koubaa, Yassine — ENIS SFAX

This paper addresses the problem of asymptotic tracking of an arbitrary smooth bounded reference output sequence in the presence of step like disturbances for a class of uncertain nonlinear multi-outputs systems, namely systems that could be described by the usual lower triangular representation thanks to an appropriate state transformation. These performances are shown to be achieved by combining an appropriate high gain state feedback control with a high gain adaptive observer under persistent of excitation condition. A filtered integral action is incorporated into the underlying state feedback control design to get a robust compensation of step like disturbances while reducing appropriately the noise control system sensitivity. The persistent excitation condition allows to avoid those useful parameter adaptation robustness design features as parameter projection or parameter adaptation freezing. This makes it possible to put the emphasis on the adaptive control design. As an illustrative example, the proposed adaptive control design is used to address the servo problem of a nonlinear double integrator using only the measurements of the position.

17:50-18:10 ThC02.5

Decentralized Output Feedback Control of Interconnected Systems Using Low Gain-High Gain Feedback Domination, pp. 13145-13150

Frye, Michael — Univ. of the Incarnate Word
Qian, Chunjiang — Univ. of Texas at San Antonio
Colgren, Richard — Univ. of Kansas
Oh, Seyool — Univ. of Kansas

This paper examines a decentralized control technique which makes use of a gain domination method that implements both low and high gain to negate the effects of high order nonlinearities found in a series of interconnected systems that are coupled by both measurable and unmeasurable states. We develop a linear controller and observer design technique that applies this low gain-high gain feedback domination technique and by doing so we construct a method that allows for the global stabilization of a general class of nonlinear system. The low gain-high gain feedback domination method is applied to an example to illustrate its performance.

18:10-18:30 ThC02.6

Spatial-Based Output Feedback Adaptive Feedback Linearization Repetitive Control of Uncertain Rotational Motion Systems Subject to Spatially Periodic Disturbances, pp. 13151-13156

Chen, Cheng-Lun — National Chung Hsing Univ.
Yang, Yen-Hsiu — National Chung Hsing Univ.

In this paper, we propose a new design of spatial-based repetitive control for rotational motion systems required to operate at varying speeds and subject to spatially periodic disturbances. The system has known model structure with uncertain parameters. To synthesize a repetitive controller in spatial domain, a linear time-invariant system is reformulated with respect to a spatial coordinate (e.g., angular displacement), which results in a nonlinear system. A nonlinear state observer is then established for the system. Adaptive feedback linearization is applied to the system with the state observer so as to minimize the tacking error. Moreover, a spatial-based repetitive controller is added and operates in parallel with the adaptively feedback linearized system, which not only further reduces the tracking error but also improves parameter adaptation. The overall output feedback adaptive feedback linearization repetitive control system is robust to structured parameter uncertainty, capable of rejecting spatially periodic disturbances under varying process speeds, and can be proved to be stable and produce bounded tracking error. Finally, feasibility and effectiveness of the proposed scheme is verified by simulation.

ThC03 304B
MPC for Constrained Systems (Regular Session)

Chair: Allgower, Frank — Univ. of Stuttgart
Co-Chair: Löfberg, Johan — Linköping Univ.

16:30-16:50 ThC03.1
Robust Output-Feedback MPC with Soft State Constraints, pp. 13157-13162

Lřvaas, Christian — Univ. of Newcastle, Australia
Seron, Maria — The Univ. of Newcastle
Goodwin, Graham C. — Univ. of Newcastle

In this paper, we present a robust output-feedback model predictive control (MPC) design for a class of open-loop stable systems with hard input- and soft state constraints. The proposed output-feedback design is based on a linear state estimator and a novel parameterization of the soft state constraints that has the advantage of leading to optimization problems of prescribable size. Robustness against unstructured model uncertainty is obtained by choosing the cost function parameters so as to satisfy a linear matrix inequality condition. The proposed output-feedback design incorporates a novel state-feedback design, which may be seen as a generalization of a previous proposal.

16:50-17:10 ThC03.2
Explicit Model Predictive Control for Systems with Linear Parameter-Varying State Transition Matrix, pp. 13163-13168

Besselmann, Thomas — ETH Zurich
Löfberg, Johan — Linköping Univ.
Morari, Manfred — Swiss Federal Inst. of Tech.

In this paper we propose a closed-loop min-max MPC algorithm based on dynamic programming, to compute explicit control laws for systems with a linear parameter-varying state transition matrix. This enables the controller to exploit parameter information to improve performance compared to a standard robust approach where no uncertainty knowledge is used, while keeping the benefits of fast online computations. The off-line computational burden is similar to what is required for computing explicit control laws for uncertain or nominal LTI systems. The proposed control strategy is applied to the controlled H´enon map to draw a comparison, in terms of complexity and control performance, with a controller based on a piecewise affine approximation.

17:10-17:30 ThC03.3
Piecewise Linear Steady–State Target Optimization for Control Systems with MPC: A Case Study, pp. 13169-13174

Lawrynczuk, Maciej — Warsaw Univ. of Tech.
Marusak, Piotr Marek — Warsaw Univ. of Tech.
Tatjewski, Piotr — Warsaw Univ. of Tech.

This paper is concerned with predictive control combined with set–point optimization in the case of fast changing disturbances. The problem is encountered in many practical applications. Because of high computational complexity, nonlinear economic optimization cannot be repeated frequently. Therefore, in practice an additional steady–state target optimization repeated as often as the MPC (Model Predictive Control) algorithm is used. Typically, the steady–state target optimization is based on a linear steady–state process model. Unfortunately, in some cases, as the one studied in the paper, the target set–point optimization based on linear or linearized models fails. It is demonstrated in the paper that a solution to this problem can be the piecewise linear approximation of the nonlinear steady–state process model in the target optimization. The research is done for the control system of a MIMO chemical reactor. The presented results clearly show the effectiveness of the proposed approach.

17:30-17:50 ThC03.4
A Robust Model Predictive Control Algorithm with a Reactive Safety Mode, pp. 13175-13181

Carson, John M. — California Inst. of Tech. Jet Propulsion Lab.
Acikmese, Behcet — Jet Propulsion Lab.
Murray, Richard M. — California Inst. of Tech.
MacMynowski, Douglas G. — California Inst. of Tech.

A reactive safety mode is built into a robust model predictive control algorithm for uncertain nonlinear systems. The algorithm is designed to obey all state and control constraints and blend two operational modes: (I) standard mode guarantees re-solvability and asymptotic convergence to the origin in a robust receding-horizon manner; (II) safety mode, if activated, guarantees containment within an invariant set about a safety reference for all time. The research is motivated by vehicle control-algorithm design (e.g., spacecraft and hovercraft) in which operation mode changes must be considered. Incorporating the reactive safety mode provides robustness to unexpected state-constraint changes; e.g., other vehicles crossing/stopping in the feasible path, or unexpected ground proximity in landing scenarios. The safety-mode control is provided by an offline designed control policy that can be activated at any arbitrary time during standard mode. The standard-mode control consists of separate feedforward and feedback components; feedforward comes from online solution of a FHC (Finite-Horizon optimal Control problem), while feedback is designed offline to generate an invariant tube about the feedforward trajectory. The tube provides robustness (to uncertainties and disturbances in the dynamics) and guarantees FHC re-solvability. The algorithm design is demonstrated for a class of systems with uncertain nonlinear terms that have norm-bounded Jacobians.

17:50-18:10 ThC03.5
Dynamic Model Predictive Control, pp. 13182-13187

Martensson, Karl — Faculty of Engineering, Lund Univ.
Wernrud, Andreas — Lund Univ.

In this paper an alternative approach to model predictive control is presented. In traditional MPC a finite horizon open loop optimal control problem is solved in each sampling instance. When uncertainties such as computational delays are present, one can encounter problems. We propose to parametrize the control sequence in each sampling instant in terms of a linear feedback controller, i.e. in each sample a dynamic feedback compensator is computed. Thus, if computational delays are present the control system runs in closed loop, decreasing the need for ad hoc solutions used in traditional MPC.

18:10-18:30 ThC03.6
Desensitized Model Predictive Control Applied to a Structural Benchmark Problem, pp. 13188-13193

Lana, Carlos — Purdue Univ.
Rotea, Mario — Univ. of Masschusetts - Amherst

This paper presents a model predictive control formulation that incorporates trajectory sensitivity to improve the robustness of the conventional model predictive control strategy. A structural control benchmark problem is used to illustrate the potential of the approach. The numerical results suggest that the proposed approach may be a viable option to increase the robustness of the conventional model predictive control strategy without increasing the computation requirements.

ThC04 308
Fuzzy Control (Regular Session)

Chair: Duan, Suolin — Jiangsu Ploytechnic Univ.
Co-Chair: Simandl, Miroslav — Univ. of West Bohemia

16:30-16:50 ThC04.1
New Approaches to H_infty Controller Designs for Discrete T-S Fuzzy System, pp. 13194-13199

Pan, Juntao — Univ. of Three Gorges
Wang, Renming — Univ. of Three Gorges
Guerra, Thierry Marie — Univ. of Valenciennes
Tian, Dong — Wuhan Univ. of science and Tech.

This paper proposed new approaches to stabilization analysis and H_infty performance for a class of discrete Takagi-Sugeno (T-S) fuzzy model. The main results given here concern their H_infty controllers design using PDC-like control laws and nonquadratic Lyapunov functions. New relaxed conditions and linear matrix inequality-based design methods are proposed that allow outperforming previous found in the literature. Finally, an example is given to demonstrate the effciency of the proposed approaches.

16:50-17:10 ThC04.2
A Fuzzy Sliding Mode Controller and Its Application, pp. 13200-13204

Duan, Suolin — Jiangsu Ploytechnic Univ.
Zou, Ling — Jiangsu Pol. Univ.
Zhenghua, Ma — Jiangsu Pol. Univ.

An approach of self-learning fuzzy sliding-mode control which combines fuzzy control with the sliding-mode control, is presented for the tracking control of a class of nonlinear systems with the parameter uncertainties. The fuzzy control rules are updated through on-line learning, which make the output of fuzzy control approximate to sliding-mode equivalent control along the direction of making sliding-mode asymptotic stable. Based on Lyapunov theory, the asymptotic stability of the overall systems is proved. The proposed method is applied to some electrohydraulic servo systems, and the results of simulation show that the satisfied control precision and stability can be obtained by using proposed method for the systems.

17:10-17:30 ThC04.3

Takagi-Sugeno Fuzzy Coordinated Control System with Original Plant Fuzzy State Observer for a Power Unit, pp. 13205-13210

Luan, Xiu-chun	Harbin Engineering Univ.
Han, Wei-shi	Qingdao Univ. of Science and Tech.
Young, Ai-guang	Qingdao Univ. of Science and Tech.
Zhai, Yu	Harbin Univ. of Science and Tech.
Yu, Jiang	harbin engineering Univ.

The Takagi-Sugeno (T-S) fuzzy multiple-variable integral control system with fuzzy state observer is designed for the coordinated control of multi-input-multi-output (MIMO) nonlinear boiler-turbine system whose operating points vary within a wide range. Linear models are first derived from the original nonlinear model on several operating points. Next the fuzzy multi-variable integral controller and the fuzzy state observer are designed via using the parallel distributed compensation (PDC) scheme, and the T-S fuzzy control system is constructed with the drum pressure as the premise variable. The problem that part of state variables can not be measured is successfully solved by introducing fuzzy state observer. Last the stability analysis is given by means of linear matrix inequality (LMI) approach, and the control system is guaranteed to be stable within a large range. The simulation results demonstrate that the control system works well over a wide region of operation.

17:30-17:50 ThC04.4

A Practical Two-Input Single-Output Fuzzy Logic Controller with an Alpha-Beta Prefilter, pp. 13211-13216

Lee, Ting-En	National Yunlin Univ. of Science and Tech.
Su, Juhng-Perng	National Yunlin Univ. of Secience and Tech.
Yu, Ker-Wei	National Kaohsiung Marine Univ.

This paper deals with the design of a practical two-input single-output (TISO) fuzzy logic controller for a nonlinear system. We firstly define two generalized errors for a nonlinear system and develop a stable feedback control scheme. Then a novel fuzzy logic controller is designed and incorporated into this scheme to achieve a better tracking response. The key feature of the proposed control scheme is that a discrete prefilter, called alpha-beta filter is placed in front of the fuzzy logic controller. The significance of using the Kalman-like fixed-gain filter is its capability of suppressing noise and feeding the fuzzy logic controller with smooth signals. From an implementation point of view, the discrete TISO fuzzy logic controller with the alpha-beta prefilter is believed to be quite simple, general and useful for practical applications. The validity of the proposed control scheme is verified through practical testing on the experimental setup called magnetic levitation system. The test results strongly suggest that the newly proposed control scheme is simple yet effective for use in a variety of feedback control systems.

17:50-18:10 ThC04.5

Sensor Fault Compensation for Nonlinear Systems Using Fuzzy Adaptive Sliding Control, pp. 13217-13222

Zhang, Yingwei	Northeastern Univ.
Qin, S. Joe	Univ. of Southern California

An active sensor fault compensation control law is developed for a class of nonlinear systems to guarantee the closed-loop stability in the presence of a fault, based on a fuzzy logic system and sliding mode. Through the adaptive process of the parameters, the dynamics caused by the fault is counteracted. The fuzzy sliding mode control is introduced to attenuate the fuzzy approximation error. Simultaneously, the closed-loop system is stable in Lyapunov sense and the tracking error converges to a neighbourhood of zero. The example of the proposed design indicates that the fault compensation control law is effective for a nonlinear system.

18:10-18:30 ThC04.6

Robust Fuzzy Guaranteed Cost Controller Design Via Piecewise Lyapunov Function Approach, pp. 13223-13228

Chen, Jun	Jiangnan Univ.
Liu, Fei	Jiangnan Univ.

This paper considers the problem of robust guaranteed cost controller design for a class of nonlinear systems subject to time-varying and norm-bounded uncertainties in both state and input matrices. The Takagi-Sugeno (T-S) fuzzy model is employed to approximate the uncertain nonlinear system. Then, two different design procedures of optimal robust guaranteed cost controller are developed by using parallel distributed compensation (PDC) scheme and piecewise Lyapunov function (PLF) approach, respectively. And it is shown that all solvability conditions for the above problem can be converted into a standard linear matrix inequality (LMI) problem. The final numerical example is given to illustrate the effectiveness of the design procedures. In addition, the results obtained by PLF method are relatively less conservative.

ThC05 307

Applications of Adaptive Control Methods (Regular Session)

Chair: Fu, Li-Chen	National Taiwan Univ.
Co-Chair: Fatehi, Alireza	K.N. Toosi Univ. of Tech.

16:30-16:50 ThC05.1

Indirect Adaptive Fuzzy Control of Unmanned Aerial Vehicle, pp. 13229-13234

Salman, Shaaban Ali	Australian Defence Force Acdemy
Sreenatha, Anavatti G.	Australian Defence Force Acad.
Choi, Jin Young	Seoul National Univ.

The design and application of indirect adaptive fuzzy controller is developed and applied to Unmanned Aerial Vehicles (UAVs). The parameters of identified model are adapted on-line based on the error between the identified model and the actual output. The model process sensitivity factor and the error between the reference input and process output are used to adapt the controller parameters. The model process sensitivity is seen to improve the convergence in addition to improving the response of the UAV, when applied to the attitude control of a typical UAV. Simulation results show the superiority of the proposed controller in the attitude control of the UAV.

16:50-17:10 ThC05.2

Adaptive Attitude Tracking Control with L2-Gain Performance for an Orbiting Flexible Spacecraft, pp. 13235-13240

Hu, Qinglei	Harbin Inst. of Tech.

This paper treats the problem of nonlinear adaptive attitude tracking control of an orbiting flexible spacecraft. It is assumed that the system parameters are unknown and the truncated model of the spacecraft has finite but arbitrary dimension. An adaptive sliding mode control law is derived for a three-axis stabilized spacecraft attitude tracking control system. The control gains are designed by solving a linear matrix inequality (LMI) problem to achieve a prescribed L2-gain performance criterion. The external torque disturbance/parametric error attenuation, with respect to the performance measure, along with control input penalty are ensured in the L2-gain sense. Lyapunov analysis is employed to show that the closed-loop system is asymptotically stable and the effect of the external disturbances/parametric error on the tracking error can be attenuated to any prescribed level. Simulation results show the effectiveness of the control scheme.

17:10-17:30 ThC05.3

Spatial Periodic Adaptive Control for Rotary Machine Systems, pp. 13241-13246

Xu, Jian-Xin	National Univ. of Singapore
Huang, Deqing	National Univ. of Singapore

A spatial periodic adaptive control (SPAC) approach is developed to deal with rotary machine systems performing speed tracking tasks. Since the angular displacement is periodic when rotating by 2pi radians, most rotary machine systems present certain cyclic behaviors with a fixed periodicity which is either a fraction or multiple of 2pi. As a consequence, unknown system parameters and disturbances that characterize the system behaviors are also periodic in nature. By utilizing the spatial periodicity, the SPAC aims at improving the system performance. In the SPAC design, the dynamics of the rotary machine systems is first converted from the temporal to spatial coordinates. Then the new adaptive controller updates the parameters and the control signal periodically in a pointwise between two consecutive spatial cycles. Using a Lyapunov-Krasovskii functional, the convergence property of the SPAC can be analyzed for high order rotary systems and the periodic adaptation can be applied to rotary systems with pseudo-periodic parametric uncertainties.

17:30-17:50 ThC05.4

Application of a New Scheme for Adaptive Unfalsified Control to a CSTR, pp. 13247-13252

Wonghong, Tanet	Process control Lab.
Engell, Sebastian	Univ. of Dortmund

In this paper, a new scheme for adaptive unfalsified control is demonstrated for a well-known example of a nonlinear plant, a continuous stirred tank reactor (CSTR) with the van-der-Vusse reaction scheme. There are two new elements in our scheme: 1. Instead of switching between a finite number of controllers from a given, fixed set, an adaptation of the controller parameters is performed. For this purpose, a population-based evolutionary algorithm is used. 2. As the cost function that was originally proposed by Safonov is unable to correctly assess the potential performance of a controller that has not been in the loop, we propose a new cost function that employs the fictitious error for the actual reference signal. This error signal is determined by estimating the impulse response of the sensitivity function from the observed data.

17:50-18:10 ThC05.5

Adaptive Control Approach for Speed Motion-Sensorless of Linear Induction Motor Unknown Resistance and Payload, pp. 13253-13258

Huang, Chin_I	National Formosa Univ.
Fu, Li-Chen	National Taiwan Univ.

In this paper, we will propose a nonlinear adaptive controller for a linear induction motor to achieve speed tracking. A nonlinear transformation is proposed to facilitate controller design. In this controller, only the primary currents are assumed to be measured. The secondary flux and speed observers are designed to relax the need of flux and speed measurement. Besides, the very unique end effect of the linear induction motor is also considered and is well taken care of in our controller design. Stability analysis based on Lyapunov theory is also performed to guarantee that the controller design here is stable. Also, the computer simulations and experiments are done to demonstrate the performance of our various controller design.

18:10-18:30 ThC05.6

A Neuro-Fuzzy Controller for Rotary Cement Kilns, pp. 13259-13264

Fallahpour, Maryam	K.N. Toosi Univ. of Tech.
Fatehi, Alireza	K.N. Toosi Univ. of Tech.
Araabi, Babak N.	Univ. of Tehran
Azizi, Morteza	Saveh Cement Co.

In this paper, we design a neurofuzzy controller to control several variables of a rotary cement kilns. The variables are back-end temperature, pre-heater temperature, oxygen content and CO2 gas content of the kiln. The fuzzy control system, as an advanced control option for the kilns, is intended to minimize the operator interaction in the control process. The proposed fuzzy controller uses a neural network to optimize TSK-type fuzzy controller. Since there is no generally applicable analytical model for cement kilns, we use the real data derived from Saveh cement factory for the plant identification. A model, which is very similar to the real plant, is identified then; and the identified model is used for control design and simulations. Extensive simulation studies justify the effectiveness and applicability of the proposed control scheme in intelligent control of cement plant.

ThC06 310A

Complex Systems (Regular Session)

Chair: Niculescu, Silviu-Iulian	Lab. of Signals and Systems (L2S)
Co-Chair: Beghi, Alessandro	Univ. di Padova

16:30-16:50 ThC06.1

Modeling, Simulation and Control of Large Scale Cryogenic Systems, pp. 13265-13270

Bradu, Benjamin	CERN (European Organisation for Nuclear Res.
Gayet, Philippe	CERN
Niculescu, Silviu-Iulian	Lab. of Signals and Systems (L2S)

This paper presents a dynamic simulator for large scale cryogenic systems using helium refrigerators and controlled by Programmable Logic Controllers (PLC) for the European Organization for Nuclear Research (CERN). The process is modeled by a set of linear differential and algebraic equations and the control policy is based on a hierarchical multilevel and multilayer framework control. First simulation results carried out on the refrigerator used in the Compact Muon Solenoid (CMS) experiment are presented. It is worth to mention that CMS is a particle detector used in the future CERN accelerator (the LHC) where a superconducting magnet of 225 tons, the largest ever built, must be maintained at 4.5K (-268.7°C). The model of this cryogenic plant is composed of 4126 equations whereof 287 differential-algebraic equations. The work objectives of this simulator are threefold: first, to provide a tool to train the operators, second to validate new control strategies before their implementation and, third, to improve our knowledge about large scale complex cryogenic systems. In order to respect the real system architecture, the simulator is composed of different modules sharing data.

16:50-17:10 ThC06.2

A Dynamic Model for the Thermal-Hygrometric Simulation of Buildings, pp. 13271-13276

Beghi, Alessandro	Univ. di Padova
Cecchinato, Luca	Univ. di Padova
De Carli, Michele	Univ. di Padova

Dynamic models for the energy simulation of building-plant systems are becoming useful tools in the process of building design by defining operating conditions and finding appropriate control strategies. Therefore simple softwares able to correctly predict the thermal behaviour of rooms, and thus allowing to get comfort conditions and loads, are needed. In this paper a dynamic simulation model (THESIS, ``THermal SImulation Software") is presented. The building structures equations are described by means of a LTI (Linear Time Invariant) state space model. The heat conduction equations for the walls are solved through an explicit finite difference technique. The model is implemented in the MATLAB/SIMULINK environment.

17:10-17:30 ThC06.3

Effect of Heterogeneity on Synchronization in Complex Network, pp. 13277-13281

Hao, Binbin	Northeastern Univ.
Jing, Qingshen	Peking Univ.
Wang, Dan	Northeastern Univ.
Zhang, Siying	Northeastern Univ.
Jing, Yuanwei	Northeastern Univ.

Synchronization in classes of continuous-time dynamical networks with different topologies is investigated. A synchronization-optimal algorithm based on the synchronization criterion is proposed so as to get the appropriate topology such that complex network has the optimal synchronizability. It has been argued that heterogeneity suppresses synchronization in unweighted networks. However, it is shown in this work that synchronizability of Type I networks is independent of heterogeneity in the degree distribution, while synchronizability of Type II networks is dependent of both heterogeneity and scale of networks. It is presented the more heterogeneous and larger scale, the poorer synchronizability of Type II networks.

17:30-17:50 ThC06.4

Enhancing Complex Network Synchronization Based on the Node Betweenness, pp. 13282-13286

Wang, Lifu	Northeastern Univ.
Wang, Qingli	Shenyang Inst. of Engineering
Jing, Yuanwei	Northeastern Univ.
Yu, Hao	Northeastern Univ.

In this paper, we present a weighted method based upon the node betweenness, and discover that synchronizability of the complex networks can be enhanced by the weighted method. And we demonstrate the validity of this method by applying this weighted method to two classes of networks with high homogeneous and heterogeneous degree distribution. The optimal synchronable condition corresponds to (Motteret al., 2005a) and can also be obtained by a tunable parameter. We hope the research can be useful for comprehensively understanding the synchronization behavior of networks and design more effective networks.

17:50-18:10 ThC06.5

Observability of Complex Systems: Minimal Cost Sensor Network Design, pp. 13287-13292

Chamseddine, Abbas — Univ. d'aix Marseille III
Noura, Hassan — United Arab Emirates Univ.
Ouladsine, Mustapha — Univ. d'aix marseille III
Raharijaona, Thibaut — Paul Cézanne Univ.

Plants instrumentation is a crucial issue due to the importance of sensors in allowing the observability and in increasing the redundancy and the reliability. Designing a sensor network becomes complicated when the complexity of the system increases. In this paper, a strategy is proposed to design a minimal cost sensor network ensuring the observability of complex systems. The strategy is based on the decomposition of complex systems into subsystems. This decomposition helps in treating each subsystem separately and allows the use of reduced order observers rather than one observer for the whole system.

18:10-18:30 ThC06.6

Control of Evolutionary Processes, Topological Index and Deformation Theory, pp. 13293-13298

Aleksandrov, A. G. — Inst. for Control Sciences, Russian Acad. of Sciences
Castro, Jr., Augusto Armando — Federal Univ. of Bahia (Univ. Federal da Bahia
Gruzman, Vladimir A. — Inst. for Control Sciences, Russian Acad. of Sciences

A general approach in studies of evolutionary processes is discussed. Such process can be described by a vector field with polynomial, analytic or smooth coefficients in phase space. The corresponding complex systems are investigated by perturbation analysis of the control and behavioral spaces together with associated bifurcation sets and discriminants. The approach is based essentially on the modern theory of deformations, the theory of logarithmic differential forms and integrable connections associated with deformations. Such a connection can be represented as a holonomic system of differential equations of Fuchsian type whose coefficients have logarithmic poles along the bifurcation set or discriminant of a deformation. The main tool in analysis of such objects is a new method for computing the topological index of a vector field.

ThC07 310B

Methods in Optimal Control Design (Regular Session)

Chair: Inalhan, Gokhan — Istanbul Tech. Univ.
Co-Chair: Er, Meng Joo — NTU

16:30-16:50 ThC07.1

Optimal Estimation and Regulator: Risk-Sensitive Method, for Systems of First Degree, pp. 13299-13304

Alcorta Garcia, Maria Aracelia — Autonomous Univ. of Nuevo Leon

The algorithms for the optimal filter and control have been obtained for polynomial systems of first grade. For the filter, two cases are presented: systems with disturbances in L^2 and systems with Brownian motion and parameter epsilon multiplying the diffusion term, in state and observations equations. The performance of this algorithms is verified and compared with the optimal Kalman-Bucy filter through an example. Besides the solution to the optimal control Risk-Sensitive problem for stochastic system, taking quadratic value function as solution of PDE HJB is obtained. These Risk-Sensitive control algorithms are compared with the L-Q control algorithms through a numerical example, using quadratic-exponential cost function to be minimized. The optimal risk-sensitive filter and control algorithms show better performance for large values of the parameter epsilon.

16:50-17:10 ThC07.2

Measuring Optimization in Optimal Control of Flexible Aerospace Vehicles, pp. 13305-13309

Brodsky, Sergey — SUAI, Saint-Petersburg StateUniversityofAerospaceInstrumentation
Nebylov, Alexander — State Univ. of Aerospace Inst.
Panferov, Alexander — SUAI, Saint-Petersburg State Univ. of Aerospace Inst.

The optimal control and parameters estimation of flexible vehicle motion and elastic displacements consist usually in solving the stabilization and trajectory tracking problems with many restrictions on dynamic properties. Sensors position defines influence of elastic oscillations on measured parameters of vehicle motion as solid body. The effective analytical approach and software for solving the problem of optimal choice of requirements for sensors number, type and positioning are suggested in this paper. Solution is based on linear programming method properties. The quadratic performance index for stochastic LTI systems and errors of measuring define inequalities-restrictions. The minimized goal function is related with number, type and accuracy of sensors.

17:10-17:30 ThC07.3

Large-Scale Task/Target Assignment for UAV Fleets Using a Distributed Branch and Price Optimization Scheme, pp. 13310-13317

Karaman, Sertac — Massachusetts Inst. of Tech.
Inalhan, Gokhan — Istanbul Tech. Univ.

In this work we consider the large-scale distributed task/target assignment problem across a fleet of autonomous UAVs. By using delayed column generation approach on the most primitive non-convex supply-demand formulation, a computationally tractable distributed coordination structure (i.e. a market created by the UAV fleet for tasks/targets) is exploited. This particular structure is solved via a fleet-optimal dual simplex ascent in which each UAV updates its respective flight plan costs with a linear update of way-point task values as evaluated by the market. We show synchronized and asynchronous distributed implementations of this approximation algorithm for dynamically changing scenarios with random pop-up targets. The tests performed on an in-house built network mission simulator provides numerical verification of the algorithm on a) bounded polynomial-time computational complexity and b) hard real-time performance for problem sizes on the order of hundred waypoints per UAV.

17:30-17:50 ThC07.4

Travelling Salesperson Problem for Dynamic Systems, pp. 13318-13323

Itani, Sleiman — Student, Massachusetts Inst. of Tech.
Frazzoli, Emilio — Massachusetts Inst. of Tech.
Dahleh, Munther A. — Massachusetts Inst. of Tech.

In this paper, we study the following version of the Travelling Salesperson Problem: Find the fastest closed trajectory for a controlled dynamic system such that its output visits all points in a given (finite) set. We present an algorithm that, if the n points are randomly sampled from a uniform distribution, produces an output trajectory the expected duration of which scales within a constant factor of the optimum asymptotically in n.

17:50-18:10 ThC07.5

A Methodology for Integrated System Identification, PID Controller Tuning and Noncausal Feedforward Control Desig, pp. 13324-13329

Carnevale, Claudio — Univ. of Brescia
Piazzi, Aurelio — Univ. of Parma
Visioli, Antonio — Univ. of Brescia

In this paper we propose a systematic methodology that integrates the three main phases of the design of an industrial control system, namely, the identification phase, the tuning of the (PID) controller and the design of a (noncausal) feedforward action. In particular, the tuning of the controller is based on frequency loop shaping where the modelling uncertainty is explicitly considered and the noncausal feedforward command input synthesis is performed by applying a stable input-output inversion procedure. In this context, a parameter that allows to handle the trade-off between aggressiveness and robustness (and control effort) is given to the user. Simulation and experimental results show the effectiveness of the methodology.

18:10-18:30 ThC07.6

Design and Analysis of Switch Mode Amplifier for Actuator Array Using MIMO Optimal Feedback Quantization, pp. 13330-13335

Hu, Jwu-Sheng — National Chiao Tung Univ.
Chen, Keng-Yuan — National Chiao Tung Univ.

The system analysis of the MIMO optimal feedback quantization used to produce switching signals is proposed here. The switching signals are then fed into the switch mode power amplifier to drive actuator array. The architecture of the power amplifier used in this paper allows the sharing of switching elements among actuators and is different from the traditional one-to-one method in actuating a large number of devices. To actuate all of the devices at the same time, the MIMO optimal feedback quantization generates control signals optimally basing on minimizing the weighted measure of quantization error. The discussion on bounding the system states under the zero initial conditions is made. The result tells that the stability can be achieved by limiting the maximum amplitude of inputs when the MIMO system has stable zeros. To simplify the computational complexity of quantization, a sub-optimal method for actuating three-actuator system is mentioned. A design example of 2-input 2-output system which is applied to the class-D stereo audio amplifier (dual actuators) is addressed. The control performance and cross-talk behavior are investigated.

ThC08 310C
Robust Time-Delay Systems II (Regular Session)
Chair: Iftar, Altug Anadolu Univ.
Co-Chair: Wu, Min Central South Univ.

16:30-16:50 ThC08.1
Linear Quadratic Regulation for Discrete-Time Systems with Multiple Delays in Single Input Channel, pp. 13336-13341
Liu, Shuai Nanyang Tech. Univ.
Xie, Lihua Nanyang Tech. Univ.
Zhang, Huanshui HIT Campus Shenzhen Univ. Town

This paper is concerned with the linear quadratic regulation (LQR) problem for linear discrete-time systems with multiple delays in a single input channel. Although the LQR problem for discrete-time systems with single delay in each of the multiple input channels has been studied in existing literature, the problem to be addressed in this paper is known to be very difficult and has not been well investigated. In this paper, we address the LQR problem for systems with multiple delays in a single input channel by first establishing a duality between the LQR problem and a smoothing problem for an associated stochastic backward system. An analytical solution to the LQR control is then derived by solving the smoothing problem and is given in terms of the solutions of Riccati difference equations of the same dimension as the plant (ignoring the delays). The infinite horizon LQR problem is also considered in this paper and the convergence and stability analysis of the LQR controller is provided.

16:50-17:10 ThC08.2
Stability Crossing Surfaces for Systems with Three Delays, pp. 13342-13347
Almodaresi, Elham Yazd Univ.
Bozorg, Mohammad Yazd Univ.

The stability of linear time-delay systems whose characteristic equations include three delays is investigated. Using geometrical relations in the polynomial plane, a graphical method is presented to visualize the stability domains in the three-dimensional space of time delays. Also, in this space, the surfaces on which the number of unstable poles of the system changes, are identified and an algorithm is presented to plot these surfaces. This work extends the results of previous works on the plane of two delays, to the three-dimensional case and initiates new studies in this direction.

17:10-17:30 ThC08.3
Stable H-Infinity Controller Design for Systems with Multiple Time-Delays: The Case of Data-Communication Networks, pp. 13348-13354
Unal, Hakki Ulas Anadolu Univ.
Iftar, Altug Anadolu Univ.

Stable H-infinity controller design is considered for systems which involve multiple time-delays. Flow control problem in data-communication networks is chosen to present the proposed design approach. An algorithm, which produces a robust stable controller, is developed. An example is also presented, where the optimal controller, which is unstable, fails to produce a stable response due to nonlinear effects. The proposed controller, however, can robustly stabilize the system and produce desired response despite uncertain time-varying multiple time-delays.

17:30-17:50 ThC08.4
New Delay-Dependent H_infty Control for Systems with a Time-Varying Delay, pp. 13355-13360
He, Yong Central South Univ.
Wu, Min Central South Univ.
Liu, Guoping Univ. of Glamorgan
She, Jin-Hua Tokyo Univ. of Tech.

This paper focuses on H_infty controller design for systems with a time-varying delay. By taking the relationship among the time-varying delay, its upper bound and their difference into account, an improved delay-dependent bounded real lemma (BRL) is proposed. The design method for H_infty controllers is given using a modified cone complementary linearisation (CCL) algorithm with a new stopping condition. Numerical examples are given to demonstrate the effectiveness and the benefits of the proposed method.

17:50-18:10 ThC08.5
Adaptive Backstepping Control of Uncertain Systems with Unknown Input Time-Delay, pp. 13361-13366
Zhou, Jing Norwegian Univ. of Science and Tech.
Wang, Wei Nanyang Tech. Univ.
Wen, Changyun Nanyang Tech. Univ.

In this paper, we show that adaptive controllers designed using the standard backstepping technique globally stabilize a class of uncertain systems with unknown input time delay and unmodeled dynamics. As such systems belong to non-minimum systems and thus our result extends the class of systems stabilizable from minimum phase systems when the standard backstepping technique is employed. Moreover, it is shown that the transient system performance can be improved by adjusting the design parameters.

18:10-18:30 ThC08.6
Inverting Control, a New Strategy on Time Delayed Systems, pp. 13367-13372
Ergenc, Ali F. Istanbul Tech. Univ.
Fazelinia, Hassan Univ. of Connecticut
Olgac, Nejat Univ. of Connecticut

In this paper we introduce a new control strategy for linear time invariant (LTI) systems with a single time delay. The delay appears within the feedback control logic. Earlier research on this class of systems determines the delay intervals for stable operations, exhaustively, exactly and completely. The newly developed inverting control logic suggests a very practical procedure of reversing the sign of the feedback control gain, in order to enlarge the stable delay intervals. This gives some additional capabilities to control system designer. The sign inversion idea is based on a critical mathematical feature of LTI-TDS (Time Delay Systems) which was first recognized under a paradigm called the Cluster Treatment of Characteristic Roots (CTCR). Several example case studies demonstrate the practicality and the advantages of the new control law.

ThC09 311C
Closed Loop Identification (Regular Session)
Chair: Chiuso, Alessandro Univ. of Padova
Co-Chair: Katayama, Tohru Doshisha Univ.

16:30-16:50 ThC09.1
A New Subspace Identification Method for Closed-Loop Systems Using Measurable Disturbance, pp. 13373-13378
Katayama, Tohru Doshisha Univ.
Ase, Hajime JFE Engineering Corp.

In this paper, we consider a closed-loop subspace identification problem without using probing inputs; but we assume that there is a measurable disturbance which can be used as a test input for identification. Deterministic and stochastic subsystems are derived by applying the orthogonal decomposition (ORT) of the joint input-output process and realization methods. We develop a new ORT-based closed-loop subspace identification method, consisting of identification of the two subsystems. Some numerical results are included to show the applicability of the present method.

16:50-17:10 ThC09.2
Bias-Compensated Least Squares Method in Closed Loop Environment, pp. 13379-13384
Ikeda, Kenji The Univ. of Tokushima

In this paper, a bias-compensated least squares (BCLS) method in the closed loop environment is proposed. It is assumed that the observation noise is a white gaussinan signal while there are no process noises. It is also assumed that the plant is controlled by a linear time invariant controller and that the closed loop system is asymptotically stable. The proposed estimator is unbiased and it does not require the reference input be informative. An iterative redesign of the prefilters is also considered in order to achieve a minimum variance estimator. The proposed BCLS method is applied for the iterative redesign of the prefilters in order to reduce the computational cost.

17:10-17:30 ThC09.3

Relay-Stabilization and Identification of Unstable Processes, pp. 13385-13389

Co, Tomas B. — Michigan Tech. Univ.

A set of conditions are found for stabilization of unstable processes using relay feedback. The relay-stabilized process will exhibit limit cycles which can then be used to obtain parameters of the process. In this paper, we explore the solution of a first- and second- order process containing one unstable eigenvalue and time delay. The resulting necessary conditions found turn out to be very tight. Simulations are given to show the identification process as well as how the limit cycle conditions apply.

17:30-17:50 ThC09.4

Modeling and Identification of a 3-DOF Planar Actuator with Manipulator, pp. 13390-13395

Gajdusek, Michal — Tech. Univ. Eindhoven
Damen, Ad A. H. — Eindhoven Univ. of Tech.
van den Bosch, P. P. J. — Eindhoven Univ. of Tech.

The goal of this paper is to describe the identification and modeling of a 3-degree-of-freedom (DOF) platform with a manipulator on top of it, which is magnetically levitated by 9 voice-coil actuators. This 3-DOF experimental setup is a pre-prototype of a 6-DOF magnetically levitated platform with manipulator in order to study combined control of both the platform and manipulator.

17:50-18:10 ThC09.5

Identifiability of Variable Coefficients for Vibrating Systems by Boundary Control and Observation in Finite Time Duration, pp. 13396-13401

Guo, Bao-Zhu — The Chinese Acad. of Sciences
Chang, Jin-De — Ocean Univ. of China

The identifiability of spatial variable coefficients for vibration string and Euler-Bernoulli beam are considered. It is shown that the coefficients can be determined by means of boundary control and observation in finite time duration. These results can be considered as the generalization of infinite time coefficients dentifiability through the application of Ingham-Beurling theorem.

18:10-18:30 ThC09.6

A Lagrangian Method for Model Reduction of Controlled Systems, pp. 13402-13407

Weiland, Siep — Eindhoven Univ. of Tech.
Wildenberg, Jochem Sebastian — IPCOS B.V.
Ozkan, Leyla — IPCOS B.V.
Ludlage, Jobert — IPCOS B.V.

This paper presents a method for closed-loop order reduction of linear systems. An approximation is carried out on the Lagrangian or Hamiltonian system that is obtained from the problem to minimize an optimization criterion subject to plant dynamics and system constraints. The resulting Hamiltonian system is reduced in complexity by means of a standard reduction techniques. The merits of the method are illustrated on an example of a distillation process.

ThC10 — 311B

Vibration and Modal Analysis (Regular Session)

Chair: Guo, Lei — UMIST
Co-Chair: Goodall, R.M. — Loughborough Univ.

16:30-16:50 ThC10.1

Control of Adaptive Optics System: An H-Infinite Approach., pp. 13408-13413

Baudouin, Lucie — LAAS-CNRS
Prieur, Christophe — LAAS-CNRS
Guignard, Fabien — Univ. de Toulouse
Arzelier, Denis — LAAS-CNRS

We apply robust control technics to an adaptive optics system including a dynamic model of the deformable mirror. The dynamic model of the mirror is a modification of the usual plate equation. We propose also a state-space approach to model the turbulent phase. A continuous time control of our model is suggested taking into account the frequential behavior of the turbulent phase. An H_infty controller is designed in an infinite dimensional setting. Due to the multivariable nature of the control problem involved in adaptive optics systems, a significant improvement is obtained with respect to traditional single input single output methods.

16:50-17:10 ThC10.2

Analysis and Control of Time Delayed Systems Via the Lambert W Function, pp. 13414-13419

Yi, Sun — Univ. of Michigan
Nelson, Patrick W. — Univ. of Michigan
Ulsoy, A. Galip — Univ. of Michigan

This paper summarizes recent research results by the authors for the analytical solution to systems of delay differential equations using the matrix Lambert W function, and its applications to analysis and control of time-delay systems. The solution has the form of an infinite series of modes written in terms of the matrix Lambert W function. This solution is analytical in terms of the parameters, coefficients and delay time, of the system, and each eigenvalue in the infinite eigenspectrum is distinguished in terms of the branches of the Lambert W function. This enables extension of methods for systems of ordinary differential equations to systems of delay differential equations. These include stability analysis, controllability and observability, as well as methods for eigenvalue assignment.

17:10-17:30 ThC10.3

Vibration Analysis of Cavitation in Kaplan Water Turbines, pp. 13420-13425

Lahdelma, Sulo — Univ. of Oulu
Juuso, Esko Kalevi — Univ. of Oulu

Cavitation is harmful to water turbines and may cause operation delays of several weeks. The real-time detection of cavitation risk is increasingly important, and even narrow cavitation-free power ranges can be utilised in load optimisation. Higher derivative signals $x^{(3)}$ and $x^{(4)}$ calculated from acceleration signals are very suitable for detecting impacts. This paper introduces a generalised moment which is defined by three parameters: the sensitivity of the moment improves when the order p of the moment increases, especially when short sample time Ä; is used. In this study, sufficently good results were obtained with moments where the order of derivation ±; = 4, p H; 4, and Ä; = 3 s. These moments detect the normal operating conditions, which are free of cavitation, and also provide a clear indication for cavitation risk at an early stage. Sufficiently long signals are required for producing reliable maximum moments and data for analysing short-term cavitation. On-line cavitation monitoring is feasible with this approach since the analysis does not need high frequency ranges and the sample times are very short. The moment can be analysed first, and it is then possible to obtain the cavitation index if the moment value exceeds the threshold. Data compression is very efficient as the detailed analysis only requires the feature values of the appropriate samples.

17:30-17:50 ThC10.4

Reduced-Order Active Control for Structural System with Nonlinear Uncertainty Based on Genetic Algorithm, pp. 13426-13431

Li, Wenzhang — Southeast Univ.
Wu, Lingyao — Southeast Univ.
Guo, Lei — UMIST

This paper presents a new active control strategy based on linear matrix inequality (LMI) and genetic algorithm (GA) for the structural systems with nonlinear uncertainties and exogenous disturbances. Based on structural dynamics theory, the nonlinear uncertain structure system state-space model is established. Then, based on all-order H_; control and GA, the controller of minimum order is obtained by searching the object function globally. The concerning genetic algorithm adopts float coding, stochastic tournament, elitist model, linear crossover and uniform mutation. Finally, a three-degree-of-freedom building model subjected to El Centro earthquake is considered using this method and the simulation results show that the provided controller has almost the same control effect as all-order H_; controller.

17:50-18:10 ThC10.5

Dissipative State Formulations and Numerical Simulation of a Porous Medium for Boundary Absorbing Control of Aeroacoustic

Waves, pp. 13432-13437

Montseny, Emmanuel	Univ. of Toulouse
Casenave, Céline	LAAS-CNRS

The problem under consideration relates to a model of porous wall devoted to aircraft motor noise reduction. For such a medium, the parameters of the propagation equation depend on the frequency, so the corresponding time-model involves non rational convolution operators. Consequently, the impedance of the wall is a non rational function of the frequency. On the basis of complex analysis and causality properties, we introduce infinite dimensional state formulations of these operators. The coupling of the so-obtained model with a standard aeroacoustic one then leads to a time-local system the analysis of which is simplified thanks to the existence of an energy functional in the sense of which the global dissipativity is insured. Some numerical results are given to illustrate the theoretical results.

18:10-18:30 ThC10.6

A Note on a Vibrating Beam That Made up of Smart Material, pp. 13438-13443

Liu, C.	Tianjin Univ. of Tech.
Xu, Gen-Qi	Shanxi Univ.
Yung, Siu Pang	Univ. of Hong Kong
Lee, Richard C. H.	Univ. of Cambridge

We study a special beam that is made up of smart material. We show that the beam possesses a number of unusual properties that makes its stability analysis very difficult. However, it does have a nice property that its eigenfunctions form a Riesz basis.

ThC11 311A

Recent Advances in Iterative and Repetitive Learning Control II
(Invited Session)

Chair: Ahn, Hyo-Sung	Gwangju Inst. of Science and Tech. (GIST)
Co-Chair: Rogers, Eric	Univ. of Southampton
Organizer: Ahn, Hyo-Sung	Gwangju Inst. of Science and Tech. (GIST)

16:30-16:50 ThC11.1

Iterative Learning Control of Upper Limb Reaching Using Functional Electrical Stimulation (I), pp. 13444-13449

Freeman, Christopher Thomas	Univ. of Southampton
Davies, Iain	Univ. of Southampton
Lewin, Paul	Univ. of Southampton
Rogers, Eric	Univ. of Southampton

An iterative learning control scheme for the application of functional electrical stimulation to the human arm is designed and implemented. The task is to track trajectories in the horizontal plane and stimulation is applied to the triceps muscle. A model of the arm is first derived which includes assistive torque about the shoulder provided by a robotic arm. A linearising controller is then designed and a linear ILC algorithm is applied to the resulting system. Experimental results show that a high level of performance can be achieved in practice, and provide justification for the system to be subsequently used by stroke patients for rehabilitation.

16:50-17:10 ThC11.2

Arm-Side Evaluation of ILC Applied to a Six-Degrees-Of-Freedom Industrial Robot (I), pp. 13450-13455

Wallén, Johanna	Linköping Univ.
Norrlof, Mikael	Linköping Univ.
Gunnarsson, Svante	Linkoping Univ.

Experimental results from a first-order ILC algorithm applied to a large-size six-degrees-of-freedom commercial industrial robot are presented. The ILC algorithm is based on measurements of the motor angles, but in addition to the conventional evaluation of the ILC algorithm based on the motor-side error, the tool-path error on the arm side is evaluated using a laser-measurement system. Experiments have been carried out in three operating points using movements that represent typical paths in a laser-cutting application and different choices of algorithm design parameters have been studied. The motor-angle error is reduced substantially in all experiments and the tool-path error is reduced in most of the cases. In one operating point, however, the error does not decrease as much and an oscillatory tool behaviour is observed. Changed filter variables can give worse error reduction in all operating points. To achieve even better performance, especially in difficult operating points, it is concluded that an arm-side measurement, from for example an accelerometer, needs to be included in the learning.

17:10-17:30 ThC11.3

On Robustness against Measurement Noise of Iterative Learning Control Based Identification (I), pp. 13456-13461

Sugie, Toshiharu	Kyoto Univ.
Sakai, Fumitoshi	Nara National Coll. of Tech.

One of the most important issues in control system design is to obtain an accurate model of the plant to be controlled. Though most of the existing identification methods are described in discrete-time, it would be more appropriate to have continuous-time models directly from the sampled I/O data. From this viewpoint, the authors have developed such a direct identification method based on ILC (Iterative Learning Control) approach. This is a new application area of ILC. The method often yields accurate models even in the presence of heavy measurement noise. The robustness against noise is achieved through (i) projection of continuous-time I/O signals onto a finite dimensional parameter space, (ii) initial models through preparatory experiment and (iii) noise tolerant learning laws. This paper examines the accuracy of the initial models and convergence property of ILC in the presence of heavy colored noise through detailed simulations, which demonstrates the robustness of the ILC based identification method.

17:30-17:50 ThC11.4

Optimal Iterative Learning Control for Batch Processes with Model Parameter Variations Using Strong Tracking Filter (I), pp. 13462-13467

Xu, Yixin	Tsinghua Univ.
Xiong, Zhihua	Tsinghua U, Beijing, P.R. China
Jiang, Yongheng	Tsinghua Univ.
Huang, Dexian	Tsinghua Univ.

An optimal iterative learning control (ILC) strategy is proposed to track product quality trajectories of batch processes by updating a linear time-varying perturbation (LTVP) model. To address the problem of model parameter variations from batch to batch, the LTVP model is renewed by using strong tracking filter (STF) algorithm. Comparing recursive least squares (RLS), STF can capture the changing dynamics of the process more accurately. The tracking error transition models can be built, and the ILC law with direct error feedback is explicitly obtained. Sufficient conditions of convergence are derived for the optimal ILC based on the LTVP model. It has also been proved that the tracking error will converge to a small constant but depend on the accuracy of the LTVP model error. If there is no model error, the tracking error can converge to zero. By using STF to update the LTVP model, the model accuracy is improved and the tracking control performance is also enhanced. The proposed strategy is illustrated on a typical batch reactor, and the results demonstrate that the performance of tracking product qualities can be improved under the proposed strategy when model parameter variations occur with respect to the batch index.

17:50-18:10 ThC11.5

Successive Linearization-Based Stochastic Repetitive Control Technique and Its Applications to SMB and CATOFIN Processes (I), pp. 13468-13473

Lee, Kwang Soon	Sogang Univ.
Yun, Woohyun	Sogang Univ.
Won, Wangyun	Sogang Univ.
Lee, Jay	Georgia Tech.

A repetitive control technique which is based on a time-varying stochastic state space model obtained by cycle-to-cycle linearization of a nonlinear fundamental process model around the operation trajectories in the previous cycle is introduced. The control technique was applied to two repetitive chemical processes: simulated moving bed, a continuous chromatograph separation process, and CATOFIN process, a catalytic propane dehydrogenation reactor where dehydrogenation and coke oxidation alternate over short periods. Numerical studies have shown that the proposed RC techniques are very effective in improving the operation of both processes.

18:10-18:30 ThC11.6

Fast Iterative Learning Control for Delay Systems: A Predictive Approach, pp. 13474-13479

Meng, Deyuan	Beihang Univ. (BUAA)
Jia, Yingmin	Beihang Univ.
Du, Junping	Beijing Univ. of Posts and

Telecommunications
Yuan, Shiying Henan Pol. Univ.

In a previous paper (Li et al. (2005)), an iterative learning control (ILC) law, proposed for linear continuous systems with a single time delay, has the ability to drive the output tracking error to zero only after one learning iteration. The convergence result is quite attractive; however, it requires unavailable system state. The aim of this paper is to provide a predictive approach to not only reach this result, but also extend it to linear continuous systems with multiple time delays. To this end, that unavailable system state is predicted and its corresponding equivalent form is obtained, based on which new ILC laws with fully available information are determined, ensuring the zero output tracking only after one learning iteration. The numerical simulation shows that this kind of ILC design is available, and furthermore the extension of the results from systems with a single time delay to those with multiple time delays is feasible.

ThC12 313
Switching and Hybrid Stochastic Systems (Regular Session)
Chair: Hwang, Inseok Purdue Univ.
Co-Chair: Costa, Oswaldo Luiz V. Univ. of Sao Paulo

16:30-16:50 ThC12.1
Generalized Coupled Algebraic Riccati Equations for Discrete-Time Markov Jump with Multiplicative Noise Systems, pp. 13480-13485
Costa, Oswaldo Luiz V. Univ. of Sao Paulo
Paulo, Wanderlei Lima Escola Pol. da Univ. de São Paulo

In this paper we consider the existence of the maximal and mean square stabilizing solutions for a set of generalized coupled algebraic Riccati equations (GCARE for short) associated to the infinite-horizon stochastic quadratic optimal control problem of discrete-time Markov jump with multiplicative noise linear systems. The weighting matrices of the state and control for the quadratic part are allowed to be indefinite. We present a sufficient condition under which there exists the maximal solution and a necessary and sufficient condition under which there exists the mean square stabilizing solution for the GCARE.

16:50-17:10 ThC12.2
State-Feedback H-Infty Control for Nonlinear Stochastic Systems with Markovian Jumps in Infinite Time Horizon, pp. 13486-13491
Lin, Zhongwei Beijing Univ. of Aeronautics and Astronautics
Lin, Yan Beijing Univ. of Aeronautics and

This paper discusses the H-infty control problem for a class of nonlinear stochastic systems with Markovian jumps subjected to both state- and disturbance-dependent noise. We establish the equivalent conditions among Hamilton-Jacobi inequality (HJI), Hamilton-Jacobi equality (HJE), the dissipative inequality and L2-gain property for this class of systems. As to the infinite time horizon case, we synthesize a worst case-based state-feedback H-infty controller.

17:10-17:30 ThC12.3
Generalized Mean-Variance Portfolio Selection Model with Regime Switching, pp. 13492-13497
Costa, Oswaldo Luiz V. Univ. of Sao Paulo
Araujo, Michael Univ. de São Paulo

In this paper we deal with a generalized multi-period mean-variance portfolio selection problem with the market parameters subject to Markov random regime switchings. We present necessary and sufficient conditions for obtaining an optimal control policy for this Markovian generalized multi-period mean-variance model, based on a recursive procedure. The analytical solution of our model provides the base for the solution of a great variety of meanvariance formulations.

17:30-17:50 ThC12.4
Performance Analysis of Kalman Filter Based Hybrid Estimation Algorithms, pp. 13498-13503
Seah, Chze Eng Purdue Univ.
Hwang, Inseok Purdue Univ.

Kalman filter based hybrid estimation algorithms have been used in many appli- cations. However, performance analysis of these algorithms is difficult because many of these algorithms use a set of Kalman filters that are coupled with each other. We present an algorithm to compute the means and cross-covariances of the residuals of the set of coupling (or interacting) Kalman filters. Specifically, we derive the cross-covariances, each of which is the covariance of the residuals of two interacting Kalman filters, to account for the mutual interactions between the Kalman filters. From the means and cross-covariances of the Kalman filter residuals, we then compute the means of the likelihood functions and the mean-squared estimation errors as performance measures of hybrid estimation algorithms. We consider the Interacting Multiple Model algorithm as an example in this paper. In general, the proposed algorithm could be applicable to various Kalman filter based hybrid estimation algorithms.

17:50-18:10 ThC12.5
Hybrid Operating Regime Selection Algorithm in Local Modeling, pp. 13504-13508
Uosaki, Katsuji Fukui Univ. of Tech.
Hatanaka, Toshiharu Osaka Univ.

Recently, local modeling has been received much attention to identify the complex systems. In local modeling, global system model is obtained by combining a number of local models, each of which has simpler structure and has a range of validity less than the full range of operation. Since the local models are identified for corresponding local operating regimes, the performance of the global model is highly affected by the choice of the local operating regimes. This paper addresses automatic selection algorithms of suitable local regimes in local modeling. Based on three criteria, Kullback Discrimination Information~(KDI), Akaike Information Criterion~(AIC), and Mean Square Error (MSE), new hybrid regime selection algorithms are developed by combining with regime integration and partition processes. Numerical simulation studies illustrate the applicability of the proposed selection algorithms.

18:10-18:30 ThC12.6
An Efficient Hybrid Estimator, pp. 13509-13514
Pina, Luís Inst. Superior Técnico, Tech. Univ. of Lisbon
Botto, Miguel Ayala Tech. Univ. of Lisbon

This paper presents an efficient state estimation algorithm for hybrid systems based on a least-squares Interacting Multiple-Model setup. Under some conditions, the proposed algorithm is shown to perform similarly or even better than the Kalman filter. However, due to the possibility of incorrect estimation of the discrete mode, deterioration of the performance may occur. The computational efficiency of the proposed algorithm is obtained by discarding as many discrete mode sequences as possible while performing the least computations possible. This is done by rapidly computing good estimates, separating the constrained and unconstrained estimates and using some auxiliary coefficients computed off-line. A numerical example shows the characteristics of the proposed algorithm and compares it with the Kalman filter.

ThC13 314
Robust and Nonlinear Estimation (Regular Session)
Chair: Yaz, Edwin Marquette Univ.
Co-Chair: Fujimoto, Kenji Nagoya Univ.

16:30-16:50 ThC13.1
Current Output Observer for Stochastic-Parameter Models and Application to Sensor Failure, pp. 13515-13520
Hounkpevi, Franck Marquette Univ.
Yaz, Edwin Marquette Univ.

In this paper, linear discrete-time systems with white stochastic parameters are considered. Most results on the optimal state estimation of linear discrete time systems with stochastic parameters rely strongly on the generalization of the one step prediction type Kalman filter to this type of systems. But it has been shown that the current output observer results in less estimation error as compared to the one step prediction Kalman Filter for the case of systems with deterministic parameters. In this work, the current output observer is generalized to stochastic-parameter systems and the estimation error performance improvement is mathematically shown. We have particularly directed our attention to the application to the sensor failure problem, which involves a stochastic model with non-Gaussian parameter distribution. Experimental results confirm our prediction and shows that the current output observer has a substantial benefit for the sensor failure problem over the one step prediction generalized Kalman filter solution.

16:50-17:10 ThC13.2

Robust FILTERING FOR Ito STOCHASTIC Systems SUBJECT TO SENSOR NONLINEARITIES, pp. 13521-13526

Ho, Daniel W. C. — City Univ. of Hong Kong
Niu, Yugang — East China Univ. of Science & Tech.
Li, C. W. — City Univ. of Hong Kong

This paper will deal with the filtering problem for uncertain stochastic systems subject to sensor nonlinearities. There exist time-varying parameter uncertainties, and state and external-disturbance-dependent noise. The robust filters are constructed for It^{o} stochastic systems, and sufficient conditions are obtained such that the filtering error systems are robustly stochastically stable with a prescribed disturbance attenuation level despite sensor nonlinearities and all admissible uncertainties. A simulation example illustrating the proposed method is given.

17:10-17:30 ThC13.3

Gaussian Filter Based on Deterministic Sampling for High Quality Nonlinear Estimation, pp. 13527-13532

Huber, Marco F. — Univ. Karlsruhe (TH)
Hanebeck, Uwe — Univ. Karlsruhe

In this paper, a Gaussian filter for nonlinear Bayesian estimation is introduced that is based on a deterministic sample selection scheme. For an effective sample selection, a parametric density function representation of the sample points is employed, which allows approximating the cumulative distribution function of the prior Gaussian density. The computationally demanding parts of the optimization problem formulated for approximation are carried out off-line for obtaining an efficient filter, whose estimation quality can be altered by adjusting the number of used sample points. The improved performance of the proposed Gaussian filter compared to the well-known unscented Kalman filter is demonstrated by means of two examples.

17:30-17:50 ThC13.4

Discrete-Time H-Infinity Gaussian Filter, pp. 13533-13538

Tahmasebi, Ali — Univ. of Windsor
Chen, Xiang — Univ. of Windsor

A discrete-time signal estimator for systems subject to both white noise and bounded-power disturbance signals is developed. Sufficient and necessary conditions for the robust optimal filter are proved and the resulting filter gain is characterized by a set of two cross-coupled Riccati equations.

17:50-18:10 ThC13.5

Set Membership State Estimation for Nonlinear Systems Using Contraction Theory, pp. 13539-13544

Videau, Gaétan — Univ. Bordeaux1
Raissi, Tarek — Univ. Bordeaux 1
Zolghadri, Ali — Univ. Bordeaux I

This paper deals with guaranteed state estimation for nonlinear continuous-time systems. Interval observers are a powerful tool to compute the bounds of the state vector by propagating the uncertainties on the initial state and the parameter vectors and the errors on the measurements. Nevertheless, a widely recognized drawback of interval analyis-based observers is the overestimation due to dependence and wrapping effects. In this paper, contraction theory is used as an alternative in order to reduce the pessimism induced by interval analysis. The proposed interval observer is based on the Luenberger approach where the observation gain is chosen in order to guarantee stability and contraction properties. The methodology is illustrated with simulations on a numerical example.

18:10-18:30 ThC13.6

Independent Component Analysis for Nonminimum Phase Systems Using H_infinity Filters, pp. 13545-13550

Fukunaga, Shuichi — Nagoya Univ. Metropolitan Coll. of Industrial Tech.
Fujimoto, Kenji — Nagoya Univ.

This paper proposes an independent component analysis (ICA) method using H1 filters for nonminimum phase systems. In the basic ICA approach, the input signal is recovered by estimating the parameter of the inverse of the mixing system. If the system is nonminimum phase, the estimated parameter diverges due to the instability of the inverse. For this problem, a inverse filter is constructed based on an H1 filter in order to estimate the state of the given plant. The learning algorithm to estimate the parameter of the system is derived by minimizing the Kullback-Leibler divergence. Furthermore, a numerical simulation demonstrates the effectiveness of the proposed method.

ThC14 318

Fault Tolerance and Coordination in Networked Control Systems (Invited Session)

Chair: Patton, Ron J. — Univ. of Hull
Co-Chair: Franze', Giuseppe — Univ. della Calabria
Organizer: Patton, Ron J. — Univ. of Hull

16:30-16:50 ThC14.1

Robust FDI for FTC Coordination in a Distributed Network System (I), pp. 13551-13556

Klinkhieo, Supat — Univ. of Hull
Patton, Ron J. — Univ. of Hull
Kambhampati, C. — Univ. of Hull

This paper focuses on the development of a suitable Fault Detection and Isolation (FDI) strategy for application to a system of inter-connected and distributed systems, as a basis for a fault-tolerant Network Control System (NCS) problem. The work follows a recent study showing that a hierarchical decentralized control system architecture may be suitable for fault-tolerant control (FTC) of a network of distributed and interacting subsystems. The main idea is to use robust FDI methods to facilitate the discrimination between faults acting within one subsystem and faults acting in other areas of the network, so that a powerful form of active FTC of the NCS can be implemented, through an autonomous network coordinator. By using a robust form of the Unknown Input Observer (UIO), fault effects in each subsystem are de-coupled from the other subsystems, thus facilitating a powerful way to achieve local FDI in each subsystem under autonomous system coordination. Whilst the autonomous distributed control system provides active FTC under learning control, the FDI-based Reconfiguration Task enhances the network fault-tolerance, so that more significant subsystem faults can be accommodated in order to achieve a suitable standard of Quality of Performance (QoP) of the NCS.

16:50-17:10 ThC14.2

Fault Detection for Networked Systems with Incomplete Measurements (I), pp. 13557-13562

He, Xiao — Tsinghua Univ.
Wang, Zidong — Brunel Univ.
Zhou, Donghua — Tsinghua Univ.

This paper investigates the fault detection problem for a class of discrete-time networked systems. Three kinds of typically encountered incomplete measurements induced by the limited-capacity communication channel are simultaneously considered, which include 1) measurements with communication delays; 2) measurements with data missing; and 3) and measurements with signal quantization. Attention is focused on the analysis and design of a full-order fault detection filter such that, for all admissible unknown inputs and incomplete measurements, the error between residual and fault is kept as small as possible. Sufficient conditions for the existence of the desired fault detection filter are first established in terms of certain linear matrix inequalities (LMIs), and then the explicit expression of the desired filter is characterized when these LMIs are feasible. A simulation example is provided to illustrate the effectiveness and applicability of the proposed method.

17:10-17:30 ThC14.3

Fault Tolerance Enhancement in Distribution Power Grids: A Voltage Set-Point Reconfiguration Approach (I), pp. 13563-13568

Casavola, Alessandro — Univ. Della Calabria
Franze', Giuseppe — Univ. della Calabria
Patton, Ron J. — Univ. of Hull

In this paper we present a supervisory strategy for voltage regulation control problems in electrical power grids based on the Command Governor (CG) approach. The scheme consists of reconfiguring the nominal voltage set-point of the network in the presence of Distributed Generation (DG) units to avoid operative constraint violations in response to unexpected load changes and/or failures. Such a reconfiguration capability allows one to enhance the fault tolerability and to prevent undesirable phenomena from occurring in the electrical power grid. We focus on an electrical

Medium Voltage (MV) distribution network subject to coordination constraints on maximum load voltages deviations and possible failures on the on-load tap changers (OLTC). Simulation results show that the CG unit ensures feasible evolutions of the overall network by reconfiguring the nominal voltage set-point, whenever critical events occur.

17:30-17:50 ThC14.4

Advanced Design Scheme for Fault Tolerant Distributed Networked Control Systems (I), pp. 13569-13574

Ding, Steven X.	Univ. of Duisburg-Essen
Zhang, Ping	Univ. of Duisburg-Essen
Chihaia, Cristian Ionut	Univ. of Duisburg-Essen
Li, Wei	Univ. of Duisburg-Essen
Wang, Yongqiang	Tsinghua Univ.
Ding, E.L.	Univ. of Applied Sciences Gelsenkirchen

This paper addresses the integrated design of fault tolerant distributed networked control systems (NCS). The NCS under consideration consists of two levels. At the lower level, sensors, actuators and local controllers are embedded and networked by sub-nets. They are coordinated and supervised by the control stations located at the higher level. The core of the design scheme is the integrated design of communication, control and fault diagnosis systems in a multilayer structure.

17:50-18:10 ThC14.5

Design of Distributed Fault Tolerant Control Systems (I), pp. 13575-13580

Sa da Costa, Jose	IST, TULisbon
Mendes, Mário J. G. C.	Inst. Superior de Engenharia de Lisboa, Pol. Inst.

When dealing with large-scale complex networked control systems, designing FDI/FTC systems is a very difficult task due to the large number of sensors and actuators spatially distributed and networked connected. Despite the research effort on developing FTC systems for NCS most of these developments still being designed globally leading to centralized FTC solutions inadequate to NCS or, assume the communication network and the process itself as two different entities loosing the potentiality of the integrated design. The FDI/FTC design method presented in this paper is able to use simple and verifiable principles coming mainly from a decentralized design, based on causal modelling partitioning of the NCS and distributed computing using multi-agents systems, allowing the use of well established FDI/FTC methodologies, or new ones, developed taking into account the NCS specificities. The design methodology is made easy using a FTCNS-MAS toolbox introduced in this paper.

18:10-18:30 ThC14.6

Network Topology Design, pp. 13581-13586

Fencl, Tomas	Czech Tech. Univ. in Prague, Faculty of Electrical Engi
Burget, Pavel	Czech Tech. Univ. in Prague, FEE
Bilek, Jan	Czech Tech. Univ. in Prague

The application of the Industrial Ethernet brings up issues of both the reliability and behaviour of the networks under a demanded load, while preserving the permitted time delay in the whole network. We propose an algorithm that designs the network topology, which meets the required fault tolerance and allows reliable communication between the parts of the control system. For this purpose, we employ an iterative genetic algorithm that designs the physical topology and veri_es the behaviour under the expected load and time delay in the whole network. We propose the chromosome representation and genetic operators required. The network results compare physical topologies, which were acquired by a common algorithm and by our algorithm.

ThC15 317

Control Issues in Biological Wastewater Treatment (Invited Session)

Chair: Pons, Marie-Noelle	ENSIC
Co-Chair: Brdys, Mietek M.A.	Univ. of Birmingham
Organizer: Pons, Marie-Noelle	ENSIC
Organizer: Brdys, Mietek M.A.	Univ. of Birmingham

16:30-16:50 ThC15.1

Nonlinear PI Control for Dissolved Oxygen Tracking at Wastewater Treatment Plant (I), pp. 13587-13592

Han, Yu	The Univ. of Birmingham
Brdys, Mietek M.A.	Univ. of Birmingham
Piotrowski, Robert	Gdansk Univ. of Tech.

The paper addresses design, implementation and simulation of a novel type of softly switched Takagi-Sugeno fuzzy PI control system for dissolved oxygen concentration (DO) tracking at wastewater treatment plant (WWTP). The proposed control system is designed, including tuning the PI controllers, entirely based on the experimental data. This control system is validated by simulation. Copyright © 2008 IFAC

16:50-17:10 ThC15.2

Comparison of Sludge Wastage Control Strategies (I), pp. 13593-13598

Pons, Marie-Noelle	ENSIC
Potier, Olivier	Nancy Univ.

In order to compare whether sludge age control by wastage from the biological reactor is more efficient than wastage from the final clarifier in wastewater treatment plants by activated sludge, the Benchmark Simulation Model 1 has been modified. The secondary settler has been made reactive and the sludge settling characteristics vary in function of the amount of gas produced by denitrification. Proportional-integral controllers were implemented with success to control the sludge age by wastage from the biological reactor or the clarifier and were tested under different dynamic situations. It was confirmed that a simple strategy of constant wastage from the biological reactor could be a good alternative when no suspended solids sensor is available.

17:10-17:30 ThC15.3

Evaluation of Different Nitrogen Control Strategies for a Combined Pre and Post-Denitrification Plant (I), pp. 13599-13604

Stare, Aljaž	Jožef Stefan Inst.
Hvala, Nadja	Jožef Stefan Inst.
Vre ;ko, Darko	Jožef Stefan Inst.
Strmcnik, Stanko	Jozef Stefan Inst.

In the paper different nitrogen control strategies are proposed and tested on a simulation model of a combined pre- and post-denitrification plant. The plant configuration corresponds to the Domžale-Kamnik wastewater treatment plant that will be upgraded for nitrogen removal using MBBR (moving bed biofilm reactor) technology. The aim of the study is to find an optimal control strategy in terms of required effluent quality and operating (i.e. carbon and aeration) costs. The tested control strategies address aeration control, internal recirculation control, and external carbon dosage control, and are based on PI and feedforward control algorithms. Simulation results indicate that the nitrate PI controller that manipulates external carbon flow-rate and ammonia PI controller that manipulates oxygen concentration in the aerobic reactors give the best performance with respect to the effluent quality and operating costs. In addition, it was shown that the control authority of the internal recirculation flow-rate was rather limited as the internal recycle flow-rate on the real plant can be increased only up to 200 % of the average influent flow-rate. Hence, no improvements in terms of effluent quality could be achieved with internal recycle control. While the improvement of effluent quality with the proposed overall control scheme is rather small if compared to basic control scheme with optimal set-points, the energy savings are quite significant reaching up to 40%.

17:30-17:50 ThC15.4

Modeling and Monitoring of Microbial Diversity in Ecosystems - Application to Biological Wastewater Treatment (I), pp. 13605-13610

Ramirez, Ivan	INRA
Volcke, Eveline	Ghent Univ. Dept. Applied Mathematics, Biometrics and Proc
Steyer, Jean-Philippe	INRA

Key microbiological conversion processes do not result from the work of a single bacterial species but are performed by a wide variety of bacteria. Up till now, this microbial diversity is usually not tracked during reactor operation and mostly neglected in mathematical models. Nevertheless, experimental evidence is available that different process conditions may favor the selection of different types of bacteria, modifying the microbial diversity and consequently the behavior of the ecosystem. This contribution assesses microbial diversity in biological wastewater treatment systems by means of two case studies: nitrification and anaerobic digestion, experimental data being provided for the nitrification process. Situation where a toxicant is present is carefully analyzed for anaerobic digestion. In both cases, the potential of process control to optimize microbial populations is discussed and it is highlighted that frequent changing of operating conditions can impact favorably to overall stability of the processes.

17:50-18:10 ThC15.5

Regulation of Volatile Fatty Acids and Total Alkalinity in Anaerobic Digesters (I), pp. 13611-13616

Palacios-Ruiz, Bernardo — Univ. of Guadalajara
Méndez-Acosta, Hugo Oscar — Univ. of Guadalajara
Alcaraz-Gonzalez, Victor — Univ. of Guadalajara - CUCEI
Gonzalez-Alvarez, Victor — Univ. of Guadalajara
Pelayo-Ortiz, Carlos — Univ. of Guadalajara - CUCEI

This paper deals with the simultaneous regulation of volatile fatty acids (VFA's) and total alkalinity (TA) in anaerobic digesters. The control scheme is conformed by an output feedback control and an extended Luenberger observer used to estimate the uncertainties associated to the controlled states (i.e., kinetics terms and inlet composition). The inlet flow rate is used to regulate the VFA's concentration, whereas an alkali solution is added directly to the digester for the regulation of the TA concentration. The control scheme is evaluated via numerical simulations under different operating conditions. Results show that the control law is capable to regulate the VFA's and TA despite of load disturbances, uncertainties in the kinetics terms, noisy measurements and control inputs restrictions.

18:10-18:30 ThC15.6

Hierarchical Control Strategy for an Integrated Wastewater Treatment Plant, pp. 13617-13622

Hoo, Karlene — Texas Tech. Univ.
Zhang, Xi — Texas Tech. Univ.

This paper presents the design of a hierarchical control system consisting of a model based centralized supervisory controller and a group of embedded controllers for a set of integrated biological reactors, which is a part of NASA's advanced regenerative wastewater treatment system. A first principle model developed by [Zhang and Hoo, 2007] is used to design the centralized model predictive controller to regulate the performance of the integrated biological reactors for on-supply & ondemand operations simultaneously. The embedded control is implemented as safety mode to guarantee the process throughput performance in case of malfunction or the loss of communication with the higher level supervisory controller. The control design is implemented and tested on a testbed that is 1/20th the scale of the actual biological reactors.

ThC17 320A

Control Education: Remote Laboratories (Regular Session)

Chair: Fontanili, Franck — Ec. des Mines d'Albi-Carmaux
Co-Chair: Navarro, Jose Luis — Univ. Pol. de Valencia

16:30-16:50 ThC17.1

Inter-University Network of Remote Laboratories, pp. 13623-13628

Dominguez Gonzalez, Manuel — Univ. de Leon
Fuertes Martinez, Juan Jose — Univ. de Leon
Reguera Acevedo, Perfecto — Univ. de Leon
Prada, Miguel Angel — Univ. de Leon
Moran Alvarez, Antonio — Univ. de Leon

New technologies provide means and tools to develop new ways of communication, organization, work, etc. that have an impact on all the scopes of the society. Higher education has also experienced those changes. In the last years, the Internet has made possible to explore new teaching strategies. In this paper, the development of a Inter-University Network (IUN) of remote laboratories is proposed. The purpose of this network is training in automatic control using the Internet to work remotely with industrial equipment. This network is supported by a technological platform developed by the research group in Automatic Control at the University of León.

16:50-17:10 ThC17.2

Remote Laboratory for Control Engineering Degrees, pp. 13629-13633

Grau, Antoni — Tech. Univ. of Catalonia, UPC
Bolea, Yolanda — Univ. Pol. de Catalunya (UPC)

This paper presents the state of development of an innovative web-based control laboratory focused on the necessity of control education community. The usefulness of the remote laboratory proposed in this paper is justified by the opportunity of organizing the remote experiments, saving time and money for the students.

17:10-17:30 ThC17.3

An Experimental Platform for E-Manufacturing and Advanced Control, pp. 13634-13639

Fontanili, Franck — Ec. des Mines d'Albi-Carmaux
van Oudenhove, Thomas — ARMINES - Ec. des Mines d'Albi-Carmaux

In this paper, we present an experimental platform for education and research purposes. The physical production system of this platform is composed of a manufacturing workshop (physical plant) remotely controlled through Internet. The information system is composed of three Web applications allowing to order products (e-commerce), plan production campaign (e-plan)and control the workshop in order to release production (e-mes). We first describe an education application for engineer students to teach them how to control several production units (possibly on different sites). This platform would also be used as a demo for research works in the field of industrial engineering.

17:30-17:50 ThC17.4

Remote Labs and Resource Sharing in Control Systems Education, pp. 13640-13645

Burget, Pavel — Czech Tech. Univ. in Prague, FEE
Fiala, OndY;ej — Czech Tech. Univ. in Prague, FEE
Fencl, Tomas — Czech Tech. Univ. in Prague, Faculty of Electrical Engi
Moc, Lukáš — Czech Tech. Univ. in Prague, FEE

The goal of this paper is to present new extensions to our remote laboratory, which has been used for more than 4 years in undergraduate courses in the Department of Control Engineering. The remote lab serves as a means of a distant-programming environment, which provides users the possibility to use control systems, widely employed in industrial applications. We have reworked the remote lab completely, in line with our long-term experience from previous lab utilisation, while keeping in mind the current trends in mobile computing. Our unique combination of the access-control system, flexible management of the laboratory infrastructure and virtual remote desktops allows users to work absolutely independently of the place and time. The students can use simulation software (such as a programmable logic controller simulator), as well as remotely control the physical experiments placed in the lab. As a result of our work, the users of the lab gain a complex, while still simple-to-use, means to learn and practise on experiments, which would otherwise be inaccessible to them.

17:50-18:10 ThC17.5

ARTIST: A Distributed Remote Control Lab, pp. 13646-13651

Basso, Michele — Univ. di Firenze
Romagnoli, Marco — Univ. di Firenze
Innocenti, Giacomo — Univ. di Firenze

The aim of the paper is to present ARTIST, the remote control laboratory at University of Florence. Students can remotely interact with a number of physical processes exploiting predefined controllers or uploading their own. The main features of the lab are: a modular approach for the realization of different control tasks for the same process, which can be executed on different lab PCs and communicate over a network; a web-service application which exploits a database to facilitate the registration of users, processes and experiments of the laboratory. ARTIST website can be found at http://artist.dsi.unifi.it.

18:10-18:30 ThC17.6

Remote Fuzzy Control of a DC Motor, pp. 13652-13658

Navarro, Jose Luis — Univ. Pol. de Valencia
Díez, José Luis — Univ. Pol. de Valencia
Valera, Angel — Univ. Pol. de Valencia
Valles, Marina — Assistant Professor

This paper presents a simple and economical approach for the development of a fuzzy control remote laboratory using Matlab. The objective of the laboratory is to offer students and professionals a valuable tool for improving their fuzzy design abilities, and to test the performance of fuzzy controllers in a real DC motor. Advantages in regular educational process are related to an increase in time and

space flexibility in the use of limited resources. For the industry, the advantages on using this approach are related to a decrease in the costs of industrial operators training in new techniques.

ThC18 320B
Robotics Vision (Regular Session)

Chair: Shimada, Akira — Pol. Univ.
Co-Chair: Zhuang, Yan — Dalian Univ. of Tech.

16:30-16:50 ThC18.1

Design and Implementation of a Visual Feedback Control System Driven by Wires, pp. 13659-13664

Shimada, Akira — Pol. Univ.
Gotoh, Kazuyuki — Pol. Univ. Japan

This paper introduces a visual feedback control method for a multiple degree of freedom mechanical system driven by wires. This system is a small serial-link robot. It consists of a small-diameter tube and two pairs of wires, which are connected to the interior of the terminal link, which pass through the interior of every other link. The mechanical system is driven by electrical motors via tension in the wires. One pair of wires is for side-to-side motion while the other pair is for up-and-down motion. Such a mechanism is frequently used in medical and industrial devices, such as endoscopes. Furthermore, a compact CCD camera is mounted on the terminal link and functions as a vision sensor. The control system consists of a visual feedback control loop and a minor loop that directly controls the sum of all the joint angles. The control law of the minor loop is designed based on a Lyapunov's theory. On the other hand, the outer visual feedback control loop is designed to track a target point detected by the vision sensor. Each loop is connected by an image Jacobian number and its inverse, which are continually updated during operations. This control method is evaluated experimentally. It is anticipated that this system will be used in a variety of applications in the future.

16:50-17:10 ThC18.2

Autonomous Surgical Robot Using Visual Servoing in the Extended Image Plane, pp. 13665-13670

Perez, Carlos — Univ. Miguel Hernández
Morales Vidal, Ricardo — Univ. Miguel Hernandez
Garcia, Nicolas M. — Univ. Miguel Hernandez
Azorin, Jose M. — Univ. Miguel Hernandez de Elche
Sabater, Jose M. — Univ. Miguel Hernandez
Cervera Mateu, Enric — Univ. Jaume I

This paper deals with the visibility problems occurring during the execution of a visual servoing task by a robotic scrub nurse. To deliver the instrument to the surgeon and to retrieve that instrument when the surgeon is finished using it, are the vision guide tasks to be performed by the robot. One of the main problems of a vision guide robotic scrub nurse is the lose of some image features during the control process. This problem can be produced by a temporal occlusion or an out-coming of one or more image features. When this problem appears, the common solution is simply stopped the visual servoing control task and started an initialization process. The solution proposed by the authors is to extend the image plane and compute the image features projected on it by a new prediction algorithm based on a sugeno type fuzzy system since computer vision methods can not be used because of the features are not visible. Experimental results demonstrate the improvements that can be obtained in the performance of the vision-based control task when the visual servoing in the extended image plane is used.

17:10-17:30 ThC18.3

Robot Detecting System of Burnable Gun Bore Based on Radio Transmission, pp. 13671-13676

Xu, Jun — Harbin Univ. of Science and Tech.
Cui, Juan — Harbin Univ. of Science and Tech.
You, Bo — Harbin Univ. of Science and Tech.
Li, Xin — Harbin Univ. of science and Tech.

According to the restriction of wire for flexibility of robot in detection system, a radio transmission and image acquisition system with RF transmission and CCD image sensor that works in short distance was designed and introduced in this paper. It has been applied in the gun bore automatic detecting system. The system has the characteristics of high integration degree, high flexibility, small volume, low power consumption and so on .Through the scene testing of prototype, the intelligent robot is proved with accurate positioning, high survey accuracy, good stability. The robot detecting system with radio transmission and remote/semi-automatic control was achieved, and the automation and accuracy of gun bore detecting was improved.

17:30-17:50 ThC18.4

Towards Autonomous Fixed-Wing Unmanned Aerial Vehicle Landing: A Vision-Aided Inertial Navigation under Sensor Reconfiguration Scenario, pp. 13677-13682

Joo, Sungmoon — Stanford Univ.
Al-Ali, Khalid M. — Carnegie Mellon Univ. - West
Ippolito, Corey — NASA Ames Res. Center
Yeh, Yoo Hsiu — Carnegie Mellon Univ. Coast Campus

While autonomous landing of unmanned aerial vehicles (UAVs) requires accurate position estimation, the standard inertial navigation unit (INU, the inertial measurement unit with a global positioning system (GPS)) provides relatively poor accuracy in altitude estimation. A common solution for this problem is to aid the INU with additional sensors and/or ground infrastructures, but the main hurdles to the approach are the limited payload of UAVs and extra cost involved. Dynamic sensor reconfiguration can be a good alternative by constructing a new sensor system utilizing available sensors around without adding new sensory equipment to UAVs. In this paper, a sensor reconfiguration scenario for autonomous fixed-wing UAV landing is considered and the resulting vision-aided inertial navigation system is investigated. This paper presents (i) a sensor fusion algorithm for a passive monocular camera and an INU based on the Extended Kalman Filter (EKF), and (ii) an object-detection vision algorithm using optical flow. The EKF is chosen to take care of the nonlinearities in the vision system, and the optical flow is used to robustly detect the UAV from noisy background. Pilot-controlled landing experiments on a NASA UAV platform and the filter simulations were performed to validate the feasibility of the proposed approach. Promising results were obtained showing 50%-80% error reduction in altitude estimation.

17:50-18:10 ThC18.5

Monocular Vision Tracking Based on Hybrid Particle Filters for a Person Following Robot, pp. 13683-13688

Zhuang, Yan — Dalian Univ. of Tech.
Wang, Wei — Dalian Univ. of Tech.
Liu, Yisha — Dalian Univ. of Tech.
Liu, Yang — Dalian Univ. of Tech.

A person following behaviour for a mobile robot with a new vision tracking algorithm is presented in this paper. According to the different characteristics of particle filter and Kalman filter, a novel approach of target tracking based on hybrid particle filters is applied to process the target object’s position and shape component respectively, whose state updating is on the basis of data fusion between these two filter algorithms. The proposed method can not only pave the way for a low-complexity particle filter algorithm in dealing with higher dimensional tracking problem, but also cover the shortage of Gaussian restriction in Kalman filter. With the result of hybrid particle filters and the projective model of camera, the distance between the target and the robot can be calculated in real-time so that the robot can decide its own action to follow the target autonomously. A series of experiments on the Pioneer 3 robot show the method’s validity and practicability.

18:10-18:30 ThC18.6

Analysis and Characterization of the PMD Camera for Application in Mobile Robotics, pp. 13689-13694

Wiedemann, Matthias — Univ. of Wuerzburg
Sauer, Markus — Univ. of Würzburg
Driewer, Frauke — Univ. Würzburg
Schilling, Klaus — Univ. Wuerzburg

Three-dimensional perception of the environment offers significant potential to improve navigation solutions for mobile systems. The Pixel-Mixed-Device Technology (PMD) offers here a small, light-weight camera generating 3-D images, based on time-of-flight measurements. This contribution analyzes the sensor characteristics and application potential for mobile robots. Specific aspects related to parameter optimization and limitations in measurements are discussed on basis of performance tests. In particular, range images in unstructured and changing scenes are of interest. Specific properties of mobile systems are taken into account to generate appropriate range images for navigation and mapping tasks in robotic applications. Related adaptations of integration time and methods to percept consistent distances are derived and characterized by tests.

ThC19 320C

Intelligent Robotics Systems (Regular Session)

Chair: Dumitrache, Ioan — Univ. Pol. of Bucharest

Co-Chair: Salichs, Miguel A. — Univ. Carlos III

16:30-17:10 ThC19.1

Attackability in Games of Pursuit and Evasion with Antagonizing Players, pp. 13695-13700

Ma, Hongbin — National Univ. of Singapore

Ge, Shuzhi Sam — National Univ. of Singapore

Lum, Kai-Yew — National Univ. of Singapore

For the games of pursuit evasion with antagonizing players, the following three stages have been proposed: detection, attack and engagement, in which the roles of the two players are symmetric and each one is meant to search and attack its opponent. In the general framework established in our previous work, while the fundamental concepts, such as detectability, for the first stage have been laid before, this paper is dedicated to the second stage and to develop the associated fundamental concepts including the attackability, which describes whether one player (say P_1) could attack its opponent (P_2) before P_2 could see P_1, under the assumptions that (i) each player has a limited range vision zone and a limited range attack zone, and (ii) P_2 would follow a predefined trajectory and P_1 could choose its trajectory so as to attack P_2 since P_1 could see P_2 first. To demonstrate the concepts of attackability by detailed analysis, % as a preliminary work, a simple yet typical planar PEAP game is discussed in this contribution, where two players are moving along two straight lines with constant speeds and each player has circular vision zone and attack zone. Sufficient and necessary conditions for all possible cases of attackability are given under several natural assumptions, which yields a complete analysis for the new concepts of attackability.

17:10-17:30 ThC19.2

A Knowledge-Based Robot Searching for an Unpredictable Goal under Unknown Environment, pp. 13701-13706

Wang, Huifang — Beijing Univ. of Tech.

Chen, Yangzhou — Beijing Univ. of Tech. Beijing, 100022,P.R.China

This paper describes a knowledge-based robot that explores an unknown environment for an unpredictable goal. Distinguishing characteristics of such environments for robotic navigation are that the goal's position is unpredictable and some obstacles cannot be sensed directly. Considering such features we propose a search algorithm for finding the goal and a simplified DPLL to allow robotic reasoning. Moreover we demonstrate the completeness and the execution cost of the search algorithm and also support the completeness and soundness of the simplified DPLL. The set memory rules allow for computer processing limitations. In addition, the simulation results of randomly produced environments demonstrate the completeness, soundness and effectiveness of method.

17:30-17:50 ThC19.3

An Order-Based Approach to Mission-Oriented Autonomous Robot Control: Managing Complexity, Merging Multiple Plans, and Performance Analysis Given Partial Probabilistic Information, pp. 13707-13712

Li, Keyong — Boston Univ.

D'Andrea, Raffaello — Cornell Univ.

This paper formulates a framework for mission-oriented robot control. The benefit of this approach is multifacet. First, it suggests a promising direction for managing the complexity of encoding control policies. Second, it establishes a natural connection between feedback control and planning. Third, it allows the analysis of the time-to-mission-accomplishment distribution with almost minimum probabilistic information. This framework has been applied to the domain of robot soccer as a test of effectiveness. The resulting system competed at par in a simplified game setting against the strategy of a former championship team in the International RoboCup Competition.

17:50-18:10 ThC19.4

Intelligent Control Via New Efficient Logics, pp. 13713-13718

Vassilyev, Stanislav — Inst. of Control Sciences, Russian Acad. of Sciences

Davydov, Artem — Inst. for System Dynamics and Control Theory, SiberianBranch

An approach to devising the upper level of control systems for multiagent systems has been developed. Problems related to automation of action planning, including those bound up with the mode of cooperative mission performance, are considered. A new efficient logic apparatus for intelligent control is proposed.

18:10-18:30 ThC19.5

Agent-Based Theory Applied in Mobile Robotics, pp. 13719-13724

Dumitrache, Ioan — Univ. Pol. of Bucharest

Dragoicea, Monica — Univ. Pol. of Bucharest

This paper presents our experience in building complex autonomous systems through modularization and task specialization. As the test-bed, mobile devices were used. Some insights regarding the integration of agent-based theory in the framework of biological intelligence are presented. The obtained results approach the the definition and implementation of the intelligent activities and their realization in the framework of agent-based theory, namely, problem solving and planning, search, decision making, and learning. The experiments presented in this work specifically describe a framework of defining navigational tasks based on artificial intelligence methods.

ThC20 321C

Automation in Micro and Nano-Handling II (Invited Session)

Chair: Fatikow, Sergej — Fak.II, AMiR

Co-Chair: Rakotondrabe, Micky — Univ. de Franche Comté

Organizer: Fatikow, Sergej — Fak.II, AMiR

16:30-16:50 ThC20.1

Robust Feedforward-Feedback Control of a Hysteretic Piezocantilever under Thermal Disturbance (I), pp. 13725-13730

Rakotondrabe, Micky — Univ. de Franche Comté

Diouf, Mamadou — FEMTO-st

Lutz, Philippe — Univ. de Franche Comté

In micromanipulation, piezoelectric cantilevers are commonly used in grippers performing pick-and-place of micro-objects. Indeed, these materials offer high accuracy and high speed. On the one hand, when working with large electric field, the behavior of the piezocantilevers provides hysteresis nonlinearity reducing their performances. On the other hand, the temperature variation of the workspace influences the accuracy. In this paper, a feedforward control is used to linearize the hysteresis and a robust feedback controller is implemented to reject the thermal disturbance. The former is based on the inverse Prandtl model while the second on the H1 robust control.

16:50-17:10 ThC20.2

Semi-Automated Control of AFM-Based Nanomanipulation Using Potential Fields (I), pp. 13731-13736

Ladjal, Hamid — Univ. of Orléans

Ferreira, Antoine — Univ. d'Orléans- ENSI de Bourges

This paper proposes a truly interactive virtual environment (VE) system for 2-D assembly tasks at the micro scale. It is based on the application of virtual potential fields as a control aid for performing safe and reliable path planning strategies. The planner covers a whole range of problems due to nanoscale effects in object assignment, obstacle detection and avoidance, path trajectory finding and sequencing. We investigated various paradigms for enabling the human operator and the automatic motion planner to cooperatively solve a motion planning task through the use of virtual potential fields. Communication between the operator and the planner is made through haptic/vision/sound modalities. First, we describe algorithms based on optimization theory and Voronoi graph construction taking into account the micro scale effects. As automatic motion planners fail due to the difficulty of discovering critical configurations, we propose cooperation paradigms with operator skills in order to solve motion planning strategies. Then, potential fields are being used as a tool to generate velocity commands from an automatic path planner as well as allowing the human to interact. Finally, the ideas presented here are supported by experiments for efficient pushing-based manipulation constructing 2-D microparticle patterns.

17:10-17:30 ThC20.3

A Nanomanipulation Platform for Semi Automated Manipulation of Nano-Sized Objects Using Mobile Microrobots Inside a Scanning

Electron Microscope (I), pp. 13737-13742
Canales, Christophe — EPFL

In the scope of the NanoHand project, a compact and versatile nanomanipulation platform is being developed. This platform is aimed to manipulate and characterize nano-sized objects with a vision feedback from a SEM. The platform is composed of mobile micro-robots with four degrees of freedom (X,Y,Z,¸;z) located on a cartesian XY stage. Thanks to its compactness, the complete platform can be loaded through the exchange bay of a SEM. Final application is the manipulation and characterization of CNTs (Carbon Nanotubes) and nanowires.

17:30-17:50 ThC20.4
Nanomanipulation and Nanoassembly of Carbon Nanotubes Inside Electron Microscopes (I), pp. 13743-13748
Nakajima, Masahiro — Nagoya Univ.
Liu, Pou — Japan
Fukuda, Toshio — Nagoya Univ.

We report nanomanipulation and nanoassembly of carbon nanotubes (CNTs) through nanorobotic manipulation inside electron microscopes. A hybrid nanorobotic manipulation system, which is integrated with a nanorobotic manipulator inside a transmission electron microscope (TEM) and nanorobotic manipulators inside a scanning electron microscope (SEM), is used. The elasticity of a multi-walled CNT (MWNT) is measured inside a TEM. The telescoping MWNT is fabricated by peeling off outer layers through destructive fabrication process. The electrostatic actuation of telescoping MWNT is directly observed by a TEM. A cutting technique for CNTs assisted by the presence of oxygen gas is also presented. The cutting procedure was conducted in less than 1 minute using a low-energy electron beam inside a scanning electron microscope. A bending technique of a CNT assisted by the presence of oxygen gas is also applied for the 3-D fabrication of nanostructure. We expect that these techniques will be applied for the rapid prototyping nanoassembly of various CNT nanodevices.

17:50-18:10 ThC20.5
Estimation of Electrical Cell–Capillary Admittance During Injection with Frequency Response Method (I), pp. 13749-13754
Hirvonen, Juha Robert — Tampere Univ. of Tech.
Vilkko, Matti Kalervo — Tampere Univ. of Tech.
Roinila, Tomi — Tampere Univ. of Tech.
Kallio, Pasi — Tampere Univ. of Tech.

This paper describes electrical equivalent circuit models of cell–capillary admittance during injection of a living cell and presents a measurement system to estimate corresponding frequency responses during microinjection tests. Since the admittance estimate is calculated from data collected during injection, the amount of data is limited. To overcome this constraint, the approach proposed in this paper takes advantage of properties of periodic pseudo random binary sequence (PRBS) excitation signal and avoids end effect anomalies of correlation calculation. The fast and accurate estimation is used to detect the degree of contact during cell injection and to detect breakage and clogging of capillary during a sequence of multiple operations.

ThC21 321B
Human Cognition, Speech and Decision-Making (Regular Session)
Chair: Zuehlke, Detlef — TU Kaiserslautern
Co-Chair: Yoon, Wan Chul — Korea Advanced Inst. of Science and Tech.

16:30-16:50 ThC21.1
Neuro-Adaptive Motion Controller with Velocity Observer for Operational Space Formulation, pp. 13755-13760
Soewandito, Dandy — National Univ. of Singapore
Oetomo, Denny Nurjanto — Monash Univ.
Ang Jr, Marcelo H — National Univ. of Singapore

An operational space controller that employs a three-layer neural network (NN) adaptive controller with the velocity observer is presented in this paper. This incorporates the versatility of NN based adaptive controller with the performance and effective formulation of the operational space framework, which accommodates unified force/motion control as well as highly redundant mechanisms postures. In this paper, it is shown that the trajectory tracking errors, the estimation tracking errors, and the NN weight errors are bounded even when the actual and accurate velocity feedbacks are not available, such as often the case in a physical robot. Consequently, the controller with velocity observer is shown to be stable. Realtime experiments on PUMA 560 robot was carried out to compare the effectiveness of the proposed NN adaptive control strategy, the inverse-dynamics control, and the Proportional-plus-Derivative (PD) control with gravity compensation.

16:50-17:10 ThC21.2
Evolving a Hierarchical Decision Making Mechanism Using Fuzzy Logic, pp. 13761-13766
Beldek, Ulas — Cankaya Univ.
Leblebicioglu, Kemal — Middle East Tech. Univ.

In this study, a new hierarchical decision-making and decision-fusion mechanism is introduced for solving decision making problems in a consistent manner. This mechanism is constructed by using a genetic algorithm. The proposed mechanism employs fuzzy logic and a performance index determined based on the performance of decision-making agents at successive hierarchical levels. The mechanism is such that the decisions in previous levels are influential on the current level decisions according to the performance index introduced. This mechanism is tested on an artificial problem, namely finding the amount of faults in a four tank water system.

17:10-17:30 ThC21.3
An Activity-Theoretic Approach to Intention Estimation, pp. 13767-13772
Jipp, Meike — Univ. of Mannheim
Bartolein, Christian — Univ. of Mannheim
Badreddin, Essam — Univ. of Heidelberg

Traditional powered wheelchair control is especially for severely disabled people cognitively and physically demanding due to the high number of input commands necessary. An intention estimation behaviour, which considers the cognitive processes of the actor, is discussed as one way in order to significantly reduce the number of required input commands. For this purpose, a continuum of, from other researchers discussed modes of human behaviours is introduced as well as cognitive processes underlying this continuum of human behaviors. A study conducted with wheelchair users confirms major assumptions of the theory and allows drawing implications for realizing an intention estimation behavior considering the cognitive processes of the actors.

17:30-17:50 ThC21.4
Face Detection with Colour Segmentation and Fuzzy Template Matching, pp. 13773-13778
Boccioli, Marco — CERN
Panzieri, Stefano — Univ. di Roma Tre
Díez, José Luis — Univ. Pol. de Valencia

On this paper it is shown a study and integration of different procedures in order to detect a face in a still picture or in a movie sequence. Once a skin colour region has been detected by colour segmentation, it is then classified as face or non-face through a template matching method. This method has been improved by the use of fuzzy theory. After face detection, face features, e.g. eyes and mouth, are then extracted.

17:50-18:10 ThC21.5
Methodologies on Brain-Machine Interaction, pp. 13779-13784
Ge, Shuzhi Sam — National Univ. of Singapore
Pan, Yaozhang — National Univ. of Singapore
Mamun, Abdullah Al — National Univ. of Singapore

Recent development in cognitive neuroscience and brain imaging technologies provides us with a increasing ability to a new multidisciplinary research, brain machine interactions (BMIs). In this paper, the critical technologies used in BMIs, such as bio-sensor, translation algorithms, and the major applications are discussed. By providing an overview of these aspects, we can see how advanced technologies in these areas can be utilized to improve the state of art BMIs. In this paper, based on real EEG data, RBF neural network method and a machine learning algorithm, weighted locally linear embedding (WLLE) are proposed for neural modeling and pattern ecognition respectively to efficiently interpret brain patterns for BMIs.

18:10-18:30 ThC21.6
Personalized Use Models in Ambient Intelligence Environments, pp. 13785-13790
Görlich, Daniel — Univ. of Kaiserslautern

Thiels, Nancy — German Res. Center of Artificial Intelligence
Meixner, Gerrit — German Res. Center for Artificial Intelligence

The impact of user interface quality has grown in software systems engineering, and will grow further with upcoming new paradigms such as Ambient Intelligence (AmI) or Ubiquitous Computing, which confront the production industry with a huge diversity of new usage situations. User in such situations cannot cope with the vast amount of information. Therefore, new models with respect to users' needs are required to support them fulfilling their tasks. In this paper, the adaptation of a task-oriented use model to future paradigms is presented by considering personal structural preferences and advanced user interaction control. The model reflects user groups' tasks and user interface structure preferences described in a system-independent language. For the future, this model is intended to be used for the run-time generation of user interfaces for adaptive software and intelligent environments, especially in the area of production and manufacturing.

ThC22 321A
Sensing, Fault Detection and Control of Hydraulic Systems
(Regular Session)

Chair: Muenchhof, Marco — Tech. Univ. Darmstadt
Co-Chair: Yao, Bin — Purdue Univ.

16:30-16:50 ThC22.1
A Study on Hydraulic Load Simulator a Study on Hydraulic Load Simulator Using Self Tuning Grey Predictor – Fuzzy PID, pp. 13791-13796
Dinh, Quang Truong — Univ. of Ulsan

Nowadays, considering the development of the industry, hydraulic actuator has a wide range of application fields. This paper presents a kind of hydraulic load simulator for conducting performance and stability test for control force of hydraulic hybrid systems. A grey prediction model GM(1,1) combined with a fuzzy PID controller is suggested to apply for this system. Furthermore, fuzzy controllers and a tuning algorithm are used to change the Grey step size to improve the control quality. The grey prediction compensator can improve the system settle time and overshoot problems. Simulations and experiments are carried out to evaluate the effectiveness of the proposed control method applied for hydraulic systems with varied external disturbance as in real working conditions.

16:50-17:10 ThC22.2
Velocity Control for a Variable Displacement Hydraulic Servo System Using Adaptive Fuzzy Sliding-Mode Control, pp. 13797-13802
Chiang, Mao-Hsiung — National Taiwan Univ.
Lee, Lian-Wang — National Taiwan Univ. of Science and Tech.
Chen, Chung-Chi — National Taiwan Univ. of Science and Tech.
Liu, Hsien-Hsueh — National Taiwan Univ. of Science and Tech.

The variable displacement hydraulic servo system performs specific characteristics on non-linearity and time-varying. An exact model-based controller is difficult to be realized. In this study, the design method and experimental implementation of an adaptive fuzzy sliding-mode controller (AFSMC) are presented, which has on-line learning ability for dealing with the system time-varying and non-linear uncertainty behaviors for adjusting the control rule parameters. The tuning algorithms are derived in the sense of the Lyapunov stability theorem; thus, the stability of the system can be guaranteed. The experimental results show that the AFSMC can perform excellent velocity control for the variable displacement hydraulic servo system.

17:10-17:30 ThC22.3
Displacement Sensor Fault Tolerance for Hydraulic Servo Axis, pp. 13803-13808
Muenchhof, Marco — Tech. Univ. Darmstadt

In this paper, a fault management system for a hydraulic servo axis is described. This system is capable of sustaining faults in the piston displacement sensor of the position-controlled hydraulic servo axis. By means of a parity equation based fault detection stage, faults in the displacement sensor as well as other sensors and components of the servo axis can be detected and subsequently be diagnosed by means of a fuzzy-logic based reasoning system. Upon the diagnosis of a piston displacement sensor fault, the system switches to a "model-sensor" which provides an estimate for the piston position. To ensure the utmost model fidelity of the model sensor, the model parameters are constantly updated by means of parameter estimation during the fault-free operation of the servo axis. Experiments at a hydraulic servo axis conclude this paper and show the high quality of the reconstructed piston displacement sensor signal.

17:30-17:50 ThC22.4
Model Adjustment and Multi-Model Based Fault Diagnosis for Hydraulic Servo Axis, pp. 13809-13814
Muenchhof, Marco — Tech. Univ. Darmstadt
Beck, Mark — Tech. Univ. Darmstadt

This paper presents a model adjustment and a multi-model based fault diagnosis approach. Both methods are based on the same idea. A physical model of the process is altered such that it mimics the behavior of the process in the presence of certain faults. A number of these modified models, each governing a different fault condition, are evaluated and the model with the smallest output error is determined. As this model is assumed to best govern the current process dynamics, it can be used to diagnose the actual state of the process. Two variations of this idea are presented, tailored specifically to online and offline operation respectively. For online applications, multiple models with fixed parameters are evaluated in parallel, whereas for offline application, an optimization approach is employed. Here, one model with several fault size parameters is regarded and the optimal fault size parameters are determined by means of an interval halving technique. Both techniques have been evaluated at a testbed and have shown very good fault detection and diagnosis capabilities.

17:50-18:10 ThC22.5
Fault Detection, Identification and Accommodation for an Electro-Hydraulic System: An Adaptive Robust Approach, pp. 13815-13820
Gayaka, Shreekant — Purdue Univ.
Yao, Bin — Purdue Univ.

In the present work, we use an adaptive robust approach for fault detection and accommodation in electro-hydraulic systems. It is well known fact that any realistic model of a hydraulic system suffers from significant extent of uncertain nonlinearities and parametric uncertainties. An adaptive robust scheme is robust to such uncertainties and tracks the change in parameters reliably. Consequently, such a scheme becomes a natural choice for designing robust fault detection algorithms for electro-hydraulic systems. In this paper, we present the main results obtained by using adaptive robust state reconstruction and adaptive robust observers for fault detection in electro-hydraulic systems. Furthermore, the useful information about faults contained in the residual is used for designing an active fault-tolerant controller. We give an outline of the stability analysis for the faulty closed loop system, which shows that all states remain bounded and desired performance is restored to acceptable limits after the occurrence of fault. Simulation results show the effectiveness of the proposed scheme.

18:10-18:30 ThC22.6
Soil Estimation Based on Dissipation Energy During Autonomous Excavation, pp. 13821-13826
Mohseni-Vahed, Shahram — King's Coll. London
Althoefer, Kaspar — King's Coll. London
Seneviratne, Lakmal D — King's Coll. London
Song, Xiaojing — King's Coll. London
Dai, J. S. — King's Coll. lLondon
Lam, H. K. — King's Coll. London

This paper describes a new algorithm for the estimation of soils into different types employing an energy-based approach. Greatly simplifying the modeling of the tool-soil interaction process, energy components occurring during a dig are computed from simple force and bucket displacement measurements. In particular, the dissipation energy can be estimated allowing a prediction of the dynamic friction forces encountered during soil-tool interaction in the field of excavation. The proposed method measures force and displacement simultaneously during the extensively horizontal dragging phase while continuously recalculating the velocity, accumulated moved soil mass and total dissipation energy, creating a specific profile depending on the soil conditions. The creation of these profiles could be useful in providing information to a low level controller able to distinguish between different types soils. The method can thus be seen as an important component allowing robust and noise-free feedback in autonomous control in excavator vehicles.

ThC23 323
Production and Logistics Structures As Complex Adaptive Systems (CASs) (Invited Session)

Chair: Monostori, Laszlo	Computer and Automation Res. Inst. Hungarian
Co-Chair: Verstraete, Paul	K.U.Leuven
Organizer: Monostori, Laszlo	Computer and Automation Res. Inst. Hungarian
Organizer: Valckenaers, Paul	K.U.Leuven
Organizer: Csáji, Balázs Csanád	MTA SZTAKI (Computer and Automation Res. Acad. of Sciences)

16:30-16:50 ThC23.1
Intelligent Product = Intelligent Agent + Intelligent Being (I), pp. 13827-13832

Valckenaers, Paul	K.U.Leuven
Saint Germain, Bart	K.U.Leuven
Verstraete, Paul	K.U.Leuven
Van Belle, Jan	K.U.Leuven
Hadeli,	K.U.Leuven
Van Brussel, Hendrik	K. U. Leuven

The notion of an intelligent product calls for research into suitability for integration as it aims for coordination and integration on an unprecedented scale. This is particularly challenging where it affects the core businesses of companies. Moreover, these integration issues go well beyond IT interoperability. This paper presents a novel concept the intelligent being as a means to achieve suitability for integration at this scale. The paper argues for a major role of the intelligent being in production and logistic systems analogous to the undeniably prominent role of maps in navigation systems. The concept of an intelligent being contributes to the design and development of complex adaptive systems by enabling integration and coordination at an unprecedented scale: the corresponding reality is the limit.

16:50-17:10 ThC23.2
A Complexity Model for Networks of Collaborating Enterprises (I), pp. 13833-13838

Csáji, Balázs Csanád	MTA SZTAKI (Computer and Automation Res.
Monostori, Laszlo	Computer and Automation Res. Inst. Hungarian

Theoretical study of complex systems receives more and more attention as most sciences broaden their perspectives. The paper first briefly overviews a few important complexity approaches, then it presents a triple-level model for describing and analyzing collaborating enterprises. The environment is treated as a stochastic process, the core topology of the collaboration is represented by a graph and, finally, the dynamic behavior of collaborating enterprises is modeled as a Complex Adaptive System (CAS). Complexity measures for the different sub-models are suggested, some complexity drivers are investigated and it is argued that the resulted model can be effectively analyzed by simulation.

17:10-17:30 ThC23.3
Correlation Analysis of TSUNAMI Effect and Failure Rate Fluctuation in Manufacturing System (I), pp. 13839-13844

Nonaka, Youichi	Production Engineering Res. Lab. Hitachi, Ltd
Lengyel, Attila,	Production Engineering Res. Lab. Hitachi Ltd.
Sugimoto, Koichi,	Tokyo Inst. of Tech.

Tremendous growth of the home information appliances requests semiconductor manufacturing to respond High Product Mix and Low Production Volume condition. Such condition in manufacturing operations challenges production management to have rapid improvement activities in an environment with uncertain productivity and demand. In this research Visualized Coefficient of Variation Analysis (VCVA) was applied to measure fluctuations in the flow of production material on a time-line basis. Based on this approach a monitoring tool was developed and implemented in a wafer manufacturing system and an assembling system to support production management in root cause analysis and productivity improvement. Results show the effectiveness of the method by visualizing TSUNAMI Effect, as a typical case of Butterfly Effect in the material flow fluctuation, by identifying the root cause equipment as the source of productivity detractor, and by revealing significant relationship between material flow fluctuation and failure rate fluctuation.

17:30-17:50 ThC23.4
A Simulation-Based Decision-Support System : The Example of a Furniture Manufacturer (I), pp. 13845-13850

Klein, Thomas	Nancy Univ.
Thomas, André	Nancy Univ.
Morel, Gerard	Nancy Univ.
El Haouzi, Hind	Nancy Univ.

In this paper, we address a way to improve a classic kanban control system, by using kanban cards as an informational/decisional entity in order to enrich shop-floor information/decision. The real-time information collected and the simulation tool proposed enable to coordinate distributed decision according to a unique and global performance indicator. Our proposition consists in enabling any shop-floor decision maker to evaluate different kanban priority scenarios according to a unified objective, taking into account the global situation of the workshop. Models of the data collection and decision support system are presented. A generic information system enable to provide a relevant view of shop-floor status. Such an information will be useful to efficiently feed a real-time simulation tool in order to evaluate solutions. The application is illustrated using the case of an industrial furniture manufacturer.

17:50-18:10 ThC23.5
Real-Time, Cooperative Enterprises for Customized Mass Production; Challenges and Solution Approaches (I), pp. 13851-13856

Monostori, Laszlo	Computer and Automation Res. Inst. Hungarian
Váncza, József	MTA SZTAKI
Kis, Tamas	Computer and Automation Res. Inst.
Erdos, Gabor	SZTAKI
Karnok, David	MTA SZTAKI
Egri, Peter	Computer and Automation Res. Inst. HungarianAcademy of

The paper underlines the main requirements of customized mass production, with special emphasis on real-timeness and cooperativeness. Main goals of a large-scale national industry-academia R&D project aimed at improving the performance of a production network that produces consumer goods in large quantities and variability are highlighted. An integrated approach is pre-sented for planning the behavior of the system at network-, factory- and plant level, as well as for adapting various plans to real execution conditions.

ThC24 324
Internet of Services (Invited Session)

Chair: Mueller, Joerg	Tech. Univ. of Clausthal
Co-Chair: Panetto, Hervé	Nancy-Univ.
Organizer: Mueller, Joerg	Clausthal Univ. of Tech.
Organizer: Zhou, Xuan	SAP
Organizer: Panetto, Hervé	ESIAL - Nancy-Univ.

16:30-16:50 ThC24.1
Model Tranformation of Collaborative Business Process into Mediation Information System (I), pp. 13857-13862

Pingaud, Hervé	ENSTIMAC
Benaben, Frederick	Ec. des Mines d'Albi-Carmaux
Touzi, Jihed	Ec. des Mines d'Albi Carmaux

Partner information systems (IS) must interact to efficiently support collaboration in an enterprise network. One way to reach this goal is to promote IS interoperability. Assuming a service oriented approach of the software architecture of each individual IS, the use of a mediation IS is described to bind the services of individual IS systems. The knowledge captured in collaborative process models expressed in Business Process Modelling Notation is considered as a basis of collaboration requirements. Therefore, it will be the prime material used in order to build an UML model of the mediation system. Transformation language mechanisms that support the resolution phase of this particular problem are explained

16:50-17:10 ThC24.2

Graphical Languages for Business Processes and Manufacturing Operations (I), pp. 13863-13868

Johnsson, Charlotta — Lund Univ.

The aim of this paper is to present trends, similarities and differences in the usage of graphical languages at the level of Process Control, Manufacturing Operations and Business Systems. The paper also gives ideas of how a common language could be used to increase the integration between the three levels and what advantages this could bring to its user.

17:10-17:30 ThC24.3

Using a Commercially Successful Empirical Enterprise Framework : Deterministic Service Oriented Architecture Service Levels (I), pp. 13869-13873

McKeachie, Ian — Griffith Univ.
Vlacic, Ljubo — Griffith Univ.

TC 5.3 and INTEROP-VLab invited session CODE: the Internet of Service session;vX5id

Abstract:This paper presents a summary of an integrated empirical enterprise framework and an aspect of its practical use. Development of the empirical framework, over some ten years, has been driven by management strategic goals and the need for successful commercial outcomes. What is offered as novel is the integrated empirical framework approach for a Service Oriented Architecture (SOA). The approach uses service interfaces' definitions at several logical levels within the Enterprise with mapping to component services thus allowing deterministic Service Level Agreement derivation using Failure Mode Effects Analysis (FMEA). As the empirical framework can incorporate arbitrary quantitative metrics, the technique allows management of risks with accurate budgeting, verifiable cost benefit design and comparison of proposed changes to existing enterprises on a cost benefit basis. Emphasis on integration of strategic frameworks and management paradigms with application and SOA components has been found to be critical to commercial success.

17:30-17:50 ThC24.4

A Peer-To-Peer-Based Service Infrastructure for Distributed Power Generation (I), pp. 13874-13879

Stäber, Fabian — Siemens AG
Gerdes, Christoph — Siemens AG
Mueller, Joerg — Clausthal Univ. of Tech.

The shift towards decentralization in power generation raises the need for a largescale control infrastructure to support a high number of distributed power generators. Peer-topeer computing provides self-organizing, Internet-scale infrastructures being resilient to node failure, which makes peer-to-peer seem a natural basis for a large-scale control application. However, raw peer-to-peer overlays lack certain properties that are crucial in a distributed power generation scenario, like a messaging service, a public key infrastructure for implementing security, etc. Therefore, the peer-to-peer overlay must be complemented by a set of service layer components fulfilling the application requirements. In this paper, we present an industrial case study where generic service components are applied on top of a peer-to-peer overlay, forming a reliable control infrastructure for distributed power generation. To illustrate our results, we present a detailed evaluation of the level of reliability achieved with the combination of a messaging service, and a replication service.

17:50-18:10 ThC24.5

Semantics in Industrial Distributed Systems (I), pp. 13880-13887

Obitko, Marek — Czech Tech. Univ.
Vrba, Pavel — Rockwell Automation
Marik, Vladimir — Rockwell Automation
Radakovic, Miloslav — Rockwell Automation

Industrial distributed systems aim at robust and flexible control of industrial processes, for which the traditional centralized approaches are not sufficient. The general problem of distributed systems is that they are still tightly coupled from the point of view of system integration and are still far from openness that would enable cooperation at a larger scale without any human intervention. To achieve better operation and integration in an open reconfigurable environment, explicit semantics is needed to capture the meaning during communication. Relevant research area is the field of ontologies and semantic web. We show how semantics can be employed in industrial systems, in particular in distributed agent-based systems, and especially using semantic web research. We review current state of the art and, based on our own experience, we discuss potentials and challenges as well as differences and similarities of applications of semantics and ontologies in industrial systems when compared to WWW oriented research.

18:10-18:30 ThC24.6

MasDISPO_xt: Annealing Furnace Planning Inside the Supply Chain of Steel Production (I), pp. 13888-13892

Jacobi, Sven — Saarstahl AG
Leon-Soto, Esteban — DFKI GmbH
Madrigal-Mora, Cristian — DFKI GmbH
Fischer, Klaus — DFKI GmbH

The production of steel normally constitutes the inception of many Supply Chains in different areas of industry. Therefore, steel manufacturing companies are strongly affected by bull whip effects and other unpredictable influences along their production chains. In the course of these integrated operations, making the right decision at a certain stage can be the difference between earning or losing a great benefit. Improving their operational efficiency is required to keep a competitive position on the market. Therefore, flexible planning and scheduling systems are needed to support these processes, which are based on considerable amounts of data, hardly processable manually anymore. MasDISPO_xt is an agent-based generic online planning and scheduling system for the observation on MES-level of the complete Supply Chain of Saarstahl AG, a globally respected steel manufacturer. This paper concentrates on the planning of the annealing furnaces as a representative example of the rough and detailed planning required in such an environment. The allocation of available capacities of annealing furnaces including alternatives to accepted orders is based on Simulated Trading to produce an evenly distributed rough planning regarding flexibility. As representative for the detailed planning, the solution for the batch-type annealing furnace is explained in detail.

ThC25 328

Industrial Application Results of Process Control (Regular Session)

Chair: Bitmead, Robert — Univ. of California San Diego
Co-Chair: Won, Sangchul — Pohang Univ. of Science & Tech.

16:30-16:50 ThC25.1

Root Cause Diagnosis of Plant-Wide Oscillations Using the Adjacency Matrix, pp. 13893-13900

Jiang, Hailei — Univ. of alberta
Patwardhan, Rohit — Matrikon Inc.
Shah, Sirish — Univ. of Alberta

Oscillations are a common type of plant-wide disturbances whose effects propagate to many units and thus may impact overall process performance. It is important to detect and diagnose such oscillations early in order to rectify the situation. Many frequency domain tools such as the power spectrum and spectrum envelope methods are capable of detecting the oscillation frequency. However, few methods are available for locating the root cause which is the main objective of oscillation diagnosis. This paper proposes a new method to diagnose the root cause of plant-wide oscillations using the adjacency matrix. A novel feature of the new method is that it utilizes the information in the process flow sheet. The method is not data-based and it can be carried out without using any data. However this method complements the data based methods very well and it is best used in combination with other data-based methods to provide powerful diagnosis of plant-wide oscillations. This paper is the subject of a newly proposed complete procedure for detection and diagnosis of plant-wide oscillation. Two industrial case studies are presented to demonstrate the applicability of the proposed procedure.

16:50-17:10 ThC25.2

Hybrid NMPC of a Supermarket Refrigeration System Using Sequential Optimization, pp. 13901-13906

Sonntag, Christian — Tech. Univ. Dortmund
Devanathan, Arvind — Univ. Dortmund
Engell, Sebastian — Univ. of Dortmund

Supermarket refrigeration systems are hybrid systems due to switching of the continuous dynamics and due to the presence of discretely switched actuators such as valves and compressors. The main control goal for these systems is to keep temperature and pressure levels within tight bounds while minimizing the wear of the compressors. In our previous work, a hierarchical model-predictive control scheme was proposed for supermarket refrigeration systems that overcomes the major drawback of traditional control schemes for these systems: excessive switching of the compressors due to synchronization of the local controllers of the display cases. In every NMPC iteration, low-level temperature controllers were employed, and the high-level optimization task was reduced to the determination of optimal parameters for these controllers. While this approach was successfully applied to systems of moderate size, it did not yield satisfactory results for larger systems due to the combinatorial growth of the search space. Furthermore, fast drastic changes of the external disturbances could not be handled well by this technique. This paper presents several extensions to overcome these problems.

17:10-17:30 ThC25.3

Stabilization of Gas-Lift Oil Wells Using Topside Measurements, pp. 13907-13912

Scibilia, Francesco — NTNU
Hovd, Morten — Norwegian Univ. of Tech. and Science
Bitmead, Robert — Univ. of California San Diego

Highly oscillatory flow regimes that can occur in gas-lift oil wells have been successfully treated using conventional linear control. However, these control systems rely on downhole pressure measurements which are unreliable or even unavailable in some cases. In this paper we propose a solution based on a high gain observer for the state of the process. The estimates are used to compute the downhole pressure, that is the controlled variable considered in the feedback control. Moreover, we propose an estimator to extend a nonlinear observer already presented in the literature, and then we compare the performances. The key feature of the solution proposed is its simplicity and that it relies only on measurements easily obtainable from the top of the single well, and thus it is immediately applicable to multiple-well systems where, since there is often one common outflow manifold, it would be hard to see from the outflow measurements which well is operating in an oscillatory regime.

17:30-17:50 ThC25.4

Controlled Variables Selection for Liquefied Natural Gas Plant, pp. 13913-13918

Singh, Arjun — Norwegian Univ. of Science and Tech.
Hovd, Morten — Norwegian Univ. of Tech. and Science
Kariwala, Vinay — Nanyang Tech. Univ.

The primary operational objective of liquefied natural gas (LNG) plants with low production capacity is to maximize LNG production. A robust control structure is required to meet economic objective while ensuring safety of the plant. The selection of appropriate controlled variables (CVs) is critical for design of the control structure. In this paper, general process understanding and the concept of self-optimizing control are used to select CVs for the liquefaction unit of an LNG process. The analysis is carried out using a steady state model developed in gPROMS. It is shown that with appropriate selection of CVs, the effect of disturbances and uncertainty can be minimized on the operational objective of the LNG plant.

17:50-18:10 ThC25.5

Managing Steam and Concentration Disturbances in Multi-Effect Evaporators Via Nonlinear Modelling and Control, pp. 13919-13924

Adams, Gregory John — Univ. of Newcastle
Burke, Brendan — CSR
Goodwin, Graham C. — Univ. of Newcastle
Gravdahl, Jan Tommy — Norwegian Univ. of Science & Tech.
Peirce, Rob — CSR
Rojas, Alejandro J. — The Univ. of Newcastle

Evaporators are core units in many industrial processes including sugar mills. The dynamics of these systems are complex and hence the systems have been frequently used to demonstrate unusual systems and control behaviour. In this paper we explore a particular control architecture commonly employed in industry. We show that the architecture can lead to poor performance due to steam and concentration disturbances. An alternative architecture is then proposed which overcomes the difficulties.

18:10-18:30 ThC25.6

Closed Loop Regulatory Control Strategies for a Fluidized Bed Reactor: An Industrial Case Study, pp. 13925-13931

Shenoy, Arjun — National Inst. of Tech. Karnataka, Suratkal
Bhat, Chetan — National Inst. of Tech. Karnataka, Suratkal
Gundappa, Madhukar — Honeywell Tech. Solutions Lab.
Gudi, Ravindra — IIT Bombay

Polyethylene is a thermoplastic commodity heavily used in consumer products. Today's gas phase LLDPE (Linear Low Density Poly Ethylene) process employs a Fluidized Bed Reactor (FBR). Modeling, Control and Optimization of FBR has received renewed interests from both industry and academia in the last two decades. The FBR model exhibits complex non-linear dynamic behavior and multiple time scales that pose challenges to control and optimization studies. In this paper we discuss various potential control strategies to regulate the reactor conditions at their set-points. Simulation results are presented to highlight the advantages and disadvantages of different controller pairing along with the possible control strategies to operate the FBR at grade conditions and also during grade transitions. This preliminary study is a gateway to more rigorous analysis and plant validation to identify the best control strategy and to provide guidelines to the operator to operate the plant at optimal conditions.

ThC26 327

Intelligent Control of Power Plants (Invited Session)

Chair: Lee, Kwang Y. — Baylor Univ.
Co-Chair: Malik, O.P. — The Univ. of Calgary
Organizer: Lee, Kwang Y. — Baylor Univ.

16:30-16:50 ThC26.1

Comparative Performance of Neuro-Fuzzy PSS Architectures with Adaptive Input Link Weights and Nonlinear Functions (I), pp. 13932-13937

Ramirez-Gonzalez, Miguel — Univ. of Calgary
Malik, O.P. — The Univ. of Calgary

Based on a Neuro-Fuzzy Controller (NFC) architecture, two approaches are presented for the design of a Power System Stabilizer (PSS) with adaptive input scaling. In the first approach, input link weights (ILWs) are introduced and the NFC is made adaptive by the online modification of the ILWs and the consequent parameters (CPs) through the gradient descent method. In the second approach, nonlinear functions (NLFs) are used in the first layer of the NFC and both NLFs and CPs are modified online by using a hybrid adaptation process. Simulation studies with a one machine-infinite bus system and a multi-machine power system show the ability of the proposed PSSs to improve the system dynamic performance.

16:50-17:10 ThC26.2

Controller Design for a 1000 MW Ultra Super Critical Once-Through Boiler Power Plant (I), pp. 13938-13943

Lee, Kwang Y. — Baylor Univ.
Van Sickel, Joel H. — Pennsylvania State Univ.
Hoffman, Jason A. — Pennsylvania State Univ.
Jung, Won-Hee — Doosan Heavy Industry and Construction Co.
Kim, Sung-Ho — Doosan Heavy Industry and Construction Co.

A large-scale 1000 MW once-through type ultra super-critical boiler power plant, requires investigation for the development of an analyzable model for use in the development of an intelligent control system. Using data from the power plant, a model is realized using dynamically recurrent neural networks. For proper operation, the plant must be broken into smaller subsystems that are each modeled by a separate neural network. Modified predictive optimal control is then used to drive the plant to desired states. Due to the computational intensity of modified predictive optimal control, it was rendered unviable by the computation time required for each time step of the controller. As an alternative, a reference governor was implemented along with a PID feedback control system that utilizes intelligent gain tuning.

17:10-17:30 ThC26.3

Fuzzy Compensation of Power-Voltage Interaction in a Combustion Turbogenerator (I), pp. 13944-13949

Hernandez-Rodriguez, Isaura — National Res. and Development Centre
Garduno-Ramirez, Raul — Electrical Res. Inst.
Garcia-Beltran, Carlos Daniel — National Res. and Development Centre

This paper introduces a compensation scheme for power-voltage interaction in a gas turbine driven power plant. The compensation scheme includes two fuzzy systems. The first fuzzy system compensates the effects of a change in voltage set-point over the power control loop. Complementarily, the second fuzzy system diminishes the effects of a change in power set-point over the voltage control loop. The compensation rules are basically obtained from the analysis of input-output interactions between the gas turbine and the electric generator. Rules are refined through simulation experiments using the full scope model of a 32 MVA combustion turbogenerator. Results show the appropriateness of the proposed fuzzy compensation scheme.

17:30-17:50 ThC26.4

Development of an Optimal Operational Planning System for Energy Plants in Steelworks (I), pp. 13950-13951

Kitagawa, Shinji — Fuji Electric Advanced Tech.
Matsui, Tetsuro — Fuji Electric Advanced Tech.
Matsumoto, Koji — Fuji Electric Systems
Nishida, Hideyuki — Fuji Electric Systems
Fukuyama, Yoshikazu — Fuji Electric Systems
Tominaga, Futoshi — JFE Steel
Mizushima, Narihito — JFE Steel

This paper proposes an optimal operational planning system of energy plants in steelworks. In steelworks, effective utilization of the by-product gas and heat energy can realize energy savings and operational cost reduction. In order to generate optimal operational plans for energy plants, startup/shutdown status (0/1 values) and/or input/output values (continuous values) of the facilities for each control interval should be determined. The facilities may have nonlinear input-output characteristics. Therefore, the problem can be formulated as a mixed-integer nonlinear optimization problem (MINLP). Particle Swarm Optimization (PSO) can be easily expanded to treat MINLP. The proposed PSO-based system is applied to actual energy plant operational planning problems with promising results.

17:50-18:10 ThC26.5

Carbon Reduction Potential with Intelligent Control of Power Systems (I), pp. 13952-13957

Venayagamoorthy, Ganesh — Missouri Univ. of Science and Tech.
Braband, Gabriele — Simmons & Simmons

Climate change caused by anthropogenic greenhouse gas (GHG) emissions such as carbon dioxide (CO2) is now widely accepted as a real condition that has potentially serious consequences for human society and industries need to factor this into their strategic plans. One salient planning assumption is that energy - essential for every activity - will become more expensive relative to other inputs. Economic growth does not have to be linked to an increase of GHG emissions and can be attained in addition to the usage of renewable energy sources by using energy efficiency technologies for power system generation, transmission, and distribution. The development of intelligent energy-efficient control technologies will both soften negative effects of the climate change on the economy and enhance energy security. This paper outlines the significant carbon reduction potential with intelligent control and optimization techniques applied to power system generation and transmission systems with and without wind farms.

18:10-18:30 ThC26.6

Intelligent Control Solutions for Steam Power Plants to Balance the Fluctuation of Wind Energy (I), pp. 13958-13963

Haase, Torsten — Univ. of Rostock
Weber, Harald — Univ. of Rostock

A stable and quality-oriented energy supply in Germany is a pre-requisite for a sustainable national economy. Therefore, also for political reasons, the wind energy as a renewable energy source in onshore and off-shore wind power plants plays a more and more important role in this context. But this increase in wind power productions generates new and up to now unknown problems in the German energy system concerning energy transportation, the reduced availability of this energy for meteorological reasons and the thereby caused need for so called “Hour Reserve from conventional power plants”. Also the fluctuation in wind power production in addition to the fluctuations of the consumer power demand and the not measured production from decentralized sources are resulting in substantially high positive and negative reserve power in the conventional power plants which are up to now not well designed for these new requirements. The analysis of these new burdens for the power plants, the development of new energy services and new strategies of control and the design of new conventional power plants in respect with an optimal operation regime are the main goals of this investigation on behalf of VGB PowerTech.

ThC27 326

Virtual Automation Networks (Invited Session)

Chair: Neumann, Peter — Inst. f. Automation und Kommunikation Magdeburg, Germany
Co-Chair: Jumar, Ulrich — ifak - Inst. f. Automation u. Kommunikation
Organizer: Neumann, Peter — Inst. f. Automation und Kommunikation Magdeburg, Germany
Organizer: Jumar, Ulrich — ifak - Inst. f. Automation u. Kommunikation

16:30-16:50 ThC27.1

Architectural Concept of Virtual Automation Networks (I), pp. 13964-13969

Neumann, Peter — Inst. f. Automation und Kommunikation Magdeburg, Germany
Pöschmann, Axel — ifak
Messerschmidt, Ralf — ifak

Twenty years ago, fieldbus systems have been developed for the factory floor and are widely introduced in industrial automation installations in the meantime. In the nineties Ethernet-based technologies have been successfully introduced to office automation followed by the usage of Internetbased applications. Today industrial automation is getting penetrated by the same IT technologies used in office automation. Nevertheless, the factory floor, respectively automation science and practice, has special requirements that clearly differ from IT-world requirements; this especially concerns safety, security, real-time, wireless and public network integration aspects. Thus – to make information technologies applicable in all fields of production industries – these technologies have to be adopted, extended or even modified. This significant challenge is extensively tackled by the European Integrated Project “Virtual Automation Networks”. The exchange of the industrial automation network base towards IT technologies also offers the unique change to build an open network platform providing easy integration and extendibility capabilities. This paper presents the open system architecture and first implementation steps for realizing a Virtual Automation Network. The concepts aimed at are characterized by modularity and intelligence, thus, enabling flexibility and re-configurability focusing on future knowledge-based and agile manufacturing enterprises.

16:50-17:10 ThC27.2

Evaluation of Real-Time Behaviour in Virtual Automation Networks (I), pp. 13970-13975

Beran, Jan — Brno Univ. of Tech. Faculty of Electrical
Zezulka, Frantisek — VUT

Ethernet-based fieldbuses continuously penetrate industrial automation and many of them have been standardized (PROFINET, EtherCAT, SERCOS III, etc.). This fact fosters utilization of established Internetworking technologies, such as TCP/IP protocol suites and web services with the aim of widening of the communication scope and seamless interconnection with higher levels of industrial automation. However, industrial applications with their special requirements especially in terms of real-time, functional safety and security call for proper extensions of the existing

Ethernet-based fieldbuses. This paper presents state of the art in development of a test bed which will serve for evaluation of real-time parameters of a point-to-point IP connections based on the established QoS metrics.

17:10-17:30 ThC27.3

Secure Virtual Automation Networks Based on a Generic Procedure Model (I), pp. 13976-13981

Wolframm, Mario — Teleport Sachsen-Anhalt GmbH
Adamczyk, Heiko — Inst. f. Automation und Kommunikation e.V. Magdeburg

Security is a huge topic, however an international standard for automation control systems is missing. The standardisation work is progressing, e.g. within the IEC. It is clear that behind security there are several well-known security objectives such as availability, integrity and confidentiality. It is also clear that the office domain provides thousands of different security solutions. A possible use for automation networks, 1 to 1 or with adaptations, is one task within the VAN project. Furthermore VAN sets its focus on IT-Security and thereby on communication security. The use of the brand-new procedure model which is part of the VDI/VDE guideline 2182 was applied. The first time use of this model was a challenge and also a benefit for the project.

17:30-17:50 ThC27.4

Wireless Network Integration into Virtual Automation Networks (I), pp. 13982-13987

Rauchhaupt, Lutz — Res. Inst.
Lakkundi, Vishwas — Brno Univ. of Tech.

Wireless automation is today an emerging topic. Industrial wireless solutions are based on Bluetooth, Wireless LAN, IEEE 802.15.4 or even proprietary radio technologies. This paper describes the functions of different wireless technologies within a Virtual Automation Network (VAN). It is shown how the VAN device architecture is applied to wireless solutions. This includes the definition of generic parameters and exemplification for IEEE 802.15.4 based systems of specific parameters. Finally, the purpose of the formal description is explained in brief.

17:50-18:10 ThC27.5

Public Network and Telecontrol Concepts in Virtual Automation Networks (I), pp. 13988-13992

Balzer, Dietrich — Company
Werner, Thomas — ifak
Messerschmidt, Ralf — ifak

This paper describes the aspects for the needed integration of public networks (Wide Area Networks) into Virtual Automation Networks as investigated in the respective work package of the equally named EU-funded project VAN. The main aspects when using public network services within automation applications are the following: (1) Real-time capabilities of public networks related to automation tasks; (2) Telecontrol requirements; (3) Provider Contracts (Service Level Agreements); (4) QoS capabilities and network monitoring from automation side. Currently available communication solutions and Service Level Agreements do not support the required capabilities for real-time applications as discrete manufacturing applications. On the one hand nowadays available fieldbus standards are primarily based on cyclic transfer of IO data and do not support distributed applications across subnet boundaries. On the other hand a vari-ety of proprietary and standardised protocols designed to communicate across public networks in telematic systems do exist. Thus fieldbus technologies and telecontrol systems today base on different technologies and protocols. In VAN a common open platform and common means for classical fieldbus tasks and tele-control tasks are defined to be able to realise Virtual Automation Networks that combine both fielbus and telecontrol related aspects. The activities focus on a seamless integration of real-time and telecontrol func-tionalities into the common open VAN platform. So the paper focuses on the network related - and not the applicational - aspects and is thus not about networked control.

18:10-18:30 ThC27.6

Engineering Concept of Virtual Automation Networks (I), pp. 13993-13998

Diedrich, Christian — Otto-von-Guericke-Univ. Magdeburg
Hengster, Harry — Schneider Electric
Hoffmann, Martin — Otto-von-Guericke Univ. Magdeburg

This paper presents the concept for the engineering of Distributed Control Systems (DCSs) based on heterogeneous communication systems as defined in the European Integrated Project "Virtual Automation Networks" (VAN). This heterogeneous communication characteristic has to be faced by the engineering concepts and tools. The VAN project has defined a common engineering workflow as basis for a VAN information model. The information model covers the functional, topological and network view and their relation to each other at detailed level. It integrates the VAN service specification on the basis of the OSI Reference ASE model. The paper presents also the mapping of the engineering concept to FDT/DTM and TCI technologies in general which is used to evaluate the information model and the usefulness of the VAN information model and the interaction of the engineering tools with the VAN devices.

ThC28 330A

Launch Vehicle and Missile Autopilot (Regular Session)

Chair: Padhi, Radhakant — Indian Inst. of Science
Co-Chair: Jun, Byung-Eul — Agency for Defense Development

16:30-16:50 ThC28.1

Implementation of Linear Homing Guidance Law on a Two-Part Homing Missile, pp. 13999-14004

Özkan, Bülent — TUBITAK-SAGE
Mahmutyaz1;c1;o_;lu, Gökmen — TUBITAK-SAGE
Özgören, Kemal — Middle East Tech. Univ.

Because of its simplicity and ease of implementation, the proportional navigation guidance (PNG) law is chosen in most of the guidance applications. In this study, the linear homing guidance (LHG) law is proposed as an alternative to PNG and its implementation on a two-part missile against a moving surface target is presented. First, the missile dynamics is modeled. Afterwards, the formulation of LHG is given. Modeling the target kinematics as well, the entire guidance and control system is built by integrating all the models mentioned above, and the relevant computer simulations are carried out. Consequently, the simulation results obtained with LHG are compared to the data acquired from the simulations with PNG. The simulations also involve the sensitivity analysis and design of modified autopilots with varying-bandwidth values upon the implementation of LHG. Finally, all the results are evaluated.

16:50-17:10 ThC28.2

Self-Scheduling Controller for a Launcher in Atmospheric Ascent, pp. 14005-14010

Saussie, David Alexandre — Ec. Pol. de Montréal
Baldesi, Gianluigi — Univ. of Rome
Doll, Carsten — ONERA
Berard, Caroline — SUPAERO

This paper describes the synthesis of a self-scheduled controller for a launcher vehicle. The problem consists in designing a control law which will be valid on the atmospheric ascent trajectory, from time 5s to time 85s after takeoff, while ensuring decoupling performances for roll rates between 0 deg/s and 30 deg/s. Eigenstructure assignment has been retained in its multi model approach. After introducing the problem itself and the launcher model, the theory related to self-scheduling synthesis is reviewed before its application on the launcher described. A first performance analysis will be carried out to validate the method and the given results.

17:10-17:30 ThC28.3

Gliding Strategy Design with the Use of Discrete Optimization, pp. 14011-14016

Kowalczuk, Zdzislaw — Gdansk Univ. of Tech.
Olinski, Krzysztof E. — Gdansk Univ. of Tech.

A glider flight strategy design problem can be effectively solved within the framework of optimal control. Optimality relates to glider characteristics and environmental conditions. One is often interested in determining an initial glider altitude position guaranteeing that a required destination point is achievable. Another way of posing such a control problem is linked with a maximal glider range resulting from given initial and environmental conditions. In fact, in practical applications, trying to determine a best flying strategy with the use of optimal approaches, we are usually faced with the problem of a large degree of freedom, which makes the classical analytical and numerical optimization methods ineffective. In this paper we introduce a simple method utilizing a search graph algorithm for the purpose of finding an optimal flight trajectory. We discuss the characteristics of this approach and present certain results of optimization performed for a glider manufactured by the PZL Z;widnik.

17:30-17:50 ThC28.4

Absolutely Stable Region for Missile Guidance Loop, pp. 14017-14022

Kim, Jong-Ju — Agency for Defense Development
Lyou, Joon — Chungnam National Univ.

In this paper, the stable region for missile guidance loop employing an integrated proportional navigation guidance law is derived. The missile guidance loop is formulated as a closed-loop control system consisting of a linear time-invariant feed-forward block and a time-varying feedback gain. By applying the circle criterion to the system, a bound for the time of flight up to which stability can be assured is established as functions of flight time. Less conservative results, as compared to the result by Popov criterion, are obtained.

17:50-18:10 ThC28.5

Energy-Insensitive Guidance of Solid Motor Propelled Long Range Flight Vehicles Using MPSP and Dynamic Inversion, pp. 14023-14028

Kothari, Mangal — Univ. of Leicester, Leicester, UK
Padhi, Radhakant — Indian Inst. of Science

A energy-insensitive explicit guidance design is proposed in this paper by appending newlydeveloped nonlinear model predictive static programming technique with dynamic inversion, which render a closed form solution of the necessary guidance command update. The closed form nature of the proposed optimal guidance scheme suppressed the computational difficulties, and facilitate realtime solution. The guidance law is successfully verified in a solid motor propelled long range flight vehicle, for which developing an effective guidance law is more difficult as compared to a liquid engine propelled vehicle, mainly because of the absence of thrust cutoff facility. The scheme guides the vehicle appropriately so that it completes the mission within a tight error bound assuming that the starting point of the second stage to be a deterministic point beyond the atmosphere. The simulation results demonstrate its ability to intercept the target, even with an uncertainty of greater than 10% in the burnout time.

18:10-18:30 ThC28.6

A Nonlinear Roll Autopilot Based on 5-Dof Models of Missiles, pp. 14029-14035

Jun, Byung-Eul — Agency for Defense Development

This paper suggests a nonlinear control law to stabilize the rolling motion of missiles. Based on the analysis of rolling moment characteristics due to pitch/yaw control cross-coupling, we propose a conjecture that the moment is described by the bilinear form of pitch/yaw acceleration and yaw/pitch control. The conjecture fits a set of wind tunnel test data and leads to a bilinear control law. An important point is that the control law is implemented by using pitch/yaw accelerations and control signals. Simulations show that the new control law can stabilize a rolling motion which is not possible for the conventional control to take care of.

ThC29 330B

Small Satellites and Propulsion Systems (Invited Session)

Chair: Schilling, Klaus — Univ. Wuerzburg
Co-Chair: Nakasuka, Shinichi — Univ. of Tokyo
Organizer: Schilling, Klaus — Univ. Wuerzburg

16:30-16:50 ThC29.1

Attitude Determination for the Nano-Satellite UWE-2 (I), pp. 14036-14041

Schilling, Klaus — Univ. Wuerzburg
Schmidt, Marco — Univ. Wuerzburg
Ravandoor, Karthik — Univ. Wuerzburg
Kurz, Oliver — Univ. Wuerzburg
Busch, Stephan — Univ. Wuerzburg

Modern miniaturization technologies enable the realization of very small satellites at masses below 1 kg, nevertheless limited attitude determination and actuator performances raise challenging control problems. Specific attitude determination aspects discussed at the example of UWE (University of Wuerzburg Experimental satellite), a standardized pico-satellite platform related to technology demonstration and space research. UWE-1 is in orbit since October 2005 and successfully completed its mission on telecommunication experiments. The successor satellite UWE-2 is focusing on an advanced Attitude Determination System (ADS) based on miniature sensors. This paper will address implementation details for the ADS, presenting in particular results from the performance evaluations in simulations and tests.

16:50-17:10 ThC29.2

Backstepping Based Approach for Controlling Spacecraft Micro Pump for Propulsion System (I), pp. 14042-14047

Teodorescu, Catalin-Stefan — L'Ec. Supérieure d'Electricité SUPELEC
Siguerdidjane, Houria — SUPELEC
Arzande, Amir — SUPELEC
Vannier, Jean-Claude — SUPELEC
Gebbers, Pit — SUPELEC
Roux, Francois — CSTM

The purpose of this paper is to design a robust controller for the new design of hydrazine micro pumps, by studying the real prototype using a high-performance oscilloscope attached to the real pump system. In other words we have designed a relatively accurate mathematical model of the micro pump by using the data extracted with the oscilloscope and then we have calculated and tested a robust controller using backstepping technique. Simulation results are satisfactory regarding the desired criteria. The micro pump consists of an electromagnetic actuator which moves a piston forward and backward (stroke 0 to a few mm). The main advantage in using these new devices consists on increase the capacity manoeuvrability of the satellite with the same tank volume gain with respect to the existing satellites systems allowing the overall system to operate even if the gas reservoir pressure level is low, thus bringing great advantages (reduced costs, better manoeuvrability).

17:10-17:30 ThC29.3

System Design and Control Aspect of a Novel Satellite Concept Panel Extension Satellite (PETSAT) (I), pp. 14048-14053

Nakasuka, Shinichi — Univ. of Tokyo

A novel concept of satellite design, named “PETSAT,” is proposed and its system design and control aspect is discussed in this paper. In this concept, a satellite is made of several "Functional Panels" such as "Communication panel," "Attitude control panel," "Thruster panel," and “Mission Panel,” each of which has a special dedicated function. By connecting these panels by reliable connection mechanism in "plugin" fashion, the total integrated system as a whole has a satellite function. The satellite is configured by multiple panels with hinges, which poses unique problems on system design, information management and dynamics and control, such as design of function distributions into panels, inter-/intra-panel communication systems architecture, moment of inertia management, flexibility, distributed control and so on. The paper will describe the basic concept of PETSAT, result of system design and subsystem development with focus on information management system and Attitude Control Panel. In-orbit demonstration plan which is now scheduled in 2008 – 2009 will also be given.

17:30-17:50 ThC29.4

Spacecraft Attitude Dynamics and Control in the Presence of Large Magnetic Residuals, pp. 14054-14059

Corno, Matteo — Pol. di Milano
Lovera, Marco — Pol. di Milano

The attitude dynamics of a satellite with a large magnetic residual dipole is analysed and the effect of perturbations of the orbital parameters on stability is discussed. The analysis is the basis for the design of an attitude control strategy that minimizes the required control torque while satisfying an absolute pointing error constraint whenever direct compensation of magnetic torque is not achievable. The proposed strategy is validated in a case study.

ThC30 330C

Automatic Control, Optimization, Real-Time Operations in Transportation (Regular Session)

Chair: Werner, Herbert — Hamburg Univ. of Tech.
Co-Chair: Papageorgiou, Markos — Tech. Univ. of Crete

16:30-16:50 ThC30.1

Distributed Controller Design for Dynamic Speed Limit Control *against Shock Waves on Freeways*, pp. 14060-14065

Popov, Andrey	Hamburg Univ. of Tech.
Babuska, Robert	Delft Univ. of Tech.
Hegyi, Andreas	Delft Univ. of Tech.
Werner, Herbert	Hamburg Univ. of Tech.

Shock waves are special types of relatively short traffic jams that propagate opposite to the driving direction. These jams increase travel time, air pollution, and negatively impact safety. One way of dealing with shock waves is to impose dynamic speed limits to eliminate them. Control strategies proposed so far are based either on expert knowledge, or are centralized controllers with high computational demand, such as model predictive control. In this paper, we design decentralized feedback controllers with a fixed structure. For the purpose of design, we use a direct optimization technique capable of dealing with the design objectives and the non-linear character of the system. The advantages of using such simple controllers are that they do not require extensive on-line computations, use only local information and are therefore more attractive from the implementation point of view. We show that a simple, static control law achieves performance similar to previous results with centralized control for the considered scenario. The controller successfully resolves the shock wave and reduces the total time spent by 20%, compared to the uncontrolled case.

16:50-17:10 ThC30.2

An Efficient Model for Urban Traffic Network Control, pp. 14066-14071

Lin, Shu	Shanghai Jiao Tong Univ.
Xi, Yugeng	Shanghai Jiao Tong Univ.

In order to control the urban traffic network through optimization methods, it is necessary to establish a proper urban traffic network model. This model should be both accurate in describing the network traffic and simple to compute. In this paper, an existing link model is at first improved to describe the main traffic dynamic behaviors more accurately. Then, a general urban traffic network topology is proposed. By modeling the network elements, a macroscopic model for urban traffic networks can be established. The model is compared with the microscopic traffic model CORSIM. It shows that this model well balances the accuracy and simpleness, and is thus suitable to real-time control.

17:10-17:30 ThC30.3

Model-Based Speed Limit Control with Different Traffic State Measurements, pp. 14072-14077

Burger, Mernout	Norwegian Univ. of Science and Tech.
Hegyi, Andreas	Delft Univ. of Tech.
De Schutter, Bart	Delft Univ. of Tech.

In this paper, traffic flow is controlled using dynamic speed limits, obtained by Model Predictive Control (MPC). MPC is a model-based approach, where the states of the system, influenced by control actions, are predicted over a certain time span. The states of the system are the mean speeds and densities on the motorway.

Traffic flow models typically use space mean speeds, while measurements on motorways are often time mean speeds. Several methods for obtaining estimates of the space mean speed based on the time mean speeds are discussed, and the possible performance loss of using another mean speed than the space mean speed for model-based traffic control is investigated. The resulting controllers, using the different estimates, are evaluated for a scenario where speed limits are used to eliminate a shock wave from a motorway by comparing the achieved reduction in the total time that the vehicles spend on the motorway (TTS).

The result show that the performance for the different estimation methods is comparable, and lead to an improvement of the TTS of around 14%

17:30-17:50 ThC30.4

Dual EKF State and Parameter Estimation in Multi-Class First-Order Traffic Flow Models, pp. 14078-14083

van Lint, Hans	Delft Univ. of Tech. Faculty of CivilEngineering andGeoscie
Hegyi, Andreas	Delft Univ. of Tech.
Hoogendoorn, Serge P.	Delft Univ. of Tech. Faculty of Civil Engineering and

In this paper we investigate a real-time traffic surveillance system based on a multi class first-order traffic flow model called Fastlane. We demonstrate a dual extended Kalman Filtering approach in which the model state and parameters can be estimated simultaneously from real-time data. The innovation is that although Fastlane maintains the dynamics of multiple vehicular classes (e.g. trucks, buses, cars), only the total mixed-class density is corrected by the filter, which is 'translated' into multi-class state corrections by means of state-dependent person car equivalents and class flow shares. Results on real data from a densely used freeway show that the DEKF procedure is able to reproduce accurate speeds and flows and physically plausible parameters.

17:50-18:10 ThC30.5

Integrated Ramp Metering and Variable Speed Limit Control of Motorway Traffic Flow, pp. 14084-14089

Papamichail, Ioannis	Tech. Univ. of Crete
Kampitaki, Katerina	Tech. Univ. of Crete
Papageorgiou, Markos	Tech. Univ. of Crete
Messmer, Albert	- independent engineer -

The impact of variable speed limits (VSL) on the aggregate traffic flow behaviour is reflected in the quantitative model proposed in this paper. VSL are incorporated in a general second-order traffic flow model as an additional control component. The integrated motorway network traffic control problem is formulated as a constrained discrete-time optimal control problem which is solved very efficiently even for large-scale networks by a suitable feasible-direction algorithm. An illustrative example is presented under different control scenarios and it is shown that traffic flow efficiency can be substantially improved when VSL control measures are used, particularly in integration with coordinated ramp metering.

18:10-18:30 ThC30.6

Adaptive Control of Generalised Dynamically Substructured Systems, pp. 14090-14095

Stoten, David P.	Univ. of Bristol
Tu, Jia-Ying	Univ. of Bristol
Li, Guang	The Univ. of Bristol

The use of the dynamically substructured systems (DSS) approach for engineering testing environments is receiving significant global interest. DSS enables a full-size, critical component to be physically tested within a laboratory environment, whilst the remaining part(s) of the entire system are modelled as a real-time numerical simulation. This paper will present a generalised substructuring framework, using a practical example for illustration. Correspondingly, a linear substructuring control (LSC) strategy is presented, together with a development of the adaptive minimal control synthesis (MCS) algorithm. Comparative simulation results of the two DSS control strategies are also included.

ThC31 306

Intelligent Robotics (Video Session)

Chair: Chung, Wan Kyun	Pohang Univ. of Science & Tech.
Co-Chair: Song, Jae-Bok	Korea Univ.

16:30-16:50 ThC31.1

Feasibility Test Results of Bilateral Teleoperation Using the Energy-Bounding Algorithm, pp. 14096-14096

Seo, Changhoon	Gwangju Inst. of Science and Tech. (GIST)
Kim, Jong-Phil	Korea Inst. of Science and Tech.
Lim, Yo-An	Gwangju Inst. of Science and Tech. (GIST)
Yoon, Joo Hong	Agency for Defense Development
Ryu, Jeha	Gwangju Inst. of Science and Tech. (GIST)

Time delays in communication channels usually make teleoperation systems unstable. To cope with this, we apply the energy-bounding algorithm (EBA) that had been proposed for stable haptic interaction. The EBA restricts the energy generated by the sample and hold operator to consumable energy by the energy-consuming physical damping in the haptic system and some part of human arm to guarantee the passivity condition of whole system. This algorithm always guarantees stable haptic interactions, but compromises the displayable impedance range of the virtual environment. The EBA can be straightforwardly applied for bilateral teleoperation due to the analogy between the haptic simulation system and the teleoperation system. The video shows some feasibility test results of the EBA for bilateral teleoperation. Various test results for free, contact, and abrupt motions show that the EBA can ensure stable bilateral teleoperation for the fairy large amount of constant/variable time delays (2.5 sec (one-way) for free motion and 300 msec (one-way) for contact motion).

Attachment

16:50-17:10 ThC31.2

Basketball Robot: Ball-On-Plate System without Visual Information, pp. 14097-14097

Lee, Kwang-Kyu TUM

Building a basketball robot is a recently launched project at the Institute of Automatic Control Engineering (LSR) for investigating fast manipulation with non-negligible dynamics and changing contact situation. This video presents some preliminary results of the project which is balancing a basketball on a plate. An aluminium plate of which the size is 25x40 cm is mounted on the end-effector of a six degree of freedom (DoF) serial industrial robot Staubli RX90. In order to update the current state of a basketball on the plate the robot is equipped with a 6 DoF force-torque sensor between the plate and the end-effector. The mass of the basketball is 0.6 kg.

The overall control scheme for the balancing a basketball consists of three parts including balancing control, impedance control, and inner position control. When the basketball loses its equilibrium on the plate and starts moving, velocity and position of the basketball are estimated by force-torque sensor data and the corresponding desired trajectory for stabilizing the ball is generated in the balancing control. The inner impedance control is supposed to take out the kinetic energy from the ball and modify the desired trajectory to avoid significant contact forces. The inner most position control loop generates motor torque commands for the robot to track the desired trajectory.

The following features can be found in this video: 1) Position-based impedance control, 2) Ball dropping, catching, and throwing by an open loop control, 3) Ball balancing on a plate against to external disturbance forces, 4) Ball balancing on a moving plate, and 4) Balancing a falling ball.

Attachment

17:10-17:30 ThC31.3

Block Type Modular Robot: Mom's Friend, pp. 14098-14098

Ahn, Ho Seok Seoul National Univ.
Baek, Young Min Seoul National Univ.
Choi, Jin Young Seoul National Univ.

Nowadays, people have various personalities and the things they want are also diverse. In the case of clothes, it is possible to produce multifariously. However it is impossible to produce variously for robot industry because the demand for robots is low and the price is high. It is needed to give the right of choice to people and the modular system can be the solution. One of the most important purposes of modulation is reusability of modules and functions. If each module has own functionality separately, people can select the modules which have the functionality they want. In this paper, we introduce a block type modular service robot system, “Mom's friend”. People choose the function block modules which have different operating system, function, and shape and heap up the block modules, like playing with blocks, for assembling the robot. Mom's Friend can recognize which block module is assembled in real-time by a self-diagnosis system and then a main supervising system connects the new block module to the whole robot system. There is no need to set up or control by people. Each block module has a pair of connection socket array for communication with other block modules. Mom's Friend makes various types of robot and it is possible to assemble any block module. We implemented eight block modules for building block type reconfigurable intelligent modular robot. SLAM module is for movement of robot. It controls 2 motors and uses sonar sensors, IR scanners, and one compass sensor. It also has obstacle avoidance function and real time map builder. Power module is a module that includes batteries to supply electric power. It supplies both 12V and 24V using lead batteries. Main module manages the connections of all modules. It gets the status of modules using many kinds of communications (e.g. TCP/IP, USB and Serial). It sends action commands of robot to each module depending on received commands and status. Vision module recognizes faces, characters and objects. Each function is implemented using optimal algorithms, because image processing needs high performance for recognition. Face processor detects faces by Haar detection algorithm and recognizes faces by OfflinePCA and SVDD algorithm. We use SIFT algorithm to recognize objects. When the robot tries to grip an object, it recognizes what the object is, and calculates how far the object is. Home appliance control module operates various home appliances using Bluetooth communication. Manipulator module controls both arms and hands. It grips an object and uses instruments. It also expresses gestures to show robot emotions to users. Head module is for emotion expression and getting two camera images. As robot neck has Pan-Tilt system, face tracking is possible. It expresses about 20 types of emotions using eyes and a mouth. Mom's friend has internal emotion and it responses directly and indirectly to external stimulus. If it knows a user's face, it has like-dislike degree to user, and expresses an emotion. Speech module recognizes users' speech in two languages (Korean and English). It has STT(Speech To Text), TTS(Text To Speech) engines. STT engine finds almost similar word in speech map. We use HMM algorithm for speech recognition. As it recognizes users' speech, it transfers commands to main module through communication network. Main scheduler manages to communicate among each module by TCP/IP communication. Although operating systems are different from other modules, one module can communicate with other modules. For proper communication, we define mark up language and develop a parser to manage these. It needs thread synchronization among processes. We assembled various types of robot using these block modules and ascertained the superiority and efficiency of the introduced modular robot system.

Attachment

17:30-17:50 ThC31.4

A Mascot-Type Facial Robot with a Linear Dynamic Affect-Expression Model, pp. 14099-14099

Lee, Hui Sung Korea Advanced Inst. of Science and Tech. (KAIST)
Park, Jeong Woo KAIST
Jo, Su Hun KAIST
Kim, Min-gyu KAIST
Lee, Wonhyong KAIST
Chung, Myung Jin KAIST

The interest of emotional interaction between robots and humans is recently increasing in human-robot interaction as with expansion of research on human-friendly robot. The facial expression is the most instinctive and impromptu way to express emotion compared with other emotional methods like a voice, gesture, skin color, *etc*. People can recognize a robot's condition intuitively if the robot shows its internal state with facial expressions. Although emotional expressions of the face in humanoids or androids have been attempted in many ways, the results have not reached the level that common people are satisfied with. Therefore, the objective of this research is to design and implement a mascot-type facial robot that can show emotional expressions effectively. In addition, a linear dynamic affect-expression model is applied to the facial robot to display continuous and various expressions.

A mascot-type facial robot is designed differing from android and mechanical type, since we can easily escape the uncanny valley effect and achieve higher familiarity with a mascot-type design. A small digital controller is implemented and installed into a designed outer form for controlling ten small DC motors and two LEDs. The developed robot is capable of showing rich expressions with LED and dynamic neck motion that is composed of two blushless DC motors. Two USB cameras are installed in the robot eyes. The robot system can be connected to common personal computers or laptops by wireless LAN, which is used for transferring affect and visual data from remote place. An operator can easily control the various facial expressions and LEDs using only three parameters based on the linear dynamic affect-expression model. Therefore, the facial robot system can be used as guiding or monitoring system with emotional expressions.

Attachment

17:50-18:10 ThC31.5

Sensor Fusion for Augmented Reality, pp. 14100-14100

Gustafsson, Fredrik Linköping Univ.
Schön, Thomas, Bo Linköping Univ.
Hol, Jeroen Linköping Univ.

The problem of estimating the position and orientation (pose) of a camera is approached by fusing measurements from inertial sensors (accelerometers and rate gyroscopes) and a camera. The sensor fusion approach described in this contribution is based on nonlinear filtering using the measurements from these complementary sensors. This way, accurate and robust pose estimates are available for the primary purpose of augmented reality applications, but with the secondary effect of reducing computation time and improving the performance in vision processing. A real-time implementation of a nonlinear filter is described, using a dynamic model for the 22 states, where 100 Hz inertial measurements and 12.5 Hz vision measurements are processed. An example where an industrial robot is used to move the sensor unit, possessing almost perfect precision and repeatability, is presented. The results show that position and orientation accuracy is sufficient for a number of augmented reality applications.

Attachment

FrPL1 Auditorium
SmartFactory - from Vision to Reality in Factory Technologies by Detlef Zuehlke (Plenary Session)

Chair: Nof, Shimon Y. — Purdue Univ.

09:00-10:00 FrPL1.1
SmartFactory - from Vision to Reality in Factory Technologies, pp. 14101-14108

Zuehlke, Detlef — TU Kaiserslautern

In our daily life we are more and more depending on the latest technologies in electronics and communication. Our mobile phones become powerful multimedia systems, our cars computer systems on wheels and our homes will turn into smart living environments. And all these advances must be turned into products in shorter cycles than ever before and in very cost-sensitive world markets. The resulting requirements for design, setup and operation of our factories therefore become a crucial question for success. In the past, we often increased complexity in structures and control systems resulting in inflexible monolithic production systems. But the future must become “lean” - not only in organization but also in planning and technology! We must develop technologies which allow us to speed up planning and setup, to adapt to rapid product changes during operation and to reduce planning effort. To meet these challenges we should also make use of the smart technologies of our daily life. The advances in wireless communication will allow us to avoid cables, powerful mobile computers or smartphones will replace many of the traditional control panels and abstract services will replace bits and bytes in control. These advances will not only lead us to mobility for machines and people but also to new challenges in system design. The SmartFactory initiative was founded by many industrial and academic partners to create and operate a demonstration and research testbed for future factory technologies. In many projects new solutions are developed, tested and evaluated. In this presentation the described changes and challenges will be discussed and the experiences of the SmartFactory approach presented.

FrA02 304A
Robust Nonlinear Control (Regular Session)

Chair: Scherer, Carsten W. — Delft Univ. of Tech.
Co-Chair: Shim, Hyungbo — Seoul National Univ.

10:30-10:50 FrA02.1
Output Feedback Stabilization for Systems Presenting Sector-Bounded Nonlinearities and Saturating Inputs, pp. 14109-14114

Gomes Da Silva Jr., Joao Manoel — Univ. Federal do Rio Grande do Sul (UFRGS)
Corso, Jones — UFSC
Castelan, Eugenio B. — Univ. Federal de Santa Catarina

In the present work a systematic methodology for computing output stabilizing feedback control laws for nonlinear systems subject to saturating inputs is presented. In particular, the class of L'ure type nonlinear systems is considered. Based on absolute stability tools and a modified sector condition to take into account input saturation effects, an LMI framework is proposed to design the controller. Both regional (local) and global stabilization results are presented. The controller structure is composed by a linear part, an anti-windup loop and a term associated to the output of the dynamic nonlinearity. Convex optimization problems are proposed in order to compute the controller matrices aiming at the maximization of the basin of attraction, or the performance enhancement with a guaranteed region of stability. A numerical example illustrates the potentialities of the methodology.

10:50-11:10 FrA02.2
Robust Controller Synthesis for the Attenuation of Non-Stationary Sinusoidal Disturbances with Uncertain Frequencies, pp. 14115-14120

Koroglu, Hakan — Delft Univ. of Tech.
Scherer, Carsten W. — Delft Univ. of Tech.

Attenuation of sinusoidal disturbances with uncertain and arbitrarily time-varying frequencies is considered. The disturbances are modeled as the outputs of an autonomous exogenous system, whose system matrix depends on some uncertain parameters and is yet skew-symmetric for all admissible parameter values. A procedure is then developed for the synthesis of a linear time-invariant controller that guarantees a desired level of attenuation at steady-state as well as sufficiently fast transient response in the face of all admissible parameter variations. The procedure is based on solving a convex optimization problem in which the variables are subject to a set of linear matrix inequality as well as equality constraints. The order of the controller is equal to the order of the plant plus the order of the exogenous system.

11:10-11:30 FrA02.3
State Feedback Controller Design for a Class of Nonlinear Systems with General Criteria, pp. 14121-14124

Jeong, Chung Seop — Marquette Univ.
Yaz, Edwin — Marquette Univ.
Yaz, Yvonne — Milwaukee School of Engineering

In this work, we provide a framework for the design of linear state feedback controllers for a class of continuous-time conic nonlinear systems driven by finite energy disturbances. This controller design is presented for various performance criteria in a unified framework using linear matrix inequalities in the formulation. Illustrative examples are included.

11:30-11:50 FrA02.4
Robust Output Feedback Controller Scheme for a Class of Uncertain Nonlinear Systems, pp. 14125-14130

Kuvulmaz, Janset — yildiz Tech. Univ.
Zergeroglu, Erkan — Gebze Inst. of Tech.

In this study, we present a new continuous output feedback type controller mechanism for the tracking problem of a class of uncertain nonlinear systems. The proposed strategy requires the uncertainties of the dynamical system to be first order differentiable and achieves semi-global asymptotic tracking when only the system outputs are measurable. The Controller design is based on a Lyapunov-type stability argument. Simulation studies on a two link planar robotic system are presented to illustrate the feasibility of the proposed strategy.

11:50-12:10 FrA02.5
Robust Tracking Controller Backstepping Design for SISO Uncertain Nonlinear System, pp. 14131-14137

Yu, Yao — Tsinghua Univ.
Zhong, Yi-Sheng — Tsinghua Univ.

Controller design problem is dealt with for a class of plants with time-varying nonlinear uncertainties and unmodeled dynamics. A new method based on signal compensation is proposed to design a robust controller. A controller designed by this method consists of a nominal controller and a robust compensator. It is shown that robust tracking property and robust tracking transient performance can be achieved simultaneously. A salient feature of our results, shown in the present paper, is that the controller is linear and time-invariant one and we can tell the users how to tune on-line the parameters of the controller with the proposed robust and transient performance.

12:10-12:30 FrA02.6
Control Lyapunov Functions: New Framework for Nonlinear Controller Design, pp. 14138-14143

He, Yu-qing — Shenyang Inst. of Automation, Chinese Acad. ofSciences
Han, Jianda — Shenyang Inst. of Automation

Control Lyapunov function (CLF) is a successful attempt to directly use of the Lyapunov function stability analysis technique of nonlinear systems in the synthesis problem. In this paper, on the basis of Freeman’s work (1996), the concept of CLF are re-analyze through using the method of set-valued analysis. And then, a new CLF based nonlinear controller design framework, called generalized pointwise min-norm (GPMN), is proposed.

Simultaneously, three robust GPMN controllers are introduced with respect to respectively parameter uncertainties, external disturbance, and the combining cases. Actually, the framework provides us a new idea of nonlinear controller design since within which many other controller design indexes can be combined without re-considering the closed loop stability. Finally, a simple simulation is conducted to show one of the typical applications.

FrA03 304B
Anti-Windup Strategies (Regular Session)

Chair: Turner, Matthew C. — Univ. of Leicester
Co-Chair: Pogromsky, A. Yu. — Eindhoven Univ. of Tech.

10:30-10:50 FrA03.1
Anti-Windup and the Preservation of Robustness against Structured Norm-Bounded Uncertainty, pp. 14144-14149

Morales, Rafael Mauricio — The Univ. of Manchester
Li, Guang — The Univ. of Bristol
Heath, William Paul — Univ. of Manchester

We consider robustness preserving anti-windup with structured norm-bounded uncertainty. A sufficient condition for the existence of such anti-windup is given, together with an expression for its construction. Existing results in the literature for additive unstructured uncertainty appear as a special case. The so-called IMC (internal model control) anti-windup does not necessarily preserve robustness for the general case.

10:50-11:10 FrA03.2
A New Perspective on Anti-Windup Design Based on Experimental Results, pp. 14150-14155

van den Berg, R.A. — Eindhoven Univ. of Tech.
Pogromsky, A. Yu. — Eindhoven Univ. of Tech.
Rooda, J.E. — Eindhoven Univ. of Tech.

Whereas stable linear systems with inputs have a unique steady-state solution, which is independent on the initial conditions and only depends on the input signals, nonlinear systems in general do not possess this property. Due to the lack of this property it is often hard to evaluate the exact behavior of the system, and thus to evaluate the 'exact' performance. In this article we present the results of three experiments performed on a simple nonlinear system, i.e. an anti-windup system consisting of a PI controlled integrator plant with input saturation and linear anti-windup controller. These results, which are validated by simulation and substantiated by theoretical results, clearly show the problems that prevent such an exact performance evaluation of the system. Based on these experimental results we come up with another definition of performance-based anti-windup design, based on the notion of convergent systems.

11:10-11:30 FrA03.3
Nonlinear Dynamic Inversion Based Anti-Windup - an Aerospace Application, pp. 14156-14161

Menon, Prathyush P — Univ. of Leicester
Herrmann, Guido — Univ. of Bristol
Turner, Matthew C. — Univ. of Leicester
Lowenberg, Mark — Univ. of Bristol
Bates, Declan G. — Univ. of Leicester
Postlethwaite, Ian — the Univ. of Leicester

A recently suggested general anti-windup (AW) compensation scheme is applied to the non-linear simulation model of the 1/16 scaled BAe Hawk aircraft model used for wind tunnel experiments. The Hawk is modelled as a nonlinear affine system subject to input constraints and has a primary control system consisting of an inner-loop nonlinear dynamic inversion controller and an outer-loop linear PID controller. To address the input constraints a recently introduced nonlinear L2 sub-optimal AW compensation method is applied and compared with a nonlinear version of the internal model control AW scheme. Nonlinear simulation results demonstrate the promise of the approach and indicate the superiority of the optimal AW scheme.

11:30-11:50 FrA03.4
Practical Approaches to Low-Order Anti-Windup Compensator Design: A Flight Control Comparison, pp. 14162-14167

Kerr, Murray Lawrence — Leicester Univ.
Turner, Matthew C. — Univ. of Leicester
Postlethwaite, Ian — the Univ. of Leicester

This paper considers three different methods for low-order anti-windup (AW) compensator design and compares their application to a realistic flight control problem, where the dominant actuator nonlinearity is aileron rate saturation. The compensator design methods all rigorously enforce at least local exponential stability via absolute stability results, but differ in both the construction of the AW compensator itself and the performance requirements used in the design. In particular, the paper compares a low order AW ``optimal'' design method in which the compensator poles and zeros are chosen by the designer and the accompanying gains synthesised optimally; a new low order method in which the optimisation procedure optimally chooses both the zeros and the gains; and a recently introduced classical design method where loopshaping is used to completely determine the gains and dynamics of the compensator. The methods are compared using a high-order nonlinear model of the lateral dynamics of an experimental aircraft, on which similar compensators have recently been flight tested.

11:50-12:10 FrA03.5
On the Tracking Problem for Linear Systems Subject to Control Saturation, pp. 14168-14173

Vieira Flores, Jeferson — UFRGS
Eckhard, Diego — UFRGS
Gomes Da Silva Jr., Joao Manoel — Univ. Federal do Rio Grande do Sul (UFRGS)

This paper addresses the problem of tracking constant references for linear systems subject to control saturation. Considering an unitary output feedback loop, containing an integral action, conditions in LMI form are proposed to compute a state feedback and an integrator anti-windup gain. These conditions ensure that the trajectories of the closed-loop system are bounded in an invariant ellipsoidal set, provided that the initial conditions are taken in this set and the references and the disturbances belong to a certain admissible set. Based on these conditions, optimization problems aiming at the maximization of the invariant set of admissible states and/or the maximization of the set of admissible references/disturbances are proposed.

12:10-12:30 FrA03.6
A Robust Algorithm against Actuator Saturation Using Integral Sliding Mode and Composite Nonlinear Feedback, pp. 14174-14179

Bandyopadhyay, Bijnan — IIT Bombay
Fulwani, Deepak — Indian Inst. of Tech. Bombay India (IIT-Bombay)
Park, Youngjin — KAIST

Integral sliding mode(ISM) based composite nonlinear feedback(CNF)tracking controller to track step signal is proposed. The proposed controller combines advantages of CNF controller like quick response without overshoot and robustness of ISM controller. Integral sliding mode is used along with CNF controller to reject disturbances and track nominal trajectory. Actuator saturation effect is considered and the stability of overall system is guaranteed with saturated actuator. Chattering is reduced by use of sigmoid function and non-linear switching gain. Effectiveness of the proposed scheme is demonstrated by simulation results.

FrA04 308
Discrete-Time Nonlinear Systems (Regular Session)

Chair: Petersen, Ian Richard — Univ. of New South Wales - ADFA
Co-Chair: Pakshin, Pavel — Arzamas Pol. Inst. of Nizhny Novgorod State Tech. Univ.

10:30-10:50 FrA04.1
Exponential Dissipativity of Discrete-Time Stochastic Systems and Robust Simultaneous Stabilization Via Output Feedback, pp. 14180-14185

Pakshin, Pavel — Arzamas Pol. Inst. of Nizhny Novgorod State Tech.
Soloviev, Sergey — N.I. Lobachevsky Univ. of Nizhny Novgorod

The paper studies robust simultaneous stabilization problem via output feedback for a set of nonlinear discrete-time uncertain systems. New version of dissipativity called exponential dissipativity is defined for discrete-time stochastic system with Markovian switching. It is proved that if this stochastic system with special choice of its parameters is exponentially dissipative then the original set of uncertain system is simultaneously stabilizable and the stabilizing control has robustness properties in the sense that it admits some feedback uncertainties. The linear robust simultaneous stabilization problem is considered as a particular case. In this case the results are obtained in the form of convergent algorithm for computing of output feedback gain, based on iterative solution of LMI's. This algorithm is applied to the problem of angular stabilization of longitudinal multi-regime aircraft motion.

10:50-11:10 FrA04.2

Robust Control for Nonlinear Discrete-Time Systems with Quantitative Input to State Stability Requirement, pp. 14186-14191

Huang, Shoudong — Univ. of Tech. Sydney
Su, Steven W. — Univ. of Tech. Sydney

In this paper, we consider state feedback robust control problems for discrete-time nonlinear systems subject to disturbances. The objective of the control is to minimize a performance function while guaranteeing a prescribed quantitative input to state stability (ISS) property for the closed-loop systems. By introducing the concept of ISS control invariant set, a sufficient condition for the problem to be feasible is given. Built on the sufficient condition, a computationally efficient control design algorithm based on one-step min-max optimization is developed. An example is given to illustrate the proposed strategy.

11:10-11:30 FrA04.3

Discretized PID Control and Robust Stabilization for Continuous Plants, pp. 14192-14198

Okuyama, Yoshifumi — Humanitech Lab.

This paper describes discrete-time and discrete-value (discretized/quantized) PID control and robust stabilization for continuous plants. Although all control systems are currently realized using discretized signals, the analysis and design of such nonlinear discrete-time control systems has not been elucidated. In this paper, the robust stability analysis of discrete- time and discrete-value (digital) control systems that accompany discretizing units at the input and output sides of a nonlinear element is performed in the frequency domain, and a method for achieving PID control and robust stabilization for nonlinear discretized systems on a grid pattern in the time and control variables space is presented. In the design procedure, a modified Nichols diagram and parameter specifications are applied. Numerical examples are provided to verify the validity of the designing method.

11:30-11:50 FrA04.4

A Discrete-Time Integral Sliding Mode Control Approach for Output Tracking with State Estimation, pp. 14199-14204

Xu, Jian-Xin — National Univ. of Singapore
Abidi, Khalid — National Univ. of Singapore

A new integral type sliding surface (ISM) is design for sampled-data systems for output tracking. ISM surface design is based on Output Feedback with a State Observer. Discrete-time control based on ISM achieves good tracking performance while allowing the pole assignment of m poles, which are otherwise zero in a deadbeat design. In particular, the new scheme can avoid overlarge control actions by avoiding the deadbeat response inherent in conventional sliding mode control designed for sampled-data systems. It will be shown in this work that, the discrete-time version of the sliding mode control based on the integral type sliding surface has O(T 2) tracking error for output tracking. An experimental example demonstrates the validity of the proposed scheme.

11:50-12:10 FrA04.5

Discrete Time Robust H^infty Control of a Class of Nonlinear Uncertain Systems, pp. 14205-14210

Ainikkal, Shaiju Johny — UNSW@ADFA
Petersen, Ian Richard — Univ. of New South Wales - ADFA

This paper presents an approach to discrete time robust H^infty control for a class of nonlinear uncertain systems based on the use of Sum Quadratic Constraints. The approach involves controllers which include copies of the system nonlinearities in the controller. The nonlinearities being considered are those which satisfy a certain global Lipschitz condition. The linear part of the controller is synthesized using linear robust H^infty control theory and this leads to a nonlinear controller which gives an upper bound on the attainable disturbance attenuation level.

12:10-12:30 FrA04.6

Integral Sliding Mode Output Tracking Controller for Sampled-Data Systems, pp. 14211-14216

Xu, Jian-Xin — National Univ. of Singapore
Abidi, Khalid — National Univ. of Singapore

A new integral type sliding surface (ISM) is design for sampled-data systems for output tracking. ISM surface design is based on Output Feedback. Discrete-time control based on ISM achieves good tracking performance while allowing the pole assignment of m poles, where m is positive integer, which are otherwise zero in a deadbeat design. It will be shown in this work that, the discrete-time version of the sliding mode control based on the integral type sliding surface results in two scenarios: A tracking error of O(T 2) if the discrete-time system is minimum-phase, and a tracking error of O(T) if the original system does not satisfy minimum- phaseness, but, rather a modified version of the system. In this work T is the sampling-time. A simulation example demonstrates the validity of the proposed scheme.

FrA05 307

Applications of Nonlinear Control Methods (Regular Session)

Chair: Chung, Chung Choo — Hanyang Univ.
Co-Chair: Ryvkin, Sergey — Trapeznikov Inst. of Control Sciences of RussianAcademy of Sciences

10:30-10:50 FrA05.1

Control of HIV Infection Dynamics by the Enhancement of the Immune System, pp. 14217-14222

Chang, H.J. — Imperial Coll. London
Astolfi, Alessandro — Imperial Col. London & Univ. of Rome Tor Vergata

The human immunodeficiency virus infection, that causes acquired immune deficiency syndrome, is a dynamic process that can be modeled via differential equations. In this paper a control method to boost the response of the immune system by means of drug scheduling is introduced. The control purpose is to steer the system to an equilibrium condition, known as long-term nonprogressor, which corresponds to an infected patient that does not develop the symptoms of acquired immune deficiency syndrome. To show the feasibility of the control methodology a human immunodeficiency virus model is studied analytically and computer simulations are presented.

10:50-11:10 FrA05.2

Fixed-Point DSP Implementation of Nonlinear H-Infinity Controller for Large Gap Electromagnetic Suspension System, pp. 14223-14228

Rocha, Paulo Henrique da — Brazilian Navy Tech. Center.
Ferreira, Henrique Cezar — Univ. of Sao Paulo
Porsch, Michael Cláudio — Brazilian Navy Tech. Center.
Sales, Roberto Moura — Escola Pol. da USP

Electromagnetic suspension systems are inherently nonlinear and, when digitally controlled, are frequently faced with hardware limitations. The main contributions of this paper are: the design of a nonlinear H-infinity controller, incluiding dynamic weighting functions, for such a system and the presentation of a practical procedure to implement this controller on a fixed-point DSP. Experimental results are also presented, in which the performance of the nonlinear controller is evaluated specifically in the initial suspension phase, when the starting gap is too far from the equilibrium working gap.

11:10-11:30 FrA05.3

Passive Actuators' Fault Tolerant Control for Affine Nonlinear Systems, pp. 14229-14234

Benosman, Mouhacine — TL@National Univ. of Singapore
Lum, Kai-Yew — National Univ. of Singapore

In this paper we consider the problem of passive fault tolerant control for nonlinear affine systems with actuators faults. We treat two types of faults; additive and loss of effectiveness faults. In each case we propose a Lyapunov-based feedback controller that ensures the local uniform asymptotic (exponential) stability of the faulty system, if the safe nominal system is locally uniformly asymptotically (exponentially) stable. We show the effectiveness of the fault tolerant controllers on the autonomous helicopter numerical example.

11:30-11:50 FrA05.4

Decentralized Robust PI Controller Design for an Industrial Utility Boiler - an IMC Method, pp. 14235-14240

Labibi, Batool — K. N. Toosi Univ. of Tech.

Marquez, Horacio J. Univ. of Alberta
Chen, Tongwen Univ. of Alberta

This paper presents a scheme for designing a robust decentralized PI controller for an industrial utility boiler system. First, a new method for designing robust decentralized PI controllers for uncertain LTI MIMO systems is presented. Su±cient conditions for closed- loop stability and diagonal dominance of a multivariable system are given. For each isolated subsystem a Żrst order approximation is obtained. Then achieving robust stability and closed- loop diagonal dominance is formulated as local robust performance problems. It is shown by selecting time constants of the closed-loop isolated subsystems appropriately, these local robust performance problems are solved and the interactions between closed-loop stabilized subsystems are attenuated. The internal model control (IMC) method is used to design local PI controllers. The suggested design strategy is applicable to unstable systems as well. Thereafter the nonlinear model of an industrial utility boiler is linearized about its operating points and the nonlinearity is modeled as uncertainty for a nominal LTI MIMO system. Using the new proposed method a decentralized PI controller for the uncertain LTI nominal model is designed. The designed controller is applied to the real system. The simulation results show the e®ectiveness of the proposed methodology.

11:50-12:10 FrA05.5
Applications of Sliding Mode Control to Drive Systems Fed by a Three-Level Voltage-Source Inverter, pp. 14241-14246
Ryvkin, Sergey Trapeznikov Inst. of Control Sciences of RussianAcademyof S
Schmidt-Obermoeller, Richard Ruhr-Univ. Bochum
Steimel, Andreas Ruhr-Univ. Bochum

The paper explains basic ideas related to the design of a sliding-mode controller for an electromechanic drive system consisting of an induction motor and a three-level voltage-source inverter. A comprehensive investigation of possible “switched structures” of the drive was carried out. Based on this analysis an original two-step design procedure allows to use the “classical” result of sliding-mode theory for the real switched system with more then 2m switched structures (m is the control space order). The performance of the considered control structure has been examined by simulation.

12:10-12:30 FrA05.6
Stability Analysis of an Electric Parking Brake (EPB) Systems with a Nonlinear Proportional Controller, pp. 14247-14253
Lee, Young Ok Hanyang Univ.
Lee, Choong Woo Hanyang Univ.
Chung, Chung Choo Hanyang Univ.
Son, Youngseop MANDO
Yoon, Paljoo Mando Corp.
Hwang, In-Yong Mando Corp.

In this paper, an Electric Parking Brake (EPB) system is modelled as a state-dependent switched system. The model involves screw friction which varies depending on the operation region. A new nonlinear proportional (P) controller is proposed and its stability is analyzed via Lyapunov and LaSalle’s theory. It is shown that the equilibrium point is locally uniform and ultimately bounded.

FrA06 310A
Fractional Differentiation and Its Applications I (Invited Session)
Chair: Sabatier, Jocelyn Univ. Bordeaux1
Co-Chair: Baleanu, Dumitru Cankaya Univ. Faculty of Arts and Sciences
Organizer: Dugard, Luc CNRS-INPG-UJF
Organizer: Sabatier, Jocelyn Univ. Bordeaux1

10:30-11:10 FrA06.1
An Overview of the CRONE Approach in System Analysis, Modeling and Identification, Observation and Control (I), pp. 14254-14265
Oustaloup, Alain Univ. Bordeaux 1 - ENSEIRB - ENSCBP
Sabatier, Jocelyn Univ. Bordeaux1
Lanusse, Patrick Univ. de Bordeaux
Malti, Rachid Univ. Bordeaux 1
Melchior, Pierre Univ. Bordeaux 1 - ENSEIRB - ENSCPB
Moze, Mathieu Univ. Bordeaux 1

The aim of the paper is to present the fundamental definitions connected to fractional differentiation and to present an overview of the CRONE approach in the fields of system analysis, modeling and identification, observation and control. Industrial applications of fractional differentiation are also described in this paper. Some recent developments are also presented.

11:10-11:30 FrA06.2
GPC Control of a Fractional-Order Plant: Improving Stability and Robustness (I), pp. 14266-14271
Romero, Miguel UNED
Vinagre, B. M. Univ. de Extremadura
de Madrid, A. P. UNED

This work deals with the use of Generalized Predictive Control (GPC) with fractional order plants. Low integer–order discrete approximations will be used as models to design the controllers. The stability and robustness of the closed loop system will be studied with the Nyquist criterion. Three techniques will be proposed to enhance robustness: the improvement of the model response at low frequencies, the use of the prefilter T, and a new recommendation to choose two of the parameters (the control horizon and the error weighting sequence) of the GPC controller.

11:30-11:50 FrA06.3
Computation of Stability Margins for Uncertain Linear Fractional-Order Systems Using Interval Constraint Propagation (I), pp. 14272-14276
Nataraj, P.S.V. Indian Inst. of Tech.
Kalla, Rambabu IIT Bombay
Deshpande, Manoj Indian Inst. of Tech. Bombay, Mumbai , INDIA

The present paper proposes an algorithm for finding the stability margins and cross over frequencies for an uncertain fractional-order system using interval constraint propagation technique. It is first shown that the problem of finding the stability margins and crossover frequencies can be formulated as a interval constraint satisfaction problem and then solved using branch and prune algorithm. The algorithm guarantees that the stability margins and the crossover frequencies are computed to prescribed accuracy and that theses values are reliable in the face of all kinds of computational errors. The other advantage of the method is that the stability margins and crossover frequencies can be computed without the need of frequency response plots or any kind of approximations. Two examples of uncertain fractional-order systems are taken from the literature and their stability margins and crossover frequencies are computed using the proposed algorithm.

11:50-12:10 FrA06.4
Half-Order Modelling of Electrical Networks Application to Stability Studies (I), pp. 14277-14282
Octavian, Enacheanu Univ.
Delphine, Riu Univ.
Nicolas, Retičre Univ.

The fractional order systems have been used successfully to model the development of induced currents in synchronous generators. State-space theory can be generalized to give a dynamical representation of fractional order systems. In this paper, modal analysis of an electrical network modeled by fractional order systems is presented. For stability aspects, a trade-off between modal and frequency approaches is performed.

12:10-12:30 FrA06.5
Synthesis of Havriliak-Negami Functions for Time-Domain System Identification (I), pp. 14283-14288
Sommacal, Laurent Univ. Bordeaux 1 - ENSEIRB
Melchior, Pierre Univ. Bordeaux 1 - ENSEIRB - ENSCPB
Malti, Rachid Univ. Bordeaux 1
Oustaloup, Alain Univ. Bordeaux 1 - ENSEIRB - ENSCBP

Fractional differentiation models have proven their usefulness in representing high dimensional systems with only few parameters. Generally, two elementary fractional functions are used in time-domain identification: Cole-Cole and Davidson-Cole functions. A third elementary function, called Havriliak-Negami, generalizes both previous ones and is particularly dedicated to dielectric systems. The use of this function is however not very popular in timedomain identification because it has no simple analytical impulse response. The only synthesis method of Havriliak-Negami elementary functions proposed in the literature is based on diffusive representation which sets restrictive conditions on fractional orders. A new synthesis method, with no such restrictions, is developed in this paper. For that purpose Havriliak-Negami function is first split into a Davidson-Cole function and a complementary one. Both functions are then synthesized in a limited frequency band using poles and zeros recursive distribution developed by Oustaloup (1995). As an example, this Havriliak-Negami function is used for a thermal system modeling.

FrA07 310B

Algorithm and Software for Optimal Control (Regular Session)

Chair: Werner, Herbert — Hamburg Univ. of Tech.
Co-Chair: Coulaud, Jean-Baptiste — Univ. Catholique de Louvain (UCL)

10:30-10:50 FrA07.1

Improving Trajectory Constraints Processing in Some Optimal Control Algorithms, pp. 14289-14294

Coulaud, Jean-Baptiste — Univ. Catholique de Louvain (UCL)
Campion, Guy — UCL-CESAME

This paper shows how the treatment of trajectory constraints in some recent software packages like the Nonlinear Trajectory Generation (NTG) can be improved by taking into account some structural properties of the initial optimal control problem that are lost in the transformation of the problem into an optimization one. The proposed method leads to a smaller complexity and a better accuracy.

10:50-11:10 FrA07.2

An Accelerator for Packages Solving Discrete-Time Optimal Control Problems, pp. 14295-14300

Chung, Hoam — Univ. of California, Berkeley
Polak, Elijah — Univ. of California
Sastry, Shankar — Univ. of California at Berkeley

We present an accelerator scheme for use with existing packages that solve nonlinear programming problems with a large number of inequality constraints that arise in the process of discretizing continuous-time optimal control problems with state-space constraints.This scheme is based on the concept of outer approximations used in semi-infinite programming and acts as an external, active constraints set strategy.

Our scheme constructs a finite sequence of inequality constrained nonlinear programming problems, containing a progressively larger subset of the constraints in the original problem, and submits these problems to a nonlinear programming solver for a fixed number of iterations. We prove that this scheme computes a solution of the original problem and show, by means of numerical experiments, that it results in reductions in computing time ranging from a factor of 6 to a factor of over 400.

11:10-11:30 FrA07.3

Solving the Goddard Problem with Thrust and Dynamic Pressure Constraints Using Saturation Functions, pp. 14301-14306

Graichen, Knut — Vienna Univ. of Tech.
Petit, Nicolas — Ec. des Mines de Paris

This paper addresses the well-known Goddard problem in the formulation of Seywald and Cliff with the objective to maximize the altitude of a vertically ascending rocket subject to dynamic pressure and thrust constraints. The Goddard problem is used to propose a new method to systematically incorporate the constraints into the system dynamics by means of saturation functions. This procedure results in an unconstrained and penalized optimal control problem which strictly satisfies the constraints. The approach requires no knowledge of the switching structure of the optimal solution and avoids the explicit consideration of singular arcs. A collocation method is used to solve the BVPs derived from the optimality conditions and demonstrates the applicability of the method to constrained optimal control problems.

11:30-11:50 FrA07.4

A Continuation Approach to State and Adjoint Calculation in Optimal Control Applied to the Reentry Problem, pp. 14307-14312

Graichen, Knut — Vienna Univ. of Tech.
Petit, Nicolas — Ec. des Mines de Paris

A well–known problem in indirect optimal control is to find a suitable initial guess for the adjoint states which is sufficiently close to the optimal solution. This paper presents a new homotopy approach to overcome this problem by deriving an auxiliary optimal control problem (OCP) for which the adjoint states are simply zero. A continuation method is employed to smoothly reach the original OCP. The auxiliary OCP can be derived with respect to any given initial trajectory of the system, for instance obtained by forward integration. The approach is applied to the space shuttle reentry problem, which represents a benchmark problem in optimal control due to its high numerical sensitivity with respect to the initial solution.

11:50-12:10 FrA07.5

A Globally Convergent Conjugate Gradient Method for Minimizing Self-Concordant Functions on Riemannian Manifolds, pp. 14313-14318

Ji, Huibo — Australian National Univ.
Manton, Jonathan H. — The Australian National Univ.
Moore, John B. — Australian National Univ.

Self-concordant functions are a special class of convex functions in Euclidean space introduced by Nesterov. They are used in interior point methods, based on Newton iterations, where they play an important role in solving efficiently certain constrained optimization problems. The concept of self-concordant functions has been defined on Riemannian manifolds by Jiang et al. and a damped Newton method developed for this context. As a further development, this paper proposes a damped conjugate gradient method, which is an ordinary conjugate gradient method but with a novel step-size selection rule which is proved to ensure the algorithm converges to the global minimum. The advantage of the damped conjugate gradient algorithm over the damped Newton method is that the former has a lower computational complexity. To illustrate the advantages, the algorithm is applied to find the center of mass of given points on a hyperboloid model, known as the Karcher mean.

12:10-12:30 FrA07.6

A Hybrid Gradient-LMI Algorithm for Solving BMIs in Control Design Problems, pp. 14319-14323

Chughtai, Saulat Shuja — Tech. Univ. of Hamburg-Harburg
Abbas, Hossam — Hamburg Univ. of Tech.
Werner, Herbert — Hamburg Univ. of Tech.

This paper presents an algorithm for solving optimization problems with bilinear matrix inequality constraints. The algorithm is based on a combination of gradient-based optimization and LMIs, which makes it fast and enables it to handle a large number of decision variables. It is applied to two controller synthesis problems: static output feedback controller synthesis and robust controller synthesis for linear parameter varying (LPV) systems using the idea of quadratic separation. Since the second problem has large number of decision variables, a hybrid approach is applied, in which LMI solvers are used for the evaluation of the cost function. The algorithm is applied to two examples, and results are compared with some existing approaches.

FrA08 310C

Reachability, Estimation and Control Synthesis under Uncertainty I (Invited Session)

Chair: Kurzhanski, A.B. — Univ. of California, Berkeley
Co-Chair: Rakovic, Sasa V. — ETH Zurich
Organizer: Kurzhanski, A.B. — Univ. of California, Berkeley
Organizer: Rakovic, Sasa V. — ETH Zurich

10:30-10:50 FrA08.1

Dynamic Augmentation and Complexity Reduction of Set-Based Constrained Control (I), pp. 14324-14329

Blanchini, Franco — Univ. degli Studi di Udine
Miani, Stefano — Univ. degli Studi di Udine
Savorgnan, Carlo — LAAS-CNRS

Computing polytopic controlled invariant sets which are maximal inside a prescribed region often yields sets which have a really complex representation. Since the associated control has a complexity which drastically increases with that of the region, this turns out to be a major problem in the implementation of the theory of controlled invariant regions. In this paper, we consider the problem of reducing the complexity of these regions and/or the complexity of the associated compensator. We propose two heuristic techniques based on spectral properties of some relevant matrices and on vertex-elimination methods. The paper presents several preliminary results which are interesting on their own such as dynamic augmentation and the properties of complex (as opposed to real) polytopic invariant regions.

10:50-11:10 FrA08.2

Robust Stability and Synthesis of Nonlinear Discrete Control Systems under Uncertainty (I), pp. 14330-14335

Kuntsevich, Vsevolod — Space Res. Inst. of NAS and NSA of Ukraine
Kuntsevich, Alexei — V.M.Glushkov Inst. of Cybernetics

With the use of Lyapunov functions chosen as the norm of state vector, we obtain the robust stability su±cient conditions for a wide class of nonlinear, and generally nonstationary, discrete-time control systems with the given set-valued parameter estimates. For a strictly monotone nonlinear function, validation of these conditions is equivalent to solution of a series of combinatorial problem in the state space. Synthesis of robustly stable control systems in a domain is performed on the basis of the obtained su±cient conditions of robust stability.

11:10-11:30 FrA08.3

Stochastic Reachability and Measurement Feedback under Control-Dependent Noise (I), pp. 14336-14341

Digailova, Irina — Moscow State (Lomonosov) Univ.
Kurzhanski, A.B. — Univ. of California, Berkeley
Varaiya, Pravin P. — Univ. of California at Berkeley

This paper deals with reachability under unknown disturbances and incomplete information on the state space variables. The unknown disturbances are described by a special type of vector-valued stochastic Brownian input noise which depends on the values of vectorvalued control. The control may be either unbounded or bounded by hard bounds. The reachabilty sets introduced here are deterministic. They consist of all points whose mean-square deviations from a tube of given controlled trajectories are small. The “reach” sets are presented in terms of level sets to solutions of appropriate types of Hamilton-Jacobi-Bellman equation, which depend on the presence or absence of additional hard bounds on the controls. These allow explicit representation of the reach sets when the controls are unbounded and are presented in terms of solutions to some dual optimization problems when the controls are bounded. Accordingly, the reach sets are either ellipsoids or convex compact sets of more complicated structure. The last fact introduces significant changes with transition from scalar to vectorvalued control-dependent noise. Finally the notions of reachability and control under incomplete feedback are introduced.

11:30-11:50 FrA08.4

Approximate Viability Using Quasi-Random Samples and a Neural Network Classifier (I), pp. 14342-14347

Djeridane, Badis — ETH Zurich
Lygeros, John — ETH Zurich

We propose a novel approach to the computational investigation of reachability properties for nonlinear control systems. Our goal is to combat the curse of dimensionality, by proposing a mesh-free algorithm to numerically approximate the viability kernel of a given compact set. Our algorithm is based on a non-smooth analysis characterization of the viability kernel. At its heart is a neural network classifier based on Bayesian regularization, which operates on a pseudorandom sample extracted from the state-space (instead of a regular grid). The algorithm was implemented in Matlab and applied successfully to examples with linear and nonlinear dynamics.

11:50-12:10 FrA08.5

On Mismatch between Initializations at Coder/Decoder in Quantized Control (I), pp. 14348-14353

Kameneva, Tatiana — Univ. of Melbourne
Nesic, Dragan — Univ. of Melbourne

This paper analyzes the stability of linear systems with quantized feedback in the presence of a mismatch between the initial conditions at the coder and decoder. We show that using the scheme proposed in Liberzon, Nesic (2007) it is possible to achieve global exponential stability of linear systems with quantized feedback when the coder and decoder are initialized at different initial conditions.

12:10-12:30 FrA08.6

Target Problems under State Contraints for Anisotropic Affine Dynamics - a Numerical Analysis Based on Viability Theory (I), pp. 14354-14359

Crück, Eva — Ec. Pol. / CNRS

We propose an approximation procedure for the dual problems of viability and reachability from a robust control point of view. Namely, given a region of the state space, we want to know whether it is possible for one control to guarantee that whatever the actions of the other control, the state stays in this region, or that starting outside of the region it is possible to reach it. We consider anisotropic affine dynamics in the sense that the dynamics is described by the sum of an autonomous term and a linear term in each input. This particular form enables us to approximate the solution of the robust control problem using a sequence of simpler control problems. We demonstrate how this approach can alleviate the computational effort required for the solution of the original problem. Our formulation is based on viability theory and differential games.

FrA09 311C

Continuous Time System Identification (Regular Session)

Chair: Kim, Youngchol — Chungbuk National Univ.
Co-Chair: Wang, Liuping — RMIT Univ.

10:30-10:50 FrA09.1

Issues in Sampling and Estimating Continuous-Time Models with Stochastic Disturbances, pp. 14360-14365

Ljung, Lennart — Linköping Univ.
Wills, Adrian George — Univ. of Newcastle

The standard continuous time state space model with stochastic disturbances contains the mathematical abstraction of continuous time white noise. To work with well defined, discrete time observations, it is necessary to sample the model with care. The basic issues are well known, and have been discussed in the literature. However, the consequences have not quite penetrated the practise of estimation and identification. One example is that the standard model of an observation being a snapshot of the current state plus noise independent of the state cannot be reconciled with this picture. Another is that estimation and identification of time continuous models require a more careful treatment of the sampling formulas. We discuss and illustrate these issues in the current contribution. An application of particular practical importance is the estimation of models based on irregularly sampled observations.

10:50-11:10 FrA09.2

Identification of First-Order Time-Delay Systems Using Two Different Pulse Inputs, pp. 14366-14371

Leon de la Barra, Bernardo A. — Univ. of Tasmania
Jin, Lihua — Chungbuk National Univ.
Kim, Youngchol — Chungbuk National Univ.
Mossberg, Magnus — Karlstad Univ.

This paper provides exact analytical expressions for the DC gain, time constant, and time delay of first-order plus time-delay (FOTD) systems from knowledge of two relative extrema in the transient response to two different finite-duration pulse inputs. The availability of these formulae leads to simple identification methods for process control settings that do not require any prior knowledge about the process DC gain and/or time delay. Variance analysis is used to study the quality of the estimates when the pulse response measurements are corrupted by noise. The proposed identification techniques compare favorably with existing FOTD identification methods both in terms of overall simplicity and user friendliness.

11:10-11:30 FrA09.3

State and Parameter Estimation for Systems in Non-Canonical Adaptive Observer Form, pp. 14372-14378

Tyukin, Ivan — Univ. of Leicester
Steur, Erick — Tech. Univ. of Eindhoven
Nijmeijer, Hendrik — Eindhoven Univ. of Tech.
Van Leeuwen, Cees — Riken Brain Science Inst.

We consider the problem of state and parameter reconstruction for uncertain dynamical systems that cannot be transformed into the adaptive canonic observer form. The uncertainties are allowed to be both linearly and nonlinearly parameterized functions of state and time. We provide a technique that allows successful reconstruction of uncertain state and parameters for a broad range of dynamical systems that belong to this class. In contrast to conventional approaches our technique is based on the concepts of weakly attracting sets, and non-uniform convergence and Poisson stability rather than the notion of Lyapunov stability. Relevance of the proposed approach to the domains of control and system identification is illustrated with examples.

11:30-11:50 FrA09.4

An Optimal Instrumental Variable Method for Continuous-Time Fractional Model Identification, pp. 14379-14384

Malti, Rachid — Univ. Bordeaux 1
Victor, Stephane, Stephane — Univ. Bordeaux1, IMS
Oustaloup, Alain — Univ. Bordeaux 1 - ENSEIRB - ENSCBP
Garnier, Hugues — Univ. Henri Poincaré, Nancy 1

This paper deals with continuous-time system identification using fractional differentiation models in a noisy output context. The simplified refined instrumental variable for continuous-time systems (emph{srivc}) is extended to fractional models. Monte Carlo simulation analysis are used to demonstrate the efficiency of the proposed optimal instrumental variable scheme.

11:50-12:10 FrA09.5

Parameter Estimation of Two-Dimensional Linear Differential Systems Via Fourier Based Modulation Function, pp. 14385-14390

Sadabadi, Mahdiye Sadat — Amirkabir Univ. of Tech.
Shafiee, Masoud — Amirkabir Univ. of Tech.
Karrari, Mehdi — Amirkabir Univ. of Tech.

In this paper, parameter identification of two-dimensional (2-D) linear differential systems via two-dimensional modulating functions is proposed. In this method, a partial differential equation on the finite time intervals converts into an algebraic equation linear in parameters. The parameters of the system can then be estimated using the least square algorithms. The underlying computations utilize a 2-D fast Fourier transform algorithm on polynomials of the data without the need for estimating unknown initial or boundary conditions at the beginning of each finite time interval. Numerical simulations are presented to confirm the theoretical results.

12:10-12:30 FrA09.6

Black-Box Identification and Simulation of Continuous-Time Nonlinear Systems with Random Processes, pp. 14391-14396

Vinet, Sylvain — SUPELEC
Vazquez, Emmanuel — Supélec

This paper proposes a methodology for black-box identification and simulation of continuous-time nonlinear dynamical systems based on random process modeling and kriging. It is assumed that the state vector is observed with noise at regularly or irregularly spaced instants. The proposed identification method consists of two steps. The first step is the estimation of the time derivatives of the state vector. The second step consists in the approximation of the controlled vector field. For the simulation of the system, a new integration scheme is proposed. This integration scheme makes it possible to deal consistently with the error of approximation of the vector field.

FrA10 311B

Switching Control I (Regular Session)

Chair: Mosterman, Pieter — The MathWorks, Inc.
Co-Chair: Zhang, Weicun — Univ. of Science and Tech. Beijing

10:30-10:50 FrA10.1

Extensions of LaSalle's Invariance Principle for Switched Nonlinear Systems, pp. 14397-14402

Wang, Jinhuan — Inst. of Systems Science,Chinese Acad. of Sciences
Cheng, Daizhan — Chinese Acad. of Sciences

In this paper the extension of LaSalle’s Invariance Principle for switched nonlinear systems is studied. Unlike most existing results in which each switching mode in the system needs to be asymptotically stable, in this paper we allow the switching modes to be only stable. Under certain ergodicity assumptions of the switching signals, two extensions of LaSalle’s Invariance Principle for global asymptotic stability of switched nonlinear systems are obtained, using the method of common joint Lyapunov function.

10:50-11:10 FrA10.2

A Unified Analysis of Switching Multiple Model Adaptive Control Virtual Equivalent System Approach, pp. 14403-14408

Zhang, Weicun — Univ. of Science and Tech. Beijing
Li, Xiaoli — Univ. of Science and Tech. Beijing
Choi, Jin Young — Seoul National Univ.

Based on virtual equivalent system concept and methodology, a unified analysis of the stability and convergence of switching multiple model adaptive control (MMAC) of linear time-invariant discrete plant is presented. The main results are expressed by three criteria. Two of them are applicable to switching MMAC systems with arbitrary control strategy, arbitrary parameter estimation algorithm and arbitrary switching index function. The third one is applicable to switching MMAC systems with one-stepahead control strategy, arbitrary parameter estimation algorithm and arbitrary switching index function. We wanted to show that virtual equivalent system concept and methodology could be a general theory of switching multiple model adaptive control.

11:10-11:30 FrA10.3

Robust Stabilization of Nonlinear Sandwich Plants Containing Generalized Hysteresis Nonlinearities, pp. 14409-14414

Manni, Andrea — Univ. of Lecce
Parlangeli, Gianfranco — Univ. degli studi di Lecce
Corradini, Maria Letizia — Univ. di Camerino

In this paper an approach for the stabilization problem of sandwich nonlinear systems containing a general nonsmooth nonlinearity is presented. The proposed solution is based on variable structure control theory and ensures the robust ultimate boundedness of the system trajectories in a neighborhood of the origin. Theoretical results have been validated by simulation on a mechanical system representing a robot-like system with one link, preceded by an hysteretic block and a first order actuator dynamics representing a DC motor and the simulation results have been confirmed the effectiveness of the proposed solution.

11:30-11:50 FrA10.4

Bumpless Transfer for Adaptive Switching Controls, pp. 14415-14420

Cheong, Shin-Young — Univ. of Southern California
Safonov, Michael G. — Univ. of Southern California

In this paper, a new bumpless transfer method is introduced based on slow-fast decomposition of the controller. The method is especially well-suited to situations in which the plant model is poor or yet to be identified, as may be the case in adaptive switching control. Simulation results are presented.

11:50-12:10 FrA10.5

Chaotification for a Class of Nonlinear Systems with Backlash Functions, pp. 14421-14425

Guan, Zhi-Hong — Huazhong Univ. of Science & Tech.
Liu, Na — Huazhong Univ. of Science & Tech.

The problem of creating chaos for a class of nonlinear systems with backlash function is studied in this paper. By utilizing the characteristic of backlash function, some criteria for guaranteeing the nonlinear system to be horseshoe type of chaos are derived based on Ř;Si’lnikov heterclinic theorem and Ř;Si’lnikov homoclinic theorem. Examples and simulations are given to illustrate the effectiveness of the theoretical results.

12:10-12:30 FrA10.6

Sliding Mode Control and Feedback Linearization for Non-Regular Systems, pp. 14426-14431

Zhang, Fu — The Mathworks
Fernandez, Benito — The Univ. of Texas at Austin
Mosterman, Pieter — The MathWorks, Inc.
Josserand, Timothy — The Univ. of Texas at Austin

This paper presents an approach for sliding mode control(SMC) and feedback linearization(FBL) of systems with relative order singularities. Traditionally, SMC and FBL are designed by taking derivatives of the output until the control signal appears(at the r_1^{rm th} derivative). When a system does not have a well-defined relative degree (r_1), the coefficient that multiplies u vanishes for some region of the state-space {cal S}_1. In this instance, conventional SMC and FBL techniques fail. The presented approach differentiates further the output until the control input appears again (the secondary relative degree, r_2) and a differential equation in u is acquired. It may be possible to solve for a dynamic compensator, or in the neighborhood of the singularity, {cal N}_1, the equations degenerate to a polynomial form. Preliminary results show that at the singularity region, {cal S}_1, the control-derivative term disappears and the differential equation is degenerated to a

center manifold defined by a polynomial (quadratic in general) equation on u. The solution to the quadratic equations is discussed. When this equation has only real roots, the system is well defined at the singularity. A switching controller can be designed to switch from the r_1^{rm th} controller when system is far away from the singularity to the r_2^{rm th} controller when the system is in the neighborhood of the singularity. We demonstrate the controller applied to the ball and beam system.

FrA11 311A
Gain Scheduling (Regular Session)
Chair: Choi, Ho-Lim Dong-A Univ.
Co-Chair: Iannelli, Luigi Univ. of Sannio in Benevento

10:30-10:50 FrA11.1
A Discrete-Time Adaptive ILC for Systems with Random Initial Condition and Iteration-Varying Trajectory, pp. 14432-14437
Chi, Ronghu Qingdao Univ. of Science and Tech.
Sui, Shulin Qingdao Univ. of Science and Tech.
Yu, Lei Qingdao Univ. of Science and Tech.

A discrete-time adaptive ILC scheme is presented for systems with time-varying parametric uncertainties. Using the analogy between the discrete-time axis and the iterative learning axis, the new AILC can incorporate a recursive Least-Squares algorithm, hence the learning gain can be tuned iteratively along the learning axis and pointwisely along the time axis. When the initial states are random and the reference trajectory is iteration-varying, the new AILC can achieve the pointwise convergence over a finite time interval asymptotically along the iterative learning axis. An extension of the new AILC is also developed by using nonlinear data weighting to systems without assuming any growth conditions on the nonlinearity.

10:50-11:10 FrA11.2
Analysis of Periodic Solutions in Piecewise Linear Feedback Systems Via a Complementarity Approach, pp. 14438-14443
Iannelli, Luigi Univ. of Sannio in Benevento
Vasca, Francesco Univ. of Sannio

Periodic solutions in piecewise linear feedback systems in Lur´e form, composed by a linear time invariant dynamical system closed in feedback through a static piecewise linear mapping are analyzed. A procedure for representing the closed loop system in complementarity form, based on resistors-diode-sources equivalent circuits of the piecewise linear characteristic is presented. Conditions for the existence of discrete–time periodic solutions in terms of solvability of a suitable static linear complementarity problem are obtained. Numerical results for a chaotic circuit show that the proposed approach can be also used to predict periodic solutions of continuous–time systems in Lur´e form provided that consistency of the discretization is assumed.

11:10-11:30 FrA11.3
Dissipative Control for Singularly Perturbed Fuzzy Systems, pp. 14444-14448
Lo, Ji-Chang National Central Univ.

Dissipative stabilizing state feedback controllers are investigated for singularly perturbed fuzzy systems. We derive sufficient conditions for the existence of (Q,S,R)-dissipative controllers for a class of nonlinear systems represented by T-S fuzzy model. Based on Lyapunov theory, the main results are cast in LMI formulation solvable by existing LMI solvers. We demonstrate that many existing technical papers are a specialized case of the general quadratic dissipative control problem involving singularly perturbed fuzzy systems. Finally the utility of the proposed method is illuminated by an example.

11:30-11:50 FrA11.4
On Robust Position Control of DC Motors by epsilon-PID Controller and Its Application to Humanoid Robot Arms, pp. 14449-14453
Choi, Ho-Lim Dong-A Univ.
Lim, Jong-Tae KAIST

In this paper, we propose a new ë;-PID controller for DC motors. We provide a systematic design steps of selecting the gains of the proposed ë;-PID controller. We also analytically show that the proposed controller provides robustness against system parameter uncertainty and reduces the effect of unknown load torque to the order of ë;. The benefit of our control approach is that the PID gains are tuned conveniently by adjusting a single ë; gain-factor. An experiment of DC motor control with its application to humanoid robot arms demonstrates the practical aspect of the proposed control method.

11:50-12:10 FrA11.5
Stability Analysis - Multiconvexity Approach, pp. 14454-14459
Lo, Ji-Chang National Central Univ.

A new stability condition in terms of LMIs is studied in this paper, continuous- and discrete-time fuzzy systems treated in a unified manner. Based on a premise-dependent Lyapunov function and multiconvexity, we release the conservatism that commonly exists in the common P approach.

12:10-12:30 FrA11.6
Speed Control for a Biped Robot, pp. 14460-14466
Tegegne, Brhanemedhn Epic Systems
Homaifar, Abdollah North Carolina A&T State Univ.
Sayyar-Rodsari, Bijan Pavilion Tech.

A biologically inspired model for a biped robot is developed. Each leg is modeled as a massless spring equipped with one radial and one angular actuator. The two legs in the model are attached to a point mass. The biped locomotion is modeled as a hybrid dynamic system that switches between four operation phases, with distinct dynamic behavior in each phase. A novel, simple yet robust control law that utilizes symmetry is developed to control the robot's speed, hopping height and balance during forward motion. The controller utilizes a feed forward artificial neural network, trained offline, to find approximate symmetric touchdown angles that are used by the control algorithm to determine actuator corrections. Simulation results show that the controller is able to maintain reference forward speed while maintaining balance during forward motion.

FrA12 313
Supervisory Control Design and Applications (Invited Session)
Chair: Zhou, Meng Chu New Jersey Inst. of Tech.
Co-Chair: Hanisch, Hans-Michael Martin Luther Univ. Halle-Wittenberg
Organizer: Zhou, Meng Chu New Jersey Inst. of Tech.
Organizer: Li, Zhiwu Xidian Univ.

10:30-10:50 FrA12.1
A Siphon-Based Deadlock Prevention Policy for a Class of Petri Nets-S3PMR (I), pp. 14467-14472
Yan, Mingming Xidian Univ.
Zhu, Rongming Xidian Univ.
Li, Zhiwu Xidian Univ.
Wang, Anrong Xidian Univ.
Zhou, Meng Chu New Jersey Inst. of Tech.

This paper focuses on the problem of deadlocks in automated flexible manufacturing systems (FMS) where deadlocks are caused by unmarked siphons in their Petri net models. A deadlock prevention policy is proposed for a subclass of Petri nets, S3PMR that can well model a large class of FMS. We distinguish siphons in such a net model by elementary and dependent ones. For each elementary siphon, a monitor is added to the plant model such that it is invariant- controlled. The monitor addition way guarantees that no emptiable control-induced siphon in the resultant net is generated due to the addition of monitors. This novel deadlock prevention policy can usually lead to a more permissive supervisor by adding a relatively much smaller number of monitors and arcs than the existing methods for the design of liveness-enforcing Petri net supervisors. Experimental study validates the result.

10:50-11:10 FrA12.2
A Modular Synthesis Approach for Distributed Safety Controllers, Part A: Modelling and Specification (I), pp. 14473-14478
Missal, Dirk Martin Luther Univ. Halle-Wittenberg
Hanisch, Hans-Michael Martin Luther Univ. Halle

The contribution provides an approach for formal synthesis of controllers ensuring safe operation on the shop floor level. It is structured into two parts. Part A presents an introduction and a survey of related work. It gives a definition of a modular DEDS model that extends ordinary Petri nets in order to provide a modular, compositional approach for designing models of the uncontrolled plant behaviour and to define controllable local state transitions. Specifications are given in terms of safety properties by means of state predicates that may be local to each partial plant or even global ones spanning across more than one partial plant. The synthesized controllers have to prevent the specified states. The major novel result of this part of the contribution is the definition of the behaviour of the plant without its complete composition. This means that the behaviour can be studied by means of modular steps within the modules and their interaction across module boundaries. This provides the basis for Part B of the contribution. An example taken from a physically real lab manufacturing system illustrates the modelling methodology and provides the plant model for the synthezis approach that is presented in Part B.

11:10-11:30 FrA12.3

A Modular Synthesis Approach for Distributed Safety Controllers, Part B: Modular Control Synthesis (I), pp. 14479-14484

Missal, Dirk — Martin Luther Univ. Halle-Wittenberg
Hanisch, Hans-Michael — Martin Luther Univ. Halle

The contribution provides an approach for formal synthesis of controllers that ensure safe operation on the shop floor level. It is structured into two parts. Part B presents the modular synthesis approach. It is based on the modular backward search in order to avoid the complexity of generating all states and state transitions of the plant model. It therefore uses modular backward steps that describe the trajectories leading to forbidden states. The generation of these trajectories is stopped as soon as a controllable (in our case preventable) step is found. From this information the models of the controllers are generated. Each controller has decision functions and communications functions. Together they establish a network of local, interacting controllers with communication. Up to now, we suppose that the plant is completely observable, i.e. the local controllers have complete information of the local states of the partial plants they are supposed to control. The method is illustrated by taking the example from Part A.

11:30-11:50 FrA12.4

Fuzzy Petri Nets Based Rescheduling Model for Semiconductor Production and Its Application (I), pp. 14485-14489

Qiao, Fei — Tongji Univ.
Wu, Qidi — Tongji Univ.
Li, Li — Tongji Univ. P.R.C
Wang, Zuntong — Tongji Univ.
Cao, Zhengcai — Tongji Univ.

The rescheduling strategy of semiconductor production refers to deciding when to start a rescheduling procedure and what kind of rescheduling method to be adopted. Both of the two problems are ill-structured and involve some fuzzy and random information. In order to solve this kind of production problem, a fuzzy Petri nets based rescheduling model (FPN-R) is proposed. FPN-R is defined as a 7-tuple, which includes an additional threshold parameter. Based on FPN-R, the fuzzy reasoning approach for rescheduling decision-making is further discussed. At last, an example of rescheduling strategy problem from semiconductor manufacturing is illustrated to show the application and feasibility of the proposed model and reasoning approach.

11:50-12:10 FrA12.5

Enumeration Algorithms for Maximal Perfect-Resource-Transition Circuits and Strict Minimal Siphons in S3PR (I), pp. 14490-14495

Xing, Keyi — Xi'an Jiaotong Univ.
Zhou, Meng Chu — New Jersey Inst. of Tech.

Resource-transition circuits (RTCs) and siphons are related to the deadlock problem and liveness control problem in Petri net models of automated manufacturing systems. This paper will concentrate on a particular type of Petri nets called systems of sequential processes with resources (S3PRs) and solves the RTC and siphon enumeration problems. A graph-based technique is first used to find all elementary RTC structures. Any RTC can be expressed as a union of some elementary RTCs. Then, an iterative method is developed to recursively construct all maximal perfect-resource-transition circuits (MPCs), which can lead the system to deadlock, from the elementary RTCs. Finally, by the one-to-one correspondence between strict minimal siphons and MPCs, a new algorithm is obtained to compute strict minimal siphons in S3PRs.

FrA13 314

Optimal Filtering and Estimation (Regular Session)

Chair: Nakamori, Seiichi — Kagoshima Univ.
Co-Chair: Han, Soo Hee — Seoul National Univ.

10:30-10:50 FrA13.1

Design of Quadratic Estimators Using Covariance Information in Linear Discrete-Time Stochastic Systems, pp. 14496-14501

Nakamori, Seiichi — Kagoshima Univ.
Hermoso, Aurora — Granada Univ.
Linares-Perez, Josefa — Granada Univ.

This paper, apart from the polynomial estimation technique based on the statespace model, examines to develop an estimation method for the quadratic estimation problem by applying the multivariate RLS Wiener estimator to the quadratic estimation of a stochastic signal in linear discrete-time stochastic systems. The augmented signal vector includes the signal to be estimated and its quadratic quantity. The signal vector is modeled in terms of an AR model of appropriate order. A numerical simulation example for the speech signal as a practical stochastic signal is implemented and its estimation accuracy is fairly improved in comparison with the existing RLS Wiener estimators. It is advantageous that the proposed method can be applied to the quadratic estimations of wide-sense stationary stochastic signals in general.

10:50-11:10 FrA13.2

A Unified Solution to Unbiased Minimum-Variance Estimation for Systems with Unknown Inputs, pp. 14502-14509

Hsieh, Chien-Shu — Ta Hwa Inst. of Tech.

A parameterized three-stage Kalman filter (PTSKF) is proposed, serving as a unified solution to unbiased minimum-variance estimation for systems with unknown inputs that affect both the system and the outputs. The PTSKF is characterized by two design parameters and includes three parts: one is for the main system state estimate, the second is for the optimal unknown inputs estimate, and the last is added to further enhance the robust filtering performance. It is shown that the extended robust two-stage Kalman filter (ERTSKF), which is an extension of the previously proposed RTSKF, and the optimal two-stage Kalman filter (OTSKF) are special cases of this new filter. Simulation results show that not only the filtering performance of the PTSKF is compatible to that of the previous proposed parameterized minimum-variance filter (PMVF) but also the computational complexity of the former is less intensive than that of the latter.

11:10-11:30 FrA13.3

Closed Form Filtering for Linear Fractional Transformation Models, pp. 14510-14515

Pasha, Syed Ahmed — The Univ. of New South Wales
Tuan, Hoang Duong — The Univ. of New South Wales

The nonlinear optimal Bayes filter is computationally intractable and at present there exists no analytical method for the nonlinear filtering problem. The standard approaches for linear approximation in the literature work reasonably well for the class of systems that are only mildly nonlinear. In this paper, we introduce a filtering approach for the most general class of nonlinear models by transforming the state space model to an equivalent representation given by the linear fractional transformation (LFT) model which is nonlinear in the feedback loop only. Based on an approximation localized to the feedback path only, we derive a closed form solution to Bayes recursion for the LFT model. We give simulation results to demonstrate the potential of the proposed filtering approach for applications where conventional methods fail.

11:30-11:50 FrA13.4

Optimal Filtering for Systems with Multiple Random Measurement Delays, pp. 14516-14521

Sun, Shuli — Heilongjiang Univ.

This paper is concerned with the optimal filtering problem for discrete-time stochastic linear system with multiple random measurement delays. Without the state augmentation, the system is transferred to an equivalent system without measurement delays and with random MV (moving average) colored measurement noise. An unbiased optimal filter is developed in the least mean square sense. Its solution depends on the recursion of a Riccati equation and a Lyapunov equation. A simulation shows the effectiveness of the proposed algorithm.

11:50-12:10 FrA13.5

Optimal Filter Design for Polynomial Systems, pp. 14522-14527

Basin, Michael V. — Autonomous Univ. of Nuevo Leon
Shi, Peng — Faculty of Advanced Tech.
Calderon Alvarez, Dario — Autonomous Univ. of Nuevo Leon

In this paper, the optimal filtering problem for polynomial system states over polynomial observations is studied proceeding from the general expression for the stochastic Ito differentials of the optimal estimate and the error variance. In contrast to the previously obtained results, the paper deals with the general case of nonlinear polynomial states and observations. As a result, the Ito differentials for the optimal estimate and error variance corresponding to the stated filtering problem are first derived. The procedure for obtaining a closed system of the filtering equations for any polynomial state over observations with any polynomial drift is then established. In the example, the obtained optimal filter is applied to solve the optimal third order sensor filtering problem for a quadratic state, assuming a Gaussian initial condition for the extended third order state vector. The simulation results show that the designed filter yields a reliable and rapidly converging estimate.

12:10-12:30 — FrA13.6

Optimal Estimation for Linear Singular Systems Using Moving Horizon Estimation, pp. 14528-14533

Boulkroune, Boulaid — Nancy Univ.
Darouach, Mohamed — Univ. Henri Poincare-Nancy
Zasadzinski, Michel — Cran

In this paper, the moving horizon recursive state estimator for linear singular systems is derived from the minimum variance estimation problem. The proposed estimate of the state using the measured outputs samples on the recent finite time horizon is unbiased and independent of any a priori information of the state on the horizon. The convergence and stability of the filter are evoked. A numerical example is presented to prove the performance of the proposed filter.

FrA14 — 318

Management of Natural Resources I (Regular Session)

Chair: Mareels, Iven — The Univ. of Melbourne
Co-Chair: Feliu, Vicente — Univ. of Castilla-La Mancha

10:30-10:50 — FrA14.1

Flood Forecasting for Heteroscedastic Streamflow Processes, pp. 14534-14539

Pianosi, Francesca — Pol. di Milano
Raso, Luciano — Pol. di Milano

The paper presents a nonlinear heteroscedastic model for flow forecasting. The model is composed of two submodels: the former provides the expected value of the flow, conditional on available information, e.g. past flow and precipitation records; the latter provides the variance of the prediction error as a function of past values of the prediction error itself and precipitation measures. The proposed model is tested on a real world case study, the inflow to Lake Verbano, Italy, where the inflow forecast is used for optimizing release decisions from the lake. Results are discussed and compared with those obtained with conventional modelling approach, where the flow is estimated based on a linear model of the flow logarithm, and the variance is not given a dynamical description but is assumed to be a time-varying parameter.

10:50-11:10 — FrA14.2

On-Line Design of Water Reservoir Policies Based on Inflow Prediction, pp. 14540-14545

Castelletti, Andrea — Pol. di Milano
De Rigo, Daniele — Pol. di Milano
Tepsich, Luca — Pol. di Milano
Soncini-Sessa, Rodolfo — Pol. di Milano
Weber, Enrico — Pol. di Milano

Stochastic Dynamic Programming (SDP) is the method most extensively adopted to design release policies for water reservoir networks. However, it suffers of the well known “curse of dimensionality”, which actually limits its applicability to small reservoir networks. In this paper we present an on-line approach to policy design that not only constitutes a viable alternative to overcome the SDP limits, but can also be used with an inflow predictor to improve the performance of SDPbased off-line policies. This latter possibility is explored and discussed through a real world case study.

11:10-11:30 — FrA14.3

Extended Ritz Method for Reservoir Management Over an Infinite Horizon, pp. 14546-14551

Pianosi, Francesca — Pol. di Milano
Soncini-Sessa, Rodolfo — Pol. di Milano

The management problem of water reservoirs can be formulated as a stochastic optimal control (SOC) problem, where the objective function is an aggregated cost that accounts for the interests acting in the water system (e.g. hydropower production, irrigation supply, etc.) and the design variable is the reservoirs release policy. Solving the SOC problem through stochastic dynamic programming is often impossible, since the numerical resolution of the Bellman equation is computationally prohibitive even for small reservoir networks. An approximate solution can be searched for by assuming a priori the family of function to which the control laws belong and replacing the SOC problem with a nonlinear programming one. Recently, a method based on this approach has been proposed in the literature, coupled with the use of nonlinear approximating networks to approximate the optimal control laws. This optimization method, called Extended RItz Method (ERIM), is suited for finite horizon SOC problems. However, management problems for environmental systems are spontaneously formulated over an infinite horizon, since the life time of the system is infinite. This paper thus presents an extension of the ERIM to the infinite horizon case. The algorithm that implements such method is tested on a numerical example where a 10-reservoirs network is optimized for hydropower production and irrigation supply.

11:30-11:50 — FrA14.4

A Modelling Methodology for Natural Dam-River Network Systems, pp. 14552-14557

Zhuan, Xiangtao — Univ. of Pretoria
Zheng, Guilin — Wuhan Univ.
Xia, Xiaohua — Univ. of Pretoria

An approach for modelling a natural dam-river network system is proposed in this paper. Generally, the relationships among the variables of a natural dam-river network system are complex and difficult to be described. In this paper, we present some simple first principle relationships among the water levels measured at a limited number of points of the network system such that a model is achieved, and data-driven. The model is identified and validated with the real time operational data. An example is given and the result shows the feasibility of the modelling methodology. It is expected that the proposed approach can be used in the operation of natural dam-river or river network systems.

11:50-12:10 — FrA14.5

Fractional IIalpha Controller Combined with a Smith Predictor for Effective Water Distribution in a Main Irrigation Canal Pool, pp. 14558-14563

Castillo, Fernando J. — Univ. of Castilla La Mancha
Rivas Perez, Raul — Havana Pol. Univ.
Feliu, Vicente — Univ. of Castilla-La Mancha

In this paper, a new fractional order IIalpha controller combined with a Smith predictor for effective water distribution in a main irrigation canal pool is designed. A new tuning method, based on frequency techniques, is proposed, providing to the controlled system the same nominal behavior than a conventional PI controller with Smith Predictor and more robustness to variations in the system gain.

12:10-12:30 — FrA14.6

Gain-Scheduled Smith PID Controllers for LPV Systems with Time Varying Delay: Application to an Open-Flow Canal, pp. 14564-14569

Bolea, Yolanda — Univ. Pol. de Catalunya (UPC)
Puig, Vicenc — Univ. Pol. de Catalunya
Blesa, Joaquim — Univ. Pol. de Catalunya (UPC)

In this paper, a new approach to design gain scheduled robust linear parameter varying (LPV) PID controllers with pole placement constraints (through LMI regions) is proposed for LPV systems with second order structure and time-varying delay. The controller structure includes a Smith predictor, real time measured parameters that schedule the controller (including the known part of the delay) and unstructured dynamic uncertainty which covers the unknown portion of the delay. Finally, this proposed control technique is validated in a real case study based on the control of a single reach canal (Lunax Gallery).

FrA15 317

Bioprocess Control Applications (Regular Session)

Chair: Bai, Er-Wei — Univ. of Iowa
Co-Chair: Steyer, Jean-Philippe — INRA

10:30-10:50 FrA15.1

Nonlinear Model Predictive Control Applied to E. Coli Cultures, pp. 14570-14575

Hafidi, Ghizlane — supélec
Tebbani, Sihem — Supelec
Dumur, Didier — Ec. Superieure d'Electricite
Vande Wouwer, Alain — Faculté Pol. de Mons

This paper proposes a nonlinear model predictive control scheme with particular application to the regulation of acetate concentration in order to maximize the biomass growth during fed-batch cultures of E. Coli. A reference feed rate which enables to maintain the acetate concentration at a specified level is first determined by means of optimal conditions. This feed rate is further used as the reference control trajectory within the NMPC algorithm. Finally, to avoid discretization problems during NMPC application, the on-line optimization is moved into a nonlinear programming strategy using the control vector parameterization approach (CVP). Some simulation results obtained on a fed-batch E. Coli bioreactor validate the efficiency of the proposed control strategy.

10:50-11:10 FrA15.2

Modeling and Parameter Estimation of Endothelial Cells, pp. 14576-14581

Bai, Er-Wei — Univ. of Iowa

A nonlinear identification approach for modeling endothelial cells is mathematically derived and experimentally tested under the realistic alternating current voltage and a square- like shape assumptions. Results demonstrate the applicability and effectiveness of the approach. The derived model is an important step in understanding a cell system and in developing controlling and treating certain disorders by new drugs.

11:10-11:30 FrA15.3

Estimation of Microalgal Photobioreactor Production Based on Total Inorganic Carbon in the Medium, pp. 14582-14587

Becerra-Celis, Giuliana — SUPELEC
Tebbani, Sihem — Supelec
Joannis-Cassan, Claire — Ec. Centrale Paris
Isambert, Arsene — Ec. Centrale Paris
Boucher, Patrick — Ec. Superieure d'Electricite

Microalgae biotechnology has been focusing on the use of algae in the production of high value compounds. During the last few decades, the intense research effort has been aiming at improving new controls and supervising tools as well as on a good process understanding. This requirement involves a large diversity and a better accessibility to process measurements. Probes or sensors are required to control the process. They are however relatively limited. Classical photobioreactors are usually equipped with temperature, dissolved oxygen and pH probes. These sensors actually provide very little online information on cell growth, viability, metabolic state and production. For the time being, sensors reliability cannot meet industrial bioprocessing requirements. In this context software sensors show numerous potentialities. The central axis of this work is the development of an extended Kalman filter (EKF) for the estimation of biomass concentration based on a dynamic process model in combination with total inorganic carbon measurement. A microalga Porphyridium purpureum was used as a model organism in this study. Numerical simulations and real-life experiments (batch and continuous mode) have been carried out and corresponding results are given in order to highlight the performance of the proposed estimator.

11:30-11:50 FrA15.4

Optimal Feedback Control of Microalgal Growth Based on the Slow Reduction, pp. 14588-14593

Papacek, Stepan — Univ. of South Bohemia
Celikovsky, Sergej — Inst. of Information Theory and Automation, Acad. of Science o
Ruiz-Leon, Javier — CINVESTAV Guadalajara

A state feedback law is proposed for on-line optimization of microalgal growth in a photobioreactor in the presence of non-measurable disturbances. The objective is to maximize a photosynthetic production rate (specific growth rate of microalgae) by manipulating the irradiance. The model describing the growth of microalgae is based on the mechanistic description in the form of the so-called photosynthetic factory. The reduction to a slow dynamics is used to derive analytically the approximation of the optimal feedback control. The analysis of the obtained explicit formula shows that the optimal feedback control actually performs optimal transfer to a constant optimal irradiance developed earlier but does not achieve principally better performance than the optimal control within the class of constant irradiance. Therefore, by reducing fast dynamics one can not reveal possible more complex optimal solutions. At the same time, this contradicts to a common belief in biotechnological community that the fast phenomena may be neglected. Illustrative simulations are included.

11:50-12:10 FrA15.5

Modeling the Temporal Evolution of the Drosophila Gene Expression, pp. 14594-14599

Haye, Alexandre — Univ. Libre de Bruxelles
Dehouck, Yves — Univ. Libre de Bruxelles
Kwasigroch, Jean-Marc — Univ. Libre de Bruxelles
Bogaerts, Philippe — Univ. Libre de Bruxelles
Rooman, Marianne — Univ. Libre de Bruxelles

The evolution of the gene expression pattern of Drosophila, from the embryonic to adult development phases, was studied on the basis of a microarray time series involving the expression levels of 4028 genes over 67 time-points. The genes presenting a similar temporal evolution of their expression levels were clustered together, so as to define a small number of representative classes. To model the network interactions responsible for the dynamic behavior of gene expression, a system of linear differential equations with constant coefficients was used. The parametric estimation of this model was performed in two stages: a first stage of linear parameter identification allowing an analytical approach to the solution, and a second stage of nonlinear parametric estimation which refines this solution. This model is shown to reproduce the experimental gene expression profiles with a fairly good precision.

12:10-12:30 FrA15.6

Classification of Activated Sludge Settleability Using Linear and Nonlinear Classification Functions, pp. 14600-14605

Gins, Geert — Katholieke Univ. Leuven
Vanlaer, Jef — Katholieke Univ. Leuven
Smets, Ilse — Biotec - Bioprocess Tech. And Control
Van Impe, Jan F.M. — Katholieke Univ. Leuven

In this paper, two classifiers are proposed to distinguish between bulking and non-bulking situations in an activated sludge wastewater treatment plant, based on available image analysis information. The first classifier consists of a simple linear classification function, while the second classifier uses a highly nonlinear /least squares support vector machine/ (LS-SVM) to distinguish between both situations. It is shown that the nonlinear LS-SVM classification function outperforms the linear classifier. Both exhibit identical misclassification rates, but fewer samples are located in the uncertainty area when using the nonlinear classifier. However, this better classification performance requires the identification of a substantial amount of model parameters, while the linear classifier is, except for the threshold values, parameterless.

FrA17 320A

Control Education: Simulation & Modelling Learning Tools (Regular Session)

Chair: Giarre', Laura — Univ. di Palermo
Co-Chair: Dormido, Sebastián — UNED

10:30-10:50 FrA17.1

Interactive Learning Module: Basic Modelling and Identification Concepts, pp. 14606-14611

Guzman, Jose Luis — Univ. of Almeria
Astrom, Karl J. — Lund Inst. of Tech.
Dormido, Sebastián — UNED
Hagglund, Tore — Professor
Piguet, Yves — Calerga Sarl
Berenguel, Manuel — Univ. of Almeria

This paper describes an interactive tool focused on teaching and learning basic concepts about modelling and identification. Modelling and identification play fundamental roles in the field of automatic control, since it is not possible to perform a control system design without having a model describing the dynamics of the process to be controlled. The tool presented in this work is dedicated to describe the most important aspects of basic modelling centralized on first and second order systems with dead-time and zero effects.

10:50-11:10 FrA17.2

Innovative Tools for Real-Time Simulation of Dynamic Systems, pp. 14612-14617

Palli, Gianluca	Univ. of Bologna
Carloni, Raffaella	Univ. of Bologna
Melchiorri, Claudio	Univ. of Bologna

In this paper, we present a software architecture, based on RTAI-Linux, for the real-time simulation of dynamic systems and for the rapid prototyping of digital controllers. Our aim is to simplify the testing phase of digital controllers by providing the real-time simulation of the plant with the same interface used for the communication between the control applications and real plant. This unified interface, based on the COMEDI library, allows to switch the controller from the simulated to the real plant without any modification of the control software. Moreover, a set of tools for helping the users in the development of the real-time simulation tasks of the plants have been developed. A great attention has been posed in the automatic generation of symbolic kinematic and dynamic models of robotic manipulators from a description of the robot in terms of kinematic parameters and inertia/center of mass of each link. The system, besides being useful for rapid prototyping of mechatronic control systems, may be used for fault detection, and also as a teaching tool in Mechatronic/Digital Control Courses. A case study, the real-time simulation and control of the PUMA 560 manipulator, is presented and discussed.

11:10-11:30 FrA17.3

A Unified Approach for Classroom and Laboratory Control Systems Education, pp. 14618-14623

Kassas, Zaher	National Inst.
Dunia, Ricardo	National Inst.

In this paper, a unified approach for control systems education will be presented. This approach is a friendly software and hardware platform that provides students with the necessary tools for gathering data for system identification, designing controllers, simulating the closed-loop system, and implementing the controller on real-time hardware. The proposed approach has been used in introductory control systems courses and can be easily extended to advanced and research-based courses. Software-based classroom assignments and projects have been presented based on this platform. Moreover, these classroom assignments and projects were smoothly extended to hardware-based labs. The feedback conveyed by students due to the incorporation of this platform into control engineering curricula has been positive. Also, professors have been endorsing the use of this platform as part of teaching control systems engineering.

11:30-11:50 FrA17.4

Learn2Control: A Web-Based Framework for Project-Oriented Control Education, pp. 14624-14629

Tometzki, Thomas	Univ. Dortmund
Volker, Marten	Chair of Process Control
Christian, Blichmann	Univ. Dortmund
Ernesto, Elias-Nieland	Univ. Dormund
Sonntag, Christian	Univ. Dortmund
Engell, Sebastian	Univ. of Dortmund

Important skills of a control engineer are the ability to subdivide complex control design projects into smaller design steps and to solve the subproblems, taking into account the interdependencies between the subtasks as well as the overall goals and requirements. In this paper, the web-based learning environment Learn2Control is presented which has been developed to complement classical teaching methods in the control engineering education at Technische Universit¨at Dortmund. Learn2Control provides the students with the opportunity to apply their knowledge of control theory and to gain experience in project-oriented workflows by means of authentic case studies on control systems design. The didactic concept aims at teaching the dependencies and the interactions between the solution of the subtasks of modeling, analysis, and controller design, and between the methods used for these tasks. In the latest version of Learn2Control, only a standard web browser and Java have to be installed on the client computers. The modeling, analysis and design tasks are processed on web pages which are generated by Java server technology on a web server. For mathematical operations, a custom multi-user Matlab web service was developed. Currently, three control design projects are available within the new framework. In addition, four projects are available in a previous version of the framework that requires a Matlab installation on the client side.

11:50-12:10 FrA17.5

Blogging As a Research and Educational Tool: A Three Years Experience, pp. 14630-14635

Giarre', Laura	Univ. di Palermo
Jaccheri, Letizia	Norwegian Univ. of Science and Tech.

Blogging can be also used to share knowledge in research and education. We have been using many blogs with the following purposes. One goal has been to raise awareness about research methods in the information technology field by supporting information exchange, collaboration, and cooperation between researchers. We have been using a common blog for 3 years to share inter- and intra disciplinary knowledge among us. We have also collected stories and interviewed colleagues and friends. An other goal is the use of blogs during our teaching experience as an instrument to support the exchange of knowledge with students. A comparison of the use of blogging is presented with positive and negative aspects that have been experienced.

12:10-12:30 FrA17.6

Advanced Modelling and Control Using a Laboratory Plant with Hybrid Processes, pp. 14636-14641

Hlava, Jaroslav	Faculty of Mechatronics, Tech. Univ. of Liberec
Sulc, Bohumil	Czech Tech. Univ. in Prague

Advanced control theory is usually associated with the use of abstract mathematical tools. It requires much time and a good theoretical background to understand and explain these tools. In ordinary university courses or in continuing professional education organized by employers, it is not easy to meet these requirements. Widely used system simulation and virtual experiments can be a good aid to increase clarity, but they cannot fully demonstrate the problems that a control designer or user may encounter in practical implementation. A laboratory scale plant has been designed for this purpose in the framework of research activities focused on hybrid systems. It exhibits most of the hybrid phenomena typical of process control applications. The plant is also equipped with industrial control hardware, so that educational (as well as research) experiments can be carried out implementing advanced hybrid control algorithms in conditions close to real world applications. The instrumentation provides a remote web access facility. A mathematical and technical description of the pilot plant is included here, and this will enable readers to consider whether a similar device could be useful for their own educational and/or research purposes. Some examples of experimental results are also given.

FrA18 320B

Localization and Mapping (Regular Session)

Chair: Devy, Michel	LAAS-CNRS
Co-Chair: Ribeiro, Carlos Henrique Costa	Tech. Inst. of Aeronautics

10:30-10:50 FrA18.1

Experimental Autonomous Flight of a Small-Scaled Helicopter Using Accurate Dynamics Model and Low-Cost Sensors, pp. 14642-14650

Vissičre, David	DGA
Bristeau, Pierre-Jean	Ec. Pol.
Martin, Alain Pierre	DGA
Petit, Nicolas	Ec. des Mines de Paris

In this paper, we address the problem of guidance and control of a small-scaled helicopter (Benzin Acrobatic from Vario with a 1.8 m diameter rotor) equipped with only low-cost sensors. These sensors are an Inertial measurement unit (IMU), a GPS, and a barometer, which represent a total cost of USD 3000 including one PC board and one micro-controller). By contrast to other experiments reported in the literature, we do not rely on any accurate IMU or GPS systems which costs are, separately, largely above the mentioned amount of USD~3000. To compensate the weaknesses of this low cost equipment, we put our efforts in obtaining an accurate flight dynamics model. This improves the prediction capabilities of our embedded Kalman filter that serves for data fusion. The main contribution of this paper is to detail, at the light of a successful reported autonomous hovering flight, the derivation of the model. We give numerous details about implementation and discuss the relevance of some modelling hypothesis based on our experience.

10:50-11:10 FrA18.2

SLAM and Data Fusion from Visual Landmarks and 3D Planes, pp. 14651-14656

Zureiki, Ayman	LAAS-CNRS
Devy, Michel	LAAS-CNRS

Structured environment can be modelled in a simplified way as a set of planar surfaces and lines. For mobile robot equipped with a 3D sensor and a camera, the incremental construction of such a model is a Simultaneous Localisation And Mapping (SLAM) problem: while exploring the environment, the robot executes motions; from each position, it acquires sensory data, extracts 3D perceptual features, and simultaneously, performs self-localisation and model update. Our robot JIDO has a 3D pivoting laser range finder, acquiring images of 3D points, and has a camera. Firstly, a segmentation algorithm of a 3D image into a set of planar faces is described: this algorithm uses a region growing strategy and the Extended Kalman Filtering to estimate the parameters of the support plane of every face. These planar faces are used as landmarks. Next, we describe how to extract 2D line landmarks by fusing data from both sensors. Our stochastic map is of heterogeneous type and contains plane and 2D line landmarks. At first, The SLAM formalism is used to build a stochastic planar map, and results on the incremental construction of such a map are presented, further on, heterogeneous map will be constructed.

11:10-11:30 FrA18.3

SLAM Using Single Laser Range Finder, pp. 14657-14662

Aghamohammadi, Ali Akbar	K.N. Toosi Univ. of Tech.
Tamjidi, Amir Hossein	KN Toosi Univ. of Tech.
Taghirad, Hamid D.	K.N. Toosi U. of Tech.

Presented method in this paper aims to develop an accurate motion model and SLAM algorithm, which is only based on the Laser Range Finder (LRF) data. Proposed method tries to overcome some practical problems in traditional motion models and SLAM approaches, such as robot slippage, and inaccuracy in parameters related to robot’s hardware. Novel insights specific to process and measurement model, and making use of them in the IEKF framework, give rise to the real time method with drift-free performance in restricted environments. Furthermore, uncertainty measures, calculated through the method, are valuable information for fusion purposes and also an accurate motion model, derived in this method, can be used as a robust and an accurate localization procedure in different structured environments. These issues are validated through experimental implementations; experiments verify method’s efficiency both in pure localization and in SLAM scenarios in the restricted environments, involving loop closures.

11:30-11:50 FrA18.4

Mobile Robot Self-Localization and Local Map Alignment with a Dempster Shafer Sensor Fusion Algorithm, pp. 14663-14668

Lee, Hyunki	KAIST
Song, Xingyong	KAIST
Cho, Hyung Suck	KAIST

An important and challenging research issue associated with mobile robots is simultaneous localization and map building (SLAM), which refers to the mobile robot’s capability of estimating its poses in the environment without external information, and simultaneous alignment of the local maps. To solve these kinds of research problems, researchers have proposed various methods such as odometry measurement, landmark matching, laser range image matching and a scale-invariant feature transform (SIFT)–based algorithm, all of which suffer from inevitable drawbacks such as a local minimum problem and a lack of SIFT features. Our solution for these problems is a sensor fusion method that uses a Dempster Shafer algorithm to fuse both the laser range information and the SIFT features information for the SLAM. Through a series of experiments, we tested and evaluated the proposed method. By real experiments, we analyzed the parameters of the ICP and SIFT features and we checked the robustness of our algorithm.

11:50-12:10 FrA18.5

An Optimal Graph Theoretic Approach to Data Association in SLAM, pp. 14669-14674

Huang, Guoquan	Univ. of Minnesota
Zhang, Xinzheng	The Hong Kong Pol. Univ.
Rad, A. B.	Simon Fraser Univ.
Wong, Y. K.	Hong Kong Pol. Univ.

In this paper, we study the problem of data association in simultaneous localization and mapping (SLAM). Since almost all existing methods for solving the problem are only able to provide suboptimal solutions, we revisit this problem and propose an optimal graph approach to resolve it. We first formulate the problem as integer programming (IP) problem, and then algorithmically prove that the IP is equivalent to a minimum weight bipartite perfect matching problem. Thus, optimally solving the bipartite matching problem is equivalent to optimally resolve the IP problem (i.e., the data association problem). Simulations validate the e_;ectiveness and accuracy of the proposed approach.

12:10-12:30 FrA18.6

Map Matching Based on Paraconsistent Artificial Neural Networks, pp. 14675-14680

Anjos da Silva, Anderson	Tech. Inst. of Aeronautics - ITA
Ribeiro, Carlos Henrique Costa	Tech. Inst. of Aeronautics

This paper presents a new method for matching metric maps generated by mobile robots that act cooperatively. This process of information matching makes it possible to perform global map generation from local maps (possibly partial and nonconsistent) provided by individual robots. The proposed method is based on a paraconsistent artificial neural network model that considers as input data the Euclidean distances between the points from each one of the partial maps. The use of this kind of input information makes the individual maps invariant with respect to relative rotation and translation among the robots in the mapping environment. The neural network then analyzes these distances to determine what are the matching belief relations among the points of the distinct maps. The algorithm implemented for the neural architecture achieved good results with very satisfactory computational performance, and made it possible to determine the certainty and contradiction degress in the map point matching analysis. The results show that the proposed approach is robust for the cases were it was applied. Equally important is the fact that the considered architecture allows for the combination of information from partial maps acquired in execution time during navigation.

FrA19 320C

Haptics Technology: Current Trends and Potential of Haptics
(Invited Session)

Chair: Kwon, Dong-Soo	KAIST
Co-Chair: Book, Wayne J.	Georgia Inst. of Tech.
Organizer: Kwon, Dong-Soo	KAIST
Organizer: Book, Wayne J.	Georgia Inst. of Tech.

10:30-10:50 FrA19.1

Control Strategies and Feedback Information in Mobile Robot Teleoperation (I), pp. 14681-14686

Farkhatdinov, Ildar	Korea Univ. of Tech. and Education
Ryu, Jee-Hwan	Korea Univ. of Tech. and Education
Poduraev, Jury	Moscow State Univ. of Tech. STANKIN

In this paper several control strategies and feedback information for teleoperation of a mobile robot are described and analyzed. Main objective is to verify the role of different types of feedback information and command strategies. Three control strategies which combined position-speed and position-position control modes are analyzed. Position-speed and position-position command strategies are used for mobile robot teleoperation. In position-speed strategy, desired speed of a mobile robot is defined by a master manipulator’s position. In position-position command strategy, robot’s position is controlled by position of master device. Hybrid command strategy, combining position-speed and position-position strategy, is introduced. Three types of feedback are provided to human-operator. Described human-robot teleoperation interfaces were tested by performing experiments. First, unilateral teleoperation was studied. Experiments with position-speed, position-position and hybrid command strategies were evaluated. Second, bilateral teleoperation of a mobile robot was studied using two types of force feedback: force feedback related to obstacle range information, and force feedback including information about the state of the robot. For experiments with bilateral teleoperation different command strategies were applied. The role of visual and sound feedback was verified also. Navigation time and positioning accuracy were measured during experiments. For each type of human-robot interaction interface advantages and disadvantages, and possible applications were described.

10:50-11:10 FrA19.2

An Analog Input Shaper for Stability Enhancement of Haptic Interfaces and Its Application to Energy-Bounding Algorithm (I), pp. 14687-14692

Lim, Yo-An — Gwangju Inst. of Science and Tech. (GIST)
Kim, Jong-Phil — Korea Inst. of Science and Tech.
Yoon, Joo Hong — Agency for Defense Development
Ryu, Jeha — Gwangju Inst. of Science and Tech. (GIST)

An analog input shaper is proposed for a haptic control system to improve stability when interacting with virtual environments. High frequency inputs to a haptic device, which usually occur in collision with virtual objects with high stiffness, can induce limit cycle oscillations and instabilities. In order to reduce these high frequency inputs to haptic devices, an analog input shaper is added to the control system. In order to minimize the delay, which is also one of major causes of instabilities, the analog input shaper is implemented with a high-pass filter instead of a low-pass filter. Since the input shaper has its own dynamics, when a haptic pointer leaves a virtual wall, a user may feel slow decrease of impedance. Moreover there may be negative impedance as if the wall is pulling. In order to solve these problems, we add linear half-wave rectifiers which allow fast decrease of impedance and no negative input to a haptic device. The rectifiers can also eliminate the undesirable energy. The input shaper reduces the total energy supplied to a haptic device by preventing high frequency inputs from flowing into a haptic device and by using rectifiers, therefore, it can be regarded as an artificial damping element. Energy-bounding algorithm, which is an energy-based method, can guarantee stable haptic interaction by limiting the input energy. So, it inevitably sacrifices transparency in haptic interaction. The analog input shaper is incorporated into energy-bounding algorithm to increase the impedance range that the algorithm can stably display. A digital filtering scheme, which uses the same structure as in an analog input shaper, is also tested. Through experiments, we show that the analog input shaper can enhance the stability and thus increase the impedance range which can be stably displayed by a haptic device.

11:10-11:30 FrA19.3

Design of New Micro Actuator for Tactile Display (I), pp. 14693-14698

Yang, Tae Heon — KAIST
Kwon, Dong-Soo — KAIST

In order to provide the realistic tactile sensation in a pin-array tactile display for a hand-held device, we need to consider the pins' gap, the pins' stroke, the output force, and the working frequency of the tactile display. This paper presents a new small-scale actuator with a solenoid, a permanent magnet, and a elastic spring for a tactile display. The feedback force of this actuator is generated by the interaction among a solenoid, a permanent magnet, and a elastic spring. We separate the elastic springs into several elastic plates in order to considerately minimize the pins' gap of tactile display without decreasing the pins' stroke, the output force, and the working frequency of the displays. In the proposed tactile actuator, a micro-pin is actuated to satisfy the above specification (the pins' gap, the output force, and the working frequency). Hence, a tactile display with the proposed tactile actuators provides realistic cutaneous sensation to human operators.

11:30-11:50 FrA19.4

Control Issues of Digital Clay -- Massive Hydraulic Actuator Array for Man-Machine Communication (I), pp. 14699-14707

Book, Wayne J. — Georgia Inst. of Tech.
Zhu, Haihong — Georgia Tech.
Huggins, James — Georgia Inst. of Tech.

Digital Clay is an NSF funded project for human machine communication through a tangible haptic surface actuated using fluid power. Digital Clay's hardware can be divided into three subsystems: massive-integrated actuator-sensor array, fluidic driving system, and control system. Focus of this paper is the control of some of the special mechanisms of Digital Clay. Specifically, the Fluid Matrix Drive, Capacitive-Coupled Resistive Sensing technology for position feedback and the other control related issues are discussed. Analysis and testing results on these topics are provided based on a 5x5 actuator array prototype. Most of the topics discussed in this paper are widely applicable to other devices as well as Digital Clay.

11:50-12:10 FrA19.5

Thermo-Tactile Interaction Using Tactile Display Device, pp. 14708-14713

Yang, Gi-Hun — KAIST
Kwon, Dong-Soo — KAIST

This paper proposes a tactile display mouse providing both pin-array type tactile display and thermal display. Micro shape and vibrotactile stimuli can be generated by pin-arrayed tactile display and various planar distributed patterns can be also displayed such as Braille cell patterns. Temperature and thermophysical property of object can be displayed by the thermal display device that is composed of a thin film resistance temperature detector(RTD), a Peltier thermoelectric heat pump and a water cooling jacket. To investigate thermo-tactile interaction, an experiment asking perceived magnitude of vibrotactile stimulus according to different temperature condition was conducted.

FrA20 321C

Advanced Intelligent System Based on Machine Vision (Invited Session)

Chair: Oda, Naoki — Chitose Inst. of Science and Tech.
Co-Chair: Murakami, Toshiyuki — Keio Univ.
Organizer: Domae, Yukiyasu — Hokkaido Univ.
Organizer: Murakami, Toshiyuki — Keio Univ.
Organizer: Oda, Naoki — Chitose Inst. of Science and Tech.
Organizer: Shibata, Masaaki — Seikei Univ.
Organizer: Komada, Satoshi — Mie Univ.
Organizer: Tao, Xiaodong — KAIST
Organizer: Takahashi, Satoru — Kagawa Univ.

10:30-10:50 FrA20.1

Image Feature Based Navigation of Nonholonomic Mobile Robots with Active Camera (I), pp. 14714-14719

Komada, Satoshi — Mie Univ.
Kinoshita, Kousuke — Mie Univ.
Hirukawa, Tatsuhiko — Mie Univ.
Hirai, Junji — Mie Univ.

This paper proposes an image feature based navigation method for active camera mounted mobile robots that are affected by nonholonomic constraint. Visual servo is applied to tracking control of the active camera to track targets in the center of image plane. Moreover, posture of nonholonomic mobile robots from targets is controlled by image features of targets that are related to relative distance and angle between robots and targets. It is confirmed that the proposed method can navigate a mobile robot in front of a target with a proper orientation through simulations and experiments.

10:50-11:10 FrA20.2

Moving Object Detection for Active Camera Based on Optical Flow Distortion (I), pp. 14720-14725

Shibata, Masaaki — Seikei Univ.
Yasuda, Yuichiro — Seikei Univ.
Ito, Masahide — Seikei Univ.

The paper describes a novel method for moving object detection for an active camera using optical flows. In the images captured with an active camera, all of static and moving objects in the workspace are moving so that the camera moves around. In our approach, the analysis of optical flows is adopted for moving objects detection.The optical flow is resolved with using image information and camera motion in our method. The camera motion is controlled with robust controller, so that the information from the camera motion contributes well precise optical flow generation. The optical flows on moving objects are distorted to differ from the theoretical one because of the object motion.Since the precise optical flow is obtained in our method, the distortions are extracted, so that the moving object is detected. The validity of our method is confirmed in several physical experiments, and then good performance is achieved. The limitations of ability and performance of our method are also examined in the experiments.

11:10-11:30 FrA20.3

Image Information Based Configuration Control of Redundant Manipulator in Bilateral System (I), pp. 14726-14731

Murakami, Toshiyuki — Keio Univ.
Ohta, T. — Keio Univ.

The paper proposes a construction method of bilateral system using redundant manipulator. In bilateral system, it is important that operation can be realized in narrow space and at remote plate. Then the master-slave robots with redundancy are convenient and needed to achieve the bilateral motion effectively. However, human operation will become difficult because of the multifunctional mechanism. Especially, operating the posture of redundant manipulator by human hand is so difficult because the manipulator redundancy enables to achieve infinite number of the manipulator posture. This paper focuses on a construction of bilateral system so that it assists the human operation by adjusting a configuration control of redundant manipulator. In particular, bilateral system utilizes visual information by cameras to recognize the target object of remote environment in slave. By using this camera information, the assist for the slave operation of redundant manipulator is realized without deteriorating the bilateral motion.

11:30-11:50 FrA20.4

Vision-Based External Force Estimation for Mobile Robots (I), pp. 14732-14737

Oda, Naoki — Chitose Inst. of Science and Tech.
Shimizu, Hiroyuki — Chitose Inst. of Science and Tech.

This paper describes an approach of vision-based external force estimation for mobile robots. The force related motion control such as force control, compliant control, impedance control and so on, requires the force sensing property. And the visual information is one of important resources for recognizing environments in mobile systems. In the proposed approach, external force and robot velocity are estimated only from visual information. Therefore, any internal sensors, such as force/torque sensor, encoder and tachometer, are not required for force sensing. The robot motion is estimated from optical flow field and disparity vector by stereo vision system, furthermore external force can be calculated by reaction force observer. The vision-based approach has a remarkable potential function, that is virtual external force affected by remote object motion in visual scene, can be generated intentionally. The validity of the proposed approach is verified by several experimental results.

11:50-12:10 FrA20.5

Motion Stereo Including Tracking Stability Analysis for 3-D Cable Reconstruction (I), pp. 14738-14742

Domae, Yukiyasu — Hokkaido Univ.
Okuda, Haruhisa — Mitsubishi Electric Corp.
Takauji, Hidenori — Hokkaido Univ.
Kaneko, Shun'ichi — Hokkaido Univ. Graduate School of Information Science and Tech.
Kimura, Yuta — Hokkaido Univ.

We propose a novel approach to the three-dimensional reconstruction of flexible cables for applications in factory automation, such as cable handling and connecter insertion using robotic arms avoiding conflicts among multiple cables. The approach is based on motion stereo with a single vision sensor. To solve the stereo correspondence problem efficiently and effectively, feature-point projection with slit beams and a feature tracking algorithm based on a robust image-matching method is applied. In addition, we define the tracking stability of the feature points in order to reject defective stereo correspondences. Experiments using these methods demonstrate that an arched cable shape can be reconstructed to an accuracy of 1.5%.

12:10-12:30 FrA20.6

An Adaptive Depth of Field Imaging System for Micromanipulation (I), pp. 14743-14748

Tao, Xiaodong — Korea Advanced Inst. of Science and Tech.
Hong, Deokhwa — Korea Advanced Inst. of Science and Tech.
Cho, Hyung Suck — KAIST

Vision-based techniques used in automatic micromanipulation are limited by small depth of field (DOF) because of high magnification and big numerical aperture of optical system. This paper proposed a new adaptive DOF image system which can adaptively adjust DOF during micromanipulation while maintaining high resolution of the images. The proposed system uses a spatial light modulator instead of fixed phase mask to make flexible wave-front coding, which can change the DOF during micro manipulation. An DOF-extension scheme is proposed based on the depth information of micro objects, which is estimated by the stereo vision method. The large DOF in the coarse assembly and high resolution in the fine assembly are achieved. The image qualities of multi micro objects in different depths are improved during the micromanipulation process. Experiment results show the feasibility of the proposed system in the micromanipulation application.

FrA21 321B

Modeling Human Performance (Regular Session)

Chair: Boy, Guy — European Inst. of Cognitive Sciences and Engineering
Co-Chair: Yoon, Wan Chul — Korea Advanced Inst. of Science and Tech.

10:30-10:50 FrA21.1

Rapid Computation of Time-Optimal, Open-Loop Forearm Movement, pp. 14749-14754

Shelton, Jeffrey N. — Purdue Univ.
Kwon, Oh-Sang — Purdue Univ.
Chiu, George T.-C. — Purdue Univ.

Minimal movement time for open-loop rotation of the human forearm, along with the associated input signal to the forearm muscles, is calculated using matrix multiplication. This permits rapid evaluation of movement times across a four-dimensional mesh of initial conditions, each moving to a common terminal state. The described discrete-time solution is based on the continuous-time solution of Tanaka et al., and the minimum-variance theory of Harris and Wolpert. Underlying algorithm concepts are discussed, and proofs of solution existence are provided.

10:50-11:10 FrA21.2

Senseless Maneuver Optimal Washout Filter Design with Human Vestibular Based (HVB) for VR-Based Motion Simulator, pp. 14755-14760

Huang, Chin_I — National Formosa Univ.
Fu, Li-Chen — National Taiwan Univ.

In this paper, we propose a new approach “HVB senseless maneuver optimal washout filter” which is based on human vestibular system, senseless maneuver and motion platform limitation for designing washout filter such that a cost function constraining the pilot sensation error (between simulator and vehicle) is minimized. This approach can curtail over strong feelings of pilot reception and increase efficiency of platform workspace for task running. Finally, the experimental results confirm the effectiveness of our algorithm hereby proposed. Moreover, the results show that a better performance can be attained.

11:10-11:30 FrA21.3

Modelling of Human Haptic Skill: A Framework and Preliminary Results, pp. 14761-14766

Wang, Zheng — Tech. Univ. of Munich
Yuan, Jun — Tech. Univ. of Munich
Buss, Martin — Tech. Univ. Muenchen

Haptic interaction in human motor tasks requires special modelling techniques in robot learning. This paper proposes a novel scheme for haptic skill modelling, covering the modelling procedure starting from reference data acquisition until a competent model is obtained. The iterative structure of the proposed scheme provides a clear guideline to the modelling workflow. The scheme as well as the distinct features of haptic skill modelling are discussed and illustrated by modelling social handshake dynamics.

11:30-11:50 FrA21.4

Modeling of Pro-Supination for Forearm Skeleton Based on MRI, pp. 14767-14772

Nojiri, Kousei — Kumamoto Univ.
Matsunaga, Nobutomo — Kumamoto Univ.
Kawaji, Shigeyasu — Kumamoto Univ.

The continuous passive motion (CPM) device we developed for the elbow joint implements pro-supination of the forearm naturally accompanying flexion and extension of the elbow joint. As the method of making the curative effect due to accompanying pro-supination clear, the range of motion (ROM) of the forearm skeleton are estimated by using of the pro-supination model of the forearm skeleton. As the pro-supination model of the forearm skeleton, there are the models Fick and others and Kecskemethy and others proposed. But, hypothesis is set in regard to the link length of the model and the rotation axis of the forearm. So, in the case of pro-supination of the forearm, it is thought that mismatch happens between the forearm skeletal model and the forearm skeleton. In this paper, by analyzing magnetic resonance imaging (MRI) of the forearm, we proposed the newer forearm skeletal model based on the biomechanics.

11:50-12:10 FrA21.5

Recognition of the Surgeon's Motions During Endoscopic Operation by Statistics Based Algorithm and Neural Networks Based ANARX Models, pp. 14773-14778

Nomm, Sven	Inst. of Cybernetics at TUT
Petlenkov, Eduard	Tallinn Univ. of Tech.
Vain, Jüri	Tallinn Univ. of Tech.
Belikov, Juri	Inst. of Cybernetics at TUT
Miyawaki, Fuijo	Tokyo Denki Univ.
Yoshimitsu, Kitaro	Tokyo Denki Univ.

The problem of recognition and short time prediction of the surgeon's hand motions during surgical endoscopic operation are approached in the present contribution using neural network based nonlinear modeling techniques and statistics based segmentation of the operating room. It is shown that proposed technique provide precise recognition of surgeon's motions.

12:10-12:30 FrA21.6

Individual Ability-Based System Design of Dependable Human-Technology Interaction, pp. 14779-14784

Jipp, Meike	Univ. of Mannheim
Wagner, Achim	Univ. of Mannheim
Badreddin, Essam	Univ. of Heidelberg

This paper highlights the importance of considering especially individual differences in intelligence when designing systems and interfaces due to their impact on operator performance in new and unfamiliar situations. For this purpose, an approach is introduced which allows assessing performance-relevant abilities of the operators on the basis of their performance on everyday life tasks. In order to increase the overall human-machine system dependability, guidelines are derived about appropriate reconfigurations of the technical system and/or its interface on the basis of the assessed performance-relevant abilities. The impact of this new approach to dependable system and interface design is discussed.

FrA22 321A

Intelligent Controllers (Regular Session)

Chair: Yang, Zi-Jiang	Kyushu Univ.
Co-Chair: Christiansson, Anna-Karin	Univ. West

10:30-10:50 FrA22.1

Control Design for Automation of Robotized Laser Metal-Wire Deposition, pp. 14785-14791

Heralic, Almir	Univ. West
Christiansson, Anna-Karin	Univ. West
Hurtig, Kjell	Univ. West
Ottosson, Mattias	Univ. West
Lennartson, Bengt	Chalmers Univ. of Tech.

In this paper a novel approach towards automation of robotized laser metal-wire deposition (RLMwD) is described. The RLMwD technique is being developed at University West in cooperation with Swedish industry for solid freeform fabrication of fully dense metal structures. The process utilizes robotized fibre laser welding and metal wire filler material, together with a layered manufacturing method, to create metal structures directly from a CAD drawing. The RLMwD process can also be used for repair or modification of existing components.

This paper faces the challenge of designing a control system for maintaining stable process variables, such as a constant layer height and a stable component temperature, during the entire manufacturing process. Several problems are identified and discussed in the paper, e.g. the difficulty of obtaining the bead height in the weld pool environment. The case study is a repair application for stamping tools, where worn out trim edges are to be repaired. Issues regarding the control design, system identification, and the practical implementation of this application are discussed.

10:50-11:10 FrA22.2

A General Adaptive Robust Nonlinear Motion Controller Combined with Disturbance Observer, pp. 14792-14797

Yang, Zi-Jiang	Kyushu Univ.
Hara, Seiichiro	Kyushu Univ.
Kanae, Shunshoku	Kyushu Univ.
Wada, Kiyoshi	Kyushu Univ.
Su, Chun-Yi	Concordia Univ.

A general adaptive robust nonlinear motion controller combined with disturbance observer (DOB) for positioning control of a nonlinear single-input-single-output (SISO) mechanical system is proposed. Theoretical performance such as transient performance, ultimate tracking error bound and mean square tracking error bound are analyzed rigorously, and simulation results are provided to support the theoretical results.

11:10-11:30 FrA22.3

Friction Compensation with Commonly-Used PD Control and Support Vector Machine, pp. 14798-14803

Zheng, Chunhong	Xidian Univ.
Su, Y. X.	Xidian Univ.
Müller, Peter C.	Univ. of Wuppertal

This paper addresses the high-precision tracking of mechanical systems with friction effect. A simple integrated proportional-derivative (PD) scheme is proposed where a support vector machine is incorporated to deal with friction. The bounded tracking is proved with Lyapunov’s direct method and the bound of tracking error can be made arbitrarily small by selecting large control gains. A major advantage of the proposed framework is that it does not use the modeling information in the controller formulation, and thus permits easy implementation in practice. Simulations performed on two single-mass servo control systems demonstrate the expected better performance of the proposed approach.

11:30-11:50 FrA22.4

A New Translation Algorithm from Ladder Diagrams to Instruction Lists, pp. 14804-14809

Yan, Yi	hangzhou dianzi Univ.
Zhang, Hangping	Hangzhou dianzi Univ.

A new algorithm for translating ladder diagrams into instruction lists is presented in this paper. To perform this task a new class of digraphs called Fractal Series Parallel (FSP) digraphs is proposed for the first time, which can represent the Boolean functions of a ladder diagram more intuitively and concisely than binary trees. Our analysis is based on the fact that a General Series Parallel (GSP) digraph can be transformed into a FSP digraph that is equivalent to the GSP one in Boolean function.

11:50-12:10 FrA22.5

Fast Operating Bit-Byte PLC, pp. 14810-14815

Chmiel, Miroslaw	Silesian Univ. of Tech.
Hrynkiewicz, Edward	Silesian Univ. of Tech.

The paper presents a few different approaches to optimizing operation speed of Programmable Logic Controllers. First approach optimizes architecture of the bit-byte CPU, second optimizes program execution, next one optimizes data exchange between bit and byte processors and the last one optimizes input/output servicing. All of them lead to a two processor’s bit-byte architecture, which support of concurrent execution of bit and byte computation tasks. In such architecture the processors can operate without waiting one for the other.

12:10-12:30 FrA22.6

Visual Navigation of a Mobile Robot in a Cluttered Environment, pp. 14816-14821

Gupta, Meenakshi	Indian Inst. of Tech. Kanpur
Uggirala, Balaji	Indian Inst. of Tech. Kanpur
Behera, Laxmidhar	Indian Inst. of Tech. Kanpur

Visual navigation of a mobile robot consists of following tasks (1) object tracking (2) depth estimation and (3) obstacle avoidance. In this paper, we present a modified version of CAMShift algorithm for object tracking, which makes tracking of fast moving object possible. A fuzzy based scheme is used for estimating depth as well as rotation angle necessary for reaching the object. A sonar based obstacle avoidance scheme is also demonstrated. The entire scheme is implemented in real time on Patrolbot, a mobile robot platform from active media robotic.

FrA23 323

Manufacturing Plant Control (Regular Session)

Chair: Wang, Zhongjie — Tongji Univ.

Co-Chair: Dolgui, Alexandre — Ec. des Mines de Saint Etienne

10:30-10:50 FrA23.1

Manufacturing Process Planning for Laser Cutting Robotic Systems, pp. 14822-14827

Dolgui, Alexandre — Ec. des Mines de Saint Etienne

Pashkevich, Anatol — Ec. des Mines de Nantes

The paper presents a new computational technique for the manufacturing process planning in laser cutting robotic systems. It focuses on the optimisation of robot motions for continuous contour tracking using the redundancy caused by the tool axial symmetry. In contrast to previous works, the developed technique is based on the dynamic programming and explicitly incorporates verification of the velocity/acceleration constraints. It also takes into account recent advances in robot mechanical design allowing unlimited rotations of some manipulator axes. The technique is implemented in a CAD package and verified in the automotive industry.

10:50-11:10 FrA23.2

Position Tracking Control with Velocity from Accelerometer and Encoder, pp. 14828-14833

Zhu, Wen-Hong — Canadian Space Agency

Lamarche, Tom — Canadian Space Agency

Being widely used in industrial systems and manufacturing lines, precision position control systems need to use high feedback control gains to reject disturbances. However, phase-lag in velocity estimation resulting from encoder measurement imposes a limitation on maximum allowable feedback gains, when system stability and control smoothness are concerned. In this paper, use of velocities derived from both acceleration and position measurements is suggested. The derived velocity possesses a much higher bandwidth without having theoretical phase-lag. Experimental results reveal that the use of velocities derived from practical accelerometers and encoders allows a typical position control system to substantially increase its feedback gains without compromising stability and control smoothness. It in turn results in much smaller tracking errors, compared to scenarios when velocities are created from position sensors only.

11:10-11:30 FrA23.3

Stability Analysis and Internal Dynamics of MIMO GMAW Process, pp. 14834-14839

Eghtesad, Mohammad — Shiraz Univ.

Bazargan-Lari, Yousef — islamic azad Univ. branch

Assadsangabi, Babak — shiraz Univ.

In this paper, stability and internal dynamics for a gas metal arc welding (GMAW) process will be studied. GMAW process is considered as a nonlinear MIMO system and input-output feedback linearization method will be applied for control purposes. Internal dynamics is the unobservable part of the system dynamics; its stability analysis is a vital step in the investigation of the system stability as a whole. Also, drop detachment dynamics, will be considered here by tracking a saw-toothed arc length voltage. Simulations results are presented to illustrate the system performance.

11:30-11:50 FrA23.4

A New Method of Dynamic Bottleneck Detection for Semiconductor Manufacturing Line, pp. 14840-14845

Wang, Zhongjie — Tongji Univ.

Chen, Jun — East China Normal Univ.

Wu, Qidi — Tongji Univ.

A global definition of bottleneck degree is first proposed by introducing an exponential function, the value of bottleneck degree for each working station can be obtained through real time calculation and compared, based on which a new method of exponential dynamic bottleneck detection (EDBD) is presented. This method provides an efficient means for bottleneck detection. Experiments under light load and heavy load prove the validity of this method.

11:50-12:10 FrA23.5

Design and Experiment Research of Abrasive Water-Jet Cutting Machine Based on Phased Intensifier, pp. 14846-14851

Xu, Jiazhong — Harbin Univ. of Science and Tech.

You, Bo — Harbin Univ. of Science and Tech.

Kong, Xiangbing — Harbin Univ. of Science and Tech.

To solve the problem of water pressure fluctuation caused by the traditional double-acting intensifier, the paper has designed abrasive water-jet cutting machine based on phased intensifier as well as open numerical control system. The structure of cutting machine as well as the hardware structure and working principle of phased intensifier are introduced. The phased intensifier employs a constant pressure variable capacity pump to provide power, compressed air to push piston back, PLC to control working sequence of two pistons, making the structure of mechanism and control system to be simplified. Experimental research on several typical materials cut by water-jet cutting machine equipped with phased intensifier is conducted, which is valuable for design_;manufacture and technological application of high pressure water equipment. It is practically proved that this system can work stably, with fluctuation rate of water pressure no more than 2.0%, as well as good cutting quality and high production efficiency.

12:10-12:30 FrA23.6

The Application of Lot Streaming to Assembly Job Shop under Resource Constraints, pp. 14852-14857

Chan, Felix T. S. — The Univ. of Hong Kong

Wong, T. C. — The Univ. of Hong Kong

Chan, P.L.Y. — The Univ. of Hong Kong

Assembly job shop problem (AJSP) is an extension of classical job shop problem (JSP). AJSP first starts with a JSP and appends an assembly stage after job completion. Lot Streaming (LS) technique is defined as the process of splitting lots into sub-lots such that successive operation can be overlapped. In this paper, the previous study of LS to AJSP will be extended by introducing resource constraints. To reduce the computational effort, we propose a new Genetic Algorithm (GA) approach which is the modification of the algorithm in our previous paper. A number of test problems are conducted to examine the performance of the new GA approach. Moreover, the single GA approach will be compared with a single Particle Swarm Optimization (PSO) approach. Computational results suggest that the new algorithm can outperform the previous one and the PSO approach with respect to the objective function.

FrA24 324

Job and Activity Scheduling I (Regular Session)

Chair: Meyer, Wolfgang — Hamburg Univ. of Tech.

Co-Chair: Allaoui, Hamid — Univ. of Artois

10:30-10:50 FrA24.1

Robust Scheduling of Cyclic Flow Shops Based on Stochastic Collision Functions, pp. 14858-14863

Fiedler, Claudia — Hamburg Univ. of Tech.

Meyer, Wolfgang — Hamburg Univ. of Tech.

By the proposed methodology for robust controller design, we quantify the schedulability of a series of process plans (or jobs) to be produced at a robotic work cell with several machines and limited transport and processing capabilities. The uncertainties of the plant model as there are statistically distributed and event driven variations of transport and processing times as well as of job release intervals, are captured by a stochastic timed Petri net. Robustness of the schedules is measured in terms of a plan achievement function which plays the role of a fitness landscape in the multi dimensional search space of feasible and non feasible schedules. The definition of the plan achievement function goes back to a collision avoidance mechanism. The approach is exemplified for periodic schedules of cyclic flow shops.

10:50-11:10 FrA24.2

Scheduling of Uncertain Multi-Product Batch Processes under Finite Intermediate Storage Policy, pp. 14864-14869

Xu, Zhenhao — East China Univ. of Science and Tech.

Gu, Xingsheng — East China Univ. of Science and Tech.

Jiao, Bin — Shanghai Dianji Univ.

There are various uncertainties in the production scheduling of the real-world applications. And in multi-product batch processes, the intermediate storage often can be used to increase plant productivity and operational efficiency. In this paper, the scheduling mathematical model for multi-product batch processes under Finite Intermediate Storage (FIS) policy with uncertain processing time has been established based on fuzzy programming theory. And the Maximum Membership Functions of Mean Value method is applied to convert the fuzzy scheduling model to the general optimization model. Furthermore, a fuzzy immune scheduling algorithm combined with the feature of the Immune Algorithm is proposed, which can prevents the possibility of stagnation in the iteration process and achieves fast convergence for global optimization. The effectiveness and efficiency of the fuzzy scheduling model and the proposed algorithm are demonstrated by simulation results.

11:10-11:30 FrA24.3

The Coordinated Scheduling of Steelmaking with Multi-Refining and Tandem Transportation, pp. 14870-14875

Guan, Jing	Northeastern Univ. Shenyang, China
Tang, Lixin	Northeastern Univ.
Liu, Jianchao	Shanghai Meishan Iron & Steel Limited Company, BaosteelComplex
Zhang, Rongpin	Shanghai Meishan Iron & Steel Limited Company, BaosteelComplex

This article explores coordinated scheduling problem arising in steelmaking and multi-refining operations. Jobs are first processed in converters and then transported downstream to be processed in refining furnaces in which two different transporters are employed in tandem at the stage of transportation. There exist multi-refining jobs. The objective is to minimize the maximum completion time satisfying no transporters confliction and buffer space. For the model, we develop a tabu search algorithm and provide the worst case analysis. Computational tests are evaluated to show the efficiency brought by the tabu search algorithm relative to lower bound and sequenced and separately algorithm.

11:30-11:50 FrA24.4

Best-Case Lower Bounds in a Group Sequence for the Job Shop Problem, pp. 14876-14881

Pinot, Guillaume	EPUN
Mebarki, Nasser	IUT de Nantes

Group sequencing is a well-studied scheduling method for the job shop problem. The goal of this method is to have a sequential flexibility during the execution of the schedule and to guarantee a minimal quality corresponding to the worst case. But the best case quality of a group sequence should also be interesting. This article presents new methods to evaluate the best case quality for any regular objective function. More particularly, three new makespan lower bounds are presented. The experiments performed with these lower bounds exhibit very good performances.

11:50-12:10 FrA24.5

A Coupled Transiently Chaotic Neural Network Approach for Scheduling Identical Parallel Machines with Sequence Dependent Setup Times, pp. 14882-14887

Yu, Aiqing	East China Univ. of Science and Tech.
Gu, Xingsheng	East China Univ. of Science and Tech.
Jiao, Bin	Shanghai Dianji Univ.

Identical parallel machine scheduling problems with sequence dependent setup times, to minimize the total completion time are studied in this paper. A mixed-integer programming formulation of this problem is presented. And a neural computation architecture based on a Coupled Transiently Chaotic Neural Network is introduced to construct the model. The transiently chaotic dynamics are defined after the energy function is constructed by a penalty function approach. Tradeoff problem existing among the penalty terms included in the energy function is overcome by using time-varying penalty parameters. Simulation results tested on different problems with 100 random initial conditions show that this approach converges to near-optimal or optimal solutions and outperforms the Hopfield neural networks.

12:10-12:30 FrA24.6

Bottlenecks in Production Lines with Rework: A Systems Approach, pp. 14888-14893

Biller, Stephan	General Motors
Li, Jingshan	Univ. of Kentucky
Marin, Samuel	General Motors
Meerkov, Semyon M.	Univ. of Michigan
Zhang, Liang	Univ. of Michigan

The bottleneck (BN) of a production system is a machine with the strongest effect on the system's throughput. In this paper, a method for BN identification in serial lines with rework and Bernoulli machines is developed. In addition, the paper provides two system-theoretic results: First, it demonstrates that BNs may be shifting not only because of changes in machine and buffer parameters but also due to changes in quality of parts produced. Second, it shows that if the split and the merge machines are not the last and the first, respectively, Bernoulli lines with rework do not observe the property of reversibility, and downstream machines may have a larger effect on the throughput than those upstream.

FrA25 328

Monitoring and Performance Assessment (Regular Session)

Chair: Visioli, Antonio	Univ. of Brescia
Co-Chair: Shah, Sirish	Univ. of Alberta

10:30-10:50 FrA25.1

Extended Prediction Error Approach for MPC Performance Monitoring and Industrial Applications, pp. 14894-14899

Zhao, Yu	Zhejiang Univ.
Gu, Yong	Zhejiang Univ.
Su, Hongye	Zhejiang Univ.
Huang, Biao	Univ. of Alberta

Performance monitoring and diagnosis of model predictive control systems (MPC) has been a great interest for both academia and industry. In recent years some novel approaches for multivariate control performance monitoring have been developed without the requirement of process models or interactor matrices. Among them the prediction error approach has shown to be a promising one, but it has certain limitations in applications. This paper further develops the prediction error approach for performance monitoring of model predictive control systems, and demonstrates its applications in two industrial MPC performance monitoring and diagnosis problems.

10:50-11:10 FrA25.2

A Technique for Abrupt Load Disturbance Detection in Process Control Systems, pp. 14900-14905

Veronesi, Massimiliano	Univ. of Brescia
Visioli, Antonio	Univ. of Brescia

A simple technique for the detection of abrupt load disturbances occurring in process control systems is proposed in this paper. The technique is based on the computation of an index using routine operating data, after a simple experiment is performed initially, and it can be employed usefully in the context of performance assessment and adaptive control. Simulation and experimental results confirm its effectiveness.

11:10-11:30 FrA25.3

Karnopp Friction Model Identification for a Real Control Valve, pp. 14906-14911

Romano, Rodrigo Alvite	Univ. of São Paulo
Garcia, Claudio	Pol. School of The Univ. of Sao Paulo

This paper presents an algorithm to estimate friction parameters of a real control valve. Data are collected from a valve installed in a bench, submitted to different input signals and subject to different friction forces. Two different parameter sets are obtained, based on distinct methods. These parameter sets are applied in the Karnopp friction model, generating two versions of the same model. These models are vali-dated with different input signals and distinct friction forces. The validation tests have revealed that both models described quite well the behavior of the control valve.

11:30-11:50 FrA25.4

Controller Performance Analysis Technology for Industry: Implementation and Case Studies, pp. 14912-14919

Lee, Kwanho	Univ. of Alberta
Xu, Fangwei	Syncrude Canada Ltd.
Huang, Biao	Univ. of Alberta
Tamayo, Edgar	Syncrude Canada Ltd.

In this paper, an industrial MPC performance monitoring technology is introduced with a focus on the industrial implementation. A plant-oriented framework for APC performance monitoring is proposed on the basis of industrial computer control systems background. A software package integrating this technology, which is called Performance Analysis Toolbox and Solutions (PATS), is introduced. The major components of PATS are discussed including process data collection, data preprocessing, process model identification, similarity clustering, control valve stiction detection, multivariate controller performance assessment, and APC economic performance assessment using linear matrix inequality optimization. An industrial case study of a hydrogen unit is illustrated. A limited trial version of the software package can be downloaded from the web http://www.ualberta.ca/_bhuang/research/research.htm

11:50-12:10 FrA25.5

Assisted Monitoring and Maintenance of Control Systems, pp. 14920-14925

Hansen, Ole Fink — Tech. Univ. of Denmark
Andersen, Nils A. — Tech. Univ. of Denmark
Ravn, Ole — Tech. Univ. of Denmark

Current process control algorithms are complex software systems that need regular maintenance in order to keep a high uptime. Experience shows that the process of understanding an algorithm by tracking signal dependencies throughout the system and recognizing a problem is a major challenge for the maintenance personnel while actually performing the needed modifications to the algorithm is relatively simple. This problem is addressed by a computer science approach to automate the tracking of signals and supply tools for monitoring running control systems, identifying failing parts of the control algorithm and alleviating the task of exploring complex control systems.

12:10-12:30 FrA25.6

Model-Plant Mismatch Detection in MPC Applications Using Partial Correlation Analysis, pp. 14926-14933

Badwe, Abhijit — Indian Inst. of Tech. Bombay
Shah, Sirish — Univ. of Alberta
Patwardhan, Sachin — IIT Bombay
Patwardhan, Rohit — Matrikon Inc.

In model predictive control of processes, the process model plays an important role. The performance of the controller depends on the quality of the model and hence on the model- plant mismatch. Although model-plant mismatch is inevitable, it is highly desirable to minimize it. For processes with large number of inputs and outputs, re-identification of the model is a costly exercise as keeping a large number of inputs in a perturbed or excited state for a long time means loss of normal production time. Hence, it would be highly desirable to detect the precise location of the mismatch so that only a few inputs would have to be perturbed and only the degraded portion of the model updated. In this work, a methodology is proposed for the detection of mismatch from closed-loop operating data. The proposed methodology is based on the analysis of partial correlations between the model residuals and the manipulated variables. Its efficacy is demonstrated on two simulation case studies as well as its application to data from an industrial process.

FrA26 327

Intelligent Control of Power Systems (Invited Session)

Chair: Lee, Kwang Y. — Baylor Univ.
Co-Chair: Mori, Hiroyuki — Meiji Univ.
Organizer: Lee, Kwang Y. — Baylor Univ.

10:30-10:50 FrA26.1

Forecasting of Electricity Price and Demand Using Auto-Regressive Neural Networks (I), pp. 14934-14938

Yamashita, Daiki — Waseda Univ.
Mohd Isa, Aishah — Waseda Univ.
Yokoyama, Ryuichi — Waseda Univ.
Niimura, Takahide — Waseda Univ.

This paper proposes a forecasting technique of electricity demand and price with volatility based on neural networks. Recent deregulation and liberalization are worldwide currents in the electric industry. The price competition was introduced in a spot market, and the price volatility is concerned because the demand side is non-elastic, and electricity differs from other general commodities. The authors firstly predict an uncertain electric power demand by using the auto-regressive model of the neural networks. The neural network is a popular feed-forward three-layer model, and the input variables of the neural networks include the historical demand, temperature, weather-related discomfort index, and the day of the week. Secondly, by using the demand forecasted and the past prices, we apply the technique for forecasting the electricity price of the next day. The utility of the proposed technique was verified by using real data of the electric power wholesale spot market.

10:50-11:10 FrA26.2

Optimal Power System Stabilizer Tuning in Multi-Machine System Via an Improved Differential Evolution (I), pp. 14939-14944

Yang, Guang Ya — The Univ. of Queensland
Mishra, Yateendra — The Univ. of Queensland
Dong, Zhao Yang — The Univ. of Queensland
Wong, Kit Po — The Hong Kong Pol. Univ.

Power system stabilizer (PSS) is one of the most important controllers in modern power systems for damping low frequency oscillations. Many efforts have been dedicated to design the tuning methodologies and allocation techniques to obtain optimal damping behaviors of the system. Traditionally, it is tuned mostly for local damping performance, however, in order to obtain a globally optimal performance, the tuning of PSS needs to be done considering more variables. Furthermore, with the enhancement of system interconnection and the increase of system complexity, new tools are required to achieve global tuning and coordination of PSS to achieve optimal solution in a global meaning.

Differential evolution (DE) is a recognized as a simple and powerful global optimum technique, which can gain fast convergence speed as well as high computational efficiency. However, as many other evolutionary algorithms (EA), the premature of population restricts optimization capacity of DE. In this paper, a modified DE is proposed and applied for optimal PSS tuning of 39-Bus New-England system. New operators are introduced to reduce the probability of getting premature. To investigate the impact of system conditions on PSS tuning, multiple operating points will be studied. Simulation result is compared with standard DE and particle swarm optimization (PSO).

11:10-11:30 FrA26.3

Multi-Agent Based Dynamic Stability Control for Low-Frequency Global Mode of Oscillations (I), pp. 14945-14950

Hiyama, Takashi — Kumamoto Univ.
Zhang, Wei — Kumamoto Univ.

This paper presents a multi-agent based dynamic stability control of electric power systems especially for low-frequency global mode of oscillations. Different types of intelligent agents are also proposed to realize the proposed wide area stability control system: monitoring agents for gathering required information to evaluate the dynamic stability of the study system, control agents which perform the actual control action, and a supervisor agent for the real time monitoring of eigenvalue based dynamic stability and the decision of the required dynamic stability control action to keep the pre-specified dynamic stability margin. The supervisor agent sends commands to a selected unit to keep the stability margin within the pre-specified range, whenever the stability margin is violated in the study system. To demonstrate the efficiency of the proposed multi-agent based dynamic stability control system, real time non-linear simulations have been performed on the Analog Power System Simulator at the Research Laboratory of Kyushu Electric Power Co.

11:30-11:50 FrA26.4

A Tabu Search Based Method for Optimal Allocation of D-FACTS in Distribution Systems (I), pp. 14951-14956

Mori, Hiroyuki — Meiji Univ.
Tani, Hidenobu — Meiji Univ.

This paper proposes a tabu search (TS) based method for optimal allocation of FACTS (Flexible AC Transmission Systems) devices in distribution systems. Distributed generation is wildly spread to smooth operation and planning in power systems so that wind power generation units are connected to distribution systems. Although they contribute to the improvement of operation and planning in distribution systems, they often bring about difficulties that the reverse power flows cause the voltage and frequency fluctuations due to uncertain wind power generation output. In this paper, a new optimization method is proposed to control the voltage deviations caused by wind power generation. It is necessary to determine the optimal allocation and the output variable of power controllers for uncertain wind power generation. As the controller, D-FACTS which imply the FACTS devices for distribution systems are used to control power flows. This paper presents the Monte Carlo method that determines the optimal allocation and the output variable of the controllers and evaluates the voltage security assessment in a stochastic way. The proposed method is successfully applied to the IEEE 32-node distribution system.

11:50-12:10 FrA26.5

Supplementary Damping Controller Design Using Direct Heuristic Dynamic Programming in Complex Power Systems (I), pp. 14957-14962

Lu, Chao — Tsinghua Univ.
Si, Jennie — Arizona State Univ.

In modern, large scale interconnected power grids, low-frequency oscillation is a key roadblock to improved power transmission capacity. Supplementary generator control, flexible AC transmission system (FACTS), and high voltage direct currents (HVDC) are engineered devices designed to damp such low frequency swings. In this paper a neural network-based approximate dynamic programming method, namely direct heuristic dynamic programming (direct HDP), is applied to power system stability enhancement. Direct HDP is a learning and approximation based approach to addressing nonlinear system control problems under uncertainty, and it is also a model-free design strategy. The action and critic networks of the direct HDP are implemented using multi-layer perceptrons; learning is carried out based on the interactions between the controller and the power system. For this design approach, real time system responses are provided through wide-area measurement system (WAMS). The controller learning objective is formulated as a reward function that reflects global characteristics of the power system under low frequency oscillation, as well as tight coupling effects among system components. Direct HDP control design is illustrated by case studies, which are also used to demonstrate the learning control performance. The proposed direct HDP learning control is also developed as a new solution to a large scale system coordination problem by using the China Southern Power Grid as a major test bed.

12:10-12:30 FrA26.6

Consideration of Wind Power and Demand Uncertainties in Unit Commitment Problem Using PSO (I), pp. 14963-14968

Istvan, Erlich — Univ. Duisburg Essen
Pappala, Venkata Swaroop — Univ. Duisburg Essen

This paper addresses a multistage stochastic model for the optimal operation of wind farm, pumped storage and thermal power plants. The output of the wind farm and the electrical demand are considered as two independent stochastic processes. The evolution of these processes over time is modeled as a scenario tree. Considering all possible realizations of stochastic process, leads to a huge set of scenarios. These scenarios are reduced by a particle swarm optimization based scenario reduction algorithm. The scenario tree modeling transforms the cost model to a stochastic model. The stochastic model can be used to estimate the operation costs of the hybrid system under the influence of the uncertainties. The stochastic model is solved using adaptive particle swarm optimization.

FrA27 326

Remote Sensor Data Acquisition (Regular Session)

Chair: Salichs, Miguel A. — Univ. Carlos III
Co-Chair: Rehm, Ansgar — Univ. of Applied Sciences Osnabrück

10:30-10:50 FrA27.1

Decentralized and Robust Target Tracking with Sensor Networks, pp. 14969-14975

Bishop, Adrian — Deakin Univ.
Pathirana, Pubudu N. — Deakin Univ.
Savkin, Andrey V. — Univ. of New South Wales

In this paper we address the problem of decentralized and robust linear filtering for target tracking using networks of (radar) sensors taking nonlinear range and bearing measurements. The algorithm introduced in this paper permits efficient data fusion from multiple sensors through a summation style fusion architecture. Moreover, we prove that the state estimation error for the linear filtering algorithm is bounded.

10:50-11:10 FrA27.2

Multi-Person Pose Recognition Using a Zigbee Sensor Network, pp. 14976-14981

Song, Kai-Tai — National Chiao Tung Univ.
Chen, Chun-Wei — National Chiao Tung Univ.

This paper presents a novel design of a robotic multi-person posture recognition system. The proposed system consists of a human posture detection module, a wireless sensor network and a multi-person activity monitoring software running on a mobile robot. The human posture detection is based on a triaxial accelerometer and the developed posture recognition algorithms. Further, the posture detection module has a Zigbee chip and an 8-bit microcontroller on board. Thus, several posture detection modules and a Zigbee node connected to the robot control computer form a Zigbee wireless network. In the Zigbee sensor network, each posture detection module can communicate with the robot onboard computer. The multi-person activity monitoring software can monitor and record the postures of multiple users on-line in real time. A posture classification algorithm is proposed by combining timedomain analysis and wavelet transform analysis. The complete algorithm has been realized in the microcontroller of the human posture detection module. In the current design, the system can classify seven human postures: falling, standing, sitting, lying, walking, downstairs. After testing the system by five users, we have demonstrated an accurate rate of 88%.

11:10-11:30 FrA27.3

Tree-Based Deployment Algorithm of Mobile Sensors in Ubiquitous Sensor Network, pp. 14982-14986

Moon, Chongchun — Inha Univ.
Park, Jaehyun — Inha Univ.
Kim, Yoo-Sung — Inha Univ.

A Sensor network, aggregation of stand alone sensor nodes, is one of the most important technology infrastructures to build a ubiquitous environment. To collect diverse data in a large area, the sensing coverage as well as power consumption of each node is an important issue in sensor networks. To enhance the coverage in sensor network that is mostly based on the ad-hoc network, the deployment algorithm of sensor nodes plays an important role in a ubiquitous sensory environment. This paper focuses on a deployment algorithm for a mobile sensor network to disperse nodes widely and uniformly. The proposed algorithm uses tree topology to reduce the computation and spreading time compare to other deployment algorithms. This paper includes the detailed algorithm and its the estimated performance simulated by NS-2 simulator.

11:30-11:50 FrA27.4

Centralized Monitoring for Vehicle Dynamics Sensor Networks, pp. 14987-14991

Rehm, Ansgar — Univ. of Applied Sciences Osnabrück

An increasing number of control systems in modern automotive vehicles is based on measurements of signals describing vehicle dynamics. Correspondingly, a large number of sensors is required. To spare on weight and even more important on costs, car manufacturers require joint processing of sensors, i.e. the individual sensors related to certain control systems should become part of a sensor network. In the paper at hand the possibilities and shortcomings of such an approach are examined from a sensor monitoring and estimation perspective. Especially, redundant and model based failure detection are considered. The focus is on signals and sensors related to vehicle dynamics and the corresponding question of fall back strategies in case of sensor failure. Corresponding problems are addressed with the introduction of a new sensor network architecture.

11:50-12:10 FrA27.5

Wireless Sensor Network Based Control System Concidering Communication Cost, pp. 14992-14997

Iino, Yutaka — Tokyo Inst. of Tech.
Hatanaka, Takeshi — Tokyo Inst. of Tech.
Fujita, Masayuki — Tokyo Inst. of Tech.

This paper is discussed on some new control methodologies for wireless sensor network based control system, minimizing communication energy consumption. Some control problems with communication cost saving are defined. Then, a heuristic control method based on the Model Predictive Control strategy with a receding horizon cost function including control performance and communication cost is proposed. For a state feedback control problem, a sufficient condition to keep stability of the closed loop system is obtained. Some numerical examples are also illustrated.

12:10-12:30 FrA27.6

Passive Correction of Position Error in Internet-Based Teleoperation, pp. 14998-15003

Fernández Villaverde, Alejandro — Univ. of Vigo
Barreiro, Antonio — Univ. of Vigo
Raimúndez, José Cesáreo — Univ. of Vigo

During the last two decades, important advances have been made in the field of bilateral teleoperation. Different techniques for performing stable teleoperation under difficult circumstances have been developed, specially in the passivity field. However, there is not one definitive method for correcting the position error, and no robust solutions for addressing this problem with variable delay communications (internet-based, for example) have been developed. In this paper an arrangement is proposed which is capable of achieving good position tracking while maintaining passivity. The resulting controller is suitable for unreliable, internet-like communications channels and its stability is independent of the plant.

FrA28 — 330A

Marine System I (Regular Session)

Chair: Pascoal, Antonio M. — ISR-Inst. Superior Tecnico
Co-Chair: Katebi, Reza — Univ. of Strathclyde

10:30-10:50 — FrA28.1

Frequency Domain Study of Longitudinal Motion Attenuation of a Fast Ferry Using a T-Foil, pp. 15004-15009

Giron-Sierra, Jose M — Univ. Complutense de Madrid
Esteban, Segundo — Univ. COMPLUTENSE DE MADRID

Longitudinal, heave and pitch, motion of ships in response to encountered waves can be smoothed using moving submerged wings, like transom flaps or a T-foil under the bow. Recently a 3 DOF detailed model of the surge, pitch and heave motions of a fast ferry has been developed, in terms of a structure of twelve transfer functions. On the basis of this model the most effective control for motion attenuation using a T-foil has been determined in the frequency domain, both for unlimited or saturated action. The results have been obtained by point to point exploration and depict amplitude and phase profiles of the controller. This result is useful to orientate linear control design. A first preliminary linear controller is presented.

10:50-11:10 — FrA28.2

A Four-Quadrant Thrust Controller for Marine Propellers with Loss Estimation and Anti-Spin, pp. 15010-15015

Pivano, Luca — Norwegian Uni. Science & Tech.
Bakkeheim, Jostein — Norwegian Univ. of Science and Tech.
Johansen, Tor Arne — Norwegian Univ. of Science and Tech.
Smogeli, Oyvind Notland — Norwegian Univ. of Science and Tech.

In this paper a nonlinear thrust controller for a fixed pitch marine propeller with torque loss estimation and an anti-spin strategy is presented. The controller, designed to work in the four-quadrant plane composed by the shaft speed and the vessel speed, is a combination of a thrust controller designed for calm sea conditions and an anti-spin strategy to reduce power peaks and wear-and-tear in extreme sea conditions. The anti-spin algorithm avoid large increase of the shaft speed once high torque losses due to ventilation are detected and set the shaft speed to normal when the loss situation is considered over. The ventilation incident is detected by monitoring the torque losses, estimated with a nonlinear observer. The performances of the proposed controller are validated by experiments carried out in a towing tank.

11:10-11:30 — FrA28.3

Position and Velocity Navigation Filters for Marine Vehicles, pp. 15016-15021

Batista, Pedro — Inst. Superior Técnico
Silvestre, Carlos — Inst. Superior Tecnico
Oliveira, Paulo Jorge — Inst. Superior Técnico

This paper presents the design and performance evaluation of two globally stable time varying kinematic Navigation Kalman filters to estimate linear motion quantities, in three dimensions, with application to underwater vehicles. The proposed technique is based on the linear time invariant Kalman filter steady state solution and employs frequency weights to explicitly achieve adequate wave disturbance rejection and attenuation of the noise of the sensors on the state estimates. In the first case study a Navigation filter is designed for the estimation of unknown constant ocean currents, linear position, and inertial velocity of an underwater vehicle with respect to a fixed point in the mission scenario. In the second case the proposed solution also addresses the estimation of the acceleration of gravity. The theoretical background is briefly introduced and simulation results are offered that illustrate the achievable performance in the presence of extreme environmental disturbances and realistic noise of the sensors.

11:30-11:50 — FrA28.4

Stable Schooling for Multiple Underactuated AUVs, pp. 15022-15027

Li, Ji-Hong — Maritime and Ocean Engineering Res. Inst. KORDI
Lee, Pan-Mook — Korea Res. Inst. of Ships andOceanEngineering,KORDI

This paper presents a stable schooling scheme for multiple autonomous underwater vehicles (AUVs) where the number of independent actuators for each vehicle are less than the degrees of freedom (DOF). In most of the formation schemes presented so far, the multiple dynamic agents usually have been modeled as particle systems whose motions can be expressed as simple double-integrator. Therefore, these formation algorithms could not directly apply to the most of actual systems, typically to the case of underwater vehicle systems whose dynamics are highly nonlinear. Moreover, the AUVs considered in this paper are underactuated that each vehicle’s 6 DOF motion is steered only by one thruster, one rudder, and one stern plane. For this kind of multiple underwater vehicles, proposed schooling scheme can guarantee the stability of the formation and further guarantee the velocity and heading matching of the group while keeping obstacle avoidances. Numerical simulations are carried out to illustrate the effectiveness of the proposed schooling scheme.

11:50-12:10 — FrA28.5

Towards a Mission Control Language for AUVs, pp. 15028-15033

Palomeras, Narcis — Univ. of Girona
Ridao, Pere — Univ. of Girona
Carreras, Marc — Univ. of Girona
Silvestre, Carlos — Inst. Superior Tecnico

This paper presents the design and implementation of a Mission Control System (MCS) for an AUV. The mission is easily described using an imperative-like pseudo-code called Mission Control Language (MCL) that allows sequential/parallel, conditional and iterative task execution. MCL can be automatically translated into a Petri net, to formally describe the mission thread of execution. Then the MCS executes the Petri net in real-time over a generic layer that communicates with a particular control architecture using prede_;ned actions and events. Concepts are illustrated with a simple mission.

12:10-12:30 — FrA28.6

Modelling and Control of Offshore Marine Pipeline During Pipelay, pp. 15034-15039

Jensen, Gullik Anthon — Norwegian Univ. of Science and Tech.
Transeth, Aksel Andreas — Norwegian Univ. of Science and Tech.
Nguyen, Tu Duc — Norwegian Univ. of Science and Tech.

A model suited for control tasks is developed for a submerged offshore pipe during the pipelay operation. The pipe is fixed in the touchdown point at the seabed in one end and attached to a pipelay vessel in the other end. The developed model is discrete and is on the form of the robot equation with minimal coordinates. Thus the methods of controller synthesis and stability analysis can be applied directly. The model constitutes a hyper redundant system and it is shown that this system is passive. A PID-controller has been suggested. The simulation results are in agreement with the theoretical results.

FrA29 — 330B

Adaptive and Robust Control in Aerospace Vehicles (Regular Session)

Chair: Choi, Jae Weon — Pusan National Univ.

Co-Chair: Lauffenburger, Jean-Philippe | Univ. of Haute-Alsace

10:30-10:50 FrA29.1

Stabilizing Nonlinear Adaptive PID State Feedback Control for Spacecraft Capturing, pp. 15040-15045

Ikeda, Yuichi | Kushiro National Coll. of Tech.
Kida, Takashi | Univ. of Electro-Communications
Nagashio, Tomoyuki | Univ. of Electro-Communications

In the future space infrastructure, the missions of refueling and capturing of the inoperative spacecraft by the orbital servicing vehicle or the space robot are considered. To achieve them, the six degrees of freedom tracking control of the chaser spacecraft is required to approach the target spacecraft. Moreover, the stability of the connected system of the chaser and target must be ensured. In addition, it is also important to suppress the position and attitude error under the influence of the disturbance. In this paper, we derive the PID controller that satisfies the stability of the spacecraft system before and after capturing, and removes the states error caused by constant disturbance. The effectiveness of controller is verified by numerical simulations.

10:50-11:10 FrA29.2

Novel Control Scheme for Helicopter Flight: Fuzzy Immune Adaptive Model Inversion Control, pp. 15046-15051

Zhao, Jia | Beijing Univ. of Aeronautics and Astronautics
Chen, Shenggong | Beijing Univ. of Aeronautics and Astronautics
Shen, Gongzhang | Beijing Univ. of Aeronautics and Astronautics

A novel control scheme, fuzzy immune adaptive model inversion control, was put forward, aiming at the large flight envelope curve control problem of helicopter. The proposed scheme was designed based on model inversion theory,biology immune response mechanism and fuzzy control method.It could achieve effective control throughout large flight envelope curve with the design of fuzzy immune online-compensation element, only needing a static inverse model on the basis of a single flight condition. Simulation results comparing with the neural network adaptive control method show the system based on the proposed scheme has better real-time performance. It can offer adaptive compensation in time for model inverse errors caused by the changes of flight conditions and achieve accurate commands tracking. Stronger robustness has been demonstrated in the case of control surface damage and sensor output noise. Good three-axis uncoupled performance has also been shown.

11:10-11:30 FrA29.3

Active Shimmy Damping Using Direct Adaptive Fuzzy Control, pp. 15052-15057

Huynh, Thai-Hoang | Univ. de Haute-Alsace
Pouly, Gaétan | Univ. de Haute-Alsace
Lauffenburger, Jean-Philippe | Univ. of Haute-Alsace
Basset, Michel | Univ. de Haute-Alsace

The shimmy phenomenon is a self-excited limit cycle oscillation occurring in many physical rolling systems, particularly in aircraft nose landing gears (NLG). This paper presents a new active damping controller developed in the context of the European DRESS ("Distributed and Redundant Electro-mechanical nose gear Steering System") project for avoiding the shimmy oscillation. The controller based on the direct adaptive control approach, consists of two terms: the fuzzy adaptive term approximates the feedback linearization control law, and the stabilizing control term compensates the structural modelling error. The closed-loop system stability is proven by using Lyapunov theory. Simulation results corresponding to different test scenarios show that the proposed controller is able to effectively damp the shimmy phenomenon.

11:30-11:50 FrA29.4

Indirect Fuzzy Adaptive Control for Active Shimmy Damping, pp. 15058-15063

Pouly, Gaétan | Univ. de Haute-Alsace
Huynh, Thai-Hoang | Univ. de Haute-Alsace
Lauffenburger, Jean-Philippe | Univ. of Haute-Alsace
Basset, Michel | Univ. de Haute-Alsace

In the context of aircraft, shimmy is an oscillatory phenomenon of the landing gear mainly due the tire dynamics and the landing gear structural dynamics. This phenomenon, which can result in severe structural damages of the landing gear, is here actively damped by an indirect fuzzy adaptive controller. The difficulties to model the ground/wheel interface require the use of an adaptive controller that can modify its behavior in accordance with the plant dynamics. Thus, the proposed controller uses a fuzzy system to estimate the plant dynamics, and then implements this estimate to generate the control law. Based on Lyapunov's theory, it is shown that the proposed adaptive control solution guarantees that the tracking errors will asymptotically converge to zero even if approximation errors appear in the estimation. Simulation results show that the proposed control law creates a realistic control input which properly damps the oscillations. This work is supported by the European DRESS project (Distributed and Redundant Electromechanical nose gear Steering System).

11:50-12:10 FrA29.5

A Model Reference Adaptive Variable Structure Controller for Reconfigurable Flight Control Systems, pp. 15064-15069

Sun, Weimeng | National Univ. of Defense Tech.
Han, Dapeng | National Univ. of Defense Tech.
Zheng, Zhiqiang | National Univ. of Defense Tech.
Peng, Xuefeng | National Univ. of Defense Tech.

This paper presents a new design of reconfigurable flight controller, applying both variable structure control and model reference adaptive control. In case of control effectors failures, aircraft model will vary, and unknown disturbances will affect the characteristics of controller. To study this problem, a model reference adaptive variable structure control law is designed, which composes a model-following adaptive control part and a variable structure control part. According to the model matching condition, an update scheme is used in the adaptive control part to eliminate system errors caused by model mismatch. With an adaptive sliding-mode gain the variable structure control part can deal with uncertain bounded disturbances of flight system. An aircraft example with stabilsator failure is presented to demonstrate the feasibility of the proposed reconfigurable control law. Simulation results show the control law is effective for reconfigurable flight control systems.

12:10-12:30 FrA29.6

Robust LPV Control of UAV with Parameter Dependent Performance, pp. 15070-15075

Chen, Jianchi | Univ. of Leicester
Gu, Dawei | Univ. of Leicester
Postlethwaite, Ian | the Univ. of Leicester
Natesan, Kannan | Univ. of Leicester

Existing control theory for linear parameter varying system uses a uniform upper bound on the induced-L2 norm for the varying parameters. In this paper, this constant is generalized as a function of parameters, the design provides varying induced-L2 performance in the presence of real-time variations and consequently gives rise to the superior robust performance of the local operating point. The controller synthesis incorporates known bounds on the rate of variation and as in the existing theory, the synthesis problem reduces to convex optimization involving linear matrix inequalities. An example, robust LPV flight control design of UAV demonstrator was used to illustrate the design criterion.

FrA30 330C

Non-Intrusive Human Monitoring (Invited Session)

Chair: Itoh, Makoto | Univ. of Tsukuba
Co-Chair: Szpytko, Janusz | AGH Univ. of Science and Tech.
Organizer: Itoh, Makoto | Univ. of Tsukuba

10:30-11:10 FrA30.1

Human Monitoring-Based Driving Support (I), pp. 15076-15087

Itoh, Makoto | Univ. of Tsukuba

From April 2004 to March 2007, a research project entitled "Situation and Intent Recognition for Risk Finding and Avoidance" was conducted. This project includes the following research topics: (i) estimation of driver's state, (ii) driver behavior modeling, (iii) intelligent information processing methods for situation recognition and visual enhancement. This paper introduces several researches in which the author participated in the project on driver monitoring techniques and design of driver support based on the driver monitoring.

11:10-11:30 FrA30.2

Toward Cooperative and Human Error-Tolerant System, pp. 15088-15093

Millot, Patrick — Univ. of Valenciennes
Vanderhaegen, Frédéric — Univ. of Valenciennes

This paper focuses on parameters related to the human machine cooperation and erroneous human behaviour affecting the system performance and safety. The concept of cooperation is presented through three prerequisites: the Know-How related to competences, Know-How-to-Cooperate related to coordination between activities and the Need-to-Cooperate to justify the activities of cooperation. It is extended to take into account normal and erroneous human behaviour. Such implementation is based on both human engineering and cognitive control principles. Examples in air traffic control illustrate these concepts for prevention support. Work perspective focuses on the integration of the correction and the containment processes of human errors.

11:30-11:50 — FrA30.3

Mental Workloads Can Be Objectively Quantified in Real-Time Using VOR (Vestibulo-Ocular Reflex) (I), pp. 15094-15099

Obinata, Goro — Nagoya Univ.
Tokuda, Satoru — Wichita State Univ.
Shibata, Naoki — Nagoya Univ.

This present study offers a new method to quantify mental workloads (MWL) utilizing vestibule-ocular reflex (VOR). The VOR method makes use of the relation between a person's VOR responses and his/her mental demands; Human VOR responses can be accurately predicted in a dynamical equation that is a function of the person's head movements, unless the person is engaging in a higher cognitive activity. In this present study, the coherence between the predicted VOR and the observed VOR was as high as 0.92 when there was no additional mental demands. However, the manipulation of MWL in five different tasks (i.e. the n-back task) revealed that the VOR coherences declined with the heavier MWL demands. This shows that MWL can be objectively quantified by measuring the gap between observed VOR responses and the mathematical-model-predicting VOR. This may be applicable in the future to quantifying a vehicle driver's MWL in real-time.

11:50-12:10 — FrA30.4

Human - Machine Interface Implementation in Designing Crane Control Based on Fuzzy Logic Algorithm, pp. 15100-15105

Szpytko, Janusz — AGH Univ. of Science and Tech.

The paper is focusing on Human Machine-Interface implementation in designing crane control based on fuzzy logic algorithm. The Human Machine-Interface application was created for visualization, monitoring and managing the transportation process realized by the crane. Control systems based on fuzzy controllers with Mamdani and Sugeno inference systems were elaborated and built using prototyping methods and tools enable for control object identification, real time tests on the control object and control algorithm implementation on target. Programmable Logic Controller

12:10-12:30 — FrA30.5

Skill Assist Neuro-Fuzzy Control of Omni-Directional Wheelchair for Attendants Considering Rotation Center of Vehicle, pp. 15106-15113

Terashima, Kazuhiko — Toyohashi Univ. of Tech.
Watanabe, Kaoru — Toyohashi Univ. of Tech.
Kondo, Yasumasa — Toyohashi Univ. of Tech.
Miyoshi, Takanori — Toyohashi Univ. of Tech.
Urbano, Juan — Toyohashi Univ. of Tech.
Kitamura, Sou — Toyohashi Univ. of Tech.
Kitagawa, Hideo — Gifu National Coll. of Tech.

For improving the operability of an omni-directional wheelchair provided with a power assist system, the system must be able to adapt to the individual characteristics of the many di.erent attendants that will use it. For achieving this purpose, an innovative human-interface using a touch panel that provides easy input and feedback information in real time of the operation of a power-assisted wheelchair was developed. The system was tested experimentally with many di.erent attendants and the results show that in addition to providing a human friendly interface by using the touch panel system with monitor it can adapt successfully to the particular habits of the attendants. Furthermore, control of rotation center of OMW is proposed by making use of OMW's potential advantage and coordination transformation.

FrB02 — 304A

Chaotic Systems and Bifurcations (Regular Session)

Chair: Bobtsov, Alexey — Saint-PetersburgStateUniversityofInformationTechnologiesMechanics andOptics
Co-Chair: Liu, Derong — Univ. of Illinois at Chicago

14:00-14:20 — FrB02.1

Robust Impulsive Synchronization for a Class of Unified Chaotic Systems with Parameter Uncertainty, pp. 15114-15118

Ma, Tiedong — Northeastern Univ.
Zhang, Huaguang — Northeastern Univ.
Liu, Derong — Univ. of Illinois at Chicago

For a class of unified chaotic systems with parameter uncertainty, a robust impulsive synchronization scheme is proposed. Based on the theory of impulsive differential equations, some new and less conservative sufficient conditions are established in order to guarantee the robust synchronization of the chaotic systems. In particular, some simple and practical conditions are derived in synchronizing the chaotic systems by equal impulsive distances and control gains. Simulation results finally demonstrate the effectiveness of the method.

14:20-14:40 — FrB02.2

Hopf Bifurcations in Normal Forms of Third Order Nonlinear Affine Control Systems, pp. 15119-15124

Innocenti, Giacomo — Univ. di Firenze
Tesi, Alberto — Univ. di Firenze
Genesio, Roberto — Univ. di Firenze

The paper investigates Hopf bifurcations in a class of simple nonlinear systems, i.e., third order affine control systems described in terms of "quadratic plus cubic" normal forms and subject to linear state feedback control laws. By employing Harmonic Balance (HB) tools, the set of system parameters corresponding to supercritical and subcritical bifurcations is analytically determined. Also, a second order harmonic approximation of the bifurcated periodic solution is provided. Such analytical results can be exploited as starting points to investigate complex behaviours of the considered class of simple nonlinear systems.

14:40-15:00 — FrB02.3

A New Criterion for Synchronization in Deterministic Underdamped Ratchets, pp. 15125-15130

Lu, Pingli — Peking Univ.
Yang, Ying — Peking Univ.
Huang, Lin — Peking Univ.

This paper deals with the synchronization for deterministic underdamped ratchets. Using the technique derived from pendulum-like nonlinear analytic theory and Kalman-Yakubovich-Popov(KYP) lemma, simple linear matrix inequality (LMI) formulations are established to guarantee the stable synchronization between two periodically driven identical deterministic, underdamped ratchets. With this new efficient criterion, the direction of transporting particles can be controlled and the distance among particles also can be fixed on some values in order to separate them. Finally, simulation results verified the applicability and validity of the proposed approach.

15:00-15:20 — FrB02.4

Global Stabilization of Periodic Orbits in Chaotic Systems by Using Symbolic Dynamics, pp. 15131-15136

Suzuki, Masayasu — Nagoya Univ.
Sakamoto, Noboru — Nagoya Univ.

In this report, a control method for the stabilization of periodic orbits for a class of discrete-time systems that are topologically conjugate to symbolic dynamics is proposed and applied to a population model in an ecosystem and the Smale horseshoe map. A periodic orbit is assigned as a target by giving a sequence in which symbols have periodicity. As a consequence, it is shown that any periodic orbits can be globally stabilized by using arbitrarily small control inputs. This work is the first attempt to systematically design a control system based on symbolic dynamics in the sense that one estimates the magnitude of control inputs and analyzes the Lyapunov stability.

15:20-15:40 — FrB02.5

Synchronizing Chaotic Systems Based on Tridiagonal Structure, pp. 15137-15142

Liu, Bin — Tsinghua Univ.
Min, Jiang — Tsinghua Univ.

Zengke, Zhang — Tsinghua Univ.

The design approach based on tridiagonal structure combines the structure analysis with the design of stabilizing controller. During the design procedure, the original nonlinear affine systems is transformed into a stable system with special tridiagonal structure. In this study, the method is proposed for synchronizing chaotic systems. There are several advantages in this method for synchronizing chaotic systems: (a) it presents a systematic procedure for construct a proper controller in chaos synchronization; (b) it can be applied to a variety of chaotic systems with lower triangular structure. Examples of Lorenz system, Chua's circuit and Duffing system are presented.

15:40-16:00 — FrB02.6

Stabilization of a Chaotic Van Der Pole System, pp. 15143-15147

Bobtsov, Alexey — Saint-PetersburgStateUniversityofInformationTechnologiesMechani
Pyrkin, Anton — Saint-Petersburg State Univ. of Information Tech. Mec
Slita, Olga — Baltic State Tech. Univ.
Nikolaev, Nikolay — Saint-Petersburg State Univ. of Information Tech. Me

An approach to stabilization problem of a chaotic Van der Pole system is presented. Control algorithm uses only measurements of output variable, not its derivatives or state vector of the system.

FrB03 — 304B

Systems with Saturation (Regular Session)

Chair: Glad, Torkel — Linkoping Univ.
Co-Chair: Marconi, Lorenzo — Univ. di Bologna

14:00-14:20 — FrB03.1

Saturated Root Locus: Theory and Application, pp. 15148-15153

Ching, ShiNung — Univ. of Michigan
Kabamba, Pierre T. — Univ. of Michigan
Meerkov, Semyon M. — Univ. of Michigan

This paper extends the standard root locus technique to systems with saturating actuators. This is accomplished by introducing the notion of S-poles, which are the poles of the quasilinear system obtained by applying the method of stochastic linearization to the system with saturation. The path traced by the S-poles on the complex plane when the gain of the controller changes from zero to infinity is the S-root locus. We show that the S-root locus is a subset of the standard root locus, which may terminate prematurely at the so-called termination points. A method for calculating these points is presented. In addition, the issue of amplitude truncation in terms of the S-root locus is investigated. Finally, an application of the S-root locus to hard disk drive controller design is presented, and it is shown that this simple technique results in a controller that compares favorably with those designed using more sophisticated approaches.

14:20-14:40 — FrB03.2

Nonlinear Output Feedback Control for Linear Systems with Input Saturation, pp. 15154-15159

Akasaka, Daisuke — Chiba Univ.
Liu, Kang-Zhi — Chiba Univ.

In this paper, nonlinear output feedback control design for linear systems subject to input saturation is addressed. Main issues of this paper are 1. stability analysis of the feedback system for both of state and output feedback and 2. design of stabilizing nonlinear feedback law. Sufficient global stability conditions for both of state and output feedback are derived. Furthermore, a design approach based on analytical solution of partial differential equations is proposed. It is shown that a class of feedback laws can be explicitly obtained, which is parameterized by nonlinear functions.

14:40-15:00 — FrB03.3

Improved Multipliers for Input-Constrained Model Predictive Control, pp. 15160-15165

Heath, William Paul — Univ. of Manchester
Li, Guang — The Univ. of Bristol

The stability and robustness of input-constrained model predictive control can be analyzed using the theory of integral quadratic constraints. We demonstrate the existence of improved multipliers when there are only stage constraints. This can significantly reduce the conservatism of any stability analysis, and we illustrate the improved performance with a simple numerical example.

15:00-15:20 — FrB03.4

Tracking Control with Saturating Actuators: A Method Based on State-Dependent Gain-Scheduling and Reference Management, pp. 15166-15171

Wada, Nobutaka — Hiroshima Univ.
Saeki, Masami — Hiroshima Univ.

In this paper, we consider tracking control problems in the presence of actuator saturation. We first show a control law that internally stabilizes a closed-loop system and the tracking error converges to zero in the case where a reference signal is generated by a certain dynamics. The control law is based on the recently developed state dependent gain-scheduling algorithm and makes it possible to achieve large region of attraction and fast convergence of tracking error. Then we extend this result to the cases where the reference signal is an arbitrary time-varying signal. The effectiveness of the proposed methods are shown through numerical examples.

15:20-15:40 — FrB03.5

Explicit Formulas for ISS Stabilization of Nonlinear Systems Subject to Bounded Inputs and Disturbances, pp. 15172-15178

Nakamura, Hisakazu — Nara Inst. of Science &Tech.
Nakamura, Nami — Nara Inst. of Science and Tech.
Nishitani, Hirokazu — Nara Inst. of Sci. & Tech.

Control Lyapunov functions (CLFs), CLF based controller designs and disturbance attenuation have attracted much attention in nonlinear control theory.However, little research exists that considers both the input constraint and the disturbance attenuation problems.For input constrained systems, we cannot stabilize under unbounded disturbances in general. Therefore, we propose an input-to-state stabilizable robust control Lyapunov function (ISS-RCLF) and an asymptotically stabilizable robust control Lyapunov function (AS-RCLF) for an input-restricted nonlinear system. In this paper, we propose a stabilizing controller for input and disturbance constrained nonlinear systems using ISS-RCLF, which becomes continuous if an ISS-RCLF has an ISS-CLF small control property. Moreover, we clarify the condition to be satisfied for an AS-RCLF and an ISS-RCLF, and when a proper function becomes an ISS-RCLF. Finally, we show the effectiveness of the proposed method by computer simulation.

15:40-16:00 — FrB03.6

Fast Robust Control of Linear Systems Subject to Actuator Saturation, pp. 15179-15184

Jasniewicz, Boris — Tech. Univ. Darmstadt
Adamy, Jürgen — Tech. Univ. Darmstadt

This paper deals with the robust stability of soft variable-structure controls. More precisely, the control of linear plants subject to parametric uncertainty and actuator saturation is considered. Earlier works are summarized and new results are presented in this paper. It is shown that for all considered types of soft variable-structure controls, the robustness analysis leads to parameter-dependent Lyapunov inequalities. An overhead crane control is given as an illustrating example.

FrB04 — 308

Topics in Control (Regular Session)

Chair: Qu, Zhihua — Univ. of Central Florida
Co-Chair: Kotta, Ülle — Inst. of Cybernetics at TUT

14:00-14:20 — FrB04.1

Finite-Time Consensus for Multi-Agent Networks with Second-Order Agent Dynamics, pp. 15185-15190

Wang, Xiaoli — Acad. of Mathematics and Systems Science
Hong, Yiguang — Chinese Acad. of Sciences

This paper considers the finite-time consensus problem for a multi-agent system with second-order individual dynamics. Local (non-smooth) time-invariant consensus protocols in different forms are constructed for each double-integrator agent dynamics in a quite unified way with help of Lyapunov function, graph theory, and homogeneity with dilation. Finite-time consensus can be obtained theoretically via the proposed non-smooth but continuous forms of distributed coordination controllers. Also, numerical analysis is given for illustration.

14:20-14:40 — FrB04.2

Design Technique for Multi-Rate Linear Systems, pp. 15191-15196

Cimino, Mauro — Oklahoma State Univ.
Pagilla, Prabhakar R. — Oklahoma State Univ.

In this paper a design technique for multi-rate, linear digital control systems is described. This technique takes into account all the sampling rates involved in the system, and generates a multi-rate system that mimics the dynamics of a desired single-rate closed-loop system. The desired closed-loop system is referred to as an ideal single-rate system (ISRS) since it operates at the fastest sampling rate present in the system. The multi-rate system is designed to achieve state-matching, at the fastest rate, with the ISRS, and to exhibit a ripple-free response with zero steady-state error in response to a step reference signal. Unlike prior work in the literature, which is applicable only to static feedback ISRS, the proposed state-space design procedure is applicable for any LTI dynamic feedback ISRS. The proposed design is successfully implemented on a hard disk drive (HDD) platform for seek control of the read-write (R/W) arm. A representative sample of the experimental results are shown and discussed to highlight the proposed multi-rate technique.

14:40-15:00 FrB04.3
Transfer Function Approach to the Model Matching Problem of Nonlinear Systems, pp. 15197-15202
Halas, Miroslav — Faculty of Electrical Engineering and InformationTechnology, Slo
Kotta, Ülle — Inst. of Cybernetics at TUT
Moog, Claude — CNRS

The mainstream for the analysis and synthesis of nonlinear control systems is the so-called state space approach. The Laplace transform of a nonlinear differential equation is non tracktable and any transfer function approach was not developed until recently. Herein, we show that one may use such mathematical tools to recast and solve the model matching problem. Note that the latter was originaly stated for linear time invariant systems, in terms of equality of the transfer function of both the model and the compensated system.

15:00-15:20 FrB04.4
Continuous Time-Varying Pure Feedback Control for Chained Nonholonomic Systems with Exponential Convergent Rate, pp. 15203-15208
Yuan, Hongliang — Univ. of Central Florida
Qu, Zhihua — Univ. of Central Florida

In this paper, feedback stabilization problem of nonholonomic chained system is studied. A new continuous and time-varying design approach is proposed and it is a pure state feedback control. By injecting an exponential decaying disturbance scaled by the norm of the states, u_1 drives the initial states away from the singular manifold {x|x_1=0,|x|neq0} that causes singularity. In addition to the continuity, such a control has the exponential convergent rate that discontinuous control has. The enclosed simulation results verified the effectiveness of the proposed approach. Comparisons made with other existing continuous and discontinuous controls show that the proposed control has superior performance.

15:20-15:40 FrB04.5
A Constant D-Scale Mu-Synthesis Approach Based on Nonsmooth Optimization, pp. 15209-15213
Prempain, Emmanuel — Univ. of Leicester
Postlethwaite, Ian — the Univ. of Leicester

This paper presents a nonsmooth optimization technique for solving a special mu-synthesis control problem. Attention is focused on controller synthesis problems that involve real diagonal scalings. An academic example illustrates the synthesis algorithm and a comparison is made with the well-known DK-iteration algorithm. This paper shows that nonsmooth optimization synthesis can provide better solutions than the standard DK-iteration algorithm.

15:40-16:00 FrB04.6
Estimate of Attractive Regions for Systems Satisfying Polytopic Uncertainties in Given Regions, pp. 15214-15219
Ohta, Yuzo — Kobe Univ.
Taguchi, Takaaki — Kobe Univ.

To estimate stability region of systems satisfying polytopic uncertainties in given regions is very important since such systems are given as models of linear systems with saturating control or nonlinear systems with nonlinear elements which satisfy sector conditions in given regions. In this paper, we propose a method to estimate the maximal robust attractive region of such systems using polytope Lyapunov functions. To demonstrate the usefulness of the proposed method we show some numerical examples.

FrB05 307
Digital Control (Regular Session)
Chair: Whidborne, James F. — Cranfield Univ.
Co-Chair: Maciejowski, Jan — Univ. of Cambridge

14:00-14:20 FrB05.1
Optimal Finite-Precision Implementations of Linear Parameter Varying Controllers, pp. 15220-15225
Whidborne, James F. — Cranfield Univ.
Chevrel, Philippe — IRCCyN / Ec. des Mines de Nantes

Digital computing devices have a finite precision. Hence when digital controllers are implemented, there is rounding on the variables and parameters resulting in the various finite-word-length effects on the closed-loop stability and performance of the system. In this paper we concentrate on the coefficient sensitivity problem. That is: to determine the controller realization that minimizes the sensitivity of the closed-loop system to small perturbations on the controller coefficients. The sensitivity minimization problem can be approximated by a stability radius maximization problem. In this paper we consider the coefficient sensitivity problem for digital implementations of linear parameter-varying controllers. The problem of maximizing the stability radius for the coefficient sensitivity problem for linear parameter-varying controllers reduces to the solution of a set of linear matrix inequalities. The approach is demonstrated on an example. Furthermore, the example shows that eigenvalue sensitivity measures are not generally suitable for linear-parameter-varying controller, finite-word-length problems.

14:20-14:40 FrB05.2
A Sampled-Data Scheme for Disturbance Rejection of Nonlinear Systems in Output Feedback Form, pp. 15226-15231
Wu, Buzhou — The Univ. of Manchester
Ding, Zhengtao — The Univ. of Manchester

This paper presents a sampled-data control scheme for disturbance rejection of nonlinear systems in output feedback form. The continuous-time controller is designed first using a filtered transformation and the internal model technique. Obtained on an emulation-based approach, the proposed sampled-data control uses the sampled output and a discrete-time implementation of the filter and the internal model is involved. The proposed control is shown to render the overall system stable in a spirit of fast sampling. Specifically, the ultimate bound of the output is allowed to be arbitrarily small by choosing appropriate gain parameters.

14:40-15:00 FrB05.3
ell_{p}-Equivalence of Discretizations of Analog Controllers, pp. 15232-15237
Zhang, Guofeng — Univ. of Electronic Science and Tech. of China
Chen, Xiang — Univ. of Windsor
Chen, Tongwen — Univ. of Alberta

This paper first introduces the fractional-order hold transformation that, together with the generalized bilinear transformation recently proposed in Zhang et al. [2007], contains all commonly used discretization methods as special cases. In light of this, it further shows that at fast sampling, all the digital approximations of an analog controller are equivalent in the sense of ell_p induced norm for pin [1, infty] when the analog controller is stable or in the sense of some gap metric even when it is unstable.

15:00-15:20 FrB05.4
State Based Self-Triggered Feedback Control Systems with L2 Stability, pp. 15238-15243
Wang, Xiaofeng — Univ. of Notre Dame
Lemmon, Michael — Univ. of Notre Dame

This paper examines a class of real-time control systems in which each control task triggers its next release based on the value of the last sampled state. Prior work by Lemmon et al. (2007) used simulations to demonstrate that self-triggered control systems can be remarkably robust to task delay. This paper derives bounds on a task's sampling period and deadline to quantify how robust the control system's performance will be to variations in these parameters. In particular we establish inequality constraints on a control task's period and deadline whose satisfaction ensures that the closed loop system's induced L2 gain lies below a specified performance threshold. The results apply to linear time-invariant systems driven by external disturbances whose magnitude is bounded by a linear function of the system state's norm. The plant is regulated by a full-information H_; controller. These results can serve as the basis for the design of soft real-time systems that guarantee closed-loop control system performance at levels traditionally seen in hard real-time systems.

15:20-15:40 FrB05.5

Multicomputer Research Desks for Simulation and Development of Control Systems, pp. 15244-15249

Dorri, Manucher	Inst. of Control Sciences RAS
Roschin, Alexander	Inst. of Control Sciences RAS

This paper is devoted to the detailed description of development processes and features of multicomputer desks based on the development software tool RDS (Research of Dynamic Systems). Powerful capabilities of multicomputer desks developed with use of RDS are illustrated by di_erent examples of control algorithms implementation for technical plants. The software tool RDS developed in Institute of Control Sciences RAS satis_es main design principles for multicomputer desks and facilitates creation of research desks for simulation and development of control systems.

15:40-16:00 FrB05.6

Embedded Model Predictive Control (MPC) Using a FPGA, pp. 15250-15255

Ling, Keck-Voon	Nanyang Tech. Univ.
Wu, Bing Fang	-
Maciejowski, Jan	Univ. of Cambridge

Model Predictive Control (MPC) is increasingly being proposed for application to miniaturized devices, fast and/or embedded systems. A major obstacle to this is its computation time requirement. Continuing our previous studies of implementing constrained MPC on Field Programmable Gate Arrays (FPGA), this paper begins to exploit the possibilities of parallel computation, with the aim of speeding up the MPC implementation. Simulation studies on a realistic example show that it is possible to implement constrained MPC on an FPGA chip with a 25MHz clock and achieve MPC implementation rates comparable to those achievable on a Pentium 3.0 GHz PC.

FrB06 310A

Fractional Differentiation and Its Applications II (Invited Session)

Chair: Sabatier, Jocelyn	Univ. Bordeaux1
Co-Chair: Baleanu, Dumitru	Cankaya Univ. Faculty of Arts and Sciences
Organizer: Dugard, Luc	CNRS-INPG-UJF
Organizer: Sabatier, Jocelyn	Univ. Bordeaux1

14:00-14:20 FrB06.1

Conservatism-Free Robust Stability Check of Fractional-Order Interval Linear Systems (I), pp. 15256-15261

Ahn, Hyo-Sung	Gwangju Inst. of Science and Tech. (GIST)
Chen, YangQuan	Utah State Univ.

This paper presents a necessary and sufficient robust stability condition of fractional-order interval linear time invariant systems. The state matrix is considered a parametric interval uncertain matrix and fractional commensurate order is considered belonging to 1 <= alpha < 2. Using existence condition of Hermitian P = P^* for complex Lyapunov inequality, we show that a fractional-order interval linear system is robust stable if and only if there exist Hermitian matrices P = P^* such that complex Lyapunov inequalities are satisfied for all vertex matrices, which is a set of selected matrices. Two numerical examples are presented to verify the validity of the proposed approach.

14:20-14:40 FrB06.2

Structural Properties of Linear Discrete-Time Fractional-Order Systems (I), pp. 15262-15266

Bettayeb, Maamar	Univ. of Sharjah
Djennoune, Saďd	Univ. of Mouloud Mammeri, Tizi-Ouzou
Guermah, Saďd	Univ. of Tizi-Ouzou
Ghanes, Malek	ENSEA

In this communication, some results on the analysis of the reachability and observability of linear discrete-time fractional order systems are given. Mathematical conditions for checking the controllability and the observability of such systems are developed. Furthermore, the concepts of the controllability realization index, the observability realization index and the structure realization index are introduced.

14:40-15:00 FrB06.3

On Bounded Real Lemma for Fractional Systems (I), pp. 15267-15272

Moze, Mathieu	Univ. Bordeaux 1
Sabatier, Jocelyn	Univ. Bordeaux1
Oustaloup, Alain	Univ. Bordeaux 1 - ENSEIRB - ENSCBP

Two state space "like" representation based methods for fractional systems L2-gain computation are proposed in this paper. The first is based on an approach already presented in the literature and leads to a new theorem. The theorem is based on the location of the eigenvalues of a matrix issued from the state space "like" representation and is then converted using Riccati theory into an LMI constraint to give the second theorem. Its formulation is similar to the well known bounded real lemma whereas it does not guarantee stability. The theorems are finally applied to car suspension analysis for the computation of modulus margins. Prospects of this study are in the fields covered by the usual bounded real lemma such as HĄ control, thus aiming at straightforward extension to fractional systems.

15:00-15:20 FrB06.4

On the Fractional PID Control of a Laboratory Servo System (I), pp. 15273-15278

Barbosa, Ramiro	Inst. of Engineering of Porto
Machado, J.A. Tenreiro	Inst. of Engineering of Porto
Jesus, Isabel S.	Inst. of Engineering of Porto

In this paper are investigated several types of fractional-order PID controllers in the velocity control of a servo system. The fractional controller is more flexible and gives the possibility of adjusting carefully the dynamical properties of a control system. The servo system is controlled by using a real-time digital control system based on MATLAB/Simulink. Results are compared with those obtained from classical PID controllers. Experimental responses are presented and analyzed, showing the effectiveness of the proposed fractional-order algorithms.

15:20-15:40 FrB06.5

Controller Design for Minimum-Phase Fractional Systems of Commensurate Order Based on Shaping the Sensitivity Function, pp. 15279-15284

Merrikh-Bayat, Farshad	Sharif Uni. of Tech.
Karimi-Ghartemani, Masoud	Univ. of Toronto

This paper is concerned with the problem of designing a controller for certain class of fractional-order systems. The powers of the Laplace variable, s, are limited to rational numbers and the plant transfer function is assumed to be minimum-phase. The approach used in this paper is based on shaping the sensitivity function which is a powerful design algorithm in frequency domain. One advantage of the proposed method is that it does not need heavy computational efforts. It is a well known result that control objectives such as command tracking and noise attenuation can be expressed in terms of the sensitivity function. The notion of coprime factorization is also developed for the systems under consideration and two illustrative examples are presented.

15:40-16:00 FrB06.6

Fractional Order Control of an Unmanned Aerial Vehicle (UAV), pp. 15285-15290

Monje, Concepción	Univ. Carlos III of Madrid
Liceaga-Castro, Eduardo	Univ. Carlos III of Madrid
Licéaga-Castro, Jesús Ulises	ITESM-CEM

This paper deals with the trajectory control problem for a rotary-wing nonlinear vehicle model. The control of this kind of systems is one of the most challenging and attractive research areas. The design scheme presented is based on the use of fractional order controllers, originated from the application of the theory of Fractional Calculus to control system design. One of the interesting features of the control strategy proposed is the use of a fractional order derivative to ensure the robustness of the nonlinear system in spite of using a linearized design model. It is shown that by assuring constant phase margin on a frequency range around the roll-off frequencies the resulting control system is robust to parameter variations and nonlinear effects. With this strategy the control design problem becomes much simpler and gives very straightforward tuning rules. Fundamental operational principles are also considered for establishing the bandwidth of the input-output channels of the system. The performance of the controller is shown through nonlinear simulations.

FrB07 310B
Stochastic Optimal Control (Regular Session)

Chair: Lampe, Bernhard P. Univ. of Rostock
Co-Chair: Krokavec, Dusan Tech. Univ. of Kosice, Faculty of Electrical

14:00-14:20 FrB07.1
Control with Guaranteed Performance for Dual-Rate Sampled-Data Systems under Stochastic Disturbances, pp. 15291-15296

Lampe, Bernhard P. Univ. of Rostock
Polyakov, Konstantin Associate Professor
Rybinskii, Vladislav SMTU
Rosenwasser, Efim N. Marine Tech. Univ. of Saint Petersburg

The paper considers the digital control of a continuous-time process under stochastic disturbances. The problem consists in finding a controller that guarantees a certain performance of the closed loop, while the disturbances belong only to a given class of disturbances. The digital controller has two parts with different sampling rates, where one rate is a multiple of the other one. The solution is found by applying the parametric transfer function (PTF) concept and the method of guaranteed performance control.

14:20-14:40 FrB07.2
Probabilistic Constrained MPC for Systems with Multiplicative and Additive Stochastic Uncertainty, pp. 15297-15302

Cannon, Mark Univ. of Oxford
Kouvaritakis, Basil Oxford Univ.
Wu, Xingjian Univ. of Oxford

The paper develops a receding horizon control strategy to guarantee closed loop convergence and feasibility in respect of soft constraints. Earlier work (Cannon et al., 2007) presented results addressing closed loop stability in the case of multiplicative uncertainty only. The present paper extends these results to the more general case of additive and multiplicative uncertainty and proposes a method of handling probabilistic constraints. The results are illustrated by a design study considering control of a wind turbine in order to maximize power capture subject to constraints on fatigue damage.

14:40-15:00 FrB07.3
Joint PDF Tracking Control for a Class of Multivariate Time-Varying Stochastic Descriptor Systems, pp. 15303-15308

Guo, Lei UMIST
Yin, Liping Southeast Univ.

This paper considers a new tracking control problem for a class of nonlinear stochastic descriptor systems, where the tracked target is a given joint probability density function (JPDF). The controlled plants can be represented by multivariate discrete-time descriptor systems with non-Gaussian disturbances and nonlinear output equations. The control objective is to find crisp algorithms such that the conditional output JPDFs can follow the given target JPDF. Rather than using statistic methods such as Bayesian estimation or Monte Carlo methods, we establish a direct relationship between the JPDFs of the transformed tracking error and the stochastic input. An optimization approach is applied to present recursive algorithms such that the distances between the output distributions and the desired one are minimized. Furthermore, a stabilization suboptimal control strategy is proposed by using of LMI-based Lyapunov theory. Simulations are provided to demonstrate the effectiveness of the stochastic tracking control lgorithms.

15:00-15:20 FrB07.4
Risk-Sensitivity Conditions for Stochastic Uncertain Model Validation, pp. 15309-15314

Ugrinovskii, Valery Univ. of New South Wales

The paper presents sufficient and (under an additional technical assumption) necessary conditions that verify the relevance of given input and output processes to an assumed stochastic uncertain system model subject to an uncertainty constraint. The approach is to establish the existence of an admissible probability model under which dynamics of the proposed stochastic system model are consistent with the given input and measurement processes.

15:20-15:40 FrB07.5
Constrained Control of Discrete-Time Stochastic Systems, pp. 15315-15320

Krokavec, Dusan Tech. Univ. of Kosice, Faculty of Electrical
Filasova, Anna Tech. Univ. of Kosice

The purpose of the paper is to present a class of algorithms used to solve the optimization problem concerning with H_infty feedback control for linear discrete-time stochastic systems with stochastic parameter uncertainties, as well as a method for the optimization problem reducing this to a standard formulation used two convex inequalities, which can be solved by linear matrix inequality (LMI) methodology. Some generalized considerations for the algorithm procedures are given and the problem of LMI set-up, using the technique based on Schur complement, for calculating the terminal weight matrix P is outlined. Finally, obtained results are adapted by that way to design constrained H_infty feedback control for system which state variable satisfy equality constraints in the mean. The procedure results the constant feedback for the linear controller defined in terms of matrix inequalities and a matrix equality.

15:40-16:00 FrB07.6
Mean-Variance Receding Horizon Control for Discrete Time Linear Stochastic Systems, pp. 15321-15326

Cannon, Mark Univ. of Oxford
Kouvaritakis, Basil Oxford Univ.
Couchman, Paul Univ. of Oxford

A control strategy based on a mean-variance objective and expected value constraints is proposed for systems with additive and multiplicative stochastic uncertainty. Subject to a mean square stabilizability condition, the receding horizon objective can be obtained by solving a system of Lyapunov equations. An algorithm is proposed for computing the unconstrained optimal control law, which is the solution of a pair of coupled algebraic Riccati equations, and conditions are given for its convergence. A receding horizon controller based on quasi-closed loop predictions is defined. The control law is shown to provide a form of stochastic convergence of the state, and to ensure that the time average of the state variance converges to known bounds.

FrB08 310C
Reachability, Estimation and Control Synthesis under Uncertainty II (Invited Session)

Chair: Rakovic, Sasa V. ETH Zurich
Co-Chair: Kurzhanski, A.B. Univ. of California, Berkeley
Organizer: Kurzhanski, A.B. Univ. of California, Berkeley
Organizer: Rakovic, Sasa V. ETH Zurich

14:00-14:20 FrB08.1
Approximate Reachability Analysis for Linear Discrete Time Systems Using Homothety and Invariance (I), pp. 15327-15332

Rakovic, Sasa V. ETH Zurich
Fiacchini, Mirko Univ. de Sevilla

This paper introduces a method for approximate reachability, for linear discrete time systems, based on homothety and set invariance. The proposed method utilizes two particular families of sets, more precisely their members, and particular forms of the approximation maps to obtain simple inner and outer approximate reachable sets/tubes. The resulting set--dynamics, induced by the uncertainty set, the underlying dynamics in the state space and the approximation maps, are restricted to these particular families of sets and under standard assumptions yield bounded and convergent approximate reachable sets/tubes. A tractable computational procedure is suggested and a few illustrative examples are provided.

14:20-14:40 FrB08.2
On the Design of Robust Tube-Based MPC for Tracking (I), pp. 15333-15338

Alvarado, Ignacio Univ. of Seville
Limon, Daniel Univ. de Sevilla
Alamo, Teodoro Univ. de Sevilla
Camacho, Eduardo Univ. of Seville

This paper deals with the design procedure of the recently presented robust MPC for tracking of constrained linear systems with additive disturbances. This controller is based on nominal predictions and it is capable to steer the nominal predicted trajectory to any target admissible steady state, that is retaining feasibility under any set point change. By means of the notion of tube of trajectories, robust stability and convergenceis achieved. The controller formulation has some parameters which provides extra degrees of freedom to the design procedure of the predictive controller. These allow to deal with control objectives such as disturbance rejection, output offset prioritization or enlargement of the domain of attraction. In this paper, output prioritization method, LMI based design procedures and algorithms for the calculation of invariant sets are presented. The proposed enhanced design of the MPC is demonstrated by an illustrative example.

14:40-15:00 FrB08.3

Optimal Measurement Feedback Control of Finite-Time Continuous Linear Systems (I), pp. 15339-15344

Dmitruk, Natalia — Inst. of Mathematics, National Acad. of Sciences of Belaru
Findeisen, Rolf — Otto-von-Guericke-Univ. Magdeburg
Allgower, Frank — Univ. of Stuttgart

We consider optimal control of linear continuous time systems subject to constrained inputs based on output measurements that are subject to set-membership uncertainties. The objective is to steer the system in a fixed finite-time to a given polyhedral set while minimizing a linear terminal cost function. To achieve this objective a min-max optimal control strategy is proposed, taking into account that at future time instants new measurement information is available for feedback. The proposed strategy coincides with the (computationally intractable) exact min-max dynamic programming solution if all future measurement times are considered. Limiting the number of instants at which the new measurement information is considered we achieve a compromise between the computational efforts for feedback construction and the performance of the closed-loop.

15:00-15:20 FrB08.4

Methods of Ellipsoidal Estimation for Linear Control Systems (I), pp. 15345-15348

Ovseevich, Alexander — Inst. for Problems in Mechanics, Russian Ac. Sc.
Chernousko, Felix L. — Russian Acad. of Sciences

We present explicit formulas for ellipsoids bounding reachable sets for linear control dynamic systems with geometric bounds on control.We study both locally and globally optimal ellipsoidal estimates with regard to different optimality criteria. In particular, we solve some essentially nonlinear boundary problems related to the search for globally optimal ellipsoids with regard to the volume criterion. It is shown that by using the explicit formulas one can efficiently pass to limits in several asymptotic problems, including passing to the limit when the phase space dimension goes to infinity.

15:20-15:40 FrB08.5

Filtering with Nonrandom Noise: Invariant Ellipsoids Technique (I), pp. 15349-15352

Polyak, Boris T. — Moscow Inst. of Control Sciences
Topunov, Michael — Inst. for Control Science

Linear time-invariant filter is presented for state estimation in LTI systems with bounded noise. The filter is optimal in the sense that it guarantees minimal error bounds (minimal invariant ellipsoid for errors of filtering). Both continuous-time and discrete-time cases are covered. The key role plays LMI technique and new version of S-theorem. Double pendulum velocity estimation is considered as an example.

15:40-16:00 FrB08.6

Dynamic Optimization for Path Coordination Problems, pp. 15353-15358

Sousa, Joao — Fac. Engenharia Univ. do Porto (VAT nr. 600027716)

A problem of optimal path coordination for two vehicles is presented. The path cost for the first vehicle is a discontinuous function of the relative positions of the two vehicles. The second vehicle is required to return its starting point. The problem is formulated in the framework of hybrid systems to model both the discontinuous dependence of the cost function on the state variable and the operating rules. The structure of the solution is outlined in the framework of dynamic optimization. The value of cooperation is given by a value function.

FrB09 311C

Frequency Domain System Identification (Regular Session)

Chair: Pintelon, Rik — Vrije Univ. Brussel
Co-Chair: Akcay, Huseyin — Anadolu Univ.

14:00-14:20 FrB09.1

Experimental Comparison of Methods for Multivariable Frequency Response Function Estimation, pp. 15359-15366

Wernholt, Erik — Linkoping Univ.
Moberg, Stig — ABB AB - Robotics

Nonparametric estimation methods for the multivariable frequency response function are experimentally evaluated using closed-loop data from an industrial robot. Three classical estimators (H1, joint input-output, arithmetic mean) and two estimators based on nonlinear averaging techniques (harmonic mean, geometric/logarithmic mean) are considered. The estimators based on nonlinear averaging give the best results, followed by the arithmetic mean estimator, which gives a slightly larger bias. The joint input-output estimator, which is asymptotically unbiased in theory, turns out to give large bias errors for low frequencies. Finally, the H1 estimator gives the largest bias for all frequencies.

14:20-14:40 FrB09.2

On the Completeness Problem for Fractional Rationals with Incommensurable Differentiation Orders, pp. 15367-15371

Akcay, Huseyin — Anadolu Univ.
Malti, Rachid — Univ. Bordeaux1

In this paper, completeness problem for a class of fractional rational basis functions with incommensurable differentiation orders is studied. Using the Muntz-Szasz theory, it is established that the completeness problem for this class of the basis functions is equivalent to another completeness problem for a particular set of uncountably many basis functions. This equivalence allows one to draw fairly general conclusions on the nature of the completeness problem for fractional rational basis functions with incommensurable differentiation orders.

14:40-15:00 FrB09.3

Frequency-Domain Gray-Box Identification of Industrial Robots, pp. 15372-15380

Wernholt, Erik — Linkoping Univ.
Moberg, Stig — ABB AB - Robotics

This paper considers identification of unknown parameters in elastic dynamic models of industrial robots. Identifying such models is a challenging task since an industrial robot is a multivariable, nonlinear, resonant, and unstable system. Unknown parameters (mainly spring-damper pairs) in a physically parameterized nonlinear dynamic model are identified in the frequency domain, using estimates of the nonparametric frequency response function (FRF) in different robot configurations/positions. The nonlinear parametric robot model is linearized in the same positions and the optimal parameters are obtained by minimizing the discrepancy between the nonparametric FRFs and the parametric FRFs (the FRFs of the linearized parametric robot model). In order to accurately estimate the nonparametric FRFs, the experiments must be carefully designed. The selection of optimal robot configurations for the experiments is also part of the design. Different parameter estimators are compared and experimental results show the usefulness of the proposed identification procedure. The weighted logarithmic least squares estimator achieves the best result and the identified model gives a good global description of the dynamics in the frequency range of interest.

15:00-15:20 FrB09.4

New Results on the Generalized Frequency Response Functions of Nonlinear Volterra Systems Described by NARX Model, pp. 15381-15386

Jing, Xingjian — Univ. of Sheffield
Lang, Z.Q. — Univ. of Sheffield
Billings, Steve A. — Univ. of Sheffield

In order that the nth-order Generalized Frequency Response Function (GFRF) for nonlinear systems described by a NARX model can be directly written into a more straightforward and meaningful form in terms of the first order GFRF and model parameters, the nth-order GFRF is now determined by a new mapping function based on a parametric characteristic. This can explicitly unveil the linear and nonlinear factors included in the GFRFs, reveal clearly the relationship between the nth-order GFRF and the model parameters, and also the relationship between the nth-order GFRF and the first order GFRF. Some new properties of the GFRFs can consequently be developed. These new results provide a novel and useful insight into the frequency domain analysis of nonlinear systems.

15:20-15:40 FrB09.5

Topological Properties in Identification and Modeling Techniques, pp. 15387-15392

Innocenti, Giacomo — Univ. di Firenze
Materassi, Donatello — Univ. degli Studi di Firenze

The paper deals with the problem of finding models and predictions within a large set of time series or random processes. Nothing is assumed about their mutual influence and dependence. The problem can not be tackled efficiently, starting from a classical system identification approach. Indeed, the general optimal solution would provide a large number of models, since it would consider every possible interdependence. Then a suboptimal approach will be developed. The proposed technique will present interesting modelling properties which can interpreted in terms of graph theory. The application of this procedure will also be exploited as a tool to provide a clusterization of time series. Finally, we will show that it turns out to be a dynamical generalization of other techniques described in literature.

15:40-16:00 FrB09.6

Frequency Content in an Axially Impacted Bar Subject to Boundary Conditions, pp. 15393-15398

Rensfelt, Agnes — UppsalaUniversity
Soderstrom, Torsten — Uppsala Univ.

We analyze the frequency contents of strain waves in an axially excited bar, where one end of the bar is subject to a free end boundary condition. The analysis is treated in the context of identification of viscoelastic materials. The free end boundary condition leads to very particular constraints on the wave propagation in the bar and it is shown how this influences the identification. Wave propagation in both elastic and viscoelastic materials is treated, and the validity of the analysis confirmed through simulated and (in the case of viscoelastic materials) experimental data. The analysis is then used in order to interpret the large frequency variations in previous studies concerning the accuracy of the estimate and optimal input signal, respectively.

FrB10 311B

Switching Control II (Regular Session)

Chair: Cheng, Daizhan — Chinese Acad. of Sciences
Co-Chair: Bosukonda, Murali Mohan — Indian Inst. of Tech. Kharagpur

14:00-14:20 FrB10.1

Mathematical Model of the Simplest Fuzzy PID Controller with Asymmetric Fuzzy Sets, pp. 15399-15404

Bosukonda, Murali Mohan — Indian Inst. of Tech. Kharagpur
Sinha, Arpita — IIT-Kharagpur

This paper deals with the simplest fuzzy PID controllers which employ two fuzzy sets for each of the three input variables and four fuzzy sets for the output variable. Mathematical model for a fuzzy PID controller is derived by using asymmetric Gamma-function type and L-function type membership functions for each input, asymmetric trapezoidal membership functions for output, algebraic product triangular norm, bounded sum triangular conorm, Mamdani minimum inference, nonlinear control rules, and center-of-sums (COS) defuzzification. The effectiveness of the simplest fuzzy PID controller is demonstrated by means of a numerical example along with its simulation results.

14:20-14:40 FrB10.2

Non-Regular Feedback Linearization of Switched Nonlinear Systems, pp. 15405-15410

Yuan, Yanyan — Inst. of Systems Science, Chinese Acad. of Sciences
Cheng, Daizhan — Chinese Acad. of Sciences

In this paper, the problem of non-regular static state feedback linearization of nonlinear switched systems is considered. Using semi-tensor product, some easily verifiable sufficient conditions for non-regular feedback linearization are obtained. Then an example is presented to illustrate the non-regular linearization process.

14:40-15:00 FrB10.3

Binary Control of Volterra Integral Equations, pp. 15411-15414

Belbas, Stavros — Univ. of Alabama

We analyze the problem of optimally controlling a system governed by a Volterra integral equation, when the controls take the values 0 or 1 and induce what we term here "amplified memory effect". Under certain conditions, we derive a set of Hamiltonian equations and a set of necessary conditions for optimality.

15:00-15:20 FrB10.4

Robust Delay Block Stabilization Via Integral Sliding Mode Control, pp. 15415-15420

Loukianov, Alexander G. — CINVESTAV IPN GDl
Espinosa Guerra, Omar — Cinvestav
Castillo-Toledo, Bernardino — CINVESTAV-GDL, Mexico

In this paper, a new discontinuous control strategy is proposed for robust stabilization of a class of uncertain multivariable linear time-delay system with delays in both the state and control variables. The integral sliding mode control technique is applied to compensate the uncertainty term and then a predictor is used to obtain free-delay closed-loop system with desired spectra. For systems presented in Block Controllable (BC) form with delay, a block dead time compensation algorithm which gives a sliding manifold is derived. An example of the application of the proposed control strategy is presented.

15:20-15:40 FrB10.5

Switching Difference Control of Parallel Streams Temperatures, pp. 15421-15426

Wang, Xingxuan — Fudan Univ.

An industrial furnace with multiple parallel passes and multiple burners is commonly used in petroleum refineries to heat the preprocessed crude oil to a specific temperature. Due to that maintaining multiple outlet temperatures of such parallel passes equal is significant for improving product quality, plant safety, and economic efficiency, etc., great efforts have been taken to control such temperatures. In this paper, a control technique based on switching control schemes, called switching difference control technique (SDCT), is proposed to distribute the inlet oil flowrates such that the outlet temperatures are as identical as possible. The principle of the proposed technique is explained, and several switching policies are introduced. Simulation examples are provided to demonstrate the effectiveness of the proposed strategy. The SDCT technique has the following advantages: it avoids the flow valves too frequently being regulated; it solves the problem of the flow coupling among multiple passes conveniently, etc.

15:40-16:00 FrB10.6

Rational Controllers in Computer/Communication Networks, pp. 15427-15432

Kabamba, Pierre T. — Univ. of Michigan
Lin, Wen-Chiao — Univ. of Michigan
Meerkov, Semyon M. — Univ. of Michigan
Tang, Choon Yik — Honeywell

Traditional feedback controllers are used to ensure system operation in a desired regime. In contrast, rational controllers are intended to determine a regime most appropriate for the system, given varying conditions of its operation. In this paper, two types of rational controllers are described and their applications in wireless personal area networks and sensor networks are presented.

FrB11 311A

Autotuning (Regular Session)

Chair: Veres, Sandor M — Univ. of Southampton
Co-Chair: Leva, Alberto — Pol. di Milano

14:00-14:20 FrB11.1

Adaptive State Feedback Nash Strategies for Linear Quadratic Discrete-Time Games, pp. 15433-15438

Shen, Dan — Intelligent Automation, Inc
Cruz, Jose B — The Ohio State Univ.

A substantial effort has been devoted to various adaptive techniques of systems. Most of these concepts work in the control domain, where every system only has one controller. Yet, for the multi-controller counterpart --- dynamic games, adaptations are usually considered from a perspective of systems, for an example, evolutionary games. In this paper, we propose a new adaptive approach for linear quadratic discrete-time games with scalar inputs and state feedback Nash strategies. We consider the effort of adaptation under a Fictitious Play (FP) framework with learning algorithms derived from conventional adaptive control methods. Convergence to Nash strategies is proved with the condition that there exists a unique state feedback strategy, which implies that the associated coupled discrete-time algebraic Riccati equations (DAREs) have a unique positive semi-definite solution. The requirement of Persistency of Excitation (PE) is satisfied by proper reference signals to be tracked.

14:20-14:40 FrB11.2

Adaptive Temperature Control in a Freezer with On-Off Actuation, pp. 15439-15444

Leva, Alberto	Pol. di Milano
Piroddi, Luigi	Pol. di Milano
Boer, Alessandro	WHIRLPOOL EUROPE s.r.l

This manuscript describes an adaptive scheme for temperature control in household freezers. Peculiar of the proposed control scheme is the use of standard sensing and actuation equipment, with particular reference to the on-off compressor. After illustrating the rationale of the proposed control, some tests on a detailed simulation model are reported, to validate the approach and show its effectiveness with respect to both food preservation and energy consumption.

14:40-15:00 FrB11.3

Fast Autotuning of Process Cascade Controls, pp. 15445-15450

Leva, Alberto	Pol. di Milano

A procedure is presented for the automatic tuning of cascade control systems. The main goal of the procedure is to achieve fast tuning, and moderate process upset. That goal is pursued by proper combination of an ad hoc relay-based identification procedure based on a single test, a specific controller structure, and a tuning rule based on a particular use of the IMC principle. Simulations are reported to illustrate the effectiveness of the proposal within its applicability limits, that are characterised as rigorously as possible (and may be widened by some of the envisaged extensions).

15:00-15:20 FrB11.4

Learning from Data Using XCS, pp. 15451-15456

Ayele, Elias	North Carolina A&T State Univ.
Homaifar, Abdollah	North Carolina A&T State Univ.
Esterline, Albert	North Carolina A&T State Univ.
Dean, Robert	GDRS
Rodgers, Dan	GDRS

In this paper, we present first of all the working principles of an accuracy based learning classifier system. We also discuss the use of learning classifier systems for learning from data by considering a sample application. The sample application, the Terrain Reasoner Weight Adapter (TRWA), is a system that learns near optimal weights to be used by a path planner while generating routes. Manually generated weights are used to generate a sample data set for training the TRWA. We detail the TRWA and the significant improvements made to the usual XCS strategies in order to achieve our goal of using a supervised learning technique for the TRWA. A reward assignment scheme is developed. The use of tournament selection instead of roulette wheel selection for selecting two parents in the GA is also analyzed. The results obtained show the efficiency of the method.

15:20-15:40 FrB11.5

Learning and Adaptation of Skills in Autonomous Physical Agents, pp. 15457-15462

Veres, Sandor M	Univ. of Southampton
Veres, Aron Gabor	SysBrain Ltd

A skills learning methodology is presented for autonomous physical agents (APA). Adaptation of skills and learning is a fundamental part of the simple agent behaviours outlined. A general framework of skills learning is described that uses skill macros to define simple behaviours by agents that communicate, sense and act in the physical world. Programmed playfulness can be easily implemented in this framework that plays an important part in acquiring sophisticated skills. Reusability of results in learning algorithms is supported by ontology based classification of learning in skills. Ontologies provide references to object instances that enable modularization of software and easy interfacing of skills with learning algorithms.

15:40-16:00 FrB11.6

MIMO Frequency Domain Iterative Tuning for Tracking Control, pp. 15463-15468

Luo, Jian	Univ. of Southampton
Veres, Sandor M	Univ. of Southampton

A new 'model-free' iterative controller tuning method is presented for multiple-inputmultiple output control systems based estimation algorithms in the frequency domain. The method relies on efficient computation of the negative gradient of the controller cost function in the frequency domain. Only one experiment is used per iteration and the method is therefore suitable for realtime implementation by periodic adjustments of the controller. Both feedback and/or feed-forward controllers can be tuned. Primary target application areas can be self-tuning feedforward/feedback controllers in industry where the reference signals are periodic.

FrB12 313

Stochastic Hybrid Systems (Regular Session)

Chair: Chang, Hyeong Soo	Sogang Univ.
Co-Chair: Ramdani, Nacim	INRIA

14:00-14:20 FrB12.1

Learning Algorithm for LQG Model with Constrained Control, pp. 15469-15474

Xu, Yankai	Tsinghua Univ.
Chen, Xi	Tsinghua Univ.

The paper considers a discrete-time linear quadratic Gaussian model with con- strained control. It is formulated with Markov systems. With the derivative equation, a performance gradient with respect to control parameters is estimated from a sample path. Then a learning algorithm is proposed to obtain a suboptimal feedback policy in affine linear form. The learning algorithm can be implemented on-line. Its improving feature makes the algorithm attain better performance than existing approaches, and the idea can be applied to more general cases.

14:20-14:40 FrB12.2

Stochastic Iterative Approximation for Parallel Rollout and Policy Switching, pp. 15475-15479

Chang, Hyeong Soo	Sogang Univ.

This paper considers stochastic iterative computation methods for approximately computing parallel rollout and policy switching policies, in the context of improving all available heuristic policies, for solving Markov decision processes and analyzes the convergence of the computation methods.

14:40-15:00 FrB12.3

A Unifying Formulation of the Fokker-Planck-Kolmogorov Equation for General Stochastic Hybrid Systems, pp. 15480-15485

Bect, Julien	Supelec

A general formulation of the Fokker-Planck-Kolmogorov (FPK) equation for stochastic hybrid systems is presented, within the framework of Generalized Stochastic Hybrid Systems (GSHS). The FPK equation describes the time evolution of the probability law of the hybrid state. Our derivation is based on the concept of mean jump intensity, which is related to both the usual stochastic intensity (in the case of spontaneous jumps) and the notion of probability current (in the case of forced jumps).This work unifies all previously known instances of the FPK equation for stochastic hybrid systems, and provides GSHS practitioners with a tool to derive the correct evolution equation for the probability law of the state in any given example.

15:00-15:20 FrB12.4

Sporadic Control of Scalar Systems with Delay, Jitter and Measurement Noise, pp. 15486-15492

Cervin, Anton	Lund Univ.
Johannesson, Erik	Lund Univ.

Event-triggered control is a promising alternative to time-triggered control, especially for severely resource-constrained networked embedded systems. Previous work has shown that event-triggered control can reduce both the output variance and the average control rate in scalar linear stochastic systems compared to time-triggered control. It has also been shown how a minimum inter-control interval can be imposed, hence the term "sporadic control". In this work we extend the analysis of event-triggered impulse control of first-order linear stochastic systems to handle general sampling intervals and minimum inter-control intervals, control delay and control jitter, and measurement noise. The results show that the advantage of sporadic control remains also in these cases.

15:20-15:40 FrB12.5

Stability and Stabilization of Markovian Jump Linear Systems with Partly Unknown Transition Probabilities, pp. 15493-15498

Zhang, Lixian — Ec. Pol. de Montreal
Boukas, El-Kebir — Ec. Pol. de Montreal

In this paper, the stability and stabilization problems of a class of continuous- time and discrete-time Markovian jump linear system (MJLS) with partly unknown transition probabilities are investigated. The system under consideration is more general, which covers the systems with completely known and completely unknown transition probabilities as two special cases, the latter is hereby the switched linear systems under arbitrary switching. Moreover, in contrast with the uncertain transition probabilities studied recently, the concept of partly unknown transition probabilities proposed in this paper does not require any knowledge of the unknown elements. The sufficient conditions for stochastic stability and stabilization of the underlying systems are derived via LMIs formulation, and the relation between the stability criteria currently obtained for the usual MJLS and switched linear systems under arbitrary switching are exposed by the proposed class of hybrid systems. Two numerical examples are given to show the validness and potential of the developed results.

15:40-16:00 FrB12.6

The Markovian Jump Contour Tracker, pp. 15499-15504

Cordeiro Junior, Albino Adriano Alves — Lab. Nacional de Computação Científica
Fragoso, Marcelo — LNCC / MCT
Georganas, Nicolas D. — Univ. of Ottawa
de Oliveira, Jauvane C. — Lab. Nacional de Computação Científica

In this paper a novel contour tracking algorithm based on a Markovian jump extension of the Kalman filter is presented, we call it the Markovian jump tracker (MJT). Markovian jump linear systems (MJLS) are suitable to model physical systems that behaves linearly but suffers abrupt changes in the dynamics from time to time (accordingly to a Markov chain process) with applications ranging from aircraft control systems to macroeconomics simulation. The tracking method we devised usesMarkovian jump filter technology to profit from available multiple linear models -to achieve overall tracker stability- each roughly describing a specific type of expected motion, for example: rotation, translation, cyclic motion, and so on.We verify the method's efficacy in preliminary experiments and compare aspects of its performance with other popular contour tracking algorithm.

FrB14 318

Management of Natural Resources II (Regular Session)

Chair: Tamura, Hiroyuki — Kansai Univ.
Co-Chair: Puig, Vicenc — Univ. Pol. de Catalunya

14:00-14:20 FrB14.1

Modeling and Policy Assessment of Carbon Tax and Emissions Trading for Preserving Global Environment, pp. 15505-15510

Tamura, Hiroyuki — Kansai Univ.
Kimura, Takashi — Kansai Univ.

In this paper we formulate a dynamic model of a profit maximization problem for assessing quantitatively how the policy of carbon tax and emissions trading would be effective to achieve the targeted reduction of the Kyoto Protocol. Furthermore, we evaluate the influence of carbon tax and emissions trading on the economy in industry in a long-term view.

14:20-14:40 FrB14.2

Formalizing and Solving the PM10 Control Problem, pp. 15511-15516

Carnevale, Claudio — Univ. of Brescia
Pisoni, Enrico — Univ. of Brescia
Volta, Marialuisa — Univ. of Brescia

Atmospheric Particulate Matter (PM10) control is at the moment a great challenge for air quality management, due to the strong non linearities that affect formation and accumulation of this pollutant. This work presents the formalization and application of a two-objective methodology to select e_;ective particulate matter control strategies on a mesoscale domain. The two considered objectives are emission reduction costs and the PM10 exposure index. The decision variables are the precursor emission reductions due to ablation technologies. The nonlinear relationships linking air quality objective and precursor emissions are described by neuro-fuzzy models, identi_;ed through the processing of simulations of the TCAM deterministic multiphase modeling system, performed in the framework of the CityDelta-CAFE Project (EU 6th Framework Program). The two-objective problem has been applied to a complex domain in Northern Italy, including the Milan metropolitan area, a region characterized by high emissions and frequent and persistent secondary pollution episodes.

14:40-15:00 FrB14.3

Global Stability in a General Impulsive Biological Control Model with Harvest, pp. 15517-15522

Nundloll, Sapna — INRIA - Project team COMORE
Mailleret, Ludovic — INRA, UR 880
Grognard, Frederic — INRIA Sophia-Antipolis

In this paper, the effects of periodic partial harvesting of a continuously grown crop on augmentative biological control are analysed. Partial harvesting can remove a proportion of both pests and biological control agents, so its influence on the control efficiency cannot be a priori neglected. An impulsive model consisting of a general predator-prey model in ODE is used. It is augmented by a discrete component to depict releases of biological control agents and the periodic partial harvesting. A stability condition for pest eradication is expressed as the minimal value of the budget per unit time to spend on predators. We consider the partial harvesting period to be fixed so that the only manipulated variable is the release period. One period is taken as the integer multiple of the other. We show that when the releases are carried out more often than the harvests, the release period influences the minimal budget. Conversely, there is no effect on this budget when releases take place as often as or less frequently than harvests.

15:00-15:20 FrB14.4

Meta-Model of an Irrigation District Distributed-Parameter Model, pp. 15523-15528

Galelli, Stefano — Pol. di Milano
Pianosi, Francesca — Pol. di Milano
Soncini-Sessa, Rodolfo — Pol. di Milano

The release policy for a reservoir's network can be designed by solving a multiobjective control problem. However, the use of resolution algorithms based on stochastic dynamic programming, with their high computational requests, imposes strong simplification in modelling the water system. In particular, downstream irrigation districts are often described as static subsystems, i.e. assuming an a priori trajectory of the water demand, while the use of the available simulation models is precluded due to their complexity. To overcome this problem, this study proposes the identification of a meta-model, i.e. a model of a simulation model, for describing an irrigation district. The meta-model computes the overall water deficit in the district, based on meteorological inputs and the water supply from an irrigation canal. Even if the meta-model is very simple, it can be given a physical interpretation in relation to the simulation model behavior. Results obtained with the original model and the meta-model over a real world case study, an irrigation district in the Padana plain, Italy, are presented.

15:20-15:40 FrB14.5

A Primer Discussion for the Application of Automatic Control to Assist Coastal Land-Water Management in the Mekong Delta, pp. 15529-15534

Nguyen, Tho — Univ. of Washington

Effective coastal land management is important to the livelihood of its local inhabitant. This challenge is especially important in developing nations. In this paper, we report our effort toward using automatic control to aid the coastal land-water management issues in the Mekong Delta of Vietnam. The report focuses on augmenting the governing dynamics of the existing VRSAP simulation of the MK Delta hydrology such that it would be manageable by a feedback control loop. Steady state linearization and analysis of the governing equations is performed in the general term of the parameters. This technique makes obvious the relationship of each parameter to the formulation of the control problem allowing the engineer to wisely choose an effective parameter for model calibration. An adaptive scheme is then developed to calibrate the chosen control parameter of lateral inflow. Initial experiments from a artificially generated data shows promising results.

15:40-16:00 FrB14.6

Robust Fractional Order PI Controller for a Main Irrigation Canal Pool, pp. 15535-15540

Rivas Perez, Raul	Havana Pol. Univ.
Feliu, Vicente	Univ. of Castilla-La Mancha
Sanchez Rodriguez, Luis	Univ. de Castila-La Mancha
Castillo, Fernando J.	Univ. of Castilla La Mancha
Linares Saez, Antonio	Construcción y Tecnologia Ambiental S.A. BEFESA

A new method is proposed to design a class of robust fractional order PI controller (FPI) based on frequency specifications for water distribution in a main irrigation canal pool. The robustness features of the obtained FPI controller are compared with the ones of an equivalent standard PI controller with the same design frequency specifications. A justification of its enhanced properties it is also provided. The interest of such fractional order controllers is justified by the fact that dynamical parameters of main irrigation canal pools may change drastically in function of its operation regimes. The designed FPI controller was implemented in a PLC of the Siemens company (Simatic 300) and was installed in a real main irrigation canal pool. The real time experimental results carried out comparing both FPI and standard PI controllers for different discharge regimes showed the superiority of the obtained FPI controller over the standard PI controller in terms of time domain performance and robustness. These results proved that the proposed design method leads to an efficient realistic FPI controller for main irrigation canal pools.

FrB15 317

Nonlinear Control and Estimation in Bioprocesses (Invited Session)

Chair: Ferreira, Eugenio	Univ. of Minho
Co-Chair: Farza, Mondher	Univ. DE CAEN, ENSICAEN
Organizer: Ferreira, Eugenio	Univ. of Minho
Organizer: Farza, Mondher	Univ. DE CAEN, ENSICAEN

14:00-14:20 FrB15.1

Robust Nonlinear Controllers for Bioprocesses (I), pp. 15541-15546

Bedoui, Anes	ENIT
Farza, Mondher	Univ. DE CAEN, ENSICAEN
M'Saad, Mohammed	GREYC CNRS UMR 6072
Ksouri, Mekki	Tunisia National School of Engineers "ENIT"

In this paper, we propose to track a pre-described profile for the substrate concentration inside a continuous and well mixed bioreactor where a single bioreaction takes place. The proposed approach uses a high gain based controller in order to achieve the control objective. Two main characteristics of the proposed controller are worth to be mentioned. The first one lies in the fact that its gain involves a design function that has to satisfy a mild condition which is given. Many expressions of such a function are proposed and it is shown that some of these expressions lead to many variants of sliding mode like controllers. In addition, the proposed controller incorporates a filtered integral action which allows to carry out a robust compensation of the state and output step disturbances, as well as a significant reduction of unavoidable measurements noises. The second main property of the proposed controller lies in the fact that its design does not require any model for the reaction rates. Indeed, the time evolution of these rates are estimated on-line through appropriate nonlinear observers. The so provided estimates are then used by the proposed control scheme. Simulation results are given is order to highlight the performance of the proposed approach.

14:20-14:40 FrB15.2

A High/low Gain Bundle of Observers: Application to the Input Estimation of a Bioreactor Model (I), pp. 15547-15552

Moisan, Marcelo	INRIA Sophia Antipolis
Bernard, Olivier	Inria
Gouze, Jean-Luc	INRIA

This paper proposes a new interval observer design based on a high/low gain concept, developed for the estimation of the input of a bioreactor. In a first step, a high gain bounded error observer is proposed, which is able to estimate the unknown input of the considered system. This observer is useful when an accurate model and noise--free measurements are available. We show that the error of the high gain observer can be dynamically bounded, and then we generate guaranteed bounds on this error through an interval observer. The estimation scheme is then extended to an uncertain framework. Taking advantage of the nature of the interval estimates, we run in parallel various observers using high or low gains values and then we take the best estimates. The method is applied to the input estimation of a simple bioreactor model.

14:40-15:00 FrB15.3

Design of a Robust Nonlinear Receding-Horizon Observer - Application to a Biological System (I), pp. 15553-15558

Goffaux, Guillaume	Faculté Pol. de Mons
Vande Wouwer, Alain	Faculté Pol. de Mons

The objective of this study is to design a robust receding-horizon observer for systems described by nonlinear models with uncertain parameters. Robustification in the presence of model uncertainties naturally leads to the formulation of a nonlinear min-max optimization problem, which can either be solved numerically or which can be converted to a simpler minimization problem using linearization along a nominal trajectory and recent results in linear robust receding-horizon estimation. This method is first evaluated in simulation and then with real-life experimental data collected from continuous cultures of phytoplankton.

15:00-15:20 FrB15.4

Observer Design for Bioprocesses Using a Dissipative Approach (I), pp. 15559-15564

Moreno, Jaime A.	Univ. Nacional Autonoma de Mexico-UNAM

Recently, the author has proposed a methodology for the design of nonlinear observers based on the dissipative theory. This methodology offers a systematic approach to the observer design providing great flexibility and generality. For example, several well known observer design methods, as the High-Gain and the Lipschitz Observers, can be treated and generalized in a unified manner by the Dissipative Approach. Moreover, different objectives in observation can be also unified and generalized by the Dissipative Approach, as for example the design of Unknown Input and Robust Observers. The objective of this paper is to show how this methodology can be applied in the design of observers for bioprocesses and its advantages for this kind of processes. An example illustrates the main ideas.

15:20-15:40 FrB15.5

Implementation of a Specific Rate Controller in a Fed-Batch E. Coli Fermentation (I), pp. 15565-15570

Rocha, Isabel	Univ. of Minho
Veloso, Ana	Univ. of Minho
Carneiro, Sonia	Univ. of Minho
Ferreira, Eugenio	Univ. of Minho
Costa, Rafael	Univ. of Minho

The specific growth rate is one of the most important process variables characterizing the state of microorganisms during fermentations mainly because the biosynthesis of many products of interest is often related with the values assumed by this parameter. In the particular case of the fed-batch operation of Escherichia coli for the production of recombinant proteins, it is important to maintain the specific growth rate below a certain threshold in order to avoid the accumulation of acetic acid throughout the fermentation and, additionally, it is often argued that both pre- and the post-induction specific growth rates should be closely controlled in order to achieve maximum productivities of the desired recombinant protein. In a previous work the authors have developed and validated by simulations a strategy for the automatic control of the specific growth rate in E. coli fed-batch fermentations based on an asymptotic observer for biomass and on developed estimators for the specific growth rates. The main purpose of the present work was to implement experimentally the developed observer, estimator and controller in a real fed-batch fermentation process. For that purpose a data acquisition and control program was developed in LabVIEW that allows the acquisition of the necessary on line data (off gas and dissolved oxygen concentration and culture weight) and the calculation of the feeding rates using the developed equations. The feedforward-feedback controller developed was able to keep the culture growing in an exponential phase throughout the fermentation without accumulation of glucose and acetate.

15:40-16:00 FrB15.6

Interval-Based Diagnosis of Biological Systems – Application to an Anaerobic Digestion Pilot Plant (I), pp. 15571-15576

Lopez-Bańuelos, Ruben Horacio	Univ. of Guadalajara - CUCEI
Alcaraz-Gonzalez, Victor	Univ. of Guadalajara-CUCEI
Steyer, Jean-Philippe	INRA
Méndez-Acosta, Hugo Oscar	Univ. of Guadalajara
Gonzalez-Alvarez, Victor	Univ. of Guadalajara
Pelayo-Ortiz, Carlos	Univ. of Guadalajara - CUCEI

Anaerobic digestion is a highly nonlinear time-varying process used for biological wastewater treatment which is subject to large disturbances of both influent concentrations and flow rates. These perturbations can lead to the crash of the digester and thus, the dynamics of the main state variables - including biomass - must be closely monitored to use this information in the design and implementation of advanced control schemes. However, such processes still suffer from a lack of reliable and cheap sensors. As a consequence, efficient monitoring, control and decision support systems are needed in order to insure the correct process operation. Particularly, there is an increasing interest on the proposal of Fault Detection and Isolation (FDI) and Fault Detection and Analysis (FDA) integrated systems. In this paper, we propose the use of interval observers in order to detect and isolate sensor faults as well as input changes in biological systems that are not observable. This approach is experimentally implemented on a 1m3 pilot scale anaerobic digestion continuous process.

FrB17 320A

Mechatronics Education (Invited Session)

Chair: Chen, Xiaoqi	Univ. of Canterbury
Co-Chair: Dimirovski, Georgi Marko	Dogus Univ. of Istanbul
Organizer: Chen, Xiaoqi	Univ. of Canterbury
Organizer: Dimirovski, Georgi Marko	Dogus Univ. of Istanbul

14:00-14:20 FrB17.1

Multi-Disciplinary Tutoring for Project-Based Mechatronics Learning (I), pp. 15577-15582

Vassura, Gabriele	Univ. of Bologna
Macchelli, Alessandro	Univ. of Bologna - Italy

A project-based learning experience has been recently developed at the University of Bologna within the second-level degree in Automation Engineering. The most relevant aspect is a co-tutoring activity jointly performed by teachers both from the mechanical area and from the automatic control area. The project was related to the design of an automated assembly system, developed for a local company that is leader in the production of technical cases. After a description of the educational goals, the paper discusses the phases of the activity and the main methodological aspects, then briefly presents the adopted tools for the design and simulation of the developed mechatronic system and finally discusses the achieved results.

14:20-14:40 FrB17.2

Mechatronics Management a Bsc Program (I), pp. 15583-15588

Kopacek, Peter	Vienna Univ. of Tech.
Ceccarelli, Marco	Univ. of cassino
Stapleton, Larry	School of Science, Waterford Inst. of Tech.
Hajrizi, Edmond	Univ. for Business and Tech.

Emerging economies in the midst of fundamental restructuring of higher education can benefit from radical approaches to engineering education programme design. The authors present the case of the development of a BSc curriculum in Mechatronics Management for one of the new international universities in Kosovo in order to demonstrate that it is possible to develop higher-education programmes in advanced engineering, which have local economic context in an emerging economy. The authors illustrate how it is possible to use theories of engineering and technology professional competence to develop a coherent higher education programme which has the potential to deliver on aggressive economic and educational objectives.

14:40-15:00 FrB17.3

Modelling and Simulation of Robot Arm Interaction Forces Using Impedance Control (I), pp. 15589-15594

de Gea, Jose	Univ. of Bremen
Kirchner, Frank	Univ. of Bremen

In this paper we present the implementation of a Cartesian impedance control method to regulate the interaction forces between a robotic arm and the environment. A complete description of the procedure to model and control both a two-link planar robot arm and its interaction with the environment is detailed and simulated using MATLAB/Simulink; from the generation of a mechanical model in SimMechanics (MATLAB), the description and tuning of a dynamic model-based controller to cancel-out the non-linearities present on the dynamic model of the robot, the modelling of an environment, and finally the control of the interaction forces making use of a Cartesian impedance control method. This type of control adjusts the dynamic behaviour of the robot manipulator when contacting the environment, basically controlling stiffness and damping of the interaction rather than the precise contact forces. Its implementation in the Cartesian Space permits future use of the results in an industrial robot, whose internal joint and torque controllers are commonly not accessible.

15:00-15:20 FrB17.4

Collaborating with a Mobile Robot: An Augmented Reality Multimodal Interface (I), pp. 15595-15600

Green, Scott A.	Univ. of Canterbury
Chen, Xiaoqi	Univ. of Canterbury
Billinghurst, Mark	Univ. of Canterbury
Chase, J. Geoffrey	Univ. of Canterbury

We have created an infrastructure that allows a human to collaborate in a natural manner with a robotic system. In this paper we describe our system and its implementation with a mobile robot. In our prototype the human communicates with the mobile robot using natural speech and gestures, for example, by selecting a point in 3D space and saying “go here” or “go behind that”. The robot responds using speech so the human is able to understand its intentions and beliefs. Augmented Reality (AR) technology is used to facilitate natural use of gestures and provide a common 3D spatial reference for both the robot and human, thus providing a means for grounding of communication and maintaining spatial awareness. This paper first discusses related work then gives a brief overview of AR and its capabilities. The architectural design we have developed is outlined and then a case study is discussed.

15:20-15:40 FrB17.5

Globalization Prospect of Credit Transfer System in Educating Control Engineers: A Developing Country Experience (I), pp. 15601-15605

Kolemisevska-Gugulovska, Tatjana	SS Cyril and Methodius Univ.
Stankovski, Mile	SS Cyril and Methodius Univ.
Andreeski, Cvetko	Faculty of Tourism and Hospitality

More that ever before nowadays is extremely important to consider the impact of high technologies on the sustainable economical and society development of the country. One of the main reasons is the high technologies and the underlining sophisticated knowledge themselves, whereas the other is the fact human resource mobility hence high education and training are an intrinsic part of the ongoing globalization processes. In turn, the actual run of high education and training as well as the associated recognition, evaluation and verification of degrees and diplomas acquired in various countries is to become more and more a global issue. The very same issues concern high education and degrees oriented towards automation, control and systems engineering. These issues are explored more closely through the case study of the actual ongoing practice in a small developing country.

15:40-16:00 FrB17.6

A Project-Based Mechatronics Program to Reinforce Mechatronic Thinking – a Restructuring Experience from the University of Canterbury (I), pp. 15606-15611

Chen, Xiaoqi	Univ. of Canterbury
Gaynor, Paul	Univ. of Canterbury
King, Richard	Univ. of Canterbury
Chase, J. Geoffrey	Univ. of Canterbury
Bones, Phil	Univ. of Canterbury
Gough, Peter	Univ. of Canterbury
Duke, Richard	Univ. of Canterbury

The approach taken during restructuring the Mechatronics Program at the University of Canterbury is described, along with challenges faced. The background of the University of Canterbury

Mechatronics program is examined, as are the challenges of integrating the program within the Department of Mechanical Engineering and the Department of Electrical & Computer Engineering. The new Mechatronics program features integrative projects during each of three Professional Education years to reinforce students' "mechatronic" thinking and hands-on abilities. The project-based course "Introduction to Mechatronics Design" features a series of application-oriented laboratory projects using a Programmable Logic Controller (PLC). The restructured program of balanced essential skills training coupled with focus streams of specialization may signal a paradigm shift in engineering education.

FrB18 320B

Mechatronics for Special Feature Robots (Regular Session)

Chair: Yen, Jia-Yush — National Taiwan Univ.
Co-Chair: Ivanescu, Mircea — Univ. of Craiova, Romania

14:00-14:20 FrB18.1

Modular Design and Simulation Study of Biomimetic Snake Robots (I), pp. 15612-15617

Lian, Feng-Li — National Taiwan Univ.
Yeh, Shang-Wei — National Taiwan Univ.

The paper discusses the design of a biomimetic snake module. The focus is on the simulation analysis of such universal mechanical modules. Based on surveyed materials from biological and robotic resources, we have successfully design two types of snake robots: wheeled and non-wheeled. Both are analyzed and tested numerically in the mechanism software: Working Model 3D. Several scenarios are tested and extensive analyses are performed.

14:20-14:40 FrB18.2

Power Reduction by Controlling Joint Compliance for the Propulsion of a Biomimetic Underwater Vehicle (I), pp. 15618-15623

Guo, Jenhwa — National Taiwan Univ.
Yen, Wei-Kuo — National Taiwan Univ.

The work describes a compliance control scheme for the caudal joint motion of a biomimetic autonomous underwater vehicle (BAUV). The purpose of the control method is to use the motor power more effectively for propulsion. A symmetric foil executing large-amplitude sway and yaw motions in a flow imitates a flapping tail fin which is used as the propulsive device of BAUV. Motions of the oscillating foil are then actuated by motors through springs. A control method was derived for the determination of the spring compliance for better use of the motors' driving power. It is verified that the compliance control method can reduce the amount of energy for the foil propulsion and is beneficial for the energy saving design for future BAUVs.

14:40-15:00 FrB18.3

Sensor Fusion in a Six-Legged Bio-Mimicking Robot (I), pp. 15624-15629

Liu, Shu-Hung — National Taiwan Univ.
Yen, Jia-Yush — National Taiwan Univ.
Chen, Yi-Ting — National Taiwan Univ.

This paper presents the construction of a six-legged bio-mimicking robot. The mechanical design includes the actuation design based on shape memory alloy (SMA) actuators and the locomotive mechanism. The motion control system implements various gaits for the robot to maneuver. The sensors used in the control system include the accelerometer, the compass sensor and the step sensors. We develop a sensor fusion formula to fuse the various sensor signals for enhanced position and velocity estimation. The measurement is useful for distributed information network for future robot team operation.

15:00-15:20 FrB18.4

Design of the Octabot Self-Reconfigurable Robot, pp. 15630-15635

Shiu, Ming-Chiuan — National Taiwan Univ. Hsiuping Inst. ofTechnology
Lee, Hou-Tsan — Takming Univ. of Science and Tech.
Lian, Feng-Li — National Taiwan Univ.
Fu, Li-Chen — National Taiwan Univ.

Self-reconfigurable robots are for the ability to change the shape of multiple cooperated robot modules that can be easily reconfigurable in the different working environment. Related work on twodimensional robots is presented. A novel design for a self-reconfigurable robot, called "Octabot", is described. The Octabot robot is a two-dimensional self-reconfigurable robot with modules composed of eight e-type electromagnets. After the magnetic force characteristics based on FEM analyses, mechanical design and system properties are described. The current designs only use single type actuator. The group of Octabots can be easily expanded to a large scale if needed in any case. Via examining the basic mechanical functions, the Octabot in self-reconfiguration shows its satisfactory performance.

15:20-15:40 FrB18.5

Backstepping Based PID Control Strategy for an Underactuated Aerial Robot, pp. 15636-15641

Mian, Ashfaq Ahmad — Nanjing Univ. of Aeronautics and Astronautics
Mian, Ilyas Ahmad — Imperial Coll. London
Wang, Daobo — Nanjing Univ. of Aeronautics and Astronautics

In this paper a nonlinear model of an underactuated quad rotor aerial robot is derived, based on Newton-Euler formalism, and backstepping based PID control strategy is implemented for the derived model. Model derivation comprises determining equations of motion of the quad rotor in three dimensions and seeking to approximate actuation forces through modeling of aerodynamic coefficients and electric motor dynamics. The derived MIMO model, constituted of translational and rotational subsystem, is dynamically unstable. A nonlinear control strategy is therefore implemented for the quad rotor aerial robot. The control strategy includes integral backstepping control for the translational subsystem and backstepping based PID control for the rotational subsystem. The stability of the control design is ensured by Lyapunov stability theorem. The performance of the nonlinear control strategy is evaluated using nonlinear simulation. The simulation results, obtained from backstepping based PID, are compared with conventional optimized PID controller. For the conventional PID controller, the optimization algorithm used is to minimize the Integral of Absolute Error (IAE). Results of comparison validate effectiveness of the backstepping based PID control strategy for the underactuated aerial robot near quasi stationary flight.

15:40-16:00 FrB18.6

A Distributed Force and Position Control for a Tentacle Manipulator, pp. 15642-15647

Ivanescu, Mircea — Univ. of Craiova, Romania
Florescu, Mihaela Cecilia — Univ. of Craiova, Romania
Popescu, Nirvana — Univ. Pol. Bucharest, Romania
Popescu, Decebal — Univ. Pol. Bucharest, Romania

The grasping control problem for a hyperredundant arm is studied. Frist, dynamic model of the arm is analyzed. The control problems are divided in the subproblems: the position control in a desired reaching area, the control of the arm around the object-load and the force control of grasping. The difficulties determined by the complexity of the non-linear integral-differential equations are avoided by using a very basic energy relationship of this system. First, the dynamic control of the arm for a desired reaching area is inferred. Then, the position controland the force control for grasping are discussed. Numerical simulation are presented.

FrB19 320C

Putting Energy Back in Robotics (Invited Session)

Chair: Macchelli, Alessandro — Univ. of Bologna - Italy
Co-Chair: Secchi, Cristian — Univ. of Modena and Reggio Emilia
Organizer: Macchelli, Alessandro — Univ. of Bologna - Italy
Organizer: Secchi, Cristian — Univ. of Modena and Reggio Emilia

14:00-14:20 FrB19.1

Compensation of Position Errors in Passivity Based Teleoperation Over Packet Switched Communication Networks (I), pp. 15648-15653

Secchi, Cristian — Univ. of Modena and Reggio Emilia
Stramigioli, Stefano — Univ. of Twente
Fantuzzi, Cesare — Univ. of Modena and Reggio Emilia

Because of the use of scattering based communication channels, passivity based telemanipulation systems can be subject to a steady state position error between master and slave robots. In this paper, we consider the case in which the passive master and slave sides communicate through a packet switched communication channel (e.g. Internet) and we provide a modification of the slave impedance controller for compensating the steady state position error arising in free motion because of packets loss.

14:20-14:40 FrB19.2

Stable Teleoperation with Time Domain Passivity Approach (I), pp. 15654-15659

Ryu, Jee-Hwan — Korea Univ. of Tech. and Education

In this paper, performance of recently modified two-port time-domain passivity approach is evaluated under serious time-varying communication delay. First, recently proposed two-port time-domain passivity approach is reviewed. A packet reflector with wireless internet connection is used to introduce serious time-varying communication delay of teleoperators. Average amount of time-delay was about 180(msec) for round trip, and varying between 175(msec) and 275(msec). Moreover some data packet was lost during the communication due to UDP data communication. Even under the serious time-varying delay and packet loss communication condition, the proposed approach can achieve stable teleoperation in free motion and hard contact as well.

14:40-15:00 FrB19.3

A New Proportional Controller for Nonlinear Bilateral Teleoperators (I), pp. 15660-15665

Nuńo, Emmanuel — Tech. Univ. of Catalonia
Ortega, Romeo — LSS-SUPELEC
Basanez, Luis — Univ. Pol. de Catalunya
Barabanov, Nikita E. — North Dakota State Univ.

One of the major breakthroughs in the problem of control of bilateral teleoperators with guaranteed stability properties has been the use of scattering signals to transform the transmission delays into a passive transmission line. Under the reasonable assumption that the human operator and the contact environment define passive (force to velocity) maps, stability of the overall system is then ensured. This robust and physically appealing scheme, first proposed by Anderson and Spong, has ever since dominated the field. In this paper we propose two novel teleoperation schemes, based on a simple P-Like controller. These schemes do not make use of the scattering or wave variables. Moreover, under the classical assumption of passivity of the terminal operators plus a gravity compensation term, we can ensure position coordination of the master and the slave.

15:00-15:20 FrB19.4

Energy Conservative Limit Cycle Oscillations (I), pp. 15666-15671

Stramigioli, Stefano — Univ. of Twente
van Dijk, Michel — Univ. of Twente

This paper shows how globally attractive limit cycle oscillations can be induced in a system with a nonlinear feedback element. Based on the same principle as the Van der Pol oscillator, the feedback behaves as a negative damping for low velocities but as an ordinary damper for high velocities. This nonlinear damper can be physically implemented with a continuous variable transmission and a spring, storing energy in the spring when the damping is positive and reusing it when the damping is negative. The resulting mechanism has a natural limit cycle oscillation that is energy conservative and can be used for the development of robust, dynamic walking robots.

15:20-15:40 FrB19.5

Port-Based Simulation of Flexible Multi-Body Systems (I), pp. 15672-15677

Macchelli, Alessandro — Univ. of Bologna - Italy
Melchiorri, Claudio — Univ. of Bologna

This paper is devoted to simulation aspects of complex multi-body systems resulting from the interconnection of rigid and flexible links. This work is the natural complement of Macchelli et al. [2006, 2007a], in which only the mathematical modeling aspects of such kind of devices have been discussed. This paper tries to show how the port Hamiltonian framework can be instrumental also for the easy implementation of efficient simulations if proper packages able to deal with the a-causality of port-based modeling techniques are used. In fact, once the main components (i.e. rigid and flexible links and kinematic pairs) have been created, the complete model just follows by port interconnection in a plug-and-play fashion. Then, it is the simulation engine that solves the causality of the overall scheme and generate the simulation code. The main steps are illustrated in detail with an example..

15:40-16:00 FrB19.6

Iterative Feedback Tuning for Hamiltonian Systems (I), pp. 15678-15683

Fujimoto, Kenji — Nagoya Univ.
Koyama, Ikuo — Nagoya Univ.

This paper is concerned with iterative feedback tuning for Hamiltonian systems. Hamiltonian systems have a property called variational symmetry which can be used to estimate the input-output mapping of the variational adjoint for certain input-output mappings of the systems. Here this property is utilized for estimating the gradient of an optimal control type cost function with respect to the design parameters of the controllers. This allows one to obtain an iterative feedback tuning algorithm for Hamiltonian systems which generates the optimal parameters by iteration of experiments. The proposed algorithm requires less number of experiments to estimate the gradient and can be used with the iterative learning control proposed previously. Furthermore, numerical simulations demonstrate the effectiveness of the proposed method.

FrB20 321C

Electrical Machine Control and Applications (Invited Session)

Chair: Gan, Wai-Chuen — ASM Assembly Automation Hong Kong Ltd
Co-Chair: Qiu, Li — Hong Kong Univ. of Sci. & Tech.
Organizer: Gan, Wai-Chuen — ASM Assembly Automation Hong Kong Ltd
Organizer: Qiu, Li — Hong Kong Univ. of Sci. & Tech.

14:00-14:20 FrB20.1

An Adaptive Sinusoidal Disturbance Rejection Controller for Single-Input-Single-Output Systems (I), pp. 15684-15689

Gan, Wai-Chuen — ASM Assembly Automation Hong Kong Ltd
Qiu, Li — Hong Kong Univ. of Sci. & Tech.

The design of an adaptive sinusoidal disturbance rejection controller for Single-Input-Single-Output (SISO) systems is presented in this paper. Sinusoidal disturbance rejection problems exist in industry applications such as velocity ripples in a CNC milling machine. The controller is first developed based on the Internal Model Principle (IMP) and the pole zero placement technique, then a Gain Scheduled (GS) robust Two-Degree-of-Freedom (2DOF) regulator is constructed to eliminate the sinusoidal disturbances with known frequencies and to achieve a desirable tracking response simultaneously, but without estimating the amplitude and the phase values of the sinusoidal disturbances. Using the small gain theorem, the system stability radius is obtained for n slow time varying sinusoidal disturbances. Finally, the proposed controller is applied to eliminate the torque and velocity ripples in the Alternating Current (AC) Permanent Magnet (PM) motor control systems.

14:20-14:40 FrB20.2

Disturbances Rejection for Precise Position Control of Linear Switched Reluctance Motors (I), pp. 15690-15695

Zhao, Shi Wei — Hong Kong Pol. Univ.
Cheung, Norbert — Hong Kong Pol. Univ.

In this paper, a passivity-based control (PBC) algorithm with disturbance estimation is proposed to obtain precise position control of a Linear Switched Reluctance Motor (LSRM) driving system. Following the modeling analysis of the driving system, a full-order controlled model is first developed. On the basis of the state error equation, the proposed robust PBC algorithm is derived from the view of energy dissipation and the global stability of the whole servo system is insured by the proposed algorithm in turn. Through the disturbance estimation, it can also reject the effect from external disturbances and make the servo system achieve precise position tracking. Simulations and experimental implementations carried out on the proposed LSRM driving system demonstrate that the proposed control algorithm is effective for the LSRM position tracking system.

14:40-15:00 FrB20.3

The Feedforward Friction Compensation of Linear Motor Using Genetic Learning Algorithm, pp. 15696-15701

Chen, Chin-Sheng — National Taipei Univ. of Tech.

This paper proposes a feedforward friction compensator based on

LuGre friction model. The various parameters in both the friction model and the system plant model would be coarsely estimated by the various experiments, and then the genetic algorithm (GA) finely optimizes the key parameters by a single identification experiment. When compared with the conventional black box learning algorithm, this model-based compensator uses only five parameters to model the nonlinear friction phenomenon and the corresponding convergent rate of parameters is fast in the learning process. Finally, the friction compensated performance of proposed algorithm is evaluated and compared with the traditional uncompensated system. The simulated and experimented results show that the velocity tracking error is drastically improved by the feedforward friction compensator in a linear motor motion system.

15:00-15:20 FrB20.4

On Control of Planar Switched Reluctance Motor (I), pp. 15702-15707

Yang, Jin Ming	South China Univ. of Tech.
Zhong, Qing	South China Univ. of Tech.
Cheung, Norbert	Hong Kong Pol. Univ.
Zhao, Shi Wei	Hong Kong Pol. Univ.

By using the energy dissipation theory and the property of the switched reluctance motor, this paper presents a nonlinear controller for the planar switched reluctance motors (PSRM). Based on the fact that the electrical time constant is much smaller than the mechanical time constant, the whole PSRM driving system is treated as a two-time-scale system and can be decomposed into two subsystems (electrical and mechanical) that are negative feedback interconnection. The controllers are designed for two subsystems respectively to ensure that they are passive. In view of the fact that the system made of two passive subsystem connected through negative feedback is still passive. Therefore, the stability of PSRM driving system is ensured in large scale. This control strategy possesses a simple structure and can be implemented easily. The experimental results show that the proposed control is effective for the position control of PSRM.

15:20-15:40 FrB20.5

Robust Control of a High Precision 4-DOF Parallel Manipulator (I), pp. 15708-15713

Cheung, Jacob W.F.	ASM Assembly Automation Ltd
Hung, Yeung Sam	The Univ. of Hong Kong

A model-based robust control design approach is considered for a novel direct-drive 4-DOF parallel manipulator aimed at high speed and high precision semiconductor packaging applications. An experimental identification method is proposed to determine the dynamic model of the manipulator and a robust feedback controller is designed in the frequency-domain using genetic algorithm. Experimental results demonstrate that the motion performance of the 4-DOF parallel manipulator including positioning accuracy and steady-state error is improved significantly when compared with traditional XY, Z and ¸; motion stages. This shows that the proposed 4-DOF parallel manipulator provides a superior alternative to the traditional motion stages for high-precision motion.

15:40-16:00 FrB20.6

A New Concept for Motion Control of Industrial Robots, pp. 15714-15715

Björkman, Mattias	ABB AB
BrogÍrdh, Torgny	ABB AB
Hanssen, Sven	ABB Automation Tech.
Lindström, Sven-Erik	ABB AB
Moberg, Stig	ABB AB - Robotics
Norrlöf, Mikael	ABB AB

This paper gives a short summary of an industrial development work on model-based motion control. This development has resulted in high robot motion performance simultaneously with an efficient use of the installed drive system of the robot.

FrB21 321B

Human-Robot Interaction (Regular Session)

Chair: Tervo, Kalevi	Helsinki Univ. of Tech.
Co-Chair: Riera, Bernard	Reims Univ.

14:00-14:40 FrB21.1

Computational Approaches to Human Arm Movement Control – a Review, pp. 15716-15723

Campos, Francisco M. M. O.	ISEL - Inst. Superior de Engenharia de Lisboa
Calado, João M. F.	ISEL - Inst. Superior de Engenharia de Lisboa

Human arm movement control theories are reviewed in the current paper. The motor planning problem stated as a generation of a time plan for the execution of a movement task, is a major concern of the current paper. It will be suggested that computational models of motor control have a strong potential for the use in the area of human motor rehabilitation. Their use can be discriminated in three main areas of application: the generation of correct trajectories to be demonstrated to human subjects during physiotherapy; the assessment of motion disorders and movement quality; and the devising of challenging interaction exercises to promote recovery.

14:40-15:00 FrB21.2

Improving Operator Skills with Productivity Model Feedback, pp. 15724-15729

Tervo, Kalevi	Helsinki Univ. of Tech.
Palmroth, Lauri	Tampere Univ. of Tech.
Hölttä, Vesa	Helsinki Univ. of Tech.
Putkonen, Aki	John Deere Forestry

The performance of a mobile working machine is subject to operating conditions, operator's actions, and technical condition of the machine. The ability of the operator has proven to be a significant factor when considering productivity or fuel efficiency. If the machine is in good technical condition with controller parameters tuned properly, the only way to increase performance, that is, productivity and fuel efficiency, is to improve the operator's skills. The goal of this paper is to research the operator evaluation problem in the case of forest harvesters. The productivity variations of the machine between work shifts are modeled using variables that describe operating conditions and the performance of the operator in different work tasks. An adaptive-network-based fuzzy inference system (ANFIS) is proposed to model the productivity. The model is trained and validated using data from several operators measured in normal work environment during several months. An algorithm based on the gradient descent rule is proposed to give feedback about the most significant areas of improvement potential. The use of the gradient-based technique in offline analysis of the operator's performance and work style is described. The variation of the performance between the operators is analyzed and the results are discussed.

15:00-15:20 FrB21.3

Assisting Upper Extremity Motion through the Use of the Potential Method, pp. 15730-15735

Nishiwaki, Kenji	Gifu Univ.
Yano, Ken'ichi	Gifu Univ.

In the near future, a labor shortage with constitute a significant problem in the fields of welfare and nursing care. To solve this problem, many welfare robots such as an upper extremity motion assistance robot and a meal assistance robot have been studied. The purpose of this paper is to develop an upper extremity motion assistance control system which will be able to avoid collisions with the user's face and other objects. Collision information is transmitted to an operator by haptic control. In order to avoid collision, a potential field was derived by a diffusion equation in order to construct an algorithm of velocity restriction for haptic feedback. The effectiveness of the proposed system is shown by simulations and experiments.

15:20-15:40 FrB21.4

Human-Machine Systems Concepts Applied to Education, pp. 15736-15741

Marange, Pascale	Univ. of Reims
Gellot, François	Univ. of REIMS
Riera, Bernard	Reims Univ.

In this paper, we interest us to Human-Machine Systems (HMS) concepts applied to Education. It is shown how the HMS framework enables to propose original solution in matter of education in the field of control engineering. We focus on practical courses on control of manufacturing systems. The proposed solution is based on an original use of real and large-scale systems instead of simulation. The main idea is to enable the student, whatever his/her level to control the whole system, from novice to expert, in a safety mode. The teacher is responsible for sharing the control design tasks between the student and the automatic system. Different teachers and students have tested this approach, on different manufacturing systems. By an experiment with a class of "10-year-old novice control engineer", we have shown the interest and the power of the proposed solution. We have proposed at the children to realize their first control program of a packaging process. This experiment encountered a big success.

15:40-16:00 FrB21.5

Hybrid Impedance Control of Human Skin Muscle by Multi-Fingered Robot Hand, pp. 15742-15749

Terashima, Kazuhiko	Toyohashi Univ. of Tech.
Mouri, Keisuke	Toyohashi Univ. of Tech.
Minyong, Panya	Pathumwan Inst. of Tech.
Kitagawa, Hideo	Gifu National Coll. of Tech.
Miyoshi, Takanori	Toyohashi Univ. of Tech.

This paper proposes an intelligent massage control system by using multi-fingered robot hand with hybrid impedance control, which is able to create the movement and the force of robot such as the human's massage. Therefore, the various massage points, such as the change of the stiffness of human skin muscle, can be controlled by using impedance control method. The hybrid impedance control, comprised of the two methods of the position-based and the force-based impedance control, were applied. The position-based impedance control is used to control the lateral position of massage on the human skin muscle. On the other hand, the force-based impedance control is used to control the force of the vertical direction on human skin muscle. This paper also gives the identification of human skin muscle through robot perception of impedance to decide the parameter of impedance controller. The control strategy using impedance control to implement an adaptive control system is presented, when human condition is changed with soft and hard skin muscle. Effectiveness of massage control system by using multi-fingered robot hand with hybrid impedance control is demonstrated through actual massage experiments of pushing and rubbing motion.

FrB22 321A

Structural Components (Regular Session)

Chair: McLoone, Sean F.	National Univ. of Ireland, Maynooth
Co-Chair: Jung, Hyung-Jo	KAIST

14:00-14:20 FrB22.1

On the Stability and Biasedness of the Cross-Relation Blind Thermocouple Characterisation Method, pp. 15750-15755

McLoone, Sean F.	National Univ. of Ireland, Maynooth
Hung, Peter C. F.	National Univ. of Ireland, Maynooth
Irwin, George W.	Queen's Univ. of Belfast
Kee, Robert J.	Queen's Univ. Belfast

The *in situ* characterisation of thermocouple sensors is a challenging problem. Recently the authors introduced a novel blind characterisation technique based on the cross-relation method of blind identification that allows *in situ* characterisation of temperature measurement probes consisting of two-thermocouple sensors with differing time constants. While the technique has a number of advantages over competing methods, including low estimation variance and no need for *a priori* estimation of the time constant ratio, it was found to be positively biased and becomes unstable at high noise levels. In this paper the origin of the stability issues and bias are analysed. It is shown that an alternative normalised cost function formulation, which eliminates the stability problem, results in negatively biased time constant estimates at high noise levels. Further, it is demonstrated that this bias is less significant when temperature variations are broadband. All results are verified using Monte-Carlo simulations.

14:20-14:40 FrB22.2

Semiactive Control System Based on MR Damper for Suppressing Vibration of Stay Cable under Wind Load (I), pp. 15756-15761

Jung, Hyung-Jo	KAIST
Jang, Dong-Doo	KAIST
Lee, Heon-Jae	KAIST
Kim, In-Ho	Sejong Univ.
Lee, Seung-Woo	KAIST

This paper investigates the performance of the semiactive control system based on magnetorheological fluid (MR) dampers for suppressing excessive vibration of stay cable installed in cable-stayed bridges under wind load. The cable model is extracted from a 156.3 m long stay cable with high tension. The external wind load is generated from the widely used wind load spectrum such as the Kaimal spectrum. Several semiactive control algorithms such as the Lyapunov stability theory-based control, the maximum energy dissipation and the clipped-optimal control are considered to find the appropriate control strategy for the cable-damper system employing MR dampers. Numerical simulations are carried out to demonstrate the effectiveness of the semiactive control systems based on MR dampers and their control performances are compared with those of passively operated control systems.

14:40-15:00 FrB22.3

Damage Detection of Bridge Structures Using Modal Flexibility under Temperature Variations (I), pp. 15762-15767

Koo, Ki Young	KAIST
Lee, Jong Jae	Sejong Univ.
Yun, Chung-Bang	KAIST

Changes in the measured structural responses, such as deflections and modal properties, induced by damage could be significantly smaller than those by environmental effects such as temperature and temperature gradients. To make the structural health monitoring more reliable and applicable to real structures, it is highly desirable to develop a methodology to distinguish the changes due to the structural damage from those by the environmental variations. In this study, a novel method to extract the damage-induced deflection under temperature variations is presented using the outlier analysis on the correlation of deflection components obtained using the modal flexibility matrix. The main idea is that temperature change in a bridge would produce global increase or decrease in deflections over the whole bridge. On the other hand, structural damages may cause local variations in deflections near the damage locations. Hence, the correlation analysis between the deflection measurements may show high abnormality near the damage locations. The proposed procedure may be summarized: (1) identification of the modal flexibility matrix from acceleration measurements, (2) calculation of the positive-bending-uniform-load deflection using the modal flexibility for each damage and temperature case, (3) construction of the outlier-threshold for the correlation of the intact deflection at different locations, and (4) damage detection using the outlier analysis on the correlation of the deflection for damage cases. To verify the applicability of the proposed method, a series of laboratory tests were carried out on a bridge model with a steel box-girder. Nineteen experiments were carried out for the first 2 days under daily temperature variations to construct the correlation data for the intact deflection, and 51 experiments were performed for two damage scenarios for the next 12 days. It has been found that the damage existence and location were detected successfully for a case with relatively small damage under the temperature variations.

15:00-15:20 FrB22.4

Extended Kalman Filter for Identification of Nonlinear Earthquake Responses of Bridges (I), pp. 15768-15773

Lee, Kyoung Jae	Daelim Industrial Co. Ltd.
Yun, Chung Bang	KAIST

Identification of the nonlinear hysteretic behavior of a reinforced concrete (RC) bridge pier subjected to earthquake loads is carried out based on acceleration measurements of the earthquake motion and bridge responses. The modified Takeda model is employed to represent the hysteretic behavior of the RC pier with a small number of parameters, in which the nonlinear behavior is described by various rules of loading and reloading rather than analytical expressions. The sequential modified extended Kalman filter algorithm is proposed to identify the unknown nonlinear parameters and the state vector separately in two steps, so that the size of the problem for each identification procedure may be reduced and possible numerical problems may be avoided.

15:20-15:40 FrB22.5

MultiRate Predictive Control of Piezoelectric Actuators, pp. 15774-15779

Habibollahi, Hossein	Amirkabir Univ.
Rezaie, Seyed Mehdi	Amirkabir Univ.
Shiry Ghidary, Saied	Amirkabir Univ. of Tech.
Zareinejad, Mohammad	Amirkabir Univ. of Tech.
Seifabadi, Reza	Amirkabir Univ. of Tech.
Razi, Kamran	Univ. of Tehran
Saadat, Mozafar	Univ. of Birmingham

Piezoelectric materials show nonlinear hysteresis behaviour when they are under high electrical field and mechanical load. Fundamental study of PEA depicts that the Hysteresis effect deteriorate the tracking performance of The PEA. This paper proposes a nonlinear model which quantifies the Hysteresis nonlinearity generated in Piezo-actuators in response to applied driving voltages. A novel perfect tracking control method based on multi rate feed forward control is proposed which uses the nonlinear model to compensate mentioned limiting factors in PEA. In this study a multi rate control method based on modified Prandtle-Ishlinskii operator as nonlinear model is implemented. It compensates rate dependant hysteresis nonlinearity in PEA. The controller structure has a simple design and can be quickly identified. The control system is capable to achieve suitable tracking control and it is convenient to use and can be quickly applied to the practical PEA applications. Experimental results are provided to verify the efficiency of the proposed method.

15:40-16:00 FrB22.6

A Highly-Directional Ultrasonic Range Sensor Using a Stepped-Plate Transducer, pp. 15780-15785

Je, Yub	Pohang Univ. of Science and Tecnology
Park, Jong-Kyu	Pohang Univ. of science and Tech.
Lee, Haksu	Pohng Univ. of Science and Tech.
Yi, Dong hoon	Phang Univ. of Science and Tech.
Moon, WonKyu	Pohang Univ. of Science and Tech.

A new type of highly-directional ultrasonic range sensor is designed, fabricated, and tested in this paper. To improve directivity, the parametric acoustic array, a nonlinear effect of media between two intensive waves, is applied to an ultrasonic range sensor. Additionally, a new type of the stepped-plate transducer is applied for generating high amplitude waves consisting of two frequencies. The proposed transducer shows a half power beam width(HPBW) of 5° at 40 kHz that is much higher directivity than the general ultrasonic range spatial sensor (typically 20°). Therefore, this research shows the possibility to improve the resolution of the ultrasonic range sensor.

FrB23 323

Intelligent Manufacturing Systems (Regular Session)

Chair: Torres, Fernando	Univ. of Alicante
Co-Chair: Hsieh, Fu-Shiung	Chaoyang Univ. of Tech.

14:00-14:20 FrB23.1

Development of a Flexible and Agile Multi-Robot Manufacturing System, pp. 15786-15791

Hoshino, Satoshi	Tokyo Inst. of Tech.
Seki, Hiroya	Tokyo Inst. of Tech.
Naka, Yuji	Tokyo Inst. of Tech.

In this paper, we address a fluctuating low-volume and high-mix manufacturing system that handles a large variety of products. The incoming products have their own task information imposed by customer demands. In other words, they are not given in advance. Consequently, the system-operating conditions vary with the changes in the given tasks over time. Because of such unpredictable fluctuations, the system might have localized heavy workloads. Therefore, workload balancing is a challenge. For this issue, we focus on multi-robots in a manufacturing system. We first describe behavioral and cooperation mechanisms among robots. Thus, by sharing their information, robots are able to respond to such dynamically changing situations reactively. We then develop a flexible and agile multi-robot manufacturing system with Automated Guided Vehicles (AGVs) and product-processing robots. Finally, we discuss the validity of the developed system.

14:20-14:40 FrB23.2

Reconfiguration Mechanism for Holonic Manufacturing Systems, pp. 15792-15798

Hsieh, Fu-Shiung	Chaoyang Univ. of Tech.

Although holonic manufacturing systems (HMS) have been recognized as a paradigm to cope with changes in manufacturing environment based on a flexible architecture, several characteristics of HMS such as re-configurability have not been characterized quantitatively. To realize these advantages, more concrete mechanisms or methodologies need to be developed. The objectives of this paper are to probe into the characteristics of reconfigurability for HMS and propose design methodologies to realize these characteristics. We formulate and study a holarchy reconfiguration problem to deal with dynamic removal/addition of holons in HMS due to failure/recovery of resources. Finding a solution from the scratch to deal with resource failures is not an appropriate approach as it may lead to chaos at the shop floor. To achieve effective reconfiguration in HMS, a viable solution must be based on the nominal configuration and cooperation of holons. We define an impact function to characterize the impact of changes due to different holons in a holarchy. A reconfiguration mechanism based on the impact function is proposed to effectively reconfigure the systems to achieve minimal cost solutions.

14:40-15:00 FrB23.3

Pull System Control for Job Shop Via a Holonic, Isoarchic & Multicriteria Approach, pp. 15799-15804

Pujo, Patrick	Aix Marseille Univ.
Ounnar, Fouzia	Aix Marseille Univ.

Faced to international competition, the industrial production requires increasingly implementation conditions. In certain cases, that forces to seek new techniques of workshop control. It is the case when it is asked to establish a Just in Time management in a Job Shop having the characteristic of working in small series. We present here a new approach for the organization of the 'control' function in such a context. This approach rests on the use of the holonic paradigm, on an isoarchic architecture and on a decision-making capacity based on a multicriteria analysis. Initially, we approach the various concepts related to this approach. Then, we detail the used multicriteria decision mechanisms as well as the implementation and instrumentation phases. The first obtained results are presented.

15:00-15:20 FrB23.4

Assembly/disassembly Strategies for Service Applications, pp. 15805-15810

Puente, Santiago T.	Univ. of Alicante
Torres, Fernando	Univ. of Alicante
Diaz, Carolina	Univ. of Alicante

This paper presents a development of assembly/disassembly systems to be applied in service applications. It uses algorithms developed for industrial applications to perform the service tasks. A robotic system to perform service applications in a cooperative environment with a human is used. The system uses product model to perform the task planning, with the designed task the required grasping points to manipulate the objects are computed according the restrictions. Two experimental results of applying the system to service applications are described.

15:20-15:40 FrB23.5

Modern Ability of Optimization-Simulation Approach, pp. 15811-15816

Antonova, Galina	Inst. of Control Sciences
Tsvirkun, Anatoly	Inst. of Control Sciences

Optimization-simulation technology is developed simultaneously with progress in numeric methods, computer science and different fields of modern mathematics. This paper gives the list of problems, which are formulated and successfully solved, and two primers of numeric procedures for decision of multiparameter multicriteria optimization problem. Iterative procedure for structural grows of large-scale system is considered on primer of fuel and energy system. For LPtau -search with averaging methodology a set of application is discussed. A part of existent proofs of convergence of numeric procedures is described.

15:40-16:00 FrB23.6

Are Automated Planners up to Solve Real Problems?, pp. 15817-15824

Sette, Fernando	Univ. of Sao Paulo
Vaquero, Tiago Stegun	Univ. of Sao Paulo
Park, Song Won	Univ. of Sao Paulo
Silva, José Reinaldo	Univ. of São Paulo

It is a well known fact that the AI planning community is very committed to apply the developments already achieved in this area to real complex applications. However realistic planning problems bring great challenges not only for the designers during design processes but also for the automated planners during the planning process itself. In addition, it is quite common to face issues about whether the available planners will be up to solve the problem being modeled during the initial design stages. In this paper we present the experience, results and issues that emerged from testing the performance of the recent planners when solving a real and complex problem such as the planning of daily activities of a petroleum plant for docking, storing and distributing oil. Due to the complexity of this real planning problem, the KE tool itSIMPLE was used in order to support all the design processes such as specification, modeling and domain model analysis that resulted in a PDDL model, automatically generated by the tool, which was used as input for planners. In addition, we present the main modeling process performed for the domain model construction.

FrB24 324
Job and Activity Scheduling II (Regular Session)

Chair: Allaoui, Hamid — Univ. of Artois
Co-Chair: Meyer, Wolfgang — Hamburg Univ. of Tech.

14:00-14:20 FrB24.1
Optimum Steelmaking Charge Plan with Unknown Charge Number Based on the Pseudo TSP Model, pp. 15825-15830

Xue, Yuncan — Hohai Univ.
Zhou, Zhentao — Hohai Univ.
Liu, Fei — Jiangnan Univ.
Yang, Qiwen — Hohai Univ.

This paper presents a mathematical charge plan model of steelmaking-continuous casting (SCC) scheduling in the computer integrated manufacturing systems environment. Based on the analysis of the difficulty to solve the scheduling problem, a pseudo travel salesman problem model is presented to describe the scheduling model. By using this method, we can solve the optimum charge problem even without known the charge number, while other methods must know the charge number previously. To solve the problem, an improved discrete particle swarm optimization (DPSO) is presented. A new crossover probability is introduced into the DPSO algorithm, which is differed to that of the GA.. Simulations have been carried and the results show that the pseudo travel salesman problem is very fit for describe the model. The computation with practical data shows that the model and the solving method are very effective.

14:20-14:40 FrB24.2
Sensitivity Analysis for the Configuration of a Multi-Purpose Machines Workshop, pp. 15831-15836

Aubry, Alexis — Grenoble INP
Rossi, André — European Univ. of Brittany
Jacomino, Mireille — Grenoble INP

In this paper, the multi-purpose machines problem denoted MPM|split|Cmax is considered. In such a problem, each machine is qualified to process a subset of product types but not necessarily all the product types. The set of the qualifications machine/product represents the configuration of the multi-purpose machines workshop. Uncertainties on the demand are considered and a question related to sensitivity analysis is answered to find the neighbourhood of a forecasted demand in which the demands are completed by the configuration before a given deadline. The stability radius of a configuration is moreover computed.

14:40-15:00 FrB24.3
Hybrid Model for Crane Scheduling, pp. 15837-15842

Del Vecchio, Carmen — Univ. Del Sannio
Barbarisi, Osvaldo — Univ. of Sannio
Parisio, Alessandra — Univ. del Sannio

In this paper an hybrid model for scheduling crane movements is presented. Cranes sharing the same track are considered. Cranes can reach any location along the track performing loading or unloading operations. As cranes share the same track their movements are constrained to avoid over crossing; tasks deadlines and priorities are also considered. Scheduler output are the assignment of the tasks to cranes and tasks starting time. Experimental data show the bene_ts deriving from the application of the proposed approach.

15:00-15:20 FrB24.4
Scheduling N Jobs and Preventive Maintenance in a Single Machine Subject to Breakdowns to Minimize the Expected Total Earliness and Tardiness Costs, pp. 15843-15848

Allaoui, Hamid — Univ. of Artois
Elmaghraby, Salah — North Caroline Univ.
Artiba, Hakim — SUPMECA PARIS
Goncalves, Gilles — Univ. of Artois

This paper focuses on a stochastic scheduling problem in which n immediately available jobs are to be scheduled jointly with the preventive maintenance in a single machine subject to breakdowns. The objective is to minimize expected total earliness and tardiness costs with a common due-date. The problem of scheduling only n jobs to minimize total earliness and tardiness costs in a single machine subject to breakdowns is well known to be NP-hard. We first give a relevant literature review dealing with the single machine to minimize the ET-cost. After we introduce the process of breakdowns considered in this paper. Last we formulate a dynamic programming to solve the problem optimally.

15:20-15:40 FrB24.5
Multi-Objective Optimization Issues in Short-Term Batch Scheduling, pp. 15849-15854

Gudi, Ravindra — IIT Bombay
Bhushan, Mani — Indian Inst. of Tech. Bombay
Kotecha, Prakash — Indian Inst. of Tech. Bombay
Kapadi, Mangesh — Honeywell Tech. Solutions

In this article, we propose a multiple objective optimization based approach for the short term scheduling of batch plants to select superior solutions when compared to the single objective problem. Two alternate approaches to optimality, viz. lexicographic and pareto-optimality based formulations are considered here. We demonstrate the suitability of lexicographic optimization for the case when the importance associated with the objectives is known a priori. Next, we also show the practicality of the pareto-optimization based approach when an explicit precedence ordering of the objectives is not known. Case studies involving the objectives of make-span minimization and profit maximization problem are considered here in the discrete state task network representation of (Kondili et al., 1993), to demonstrate the practicality of the above approaches, towards deciding on operating schedules.

15:40-16:00 FrB24.6
Hybrid Particle Swarm Optimization for Stochastic Flow Shop Scheduling with No-Wait Constraint, pp. 15855-15860

Liu, Bo — Centre for World Food Studies,VU Univ. Amsterdam
Wang, Ling — Tsinghua Univ. Beijing, 100084, China
Qian, Bin — Tsinghua Univ. Beijing 100084, China
Jin, Yihui — Tsinghua Univ.

The flow shop scheduling with the no-wait constraint is a typical NP-hard combinatorial optimization problem and represents an important area in production scheduling. In this paper, a class of particle swarm optimization (PSO) approach with simulated annealing (SA) and hypothesis test (HT), namely PSOSAHT is proposed for the stochastic flow shop scheduling with no-wait constraint to minimize the maximum completion time (makespan). The developed algorithm not only applies evolutionary search guided by the mechanism of PSO, but it also applies the local search guided by the jumping mechanism of SA. Thus, both global exploration and local exploitation are balanced. Meanwhile, it applies HT to perform a statistical comparison to avoid some repeated search to some extent. Simulation results and comparisons demonstrate the feasibility, effectiveness and robustness of the proposed hybrid PSO-based algorithm.

FrB25 328
Control Mechanisms in Systems Biology (Invited Session)

Chair: Ogunnaike, Babatunde A. — Univ. of Delaware
Co-Chair: Hahn, Juergen — Texas A&M Univ.
Organizer: Ogunnaike, Babatunde A. — Univ. of Delaware
Organizer: Hahn, Juergen — Texas A&M Univ.

14:00-14:20 FrB25.1
Analysis of Feedback Mechanisms in Cell-Biological Systems (I), pp. 15861-15866

Waldherr, Steffen — Univ. of Stuttgart
Eissing, Thomas — Univ. of Stuttgart
Allgower, Frank — Univ. of Stuttgart

A major issue in systems biology, which is well studied in control theory, is the analysis of feedback circuits in a dynamical system. These circuits endow biological systems with required functional properties. We give an overview on recent research results for the analysis of feedback circuits in cell-biological systems using methods from control theory. Starting from the known functional roles of feedback circuits, we summarize the biological questions that motivate a control theoretical analysis and perspective. Then, suitable methods for such an analysis are presented. We discuss how to apply these methods to biological research problems by summarizing different research projects that deal with feedback circuits in cell-biological systems.

14:20-14:40 FrB25.2

Fuzzy Modeling of Signal Transduction Networks (I), pp. 15867-15872

Huang, Zuyi (Jacky) Texas A&M Univ.
Hahn, Juergen Texas A&M Univ.

This work proposes a fuzzy modeling–based approach for describing signal transduction networks. Many key steps in signal transduction mechanisms have been investigated qualitatively in the literature, however, only little quantitative information is available. Fuzzy models can make use of this situation as fuzzy rules can be based upon the qualitative information that is found in the literature whereas training of the model can be performed with data that is available. This combination of a fuzzy rule set based upon qualitative information with parameters to be determined from data can result in models where fewer parameters need to be estimated than if fundamental or black-box models were used. This work investigates the use of fuzzy modeling to describe an IL-6 signal transduction mechanism as it plays a key role in the body's response to inflammation. The resulting model is capable of capturing the dynamics of key components of the IL-6 signal transduction pathway.

14:40-15:00 FrB25.3

An Approximate Internal Model Principle: Applications to Nonlinear Models of Biological Systems (I), pp. 15873-15878

Andrews, Burton The Johns Hopkins Univ.
Sontag, Eduardo D. Rutgers Univ.
Iglesias, Pablo A. Johns Hopkins Univ.

The proper function of many biological systems requires that external perturbations be detected, allowing the system to adapt to these environmental changes. It is now well established that this dual detection and adaptation requires that the system have an internal model in the feedback loop. In this paper we relax the requirement that the response of the system adapt perfectly, but instead allow regulation to within a neighborhood of zero. We show, in a nonlinear setting, that systems with the ability to detect input signals and approximately adapt require an approximate model of the input. We illustrate our results by analyzing a well-studied biological system.These results generalize previous work which treats the perfectly adapting case.

15:00-15:20 FrB25.4

Structural Sensitivity Analysis of Metabolic Networks (I), pp. 15879-15884

Uhr, Markus ETH Zurich
Stelling, Joerg ETH Zurich

The knowledge about control and dynamics of biological systems is often limited or incomplete but, especially for cell metabolism, network structures are often well-characterized. A major challenge in systems biology, therefore, concerns the reverse-engineering of cellular control structures from the available knowledge on the controlled systems' structures. Here, we propose a method to analyze the sensitivities in metabolic reaction networks that makes use only of the stoichiometry of the metabolic network and the assumption that the biological system is (and remains) in steady state. It is based on least-squares analysis of reaction flux adjustments to disturbances, for which we present an analytic solution. The method can be extended to include multivariate disturbances and, if a reference flux distribution as an operating point is available, to compute relative sensitivities. The resulting sensitivities are instrumental in predicting the regulation of the affected reactions. We demonstrate the utility of the method with the example of a medium-size network model for E. coli metabolism. In particular, we focus on the relation of structural network sensitivities to the variance of gene expression data resulting from external perturbations and from the action of cellular control circuits.

15:20-15:40 FrB25.5

A Control System Hypothesis of the N-Methyl-D-Aspartate Glutamate Receptor's Role in Alcoholism and Alcohol Withdrawal (I), pp. 15885-15890

McDonald, Mary K. Univ. of Delaware
Schwaber, James S. Thomas Jefferson Univ.
Ogunnaike, Babatunde A. Univ. of Delaware

Alcoholism and alcohol withdrawal, complicated physiological conditions with significant consequences for physical and emotional health, have been the focus of extensive studies in various scientific disciplines for centuries. In America alone, alcoholism is known to affect 14 million people; it accounts for an estimated annual cost of 100 billion in healthcare and related productivity losses, and according to the Centers for Disease Control, there were 34,833 chronic alcohol-related deaths in 2001. Various experimental studies have strongly suggested that many of the physiological consequences of alcoholism and alcohol withdrawal may be associated with alcohol-induced inhibition of N-methyl-Daspartate (NMDA) glutamate receptors, but the mechanisms are not completely known. (Glutamate is an important excitatory neurotransmitter and its NMDA receptors are expressed widely throughout the brain.) In this paper, we postulate the following hypothesis: that the level of unblocked NMDA receptors is controlled in alcoholism to maintain at a constant level, the amount of glutamate release and extent of glutamatergic excitation; that ethanol blocks these receptors, and additional receptors are generated to compensate for the loss; we then develop and analyze a control system model predicated on this hypothesis. Our model shows, among other things, that upon cessation of alcohol consumption, no additional generation of NMDA receptors occurs, but the number of unblocked NMDA receptors increases dramatically, leading to the excitotoxicity observed clinically. This first attempt at a control system representation of the NMDA receptor's role is thus able to capture the essence of some key organism-wide responses observed in alcoholism and alcohol withdrawal. Future work will involve incorporating additional molecular details to obtain a more accurate model which can then be potentially useful in postulating treatment regimens for alcohol withdrawal.

15:40-16:00 FrB25.6

Systems Analysis of the Insulin Signaling Pathway (I), pp. 15891-15896

Kwei, Eric Univ. of California, Santa Barbara
Sanft, Kevin Univ. of California, Santa Barbara
Petzold, Linda Univ. of California Santa Barbara
Doyle, Francis Univ. of California at Santa Barbara

Analysis of a detailed mathematical model of the insulin signaling pathway yields a more quantitative understanding of the mechanisms underlying insulin resistance and its subsequent progression to type 2 diabetes. A simple dynamic sensitivity analysis of the model allows optimization of input perturbation as well as state measurement selection for experimental parameter identification. Finally, a stochastic version of the model has yielded promising preliminary results on the impact of cellular noise on insulin sensitivity.

FrB26 327

AI Applications in Power Plants (Regular Session)

Chair: Mori, Hiroyuki Meiji Univ.
Co-Chair: Zhang, Ruiyou Northeastern Univ.

14:00-14:20 FrB26.1

Discrete-Time Backstepping Synchronous Generator Stabilisation Using a Neural Observer, pp. 15897-15902

Alanis, Alma Y. Cinvestav
Sanchez, Edgar N. CINVESTAV
Loukianov, Alexander G. CINVESTAV IPN GDI

This paper deals with adaptive tracking for discrete-time MIMO nonlinear systems in presence of bounded disturbances, based on a neural observer. A high order neural network structure is used to approximate a control law designed by the backstepping technique, applied to a block strict feedback form (BSFF); besides the observer is based on a recurrent high-order neural network (RHONN), which estimates the state vectors of the unknown plant dynamics. The learning algorithm for both neural networks is based on an Extended Kalman Filter (EKF). The applicability of the proposed approach is tested, via simulations, by its application to synchronous generators control.

14:20-14:40 FrB26.2

An LMI Design of an Observer Based Fuzzy PSS, pp. 15903-15908

Soliman, Mahmoud — Banha Univ.
Elshafei, Abdel Latif — Cairo Univ.

Power systems are highly nonlinear systems that exhibit undesirable oscillations following disturbances. Power system stabilizers (PSS) are usually incorporated to provide auxiliary excitation signals to damp these oscillations. Our objective is to improve the PSS performance via the use of fuzzy logic and LMI techniques. A power system is viewed as a polytopic model that can be adequately represented by a Takagi-Sugeno fuzzy system. A power system stabilizer based on the parallel distributed control principle is suggested. Typically, speed measurement are used as feedback signals. Consequently, a fuzzy observer is included to estimate the unmeasured states. LMI conditions that guarantee the stability and robust pole clusteringof the closed loop system are derived. Simulation results of both single-machine and multi-machine models confirm the effectiveness of the proposed algorithm

14:40-15:00 FrB26.3

A Simulation Model of Spray Flash Desalination System, pp. 15909-15914

Goto, Satoru — Saga Univ.
Yamamoto, Yuji — Saga Univ.
Sugi, Takenao — Saga Univ.
Yasunaga, Takeshi — Saga Univ.
Ikegami, Y. — Saga Univ. Japan
Nakamura, Masatoshi — Graduate School of Science and Engineering, Saga Univ.

In this paper, a simulation model of a spray flash desalination system is proposed. In the spray flash desalination system, the freshwater is made from the evaporation-condensation process, i.e., evaporation of warm surface seawater in a flash chamber and condensation of the generated vapor by deep cool seawater. A main simulation model of the spray flash desalination system is constructed by using physical relations such as the energy conservation law and the mass conservation law. Simulation results of the proposed simulation model are compared with the experimental results of an experimental plant of the splay flash desalination system, and it shows the effectiveness of the proposed simulation model.

15:00-15:20 FrB26.4

Intelligent Control of a Fuel Cell Power Plant, pp. 15915-15920

Choi, Tae-Il — Pennsylvania State Univ.
Lee, Kwang Y. — Baylor Univ.

Fuel cells will become more attractive to mainstream electricity users as they improve in capability and decrease in cost. Molten Carbonate Fuel Cell (MCFC) stack dynamic model was developed to analyze a spectrum of dynamic responses, and a simplified process flow diagram of a fuel cell power plant is presented. The neural network (NN) computing architectures suggest that they may be good candidates for implementing real-time controllers for complicated, nonlinear dynamic systems. A new concept of intelligent setpoint reference governor (I-SRG) using heuristic algorithm will be developed to find the optimal setpoints based on system constraints and performance objectives.

15:20-15:40 FrB26.5

A New Methodology to the Control Problem of Horizontal Axis Wind Power Plants Using Adaptive Neural Network, pp. 15921-15926

Bati, Akram — Univ. of Tech.
Rashid, Kasim — RMC, Kingston, Ontario, Canada
Al-Rubaiee, Safa — Univ. of Tech.

The main goal of this study is to afford an involvement to the control problem of horizontal axis wind power plants by means of neural network approach. The current paper is a part of a research plan to study the dynamics and control of horizontal axis wind turbines. This work presents a novel methodology to control wind power plants. It makes use of an adaptive neural networks self-tuning control system of medium scale wind turbine system through different operating conditions. The planned control system consists of neural networks forward and inverse identifiers, which are used to model their dynamics, and to adapt neural controller parameters. A reference model is used to enhance the training course and neural controller which is used to produce control signal to the pitch angle actuator. The planned control system carry out high-quality performance which reveal that the proposed control system is in fact an innovative contribution in the control field of horizontal axis wind turbine power generation systems judge against with previous works. Copyright © 2002 IFAC

15:40-16:00 FrB26.6

Power-Grid-Partitioning Model and Its Tabu-Search-Embedded Algorithm for Zonal Pricing, pp. 15927-15932

Zhang, Ruiyou — Northeastern Univ.
Wang, Dingwei — Northeastern Univ.
Yun, Won Young — Pusan National Univ.

Power grid partition is a major problem in power markets based on zonal marginal price (ZMP). As the preparation of modeling, the zone of a node set is defined as the minimum-girthed convex polygon containing these nodes, and a theorem judging common nodes between two zones of node sets is proposed. Then, the power-grid-partitioning problem is described as a combinatorial optimization model, and solved by a heuristic algorithm embedded by tabu search (TS). Finally, two actual examples comprising 27 and 323 nodes from northeastern power grid of China prove the validity of the proposed algorithm. In contrast to other partitioning methods, the proposed one in this paper is electrical-information considered and automatically finished, and therefore applicable to actual power system.

FrB27 326

Remote and Distributed Control (Regular Session)

Chair: Schilling, Klaus — Univ. Wuerzburg
Co-Chair: Salichs, Miguel A. — Univ. Carlos III

14:00-14:20 FrB27.1

Process Control Via Network, pp. 15933-15938

Yliniemi, Maija Leena — Docent

The explosive growth in the area of computing and networking has occurred. This has caused an increased reliance on distributed computing and process operations across the networks. The main aspect in the process control across network is the network delay, which depends on the network type and protocol. This paper gives the literature review about the network-based control systems and the methods developed for handling and compensating the network delay in a control loop. In the experimental part the research environment for examining the control performance of a laboratory-scaled process across three different wired networks and wireless ad-hoc network is described and the control results are compared. The wired networks are Ethernet, Internet and FUNET, which is the network operating between the universities in Finland. This means that the distances between the operator and the process to be controlled vary remarkably from twenty meters to several hundred kilometers. Also the transmission speed of the network is different. The network delays are measured and compared with each other. Also the loss of data packages in different networks is examined.

14:20-14:40 FrB27.2

A Petri Net Model of Distributed Control in a Holonic Manufacturing Execution System, pp. 15939-15944

Demongodin, Isabel — Univ. Paul Cézanne
Hennet, Jean-Claude — LSIS Information and Systems Science Lab.

In a holonic manufacturing execution system, operations assignment and scheduling can be decided in real time by automatic negotiation between order holons and resource holons. Negotiation is used to conciliate the goals pursued by the software agents who constitute the control part of the holons. This paper proposes mathematical criteria to represent the agents' goals, a game theoretic approach to analyze the possible outcomes of the negotiation process, and a Petri net model to represent the interaction protocols between order and resource agents. This model is analyzed in view of verifying the required properties of the protocol. In particular, certain conditions are proposed under which the following requirements are verified: no-blocking, selection of exactly one resource for each order, protocol termination in a bounded time.

14:40-15:00 FrB27.3

Stability Analysis of Multi-Input and Multi-Output Networked Control Systems, pp. 15945-15950

Ma, Weiguo — Dalian Univ. of Tech.
Shao, Cheng — Dalian Univ. of Tech.

The stability of multi-input and multi-output networked control systems (MIMO NCS) is considered in this paper. A less conservative delay dependent stability criterion for MIMO NCS is proposed in terms of linear matrix inequality. The new result is obtained by taking the relationship between the delay upper bounds into account in Lyapunov functional, estimating the upper bound of the derivative of Lyapunov functional without ignoring the additional useful terms and introducing the new free-weighting matrices. The resulting criterion is also extended to the stability analysis for MIMO NCS with time-varying structured uncertainties. Numerical example demonstrates that the proposed criteria are less conservative than the existing ones.

15:00-15:20 FrB27.4

Multi-Agent Control System of a Kraft Recovery Boiler, pp. 15951-15956

Herrera Sosa, Ivan Raul	Univ. of São Paulo
Park, Song Won	Univ. of Sao Paulo
Silva, José Reinaldo	Univ. of São Paulo

In this paper the authors have undertaken an attempt to implement the Multi-agent technology on controlling a recovery boiler, aiming to manage and integrate production, quality and security to the process. The operation of the recovery boiler has two well defined objectives, each one with its operational constraints: (1) steam production, an important asset in the pulp and paper process, and, (2) reduction of inorganic reagents to recover sulfate and sodium carbonates, the necessary chemicals in the Kraft pulp production. Each one of these functions, is an independent system inside the recovery boiler, however they have their performances connected to each other by common variables present in the process. This is exactly the definition of an agent system, in other words, a definition of a Multi-Agent System (MAS), for which there is not an optimization, but the search for the best possible outcome. Agents' engineering aspects are addressed by adopting the domain independent software standard, formulated by FIPA. Jade core Java classes are used as a FIPA specification implementation. A dynamic model of a Kraft Recovery Boiler was built on a Matlab-Simulink platform.

15:20-15:40 FrB27.5

Two Ways for Remote Plant Control, pp. 15957-15962

Zakova, Katarina	Slovak Univ. of Tech.
Huba, Mikulas	Slovak Univ. of Tech.

The paper presents several possibilities of remote control of experiments. One direction of the research is devoted to the use of Matlab software environment. There are number of ways how to approach Matlab remotely. They include e.g. Matlab S-function, COM, DDE, shared communication file or Virtual Reality Toolbox. One of these proposed concepts was used and tested for control of the inverted pendulum system. This approach was compared with the method enabling to approach the plant directly without using Matlab package. Finally, the gained experience is discussed in the paper.

15:40-16:00 FrB27.6

On the Source-Channel Coding Tradeoff in Networked Control, pp. 15963-15966

Johansson, Mikael	Royal Inst. of Tech.

This short note considers the source-channel coding tradeoff in networked control systems. Specifically, we consider how to optimally allocate a fixed number of bits to source and channel coding in order to minimize the estimation error variance of a Kalman filter operating over a binary erasure channel. We develop an analytical model for the system performance, quantify the source-channel coding tradeoff and compare the optimal performance with what can be achieved with the optimal performance of a collocated estimator using both analytical studies and extensive monte carlo simulations.

FrB28 330A

Marine System II (Regular Session)

Chair: Silvestre, Carlos	Inst. Superior Tecnico
Co-Chair: Bitmead, Robert	Univ. of California San Diego

14:00-14:20 FrB28.1

Identification of Longitudinal and Trasnversal Dynamics of a Fast Ferry, pp. 15967-15972

Muńoz-Mansilla, Rocío	UNED
Aranda, Joaquin	Univ. Nacional de Educación a Distancia
Díaz, Jose Manuel	UNED
Chaos, Dictino	UNED
de la Cruz, Jesús M	Complutense Univ.

An analysis of the system identification methods have been carried out and a new alternative approach is proposed in order to estimate models for heave, pitch and roll dynamics of a high speed craft. As starting point, a first approach resolves the identification subject as an optimization problem to fit the best model, and uses genetic algorithms and nonlinear least squares with constraints methods applied in the frequency domain. The second and definitive one suggests a new parameterization which facilitates obtaining high quality starting values and avoids non-quadratic functions in the cost function. At last it is shown an example in which the two approximations are applied and compared.

14:20-14:40 FrB28.2

Improving Aiding Techniques for USBL Tightly-Coupled Inertial Navigation System, pp. 15973-15978

Morgado, Marco	Inst. Superior Técnico
Oliveira, Paulo Jorge	Inst. Superior Técnico
Silvestre, Carlos	Inst. Superior Tecnico
Vasconcelos, José Fernandes	Inst. Superior Técnico

This paper presents two Tightly-Coupled fusion techniques to enhance position, velocity and attitude estimation based on position fixes of an Ultra-Short Base Line (USBL) positioning system with low update rates and the high rate Inertial Navigation System (INS) outputs, subject to bias and unbounded drift. In this framework, the vehicle interrogates transponders placed at known positions of the mission scenario to obtain a measure of distance and attitude of the vehicle relatively to the transponders. Whereas the travel time of the acoustic signals from the transponder to the vehicle is commonly approximated in the literature by half of the Round Trip Time (RTT), a method that exploits the full RTT is presented taking into account the interrogation instant estimates and the associated uncertainty. The relevance of the inclusion of the interrogation instant information and the enhanced performance outcome from the proposed techniques are assessed in Monte Carlo simulations of the overall navigation system.

14:40-15:00 FrB28.3

Model Predictive Control with State Dependent Input Weight: An Application to Underwater Vehicles, pp. 15979-15984

Marafioti, Giancarlo	Norwegian Univ. of Science and Tech.
Bitmead, Robert	Univ. of California San Diego
Hovd, Morten	Norwegian Univ. of Tech. and Science

Model predictive control (MPC) is an excellent approach for controlling systems with constraints. For nonlinear systems, nonlinear model predictive control (NMPC) is a natural solution, but it seems to be not suitable for system with relative fast dynamics. The main disadvantage is the time needed for solving the corresponding optimisation problem. Different approaches are used to simplify the optimisation problem and most of them yield an approximated optimal solution. It may happen that the best plant performances are obtained on the constraint borders. Thus, a controller that is able to handle and to work as close as possible to constraints without violating them, is desired. A faster computational power availability and improvements on the algorithms, make both the academic community and the industry to work intensively on the feasibility of using MPC on faster dynamics systems. In this work a model predictive control approach for controlling the depth of an underwater vehicle, with relatively fast nonlinear dynamics, is presented. Three different approaches are considered. For the internal model both a linear time invariant (LTI) and a linear time varying (LTV) model are implemented. A constant input weight is used for the LTI model, while for the LTV model also a state dependent input weight is utilised. The latter shows improvement on the control performance. An Extended Kalman Filter is used for state estimation.

15:00-15:20 FrB28.4

A Totally Stable Adaptive Control for Path Tracking of Time-Varying Autonomous Underwater Vehicles, pp. 15985-15990

Jordan, Mario A.	IADO-CONICET, DIEC-UNS
Bustamante, Jorge Luis	Argentinean Inst. of Oceanography

This paper deals with the problem of adaptive path tracking of autonomous underwater vehicles with time-varying dynamics. The controller design is based on a speed-gradient adaptive law. A high-performance control behavior is aimed, so the full actuator dynamics is considered together with that of the vehicle. To this end, a state/disturbance observer is developed in the state feedback employing inverse dynamics. It is proved that the error paths can converge asymptotically to null when only the nonlinear static characteristic of the thrusters is involved in the design. When the actuator dynamics is considered too, only attractivity of the error paths to a residual set can be stated. The framework for this last proof relies on the concept of total stability. One main characteristic of our approach is that it can cope with a wide variety of bounded time-varying parameters with no limitations at all on their rates or a-priori knowledge.

15:20-15:40 FrB28.5

Neural Network-Based Underwater Image Classification for Autonomous Underwater Vehicles, pp. 15991-15995

Kim, Tae Won	STI Medical Systems
Yu, Son-Cheol	Univ. of Hawaii
Yuh, Junku	US Embassy Tokyo

Image processing has been one of hot issues for real world robot applications such as navigation and visual servoing. In case of underwater robot application, however, conventional optical camera-based images have many limitations for real application due to visibility in turbid water, image saturation under underwater light in the deep water, and short visible range in the water. Thus, most of underwater image applications use high frequency sonar to get precise acoustic image. There have been some approaches to apply optical image processing methods to acoustic image, but performance is still not good enough for automatic classification/recognition. In this paper, a neural network-based image processing algorithm is proposed for acoustic image classification. Especially, shadow of an acoustic object is mainly used as a cue of the classification. The neural network classifies a pre-taught image from noisy and/or occlude object images. In order to get fast learning and retrieving, a Bidirectional Associative Memory (BAM) is used. It is remarked that the BAM doesn't need many learning trials, but just simple multiplication of two vectors for generating a correlation matrix. However, because of the simple calculation, it is not guaranteed to learn and recall all data set. Thus, it is needed to modify the BAM for improving its performance. In this paper, complement data set and weighted learning factor are used to improve the BAM performance. The test results show that the proposed method successfully classified 4 pre-taught object images from various underwater object images with up to 50% of B/W noise.

15:40-16:00 FrB28.6

Compliant Coordination and Control of Multiple Vehicles with Discrete-Time Periodic Communications, pp. 15996-16001

Almeida, João	Inst. Superior Técnico
Silvestre, Carlos	Inst. Superior Tecnico
Pascoal, Antonio M.	ISR-Inst. Superior Tecnico

This paper addresses the problem of coordinated path-following of networked autonomous vehicles with discrete-time periodic communications. The objective is to steer a group of autonomous vehicles along given spatial paths, while holding a desired inter-vehicle formation pattern. For a class of vehicles, we show how Lyapunov based techniques, graph theory, and results from networked control systems can be brought together to yield a decentralized control structure where the dynamics of the cooperating vehicles and the constraints imposed by the topology of the inter-vehicle communications network are explicitly taken into account. Compliant vehicle coordination is achieved by adjusting the speed of each vehicle along its path according to information exchanged periodically on the positions of a subset of the other vehicles, as determined by the communications topology adopted. The closed loop system, obtained by putting together the path-following and coordination strategies, takes an interconnected feedback form where both systems are input-to-state stable (ISS) with respect to the outputs of each other. Stability and convergence of the overall system are guaranteed for an adequate choice of gains.

FrB29 330B

Cooperative Motion Control of Multiple Autonomous Vehicles
(Invited Session)

Chair: Pascoal, Antonio M.	ISR-Inst. Superior Tecnico
Co-Chair: Aguiar, A. Pedro	Inst. Superior Tecnico
Organizer: Pascoal, Antonio M.	ISR-Inst. Superior Tecnico
Organizer: Aguiar, A. Pedro	Inst. Superior Tecnico

14:00-14:20 FrB29.1

Decentralized Control of Swarms with Collision Avoidance Implications (I), pp. 16002-16007

Niccolini, Marta	Univ. of Pisa
Pollini, Lorenzo	Univ. of Pisa
Innocenti, Mario	Univ. of Pisa

The paper reviews some approaches to the decentralized control of a swarm of unmanned vehicles, and then proposes a new algorithm capable of managing collisions between vehicles and with obstacles. The swarm goal is to achieve a desired shape and position in space, formalized using an abstraction based approach. Formation statistics are defined in analogy with phisical bodies: center of mass position and inertia moments. Each agent elaborates its own estimate of these variables using a consensus algorithm capable of tracking a ramp reference, in order to reduce tracking errors. Gyroscopic and damping terms are added to the control law in order to avoid collision between vehicles and with obstacles. The obstacle avoidance terms appear in the control law only in the presence of obstacles or nearby vehicles; thus system dynamics change during the system evolution. This behavior was modeled as a hybrid system and proof of stability is given, under mild conditions, using the Common-Lyapunov function approach. The proposed methodology is validated through extensive numerical simulation.

14:20-14:40 FrB29.2

Ship Formation Control: A Guided Leader-Follower Approach (I), pp. 16008-16014

Breivik, Morten	Norwegian Univ. of Science and Tech.
Hovstein, Vegard E.	Maritime Robotics AS
Fossen, Thor I.	NTNU

This paper considers the topic of formation control for fully actuated ships. Within a leader-follower framework, a so-called guided formation control scheme is developed by means of a modular design procedure inspired by concepts from integrator backstepping and cascade theory. Control, guidance, and synchronization laws ensure that each individual formation member is able to converge to and maintain its assigned formation position such that the overall formation is able to assemble and maintain itself while traversing an arbitrary, regularly parameterized path that is chosen by a formation control designer. A key novelty of the approach is the derivation of guidance laws that are applicable to off-path traversing of curved paths. The helmsman-like transient motion behavior associated with the scheme is illustrated through a computer simulation involving three fully actuated ships.

14:40-15:00 FrB29.3

Coordinated Path Following of Multiple UAVs for Time-Critical Missions in the Presence of Time-Varying Communication Topologies (I), pp. 16015-16020

Aguiar, A. Pedro	Inst. Superior Tecnico
Kaminer, Isaac	Naval Postgraduate School
Ghabcheloo, Reza	Inst. Superior Técnico
Pascoal, Antonio M.	ISR-Inst. Superior Tecnico
Hovakimyan, Naira	Virginia Pol. Inst.
Cao, Chengyu	Virginia Pol. & State Univ.
Dobrokhodov, Vladimir	Naval Postgraduate School
Xargay, Enric	Virginia Pol. Inst. and State Univ.

We address the problem of steering multiple unmanned air vehicles (UAVs) along given paths (path-following) under strict temporal coordination constraints requiring, for example, that the vehicles arrive at their final destinations at exactly the same time. Path-following relies on a nonlinear Lyapunov based control strategy derived at the kinematic level with the augmentation of existing autopilots with {cal L}_1 adaptive output feedback control laws to obtain inner-outer loop control structures with guaranteed performance. Multiple vehicle time-critical coordination is achieved by enforcing temporal constraints on the speed profiles of the vehicles along their paths in response to information exchanged over a dynamic communication network. We consider that each vehicle transmits its coordination state to only a subset of the other vehicles, as determined by the communications topology adopted. We address explicitly the case where the communication graph that captures the underlying communication network topology may be disconnected during some interval of time (or may even fail to be connected at any instant of time) and provide conditions under which the closed-loop system is stable. Flight test results obtained at Camp Roberts, CA in 2008 and hardware-in-the-loop (HITL) simulations demonstrate the benefits of the algorithms developed.

15:00-15:20 FrB29.4

Cooperative Control of Underwater Glider Fleets by Fault Tolerant Decentralized MPC (I), pp. 16021-16026

Longhi, Sauro	Univ. Pol. delle Marche
Monteriù, Andrea	Univ. Pol. delle Marche
Vaccarini, Massimo	Univ. Pol. delle Marche

A fleet of Autonomous Underwater Vehicles (AUVs) moving together in a prescribed pattern can form an efficient data acquisition network. The problem is to control several AUVs such that after transients, they form a required formation and move along a desired trajectory. The capability to accomplish the mission even in case of faults, is a fundamental requirement for these kind of missions. A completely decentralized predictive control and FDI strategy is here proposed for allowing cooperation. Trough an underwater communication channel, each vehicle broadcasts its position, its future behavior and its actuator/sensor fault situation. Based both on the local and the received information, each vehicle selects the desired formation to keep and plans its future actions. Simulation results are provided to validate the approach.

15:20-15:40 FrB29.5

Leaderless Formation Control Using Dynamic Extension and Sliding Control (I), pp. 16027-16032

Zheng, Zhibo	Columbia Univ.
Girard, Anouck	Univ. of Michigan, Ann Arbor
Spry, Stephen	Univ. of California, Berkeley

We present a design of a leaderless formation controller for networked vehicle systems, which uses concepts from sliding mode control and dynamic extension. A single gain varies the importance of the relative and absolute position terms, allowing for tight or loose formations. This approach is proven mesh stable. Applications include formation flying of Unmanned Air Vehicles as well as possible extensions to satellites or Autonomous Underwater Vehicles.

15:40-16:00 FrB29.6

Distributed Control Design for Underwater Vehicles, pp. 16033-16038

Balderud, Jonas	Univ. of Strathclyde
Giovanini, Leonardo	Industrial Control Centre
Katebi, Reza	Univ. of Strathclyde

The vast majority of control applications are based on non-interacting decentralized control designs. Because of their single-loop structure, these controllers cannot suppress interactions of the system. It would be useful to tackle the undesirable effects of the interactions at the design stage. A novel model predictive control scheme based on Nash optimality is presented to achieve this goal. In this algorithm, the control problem is decomposed into that of several small-coupled mixed integer optimisation problems. The relevant computational convergence, closed-loop performance and the effect of communication failures on the closed-loop behaviour are analysed. Simulation results are presented to illustrate the effectiveness and practicality of the proposed control algorithm.

FrB30 330C

Control Design for Transportation Vehicles and Systems

(Regular Session)

Chair: Panferov, Alexander	SUAI, Saint-Petersburg State Univ. of Aerospace Inst.
Co-Chair: Li, Pingkang	Beijing Jiaotong Univ.

14:00-14:20 FrB30.1

Torque Observer Modelling for Vehicle Transmission Shifting Processing Based on Neural Networks, pp. 16039-16044

Li, Pingkang	Beijing Jiaotong Univ.
Jin, Taotao	Beijing Jiaotong Univ.
Du, Xiuxia	Beijing Jiaotong Univ.

To reduce shock during transmission gear shift, a Neural Network based torque observer for vehicle transmission shifting processing modelling is proposed in this paper. The problem with nonlinear model identification for an excessive number of candidate model terms or basis functions has been treated, using an Extended Kalman Filtering algorithm. The modelling of transmission input torque, which is needed by the observer for accurate clutch pressure estimation, is addressed and implemented using a Radial Basis Function Neural Network (RBFNN) based observer. A linear combination of model terms, or basis functions of the RBFNN, which are nonlinear functions of the system variables is identified as a linear-in-the-parameters model. The resulting observers are validated via off-line simulation tests, as well as experiment tests at different sampling frequencies on a test vehicle bench, for demonstration the observer performance and establishment the feasibility of the approach.

14:20-14:40 FrB30.2

Traffic Control of Internal Tractors in Port Container Terminal Using Simulation, pp. 16045-16050

Lau, Henry	The Univ. of Hong Kong
Lee, Nicole	The Univ. of Hong Kong

Tight cooperative control of mobile entities and resources is essential to enhance the efficiency and effectiveness of terminal operation. The paper aims at developing an integrated simulation model which integrates the traffic flow control of internal tractors and the berth operation of a container terminal for evaluation of control policies adopted. Terminal operation is modeled as a discrete event system using the AutoMod simulation tool. The model provides a definitive basis for evaluating the performance of the berth and for determining the potentials for the operation improvements such as to resolve traffic congestion problems of a port container terminal.

14:40-15:00 FrB30.3

Wheelslide and Wheelskid Protection for a Single-Wheel Drive and Brake Module (SDBM) for Rail Vehicles, pp. 16051-16056

Stuetzle, Thorsten	RWTH Aachen Univ.
Engelhardt, Thomas	RWTH Aachen Univ.
Enning, Manfred	RWTH Aachen Univ.
Abel, Dirk	RWTH-Aachen Univ.

In this paper, the dynamic behaviour of a rail vehicle with single-wheel drive and brake modules is analysed. It is shown that in the wheelslide or wheelskid case, the linearised plant obtains an unstable pole whose location is determined by the shape of the current creep force curve. By considering possible variations in the shape of the creep force curve, the corresponding variation of the pole location in the right-half plane is calculated and a controller structure for creepage control and creep velocity control is suggested. If the controller design takes the worst-case pole location into account, the resulting controller stabilises the closed loop even at small velocities. This fact is finally illustrated through simulation results.

15:00-15:20 FrB30.4

Modeling and Straight Transfer Transformation Control of Shipboard Crane Considering Ship Sway, pp. 16057-16064

Ito, Ryuji	Toyohashi Univ. of Tech.
Hieda, Kazuya	Toyohashi Univ. of Tech.
Terashima, Kazuhiko	Toyohashi Univ. of Tech.
Kaneshige, Akihiro	Tokuyama Coll. of Tech.

The purpose of this paper was to develop a control system for a shipboard crane that considers safety and work efficiency. A shipboard crane model was built and a straight-transfer transformation control system was designed. In order to realize transfer trajectory control, a Two-Degree-of-Freedom (2-DOF) control system was applied. It was demonstrated that the work efficiency of transferring a load to a target position can be improved by considering shipboard sway, by using a 2-DOF system that combines a feedforward control system with a feedback control system, and making the transfer trajectory follow the desired one.

15:20-15:40 FrB30.5

Integrated-Equilibrium Routing of Traffic Flows with Congestion, pp. 16065-16070

Li, Zhenlong	Beijing Univ. of Tech.
Zhao, Xiaohua	Beijing Univ. of Tech.

The routing of traffic flows is an important mechanism to alleviate traffic congestion. However, it faces a dilemma. For the traffic manager, it is desirable to achieve system optimum, which may discriminate against some users, and yet the user wishes to use the shortest route to maximize his/her utility, which may result in inferior system performance. Based on the conflict between the "system" and the "users", the game theory is used to study the traffic routing problem in this paper. After shortage of the traditional routing model had been analyzed, a new concept called satisfactory degree is introduced. An integrated-equilibrium model based on double-objective optimization and corresponding algorithm are respectively proposed. At last, an example is conducted to illustrate that traffic flows are guided more efficiently and rationally using the integrated-equilibrium model.

15:40-16:00 FrB30.6

Mathematical Modeling, Simulation and Control of Flexible Vehicles, pp. 16071-16076

Panferov, Alexander — SUAI, Saint-Petersburg State Univ. of Aerospace Inst.
Nebylov, Alexander — State Univ. of Aerospace Inst.
Brodsky, Sergey — SUAI, Saint-Petersburg StateUniversityofAerospaceInstrumentation

Possible approaches to the mathematical description of different types of flexible vehicles in view of structural oscillations, oscillations of fluid in tanks and moving masses inside the vehicle are observed. Elastic bending of a body surface in interaction with a surrounding medium in a broad band of speed variation are taken into account. Problems of regulator’s synthesis and effective damping of elastic oscillations are solved for nonstationary flexible controlled plant. In the process of regulator’s synthesis the local aerodynamic effects, dynamics and metering errors of sensors, time lag of engines and other elements of control system are considered. Methods of varying eigenfrequencies estimation in the real time are used for the control quality increasing. Principles of universal software design were developed for solving these complex problems of dynamic properties research, simulations of elastic vehicles motion and synthesis of perfect control law. Functioning of the program package is demonstrated and outcomes of calculations are presented.