IEEE ROBIO2016 Technical Program

Saturday December 3, 2016

Reception
18:30-20:30 China Hall, 2F Valley Wing **Welcome Reception**

Sunday December 4, 2016

Track 1	Track 2	Track 3	Track 4	Track 5	Track 6	Poster
09:00-10:00 China Hall, 2F Valley Wing Plenary Session I: Towards Surgeon-Robot Collaborative Surgery (Prof. Yunhui Liu, the Chinese University of Hong Kong)						
10:00-10:20 Coffee Break, 2F Foyer						
10:20-11:50 SuA01 Room 31 Mobile Robotics I	10:20-11:50 SuA02 Room 32 Medical Robotics I	10:20-11:50 SuA03 Room 33 Biologically Inspired Robotics I	10:20-11:50 SuA04 Room 34 Intelligent Control	10:20-11:50 SuA05 Room 35 Interactive Systems	10:20-11:50 SuA06 Room 36 Sensing	
Lunch						
13:00-14:30 SuB01 Room 31 Mobile Robotics II	13:00-14:30 SuB02 Room 32 Medical Robotics II	13:00-14:30 SuB03 Room 33 Biologically Inspired Robotics II	13:00-14:30 SuB04 Room 34 Grasping and Manipulation I	13:00-14:30 SuB05 Room 35 Robot Vision I	13:00-14:30 SuB06 Room 36 Space Robotics	
14:40-16:10 SuC01 Room 31 Mobile Robotics III	14:40-16:10 SuC02 Room 32 Human Support Robotics	14:40-16:10 SuC03 Room 33 Soft Robotics I	14:40-16:10 SuC04 Room 34 Grasping and Manipulation II	14:40-16:10 SuC05 Room 35 Robot Vision II	14:40-16:10 SuC06 Room 36 Path and Motion Planning	14:40-17:00 SuPOS 2F Foyer Poster Session I
16:10-16:30 *Coffee Break*, 2F Foyer, Valley Wing						
16:30-18:00 SuD01 Room 31 Mobile Robotics IV	16:30-18:00 SuD02 Room 32 Aerial Manipulator Systems	16:30-18:00 SuD03 Room 33 Soft Robotics II	16:30-18:00 SuD04 Room 34 Biomimicking Robots/Systems	16:30-18:00 SuD05 Room 35 Robot Vision III	16:30-18:00 SuD06 Room 36 Underwater Robots and Snake Robots	

Monday December 5, 2016

<table>
<tr><th>Forum</th><th>Track 1</th><th>Track 2</th><th>Track 3</th><th>Poster</th></tr>
<tr><td colspan="5">09:00-09:40 Special Forum on Smart Manufacturing, China Hall, 2F Valley Wing

Opening Ceremony</td></tr>
<tr><td colspan="5">09:40-10:00 Coffee Break, 2F Foyer, Valley Wing</td></tr>
<tr><td colspan="5">10:00-11:40 Special Forum on Smart Manufacturing, China Hall, 2F Valley Wing

10:00-10:50 Keynote1: Surgical Navigation Technology, Automated Design and Additive Manufacturing of Surgical Robots and Telemanipulators
(Tim Leuth, Technical University Munich, Germany)

10:50-11:40 Keynote2: Learning from Real Issues –Toward New Generation of Industrial Robots-
(Kazuhiro Kosuge, Tohoku University, Japan)</td></tr>
<tr><td colspan="5">Lunch</td></tr>
<tr><td colspan="5">13:00-14:00 China Hall, 2F Valley Wing

Plenary Session II: Robots and Protein Kinematics (Prof. Gregory S. Chirikjian, Johns Hopkins University)</td></tr>
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<tr><td>14:10-15:40 Special Forum on Smart Manufacturing
China Hall, 2F Valley Wing
14:10-14:40 Keynote3: Develop the Intelligent Multi-arm robot for Future Webfied Manufacturing
(Zhongxue Gan, Ningbo Institute of Intelligent Manufacturing Industry, China)
14:40-15:10 Keynote4: C2M Business Ecosystem (Yunlan Zhang, Redcollarr Ltd., China)
15:10-15:40 Keynote5: Smart Manufacturing in the Internet Age
(Haibin Yu, State Keylab, SIA, China)</td><td>14:10-15:40 MoC01
Room 31
Mobile Robotics V</td><td>14:10-15:40 MoC02
Room 33
Rehabilitation and Assistive Robotics I</td><td>14:10-15:40
MoC03
Room 35
Robot Vision IV</td><td rowspan="3">14:40-17:00 MoPOS
2F Foyer
Poster Session II</td></tr>
<tr><td colspan="4">15:40-16:00 Coffee Break, 2F Foyer, Valley Wing</td></tr>
<tr><td>16:00-17:30 Special Forum on Smart Manufacturing
China Hall, 2F Valley Wing
16:00-16:30 Keynote6: States and Development of China's Machine Tool
(Feng Liang, China Machinary Ltd., China)
16:30-17:00 Keynote7: Intelligent Strategy of Hisense
(Zhigang Wang, Hisense kelon electrical holdings CO., LTD, China)
17:00-17:30 Kyenote8: The Dilemma of Industrial Robot Localization and its Key Unit Solution
(Peizheng Cheng, Shenzehn Inovance Technology Co. Lt. China)</td><td>16:00-17:30 MoD01
Room 31
Multi-Robot Systems</td><td>16:00-17:30 MoD02
Room 33
Rehabilitation and Assistive Robotics II</td><td>16:00-17:30
MoD03
Room 35
Actuators</td></tr>
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<tr><td>18:30-20:30 China Hall, 2F Valley Wing

Conference Banquet</td></tr>
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Tuesday December 6, 2016

<table>
<tr><th>Track 1</th><th>Track 2</th><th>Track 3</th><th>Track 4</th><th>Track 5</th><th>Track 6</th><th>Poster</th></tr>
<tr><td colspan="7">09:00-10:00 China Hall, 2F Valley Wing
Plenary Session III: Autonomous Underwater Vehicles Are Doing Something Great and Fascinating (Prof. Tamaki Ura, Kyushu Institute of Technology)</td></tr>
<tr><td colspan="7">10:00-10:20 Coffee Break, 2F Foyer</td></tr>
<tr><td>10:20-11:50 TuA01
Room 31
Autonomous Underwater Tracking and Navigation</td><td>10:20-11:50 TuA02
Room 32
Humanoid Robots I</td><td>10:20-11:50 TuA03
Room 33
Rehabilitation and Assistive Robotics III</td><td>10:20-11:50 TuA04
Room 34
SLAM & Sensor Networks I</td><td>10:20-11:50 TuA05
Room 35
Micro/Nano Robotics</td><td>10:20-11:50 TuA06
Room 36
Robot Modeling & Control</td><td></td></tr>
<tr><td colspan="6">Lunch</td><td></td></tr>
<tr><td>13:00-14:30 TuB01
Room 31
Autonomous Cognition and Control for Underwater Robots</td><td>13:00-14:30 TuB02
Room 32
Humanoid Robots II</td><td>13:00-14:30 TuB03
Room 33
Intelligent Systems</td><td>13:00-14:30 TuB04
Room 34
SLAM & Sensor Networks II</td><td>13:00-14:30 TuB05
Room 35
Industrial Robotics</td><td></td><td></td></tr>
<tr><td>14:40-16:10 TuC01
Room 31
Computational Intelligence</td><td>14:40-16:10 TuC02
Room 32
Robot Design & Control</td><td>14:40-16:10 TuC03
Room 33
Flying Robots & Biologically Inspired Robot</td><td>14:40-16:10 TuC04
Room 34
Human-Machine Interface</td><td>14:40-16:10 TuC05
Room 35
Human-Robot Interaction</td><td></td><td rowspan="3">14:40-17:00 TuPOS
2F Foyer
Poster Session III</td></tr>
<tr><td colspan="5">16:10-16:30 Coffee Break, 2F Foyer</td><td></td></tr>
<tr><td>16:30-18:00 TuD01
Room 31
Latest I (Vision)</td><td>16:30-18:00 TuD02
Room 32
Latest II (Hand & Manipulation)</td><td>16:30-18:00 TuD03
Room 33
Latest III (Humanoid & Mobile Robot)</td><td>16:30-18:00 TuD04
Room 34
Latest IV (Flying Robots & Intelligent Systems)</td><td>16:30-18:00 TuD05
Room 35
Latest V (Intelligent Cotrol)</td><td></td></tr>
<tr><td colspan="7">18:30-20:30 China Hall, 2F Valley Wing
Farewell Party</td></tr>
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Wednesday December 7, 2016

Technical Tour	Workshop
08:30-15:30 Technical Tour	13:00-18:00 Local Workshop

Sunday, December 4th, 2016

Mobile Robotics I

Chair *Yili Fu, Harbin Institute of Technology*
Co-Chair *Jackrit Suthakorn, Mahidol University*

10:20–10:35 SuA01.1

Modeling and Diving Control of a Vector Propulsion AUV

Zhuo Ge, Qingsheng Luo, and Guanhao Liang
Sch. of Mechatronical Engineering, Beijing Institute of Technology, China
Cheng Jin
Sch. of Aeronautic Science and Engineering, Beihang University, China

- A novel four-axis vector water-jet propulsion underwater vehicle is proposed.
- The kinematic and dynamic models of the AUV are established and analyzed.
- Focusing on the vertical depth control of the AUV, a reliable adaptive sliding mode controller is presented.
- The prototype test results validate that the control method is feasible and reliable.

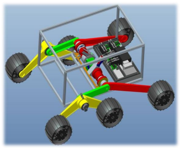
Prototype of the AUV

10:35–10:50 SuA01.2

A Novel Active Deform and Wheel-legged Suspension of Mars Rover

Junqiang Zheng, Zhen Liu, Haibo Gao
Haitao Yu and Zongquan Deng
State Key Laboratory of Robotics and System
Harbin Institute of Technology, China

- The suspension of mars rover is designed base on rock-bogie suspension.
- The suspension makes the rover be able to climb slope which gradient is more than 20.
- The suspension makes the rover be able to go through a large area of soft terrain.
- A special designed planetary gear is used to keep the pitch angle changing little through deforming and wheel-legged movement.



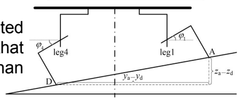
3D Model of Mars rover

10:50–11:05 SuA01.3

Design and Evaluation of Quadruped Gaits for Amphibious Spherical Robots

Liwei Shi, Shaowu Pan, Shuxiang Guo, Kun Tang, Ping Guo, Rui Xiao, Yanlin He
the Key Laboratory of Convergence Medical Engineering System and Healthcare Technology, the Ministry of Industry and Information Technology, School of Life Science, Beijing Institute of Technology, China

- Three types of quadruped gaits were designed for the amphibious spherical robot to enhance its adaptabilities to various terrains.
- The robotic gaits were implemented on the FPGA and provided adjustable motion speeds.
- A MEMS inertial measurement unit was used to estimate the attitude of the robot.
- The gait of the robot was adaptively adjusted with compensation values, which ensured that it was able to walk on a slope no larger than 20 degrees.

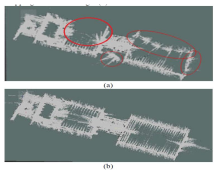


11:05–11:20 SuA01.4

Visual Laser-SLAM in Large-scale Indoor Environments

Xiao Liang, Haoyao Chen, and Yanjie Li
SMEA, HIT Shenzhen Graduate School, China
Yunhui Liu
MAE, Chinese University of Hong Kong, China

- An efficient approach was proposed to address the loop detection problem in laser-based SLAMs;
- Visual information was imported to detect trajectory loops in a large environments;
- ORB features and bags-of-word were applied in the proposed approach;
- The LRGC and SPA optimization algorithm were utilized to implement the SLAM.



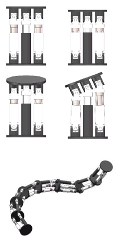
Visual Laser-SLAM in a indoor large-scale library

11:20–11:35 SuA01.5

3-DOF Bionic Parallel Mechanism Design and Analysis for a Snake-like Robot

Meng Li[1], Zhengcai Cao[1], Dong Zhang[1] and Yili Fu[2],
[1]Beijing University of Chemical Technology, China
[2]Harbin Institute of Technology, China

- Bionic mechanism is inspired by natural snakes' skeleton structure to imitate the motion mode of snake.
- The dexterity of parallel mechanism is analyzed. It is approximate to a rotating joint with a higher load capacity.
- The experimental result of snake like robot movement confirmed the usability of the mechanism.

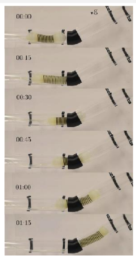


11:35–11:50 SuA01.6

Fabrication, Design and Control of a Multi-Material—Multi-Actuator Soft Robot Inspired by Burrowing Worms

A. Calderon [2], J. Ugalde [1], J.C. Zagal [1] and N. O. Perez-Arancibia [2].
[1]U. Of Chile, Chile [2]U. Of Southern California, USA.

- The design fabrication and control of a pneumatic soft robot able to locomote inside pipes is shown.
- The method of motion is inspired by the locomotion mode of earthworms when burrowing underground .
- Experimental results show that the system is able to locomote inside pipes in different angles, even in elbow connections and vertical pipes.



Medical Robotics I

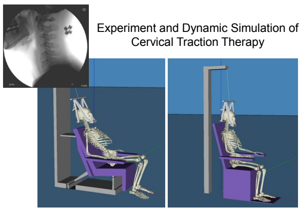
Chair *Max Q.-H. Meng, The Chinese University of Hong Kong*
Co-Chair *Wei-Hsin Liao, The Chinese University of Hong Kong*

10:20–10:35 SuA02.1

Comparative Experiment and Dynamic Simulation on Cervical Traction Therapy

Lawrence KF Wong and Zhiwei Luo
Graduate School of System Informatics, Kobe University, Japan
Nobuyuki Kurusu
Minato Medical Science Co.,Ltd, Japan
Keiji Fujino
Fujino Orthopedics Hospital, Hamamatsu, Japan

- Radiographic study of 6 male adults during cervical traction therapy in inclined and sitting positions
- Using the data to improve the accuracy of a simulation model
- Result suggests inclined position can better achieve desired traction angles and create separations on targeted segment

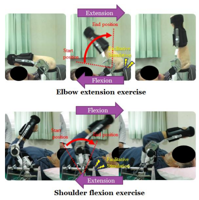

Experiment and Dynamic Simulation of Cervical Traction Therapy

10:35–10:50 SuA02.2

Training Condition Research on Selective DOF Constrainable Rehabilitation Unit with Shrinkable Electrical and Vibratory Stimulation Timing and Duration Control System for Hemiplegic Shoulder-Flexion and Elbow-Extension

Koutaro Taniguchi∗, Yong Yu∗, Tomokazu Noma†, Hiroko Yamanaka‡, Isamu Fukuda‡, Shuji Matsumoto § , Megumi Shimodozono § and Kazumi Kawahira §
∗Graduate School of Science and Engineering, Kagoshima University, Japan
†Kirishima Rehabilitation Center, Kagoshima University Medical and Dental Hospital, Japan
‡Jifukai Healthcare Corporation Atsuchi Rehabilitation Hospital, Japan
§ Department of Rehabilitation and Physical Medicine, Graduate School of Medical and Dental Sciences, Kagoshima University, Japan

- We evaluate the clinical practicality of our rehabilitation system, which enables training movements of both the elbow and shoulder using a single device.
- This system allow for controlled intervention timing and duration of shrinkable electrical stimulation (SES) and vibratory stimulation.
- This paper demonstrates the effectiveness of a combination of SES and vibration, and the clinical practicality of the proposed training.



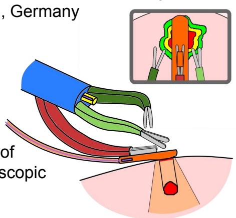
Rehabilitation Training

10:50–11:05 SuA02.3

A new Concept for a Single Incision Laparoscopic Manipulator System Integrating Intraoperative Laparoscopic Ultrasound

Sandra V. Brecht[1], Yannick S. Krieger[1],
Jens-Uwe Stolzenburg[2] and Tim C. Lueth[1]
[1] Institute of Micro Technology and Medical Device Technology (MiMed), Technische Universität München, Germany
[2] Department of Urology of the Universitätsklinikum Leipzig AöR, University of Leipzig, Germany

- Concept for a 3D-printed manipulator for single incision laparoscopic surgery integrating ultrasound imaging for augmented reality features
- Aims: enhanced tissue manipulation, superimposing of additional information of the inside of the organ gained by laparoscopic ultrasound onto the laparoscopic image

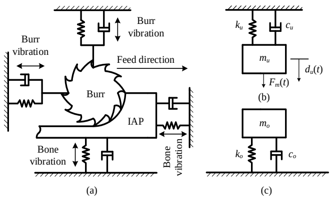


11:05–11:20 SuA02.4

Estimation of tool position based on vibration sense during robotic bone milling

Yu Dai and Jianxun Zhang
Institute of Robotics and Automatic Information System, Nankai University, China
Yuan Xue
Department of Orthopedic Surgery, Tianjin Medical University General Hospital, China

- A vibration signal acquiring and processing method to estimate the tool position during bone milling process.
- Dynamic of surgical milling is analyzed theoretically.
- Vibration signal of milling device is recorded by an accelerometer and analyzed.



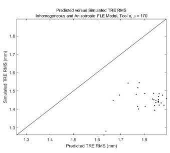
Dynamic model of bone and burr during cutting process

11:20–11:35 SuA02.5

Estimation of Target Registration Error Considering Small Inhomogeneous and Anisotropic Bias in Fiducial Localizer Error

Zhe Min and Max Q.-H. Meng
Electronic Engineering, The Chinese University of Hong Kong, N.T., Hong Kong

- Inhomogeneous and anisotropic bias in Fiducial Localization Error (FLE) is considered in theoretical formulation of TRE RMS in rigid point-based registration.
- Extensive Monte Carlo simulations have been done to verify the algorithm with various FLE models.
- The results show that in most cases, the theoretical formulation of TRE RMS can serve as an upper bound for the real one.

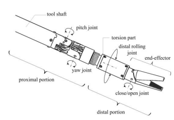

Predicted versus simulated TRE RMS

11:35–11:50 SuA02.6

Development of a Human-arm Like Laparoscopic Instrument

Hongbing Li, Weiwen Liu
Shanghai Jiaotong University, China
and Kenji Kawashima
Tokyo Medical and Dental University, Japan

- This paper a new, inexpensive seven DOFs primary slave manipulator and a new wrist mechanism with five DOF is proposed.
- The developed wrist mechanism has an additional twisting joint which can solve the potential safety problem in conventional surgical instrument.
- The proposed forceps has three DOFs in assuming the position and posture and a gripper to allow fine enough manipulation.


Developed human arm like laparoscopic instrument

Biologically Inspired Robotics I

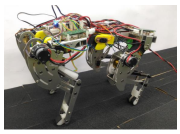
Chair *Jinguo Liu, Shenyang Institute of Automation (SIA)*
Co-Chair *Yang Ding, Georgia Institute of Technology*

10:20–10:35	SuA03.1

Development of A Flexible Coupled Spine Mechanism For A Small Quadruped Robot

Ryosuke Kawasaki, Ryuki Sato, Eiki Kazama,
Aiguo Ming and Makoto Shimojo
Department of Mechanical Engneering and Intelligent Systems,
The University of Electro-Communications, Japan

- A flexible spine mechanism inspired by animals' spine has been developed.
- The mechanism consists of a passive joint and cables which connect spine and legs.
- The legs and spine motions are coupled like animals by the mechanism.
- The robot with the flexible spine realized longer jump than that with a rigid spine.



The robot with a flexible spine

10:35–10:50	SuA03.2

Development and Attitude Control of a Hexapod Bionic-Robot

Lei Zhang, Dedong Li and FangYang
Department of Automation and Control, Ocean University of China, China
Cechong Liu
Department of Mechanical Engineering, Ocean University of China, China

- A Hexapod Robot that is with aluminum frame and universal foot was designed.
- Development of the Hexapod Robot controller that possesses superior stability, real-time performance and practicability.
- Attitude adjustment for the sloping robot based on attitude-position closed loop control.
- MATLAB simulation for the attitude-position closed loop control algorithm.

The model of Hexapod Robot

10:50–11:05	SuA03.3

Experiments and Analysis of Cormorants' Density, Wing Loading and Webbed Feet Loading

Xiaoqiang Xue, Xiaofei Zhao, Jinguo Huang, Xingbang Yang,
Guocai Yao, Jianhong Liang, Daibing Zhang
Institute of mechanical engineering and automation, Beihang University, China

Images of webbed feet' outlines read by algorithm

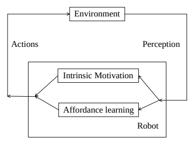
- The data of Cormorants can serve for the design of Aquatic unmanned aerial vehicle.
- Cormorants' average density, average wing loading and average webbed feet loading is respectively 0.738g/cm³, 1.58 g/cm² and 25.3 g/cm².
- It requires different propulsion systems in both water and air for AquaUAV.

11:05–11:20	SuA03.4

Affordance Discovery Based on Intrinsic Motivation in Robots

Chang'an Yi
School of Electronic Information and Engineering, Foshan University, China
Huaqing Min, Jinhui Zhu and Pengshuai Yin
School of Software Engineering, South China University of Technology, China

- An intrinsic motivation based function is proposed to discover affordances.
- The robot learns affordances equipped with perceptual and behavioral capabilities as limited as a 5-months-infant.
- The NAO humanoid robot could construct the searchable relationships and make the target object be the center of its vision.



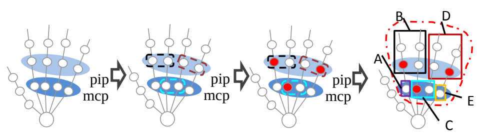
The relationship between affordance learning and intrinsic motivation.

11:20–11:35	SuA03.5

An actuation configuration of inter-module coordination and the evaluation for the mechanical implementation to a prosthetic hand

Yuan Liu, Li Jiang, Dapeng Yang*, Hong Liu
State Key Laboratory of Robotics and System, Harbin Institute of Technology, China

- A tolerance grasping experiment is finished to describe the human hand move characteristics
- A novel actuation configuration of inter-module coordination is obtained
- The evaluation for the mechanical implementation is finished, which could help in the development of a versatile, anthropomorphic physical property and easy-control prosthetic hand.

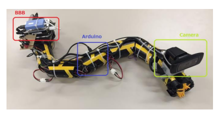


11:35–11:50	SuA03.6

Development of Remote Robot Control System for Snake-like Robot based on SSH Protocol and iOS System

Yang Tian and Shugen Ma
Department of Robotics, Ritsumeikan University, Japan
Shugen Ma
Department of Electrical Engineering and Automation, Tianjin University, China

- The next generation of remote robot control system is asked to be utilized efficiently and conveniently via Internet protocol (IP) based network
- A critical issue about security of the IP based system is network attacks
- An iOS (Apple Mobile Operating System) based application with SSH (Secure Shell) protocol to prevent the network attacks via Wi-Fi network.



Snake-like robot platform.

Intelligent Control

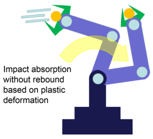
Chair *Taku Senoo, University of Tokyo*
Co-Chair *Guangming Xie, Peking University*

10:20–10:35	SuA04.1

Plastic Deformation Control Based on Time-varying Impedance Adjustment

Masanori Koike, Taku Senoo, Kenichi Murakami and Masatoshi Ishikawa
The University of Tokyo, Japan

- This study proposes a time-varying impedance control to smoothly stop an incoming object.
- The impedance dynamics are made from the Maxwell model.
- The time-varying control with a robotic arm is executed in comparison with constant impedance.
- The simulation results shows the time-varying control's efficiency.



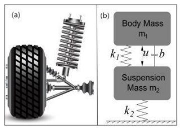
Study concept

10:35–10:50	SuA04.2

Road Excitation Predictive Discrete-Time Sliding Mode Control of Vehicle Suspension System

Yu Zhang
School of Mechanical Engineering, Shandong University of Technology, China
Chenchen Yuan
FST, University of Macau, China
Zhenning Yu
Logistics College, Beijing Normal University Zhuhai, China

- Proposing a novel controller for vehicle suspension system to regulate driving state;
- Only a simple second-order vehicle suspension is required;
- Providing a fast dissipation speed to eliminate the oscillations as soon as possible;
- To integrate with quarter-car seamlessly and provide a satisfactory road holding ability.



A quarter model of vehicle suspension system

10:50–11:05	SuA04.3

Adaptive Type-2 Fuzzy Output Feedback Control for Flexible Air-breathing Hypersonic Vehicles

Yifan Liu, Zhiqiang Pu, Jianqiang Yi
Chinese Academy of Sciences,
University of Chinese Academy of Sciences,China

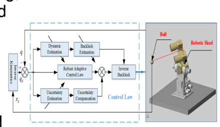
- An adaptive type-2 fuzzy output feedback control scheme for the longitudinal dynamics of flexible air-breathing hypersonic vehicles is proposed.
- Based on the interval type-2 fuzzy logic system, a reduced-order fuzzy observer is designed to estimate the immeasurable states.
- By the backstepping control approach, an adaptive type-2 fuzzy output feedback controller is constructed.
- The stability of the closed-loop systems is explored.

11:05–11:20	SuA04.4

Robust Adaptation Based Backlash and Friction Compensation for 3-DOF Robotic Head With Dynamic Uncertainties

Yi Ren[1],Yang Zhou[2],Yikun Gu[1*],Y Liu[1],M Jin[1],H Liu[1],
1 State Key Laboratory of Robotics and Systems, Harbin Institute of Technology, China
2 Science and Technology on Space Intelligent Control Laboratory, Beijing Institute of Control Engineering, China

- A novel robust adaptive controller is proposed for the 3-DOF robotic head system.
- Unknown backlash, friction and dynamic uncertainties are simultaneously coped with
- Inverse backlash compensation and model-based friction compensation are incorporated into this robust adaptive scheme
- The controller is mathematically derived by using Lyapunov stability analysis. Simulation results are presented to show the high tracking performance of the controller.



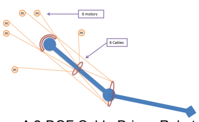
The control scheme with robotic head with SimMechanics model of the robotic head tracking a moving ball

11:20–11:35	SuA04.5

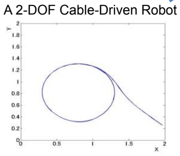
Passive Velocity Field Control of a Redundant Cable-Driven Robot with Tension Limitations

Sheng Cao[1], Zhiwei Luo[1,2] and Changqin Quan[1]
1.Graduate School of System Informatics, Kobe University, Japan
2.Beijing Institute of Technology, China

- We propose a novel dynamic control approach for a cable driven robot with high redundant actuation and cable tension limitations based on PVFC.
- This control method realized the tracking motion performance as well as the passivity and solved the problem of cable tension limitation with an easy wrench adjustment algorithm without any heavy optimization for tension distribution.
- Computer simulation shows the effectiveness of our control approach.



A 2-DOF Cable-Driven Robot



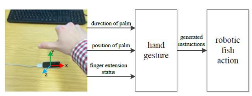
Motion trajectory of the robot

11:35–11:50	SuA04.6

Recognition based Teleoperation Framework of Robotic Fish

Jinpeng Mi, Zhen Deng, and Jianwei Zhang
TAMS, University of Hamburg, Germany
Yu Sun, Yu Wang
Harbin Institutes of Technology Shenzhen Graduate School, China

- A teleoperation framework based on gesture recognition was developed
- The recognized hand gestures were mapped to corresponding swimming behaviors of underwater robotic fish.
- The teleoperation framework offers the opportunity for onlookers to directly interact with the robotic fish.



Interactive Systems

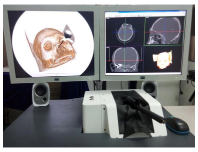
Chair *Zeng-Guang Hou, Institute of Automation, Chinese Academy of Science*
Co-Chair *zhou hongjun, Tongji University*

10:20–10:35	SuA05.1

Development of a Multi-modal Interactive System for EEA Surgery Simulation

Jianlong Hao, Xiaoliang Xie, Gui-Bin Bian, and Zeng-Guang Hou
State Key Laboratory of Management and Control for Complex Systems, Institute of Automation, University of Chinese Academy of Sciences, China

- A simulator providing visual, haptic and audible feedback for boning drilling task
- A customized 3-DOF haptic interface for endoscopic endonasal approach surgery
- Based on patient-specific preoperative computed tomography(CT) image data
- Contact force and vibration for haptic feedback and drilling sound for audio feedback



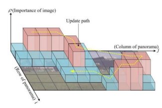
Multi-modal interactive system for EEA surgery simulation

10:35–10:50	SuA05.2

Information Based Hybrid Performance Evaluation Criterion for Panorama Refreshing in Robotic Tele-Observation

Danhua Han, Hongpeng Wang and Jingtai Liu
Institute of Robotics and Automatic Information System, Nankai University, China
Tianjin Key Laboratory of Intelligent Robotics, Nankai University, China

- Because of the diversity of environment, refreshing the environment uniformly is inefficient.
- The more information the panorama has, the more real it can show the environment.
- A hybrid performance evaluation criterion based on information entropy is proposed.
- Based on this criterion, a better refreshing path can be found.



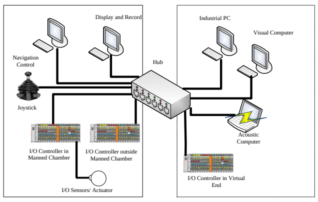
A update path for the panorama whose different regions have different importance.

10:50–11:05	SuA05.3

Design and Implementation of Manned Submersible Semi Physical Simulation System

Tao Xue, Yanzhu Zhang, and Guanhua Feng
Shenyang Ligong University , P.R. China
Yang Zhao, Shengguo Cui, and Kaizhou Liu
Shenyang Institute of Automation, Chinese Academy of Sciences, P.R. China

- Improved the safety factors of Manned Submersible Vehicle and shorten the pilot training cycle.
- Research on system model and hardware structure.
- Motion data simulation.
- Network performance test.

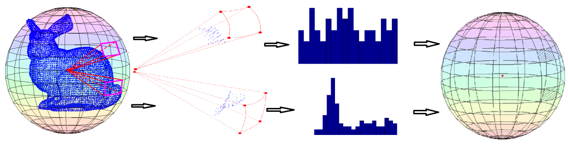


The hardware structure

11:05–11:20	SuA05.4

A Global Feature-less Scan Registration Strategy Based on Spherical Entropy Images

Bo Sun, Houde Dai, Yadan Zeng
Quanzhou Institute of Equipment Manufacturing, Haixi Institues
Chinese Academy of Sciences, Jinjiang, Fujian, 36200, China
Email: {bo.sun,dhd,zyadan}@fjirsm.ac.cn



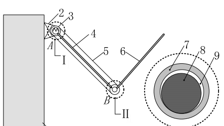
- presents a global feature-less scan registration strategy based on the Spherical Entropy Image (SEI) and the Generalized Convolution Theorem
- 3D rotation is then estimated by the Generalized Convolution Theorem based on Spherical Fourier Transform of the SEI.
- the Phase Only Matched Filtering (POMF) is adopted for translation recovery

11:20–11:35	SuA05.5

Influence of Joint Clearance on the Dynamic Characteristics of the Lunar Rover Deployable Panels

XueSong Qiu and Peng Gui
College of mechanical engineering, Yanshan University, China

- Joint clearance is one of the key factors that affect mechanical properties.
- The joint model with clearance is established.
- The dynamical model of deployable panels with clearance is established ,which is analyzed by MATLAB.
- Provide theoretical basis for optimization design of mechanism with clearance.



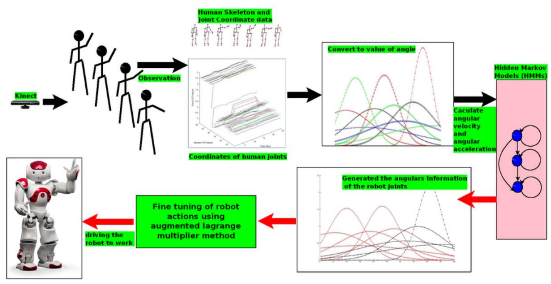
partial enlarged detail of I and II

Representation of mechanical system with clearance

11:35–11:50	SuA05.6

Learning by Showing: An End-to-end Imitation Leaning Approach for Robot Action Recognition and Generation

Chao Zhuang[1] , Hongjun Zhou[2] , Shigeyuki Sakane[3]
[1,2] School of Electronics and Information,Tongji University,China,
[3]Department of Industrial and Systems Engineering,Chuo University,Japan



Sensing

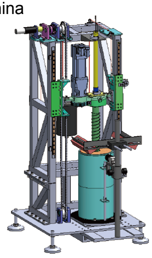
Chair *Jun Zhang, Southeast University*
Co-Chair *Shuo Wang, Institute of Automation,Chinese Academy of Sciences*

10:20–10:35	SuA06.1

Drilling States Monitoring for a Planetary Drilling & Coring Testbed (PDCT): Method and Design

Junyue Tang, Shengyuan Jiang, Chongbin Chen, Qiquan Quan, Fengpei Yuan, and Zongquan Deng
State Key Laboratory of Robotics and System,
Harbin Institute of Technology, China

- Presents a novel flexible tube coring method (FTC) for future planetary explorations
- Develops a Planetary Drilling & Coring Testbed (PDCT)
- Designs a drilling load states and soil flowing states monitoring method
- Demonstrates that PDCT can be used for verification of drilling model



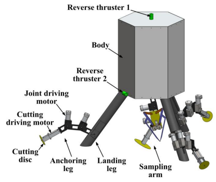
Planetary Drilling & Coring Testbed

10:35–10:50	SuA06.2

Anchoring and Sampling Processes Analysis of a Landing Robot in Asteroid Exploration

Jun Zhang and Aiguo Song
School of Instrument Science and Engineering, Southeast University, China
Wei Lu
College of Engineering, Nanjing Agricultural University, China

- Present a landing robot based on cutting method for asteroid exploration
- The robot consists of a body, three landing and anchoring legs, one sampling arm, three thrusters, a sensing and control system
- The anchoring and sampling processes are mainly analyzed
- The motion control of the anchoring leg is tested which verifies the feasibility of cutting in anchoring and sampling



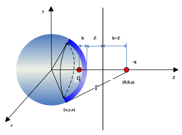
CAD model of the robot with anchoring and sampling capabilities

10:50–11:05	SuA06.3

Study on Electrostatic Adhesion Mechanism of Lunar Dust Based on DEM

Xuyan Hou and Kaidi Zhang
School of Mechatronics Engineering, Harbin Institute of Technology, China
Jing Jiang
School of Mechatronics Engineering, Harbin Institute of Technology, China

- Study of electrostatic adhesion mechanism and adhesive mechanics model of lunar dust
- Components of electrostatic adhesive force are investigated by DEM, FEM and image method
- An adhesive force plug-in is developed by applying the API function on the software platform of EDEM, and the electrostatic adhesive mechanics model is verified based on the plug-in



Schematic diagram of charge distribution on lunar dust particle

11:05–11:20	SuA06.4

A Slope Location and Orientation Estimation Method Based on 3D LiDAR Suitable for Quadruped Robots

Xiangrui Meng, Chao Zhou, Zhiqiang Cao, Leijie Zhang, Xilong Liu, and Shuo Wang
Institute of Automation, Chinese Academy of Sciences, China
School of Computer and Control Engineering, University of Chinese Academy of Sciences, China

- A slope location and orientation method based on PROSAC algorithm.
- The external parameters calibration for Velodyne VLP-16 is introduced.
- The method is suitable for quadruped robots with a 3D LiDAR.

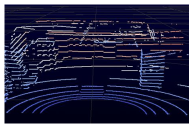


Fig. Point Cloud Environment

11:20–11:35	SuA06.5

Size Calculation Methods for Remote Obstacles Based on Line Structured Light Sensor

Haiyan Shao[1], Kejie Li[2], Zhenhai Zhang[2], Shanping Qiao[3], Yu'e Yang[1], Jinkai Zhang[1]
1.Dept. Mechanical Engineering, University of Jinan, China
2.Dept. Mechatronic Engineering, Beijing Institute of Technology, China
3.Dept. Information Science and Engineering, University of Jinan, China

- Size calculation methods and recognition principles for obstacles based on a new line structured light sensor are proposed.
- The detecting distance of this sensor for obstacles is about 100 meters.
- The feasibility of obtaining the obstacle feature information is verified by experiments.
- The calculation methods have the advantages of strong recognition, more targeted and fast.

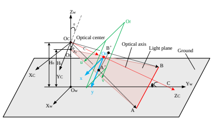


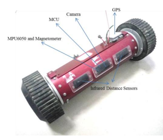
Fig.2 Detection schematics of line structure light sensor without obstacles

11:35–11:50	SuA06.6

Low-cost Map Building and Obstacle Avoidance of Miniature Reconnaissance Robot

Xuanyang Shi, Junyao Gao and Yi Liu
School of Mechatronical Engineering, Beijing Institute of Technology, China
Jingchao Zhao, Fangzhou Zhao, Haoxiang Cao and Chuzhao Liu
School of Mechatronical Engineering, Beijing Institute of Technology, China

- Platform and kinematic model of Miniature Reconnaissance Robot
- Local Map Building based on two infrared distance sensors
- Route Planning based on Local Map



Miniature Reconnaissance Robot

Mobile Robotics II

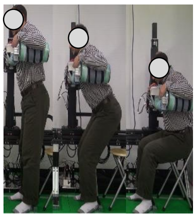
Chair *Tatsuo Arai, Osaka University*
Co-Chair *Qiquan Quan, Harbin Institute of Technology*

13:00–13:15	SuB01.1

Experimental Validation of a Motion Generation Model for Natural Robotics-Based Sit to Stand Assistance and Rehabilitation

Ahmed Asker[1], Samy F. M. Assal[1], Ming Ding[2], Jun Takamatsu[2], Tsukasa Ogasawara[2], and A. M. Mohamed[1]
[1] Egypt-Japan University of Science and Technology, Alexandria, Egypt
[2] Nara Institute of Science and Technology, Nara, Japan

- The minimum shoulder jerk (MSJ) criterion is used to model the natural human motion during sit-to-stand transfer.
- A 2-DOF Cartesian Robot testbed is developed to compare the MSJ trajectory and the one that is obtained from a commercial lifter.
- The simulation and experimental results prove that the MSJ criterion results in a natural pattern of motion.
- Also, the required assisting force is low which can reduce fatigue due to repeated lifting.

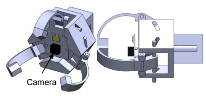


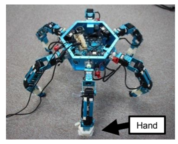
13:15–13:30	SuB01.2

Development of Multi-functional Robot Hand for Multi-Legged Robot

Ryo Akiyama, Kazuto Kamiyama, Masaru Kojima, Mitsuhiro Horade, Yasushi Mae, and Tatsuo Arai
Department of Systems Innovation, Osaka University, Japan

- The multi-functional robot hand for multi-legged robot "ASTERISK" is proposed.
- The closed hand is used as a leg, which could sense three-dimensional force by measuring deformation of closed hand from inner camera.
- The open hand can use for visual inspection.
- The proposed hand has the ability to grasp a small object.





13:30–13:45	SuB01.3

Structural Design and Dynamics Analysis of Lower Extremity Exoskeleton Assist Mechanism

Maoyu Zhang, Yueri Cai, Shusheng BI
School of Mechanical Engineering and Automation, Beihang University

- Lower Extremity Exoskeleton Assist Mechanism
- Gait Analysis
- The mechanism structure Design
- Seven Connecting Rod Model
- Dynamics Modelling and Analysis
- Dynamics Simulation

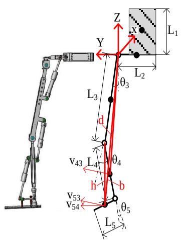


Fig.1 Structural diagrams of lower extremity exoskeleton bodies

13:45–14:00	SuB01.4

Special Robot Lab, Beijing Institute of Technology, *Gao's Lab*

Fault Detection of two wheel inverted pendulum robot with center of gravity self-adjusting mechanism

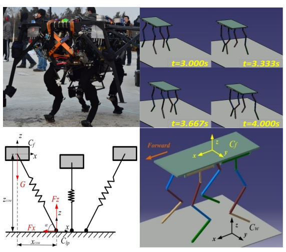
Yubai Liu, Xueshan Gao, Yu Mu and Yunqi Lv

14:00–14:15	SuB01.5

北京理工大学 BEIJING INSTITUTE OF TECHNOLOGY

Stability analysis of quadruped robot based on compliant control

Zhe Xu, Junyao Gao, Chuzhao Liu



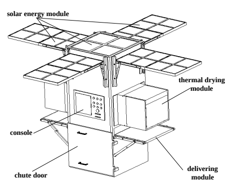
In this paper, we focus on allowing heavy quadruped robot to be self-adaptive to various disturbances. The SLIP method is applied in regulating feet landing positions. Moreover, yaw motion is discussed to revise direction-deflection after disturbance of external force. In dynamics analysis, both inverse dynamics and balance controller are employed to predict desired torque of joints. The main contribution is an active compliant controller with respect to robot posture.

14:15–14:30	SuB01.6

Synthesis and Simulation Analysis of the repeated foldable waste disposal robot of the marine

Yang Zhang and Ming Hu*
Key Laboratory for Reliability Technology of Mechanical & Electrical Product of Zhejiang Province, Zhejiang Sci-Tech University, China

- Design method of the repeated foldable waste disposal robot of the marine.
- Structure synthesis of the compact module, thermal-drying module, delivering module and solar-energy module.
- Motion simulation verification of the repeated foldable waste disposal robot of the marine.



Configuration of the repeated foldable waste disposal robot of the marine

Medical Robotics II

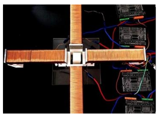
Chair *Weidong Chen, Shanghai Jiao Tong University*
Co-Chair *Shumei Yu, Soochow University*

13:00–13:15	SuB02.1

RectMag : An Accurate Magnetic Field Model based Actuation System

Hao Gu, Shuang Song and Max Q.-H. Meng
Mechanical Engineering and Automation, Harbin Institute of Technology Shenzhen Graduate School, China

- RectMag: four rectangular electromagnetic coils and three degrees of freedom
- Control: mathematical model and the analytical expression
- Experiments: rotation experiment; translational experiment; rectangular route experiment



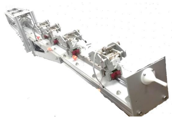
RectMag: The magnetic actuation system

13:15–13:30	SuB02.2

Design and Control Method of Surgical Robot for Vascular Intervention Operation

K. Wang, B. Chen and X. Xu
Department of Instrument Engineering, Shanghai Jiao Tong University, China

- The manipulator is designed to transmit and rotate the guide wire like a doctor's hand.
- A distributed multi MPUs circuit system is used to drive.
- Some robot motion experiments are introduced.
- The system can realize a great extent the simulated operation process of medical personnel.



The robot prototype using for catheter operation

13:30–13:45	SuB02.3

Design a flexible surgical instrument for robot assisted minimally invasive surgery

Xingze Jin and Mei Feng
School of Mechanical Science and Engineering, Jilin University, China

13:45–14:00	SuB02.4

Static Modeling and Analysis of Continuum Surgical Robots

Han YUAN, Zheng LI, Hongmin WANG and Chengzhi SONG
Institute of Digestive Disease and Chow Yuk Ho Technology Center for Innovative Medicine
The Chinese University of Hong Kong

- The static model of the robots is established based on Newton-Euler method with considering the effect of gravity and external loads.
- The static profiles of the continuum robot are calculated under different driving (cable tensions) and loading (external load) conditions.
- Significant effect of the external load on the static equilibrium of the robot is found, which is mainly due to the large compliance of the continuum section.

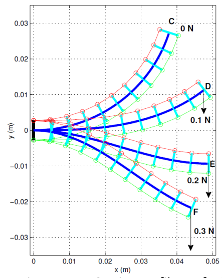


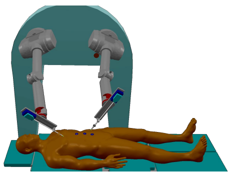
Figure 1 Static profiles of the robot with different external loads

14:00–14:15	SuB02.5

Kinematic Analysis and Simulation of a MISR System using Bimanual Manipulator

Dewei Yang, Lianxiang Wang and Yao Li*, Member, IEEE

In this paper, a MISR system using bimanual manipulator is introduced. The system is simulated under a virtual reality (VR) environment to validate the dynamics and control. A new control scheme was proposed to track desired position and orientation of the surgery instrument under the RCM constraint. The VR system has been utilized to compare different inverse kinematics solver to improve the computation efficiency. Both the simulation and the experiment results show that the new control scheme provide fast online solution for the bimanual MISR system, which could also be extended to other manipulation applications.

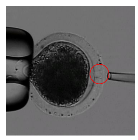


14:15–14:30	SuB02.6

Experimental Verification of Novel Two-point Supported Piezo-driven Cell Injector

Jiaqi Huang, Haibo Huang, Liguo Chen, Xiangpeng Li, Hao Yang, Yadi Li, and Leilei Zhang
Robotics and Microsystems Center, SooChow University, China
Yaowei Liu
Institute of Robotics and Automatic Information System, Nankai University, China

- A novel structure piezo-driven injector for ovum cell injection
- The injector is test in air and cell- culture medium
- Pig's ovum was prepared for penetrating manipulation experiment
- New injector can keep the cytoplasm and it's membrane in a good condition



Slight damage after penetrating

Biologically Inspired Robotics II

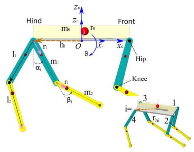
Chair *Li Wen, Beihang University*
Co-Chair *Guangming Xie, Peking University*

13:00–13:15	SuB03.1

Study on the Morphological Parameters of Quadruped Robot Designs Considering Ditch Traversability

Yifu Gao, Victor Barasuol, Darwin Caldwell and Claudio Semini
Department of Advanced Robotics,
Istituto Italiano di Tecnologia (IIT), Italy

- Study on the influence of morphological parameters of quadruped robots in ditch crossing scenario
- Simulations performed based on static stability and kinematics
- Research and comparison on impact of knee configurations



Morphological parameters researched

13:15–13:30	SuB03.2

Research on a Fast Measurement Equipment for Robot Repeatability

Yingzhong Tian, Shouchen Yang,Hui Geng Long Li
School of Mechatronic Engineering and Automation, Shanghai University, China

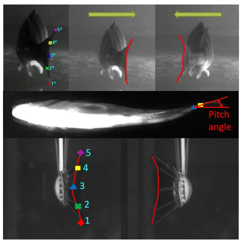
Wenbin Wang
Mechanical and Electrical School of Shenzhen Polytechnic, Guangdong 518055, China.

13:30–13:45	SuB03.3

Quantitative hydrodynamic investigation of fish caudal fin cupping motion using a bio-robotic model

Kainan Hu, Ziyu Ren, Yueping Wang
Tianmiao Wang and Li Wen*
School of Mechanical Engineering and Automation, Beihang University, China

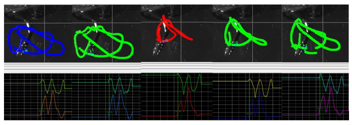
- The result of biological observation was input to the robotic caudal fin.
- Thrust force and thrust efficiency were measured and calculated.
- PIV result showed different wake structures between cupping and flapping.



13:45–14:00	SuB03.4

The Kinematics Analysis of Webbed Feet during Cormorants' Swimming

Jinguo Huang, Xiao Gong, Zeyu Wang, Xiaoqiang Xue, Xingbang Yang, Jianhong Liang, Daibing Zhang
Institute of mechanical engineering and automation, Beihang University, China


The tracking flapping process of the five key points

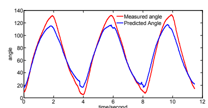
- The motion parameters of each joint of the fins are got with the help of the high speed camera motion capture system.
- By fitting to the three-dimensional coordinates of the movement, we got the curve equation of the five marked points of flippers.
- We defined the equation form of undulate propulsion motion in the 3D space and achieved the description of the undulation.

14:00–14:15	SuB03.5

A novel elbow joint modeling method based on sEMG

Jianhua Zhang , Kexiang Li , Luguang Liu, Jinchang Liu and Jidong Jia
Department of Mechanical Engineering Hebei University of Technology, Tianjin
High Technology Research and Development Center of the Ministry of Science and Technology, Beijing, China

- The skeletal muscle force model was built by physiological structure and micro mechanical properties.
- Based on the theory of muscle fiber slippage and sEMG.
- Taking into the effects of the characteristics of the internal viscous force from the muscle.
- By establishing the dynamic model to get the relationship between the sEMG and θ.

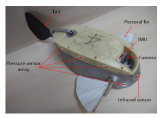

Measured angle and Model prediction angle

14:15–14:30	SuB03.6

Model Identification for the Yaw Motion of a Tail-Actuated Robotic Fish

H. Zhang, W. Wang, C. Wang, R. Fan and G. Xie
College of Engineering, Peking University, China
Y. Qu
The 76315 Troop of the PLA, China

- A modeling method for yaw motion of a robotic fish through system identification is proposed.
- Transfer Functions of the robot are derived by data-driven model identification method.
- Simulations and experimental results are compared to validate the effectiveness of this method.
- A model-based yawing PID controller is designed.


Tail-Actuated Robotic Fish

Grasping and Manipulation I

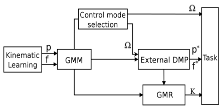
Chair *Atsushi Kakogawa, Ritsumeikan University*
Co-Chair *Akira Nakashima, Nanzan University*

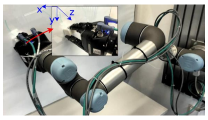
13:00–13:15	SuB04.1

Human Compliant Behavior from Demonstration for Force-based Robot Manipulation

Zhen Deng, Jinpeng Mi, Lasse Einig, Jianwei Zhang
TAMS, informatics, University of Hamburg, Germany
Cheng Zou
Fuzhou University, China

- A learning framework is introduced to learn compliant behavior from demonstration and transferring it to robot.
- Learning method combine dynamic motor primitive with probability method.
- After human compliant behavior learning, a hybrid external position/force control is presented to enable robot to produce a human-like compliant behavior.



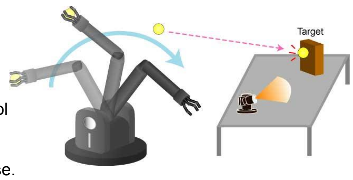


13:15–13:30	SuB04.2

Robotic Pitching by Rolling Ball on Fingers for a Randomly Located Target

Taku Senoo, Yuuki Horiuchi, Yoshinobu Nakanishi, Kenichi Murakami and Masatoshi Ishikawa
Department of Information Physics and Computing, University of Tokyo, Japan

- A robotic pitching task with the goal of implementing dynamic manipulation has been achieved.
- The strategy used to control the pitching direction of the ball involves rolling the fingers on the ball at release.
- In the experiments, a high-speed hand-arm system throws a ball toward a randomly located target recognized by using high-speed vision.

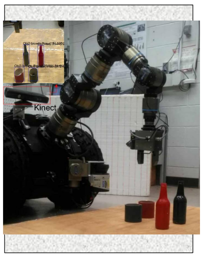


13:30–13:45	SuB04.3

Analytic Approach for Natural Language based Supervisory Control of Robotic Manipulations

Yu Cheng, Jiatong Bao, Yunyi Jia, Zhihui Deng, Lixin Dong, Ning Xi
Electrical and Computer Engineering, Michigan State University, USA

- Separate natural language processing and task planning.
- Introduce supervisory control to model and analyze the task planner.
- Unify linguistic input and sensory input at the same level.
- Propose an algorithm to learn new skills from online one-shot training by using natural language instructions.

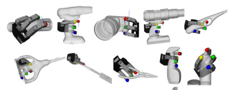


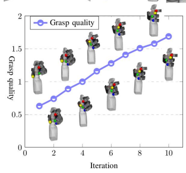
13:45–14:00	SuB04.4

Learning Partial Power Grasp with Task-specific Contact

Miao Li
Wuhan University

- A learning-based model encapsulates the relations among the task-specific contact, the graspable object feature and the finger joints.
- A grasp adaptation strategy is proposed to increase the grasp feasibility.





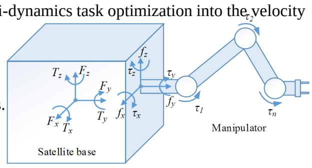
14:00–14:15	SuB04.5

Motion Planning for Redundant Free-floating Space Robot with Local Optimization of Reaction Torque and Joint Torque Simultaneously

Cheng Zhou, Minghe Jin, Yechao Liu and Hong Liu
State Key Laboratory of Robotics and System, Harbin Institute of Technology, Harbin, Heilong Jiang , China

(1) This paper presents a novel way to derive the analytical expression of the reaction torque acted on the satellite base's centroid.
(2) Two ways (null-space based solution and Lagrange multipliers based solution) to solve the reaction torque plus joint torque minimization issues are proposed in this paper, and the comparison between these two are made.
(3) A special discretization strategy is introduced to achieve the velocity level planning with dynamics task optimization. Furthermore, this special discretization strategy is used in the task-priority based algorithm, thus this strategy is used to transform the acceleration level control scheme for multi-dynamics task optimization into the velocity level control scheme.

(4) A set of numerical experiments of a 7 DOF manipulator verify the validity and feasibility of the proposed algorithms.

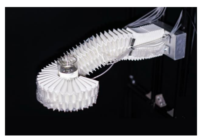


14:15–14:30	SuB04.6

Design and Simulation Analysis of a Soft Manipulator based on Honeycomb Pneumatic Networks

Hao Jiang, Xinghua Liu, Xiaotong Chen, Zhanchi Wang, Yusong Jin and Xiaoping Chen
Computer Science, University of Science and Technology of China, China

- Honeycomb Pneumatic Networks (HPN) is developed by combining compressed honeycomb structure and pneumatic networks
- The design of a soft HPN manipulator with a decent load bearing capacity
- Evaluation metrics assessing the load bearing capacity and flexibility of soft manipulators
- Nonlinear FEM analysis based on the evaluation metrics



The HPN manipulator is holding a glass of water

Robot Vision I

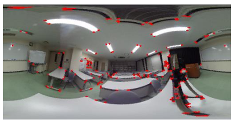
Chair *Shigang Li, Hiroshima City University*
Co-Chair *Xiaolong Zhou, Zhejiang University of Technology*

13:00–13:15	SuB05.1

Discrete Spherical Harris Corner Detector

Shigang Li
Graduate School of Information Sciences,Hiroshima City University,Japan
Hanchao Jia
Yahoo Japan Corporation, Japan
Jianfeng Li
Graduate School of Engineering, Tottori University, Japan

- A method of detecting Harris corners from spherical retina image
- Compute gradient of each pixels as a 3D vector represented at orthogonal coordinate system to avoid a pole problem
- Detect the Harris corners based on the 3D gradient vectors by modifying the conventional Harris corner detector for 2D planar image



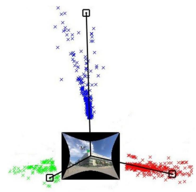
Harris corners detected from a spherical retina image by the proposed method

13:15–13:30	SuB05.2

Simultaneously Vanishing Point Detection and Radial Lens Distortion Correction from Single Wide-Angle Images

Sen Yang, Jiangpeng Rong, Shiyao Huang, Zeyu Shang, Yongjie Shi, Xianghua Ying, and Hongbin Zha
Key Laboratory of Machine Perception (Ministry of Education), Peking University, China

- Utilize statistical quantities and grouping of detected lines based on vanishing points
- Firstly, perform distortion image correction and then vanishing point detection with some assumption value of distortion parameter
- Secondly, calculate score function defined as combining standard variation of lengths of detected lines to multiple peaks in Hough space, with grouping of vanishing points
- Perform experiments using images taken by ourselves or download from public internet



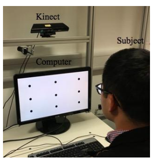
Results for vanishing point detection

13:30–13:45	SuB05.3

3D Eye Model-Based Gaze Estimation from A Depth Sensor

Xiaolong Zhou and Zhanpeng Shao
Zhejiang University of Techonology, China
Haibin Cai, Hui Yu, and Honghai Liu
University of Portsmouth, UK

- **An effective 3D eye model-based gaze estimation method** that can achieve a relative low average estimation error (about 3.78°) with free head movements is proposed.
- **An improved means of gradients iris center localization method** is presented to improve the accuracy and dramatically reduce the computational cost.
- **A geometric constraints-based method** is proposed to estimate the eyeball center and calculate the Kappa angle.



Gaze estimation setup

13:45–14:00	SuB05.4

Correction of Over- and Underexposed Images Using Multiple Lighting System for Exploration Robot in Dark Environments

Jonghoon Im, Hiromitsu Fujii, Atsushi Yamashita and Hajime Asama
Department of Precision Engineering, The University of Tokyo, Japan

- This paper proposes a method to correct over- and underexposed images.
- Multiple images are acquired by alternately turning on and off each illumination.
- Over- and underexposed areas in input images are corrected by other images.
- The experimental results showed the effectiveness of our proposed method

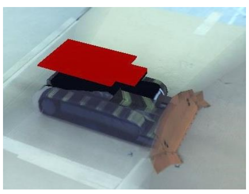
Experimental result

14:00–14:15	SuB05.5

Simultaneous Tele-visualization of Construction Machine and Environment Using Body Mounted Cameras

Wei Sun, Soichiro Iwataki, Ren Komatsu, Hiromitsu Fujii, Atsushi Yamashita, and Hajime Asama
Precision Engineering, Faculty of Engineering, The University of Tokyo, Japan

- Tele-visualization of the construction machine is demanded.
- A tele-visualization system for both the construction machine and the surrounding environment is proposed.
- The result of the simultaneous tele-visualization experiment is confirmed from the on-line video.
- Both the construction machine and the surrounding can be visualized in an arbitrary view.



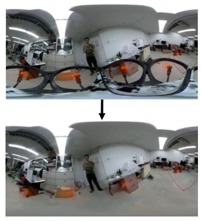
Result of the simultaneous tele-visualization experiment

14:15–14:30	SuB05.6

Optical Flow-based Video Completion in Spherical Image Sequences

Binbin Xu, Sarthak Pathak, Hiromitsu Fujii, Atsushi Yamashita and Hajime Asama
Department of Precision Engineering, The University of Tokyo, Japan

- A new spherical video completion method is proposed to remove occlusions and recover background.
- Polynomial models are used to model the optical flow and interpolate the occluded motion regions.
- Corresponding pixels are warped back by tracing optical flow trajectories to fill in the occlusions.
- Quantitative experiments were done and compared with prior methods.



Robot occlusions were removed to recover the true background.

Space Robotics

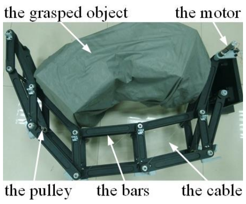
Chair *Zhang Qiang, Dalian University*
Co-Chair *Wei-Hsin Liao, The Chinese University of Hong Kong*

13:00–13:15	SuB06.1

Analysis of the Influence of Parameters Change on Effective Grasping Force of an Underactuated Robotic Hand

Shangling Qiao*, Hongwei Guo,
Rongqiang Liu, Zongquan Deng
State Key Laboratory of Robotics and System,
Harbin Institute of Technology, 150001 Harbin, China

- highly underactuated as it contains several cable-bar units controlled by a single motor through a cable.
- the equivalent grasping model are established based on the equivalent joint driving torques
- the influence of parameters change on effective grasping force are analyzed based on circular grasping space.



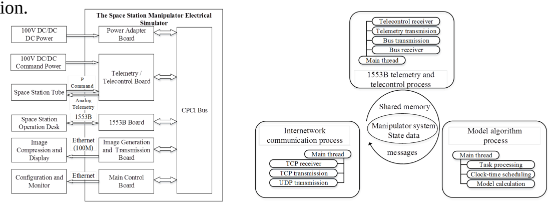
the sample grasping

13:15–13:30	SuB06.2

The Electrical Simulator for the Space Station Manipulator under Linux/RTAI

Minghe Jin, Cheng Zhou, Zongwu Xie, Ziqi Liu ,Ze Zhang, Yechao Liu, Hong Liu
State Key Laboratory of Robotics and System, Harbin Institute of Technology, Harbin

The assembly of the space manipulator model consists of the joint controller model, the joint dynamics model and the serial manipulator model. Besides, the whole manipulator model and the other external devices related program are running under the real-time operating systems Linux/RTAI. The electrical simulator integrates telemetry interface, telecontrol interface and camera interface to response related command and exchange data with the space station.

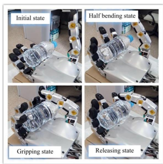


13:30–13:45	SuB06.3

Development of a Dexterous Hand for Space Service

Zhao Zhijun, Li Daming, Gao Sheng, Yuan Baofeng, Wang Yaobing
Beijing Key Laboratory of Intelligent Space Robotic Systems Technology and Applications, Beijing Institute of Spacecraft System Engineering, Beijing, China
Yang Yanchao
Beijing University of Posts and Telecommunications, Beijing, China

- Significance introduction of the space service hand
- Five fingers dexterous hand structural design
- Kinematic analysis of the fingers in the hand
- Hand Performance test by bending the fingers and grapping the bottle
- Conclusion



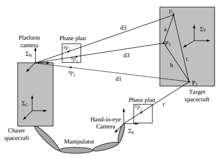
Gripping bottle of the hand

13:45–14:00	SuB06.4

Pose Estimation of Large Non-cooperative Spacecraft Based on Extended PNP Model

Xiaodong Du, Lei Chen, and Sheng Gao
Beijing Institute of Spacecraft System Engineering, China
Ying He
Harbin Institute of Technology, China

- Pose estimation of a large non-cooperative spacecraft in close range
- The platform camera and the hand-in-eye camera with no image overlap share the recognition task
- The proposed algorithm calculates the relative pose by solving the Extended PnP problem
- Computer simulation validate the proposed algorithm



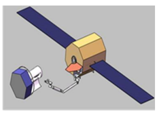
Pose Estimation Model

14:00–14:15	SuB06.5

Trajectory Planning of a Redundant Space Manipulator Based on IHPSO Algorithm

Jianxia Zhang and Xiaopeng Wei
School of the Mechanical Engineering, Dalian University of Technology, China
Dongsheng Zhou and Qiang Zhang
Key Laboratory of Advanced Design and Intelligent Computing, Ministry of Education, Dalian University, China

- This paper proposed an IHPSO algorithm based trajectory planning method to plan the trajectory.
- Firstly, a 3D model of the redundant space manipulator is designed by SolidWorks.
- Then, the kinematics equation combined with the generalized Jacobian matrix are adopted.
- Lastly, the sine function is employed to get unknown parameters optimized by the IHPSO algorithm.



3D Model of the Space Manipulator

Mobile Robotics III

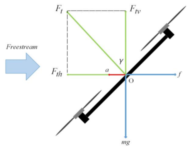
Chair *Ming Zeng, Tianjin University*
Co-Chair *Jian Huang, Kindai Universoty*

14:40–14:55	SuC01.1

A Wind Estimation Method for Quadrotors using Inertial Measurement Units

Yao Song, Qing-Hao Meng, Bing Luo, Ming Zeng
Shu-Gen Ma and Pei-Feng Qi
School of Electrical Engineering and Automation, TianJin University, China

- The paper gives a correction method for the inclination-angle measurement based wind estimation.
- The correction method considers the effects of the quadrotors' acceleration.
- Simulation was done to verified the correction method.



14:55–15:10	SuC01.2

Efficient Force Distribution Algorithm for Hexapod Robot Walking on Uneven Terrain

Yufei Liu, Liang Ding, Haibo Gao, Guangjun Liu, Zongquan Deng, Haitao Yu
State Key Laboratory of Robotics and System
Harbin Institute of Technology, China

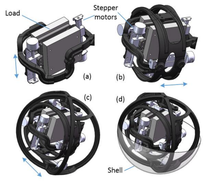
- Force distribution is an important problem for the legged robots with active force control.
- Paper presents a force distribution algorithm for redundant problem reduction, linearization and reducing the internal force.
- Combining the distribution algorithm with force control, the robot can walk on the uneven terrain.
- The extensive experiments have been carried out and the results have demonstrated the effectiveness of the presented algorithm.

15:10–15:25	SuC01.3

Development of a Holonomic Mobile Spherical Robot with 3D Center of Gravity Shifting Actuators

Meng Chen, Yingpeng Gao and Wen J. Li
City University of Hong Kong, China
Winston Sun, Shaodong Zhan and Guanglie Zhang
Shenzhen Academy of Robotics, China

- Development of a spherical robot prototype to be completely enclosed, weatherproof, and holonomically rolling.
- Constantly shifting the robot's center of gravity (COG) to pre-determined 3D patterns.
- Use only stepper motors to shift the COG, all payload motions are translational only.
- Linear-motor attached gimbal frame mechanisms will be tangled-free.

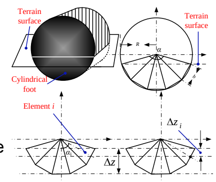


15:25–15:40	SuC01.4

Analysis of the normal bearing capacity of the terrain in case of foot-terrain interaction based on Terzaghi theory

Chuanxiao YANG, Liang DING, Dewei TANG, Haibo GAO, Zongquan DENG, Guanyu WANG
State Key Laboratory of Robotics and System
Harbin Institute of Technology, China

- Static models in Terzaghi theory and its extended versions are built and simulations are performed.
- Normal contacting experiments of the monopod on soft terrain are carried out, and the relative motion parameters are measured by 6 axis F/T sensors
- The combined dynamic model of predicting the bearing capacity is proposed and verified as a reliable model for future applications.

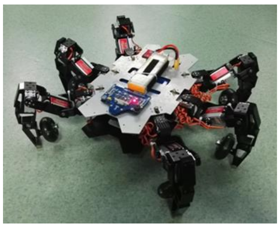


15:40–15:55	SuC01.5

Gait Planning for a Multi-motion Mode Wheel-legged Hexapod Robot

Yue Zhai, Peng Gao, Yu Sun, Shijia Zhao, Zhongliang Jiang, Bing Li, Ying Hu*, Jianwei Zhang
Harbin Institute of Technology Shenzhen Graduate School
Shenzhen University Town, Guangdong, China

- A 18-DOF wheel-legged hexapod robot is built to combine the advantages of both wheeled robot and legged robot
- Foot trajectory of walking mode during the swing phase is planned using sine function
- Foot trajectory for skating is optimized in order to achieve the maximum constant velocity
- The walking gait and the skating gait are simulated on Gazebo and tested through experiments

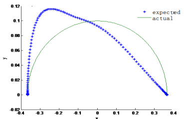

The Wheel-legged Hexapod Robot

15:55–16:10	SuC01.6

Foot End Trajectory with Small Oscillation Generation Method of the Adjustable Stiffness Active Flexible Joint Robot

Yanlei Shi, Guoshuai Ding, Minglu Zhang and Xiaojun Zhang
Hebei University of Technology, Tianjin, China

- Output Law of Driving Motor with Variable Stiffness Active Flexible Joint.
- Method of Trajectory Generation at the Foot End.
- Joint Active Variable Stiffness Coefficient Adjustment Strategy
- The actual foot curve and the desired end curve.


The actual foot curve and the desired end curve

Human Support Robotics

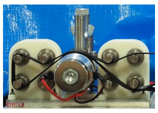
Chair *Atsushi Konno, Hokkaido University*
Co-Chair *Shouhei Shirafuji, The University of Tokyo*

14:40–14:55 SuC02.1

Locking Mechanism using an Overlapped Flat Belt and Ultrasonic Vibration

Naotaka Matsui
Dept. of Precision Engineering, The University of Tokyo
Shouhei Shirafuji, Jun Ota
Research into Artifacts, Center for Engineering, The University of Tokyo

- A novel locking device for a flat belt was proposed.
- Lock and unlock states depends on frictional coefficient on a flat overlapped belt structure.
- Lock and unlock states can be changed by reducing frictional coefficient using ultrasonic vibration.
- The experiment was conducted for verifying the proposed mechanism.

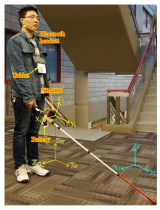


14:55–15:10 SuC02.2

An Indoor Navigation Aid for the Visually Impaired

He Zhang and Cang Ye
Dept. of Systems Engineering, University of Arkansas Little Rock

- Visual SLAM using a 3D time-of-flight camera
- Visual-Range Odometry for egomotion estimation
- 2-step graph SLAM: floor plane as landmark in 3D graph SLAM and wall-lines as landmarks in 2D graph SLAM
- Global path planning based on a point-of-interest graph
- Speech interface for human-device interaction



The Smart Cane

15:10–15:25 SuC02.3

A New Powered Ankle-Foot Prosthesis with Compact Parallel Spring Mechanism

Fei Gao, Yannan Liu, and Wei-Hsin Liao
Department of Mechanical and Automation Engineering
The Chinese University of Hong Kong, Hong Kong, China

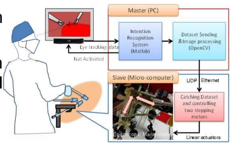
- A innovative powered ankle-foot prosthesis employing a compact parallel spring mechanism is proposed
- With cam profile, the parallel spring mechanism is designed to reproduce human ankle controlled dorsiflexion stiffness
- Prototype is fabricated and tested
- Performances of smart prosthesis are similar to the normal gait; energy efficiency is improved

15:25–15:40 SuC02.4

Pupil Variation for Use in Zoom Control

Yang Cao
Graduate School of Creative Science and Engineering,Waseda University,Japan
Yo Kobayashi, Satoshi Miura, Masakatsu G. Fujie and Shigeki Sugano
Faculty of Science and Engineering, Waseda University, Japan
Kazuya Kawamura
Graduate School & Faculty of Engineering, Chiba University, Chiba, Japan

- An endoscopic manipulator control system based on eye tracking
- New approach for the zoom control for an endoscopic manipulator using **pupil diameter variation**
- A zoom judge algorithm



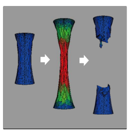
Overview of proposed system

15:40–15:55 SuC02.5

Experimental and Numerical Analysis of Damage Fracture Mechanics of Brain Parenchyma

Xiaoshuai Chen, Kazuya Sase and Atsushi Konno
Information Science and Technology, Hokkaido University, Japan
Teppei Tsujita
Mechanical Engineering, National Defense Academy of Japan, Japan

- A damage and fracture model was proposed to simulate damage and fracture behavior of brain parenchyma.
- The damage fracture model is for brain surgery simulations.
- Mechanical properties and proposed model parameters were identified.
- Tensile simulations were conducted to verify the accuracy of proposed damage model.



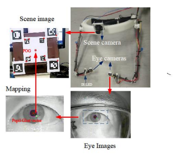
A simulation with a damage fracture model

15:55–16:10 SuC02.6

Toward Flexible Calibration of Head-mounted Gaze Trackers with Parallax Error Compensation

Dan Su and Y. F. Li
Dept. of Mech. & Biomed. Eng., City University of Hong Kong, China

- A nature and less-tedious calibration approach is proposed for head-mounted gaze trackers.
- The traditional GP regression and SGPP are applied to improve the estimation accuracy.
- The heat map, the correlation test & the blob analysis for detections of eye blinks and users' distractions.
- The parallax error compensation via the virtual affine parallax structure



Soft Robotics I

Chair *Erbao Dong, University of Science and Technology of China*
Co-Chair *Chaoquan Tang, China University of Mining and Technology*

14:40–14:55	SuC03.1

A Soft Earthworm-like Robot Targeted for GI Tract Inspection

HoLam Heung[1], Philip W.Y. Chiu[2,3], Zheng Li[2,3]

[1] Biomedical Engineering Programmme, the Chinese University of Hong Kong, Hong Kong
[2] Institute of Digestive Disease, CUHK, Hong Kong
[3] Chow Yuk Ho Technology Centre for Innovative Medicine, CUHK, Hong Kong

- A pneumatic driven soft earthworm-like robot targeted for gastrointestinal (GI) tract inspection is presented. It contains two expanding sections for anchoring and one extending section with bending function.
- Locomotion (crawling and bending) is controlled by a designed pneumatic control system.
- All the robot prototypes could crawl effectively in tubular environment. Performance inside pig colon could be improved by increasing the middle section of the robots.

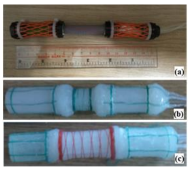


Figure 1 Three versions of the soft earthworm-like robot and their locomotion

14:55–15:10	SuC03.2

3D Printed Soft Gripper for Automatic Lunch Box Packing

Zhongkui Wang, Damith Suresh Chathuranga, and Shinichi Hirai
Soft Robotics Laboratory, Ritsumeikan University, Japan

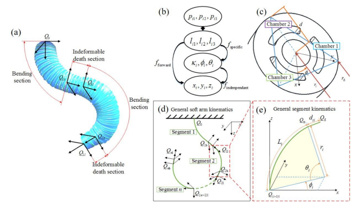
- A 3D printed soft robot gripper with modular design was proposed for lunch box packing;
- The gripper consists of a rigid base and 3 soft fingers. A snap-lock mechanism was designed for easy assembly without using screws;
- All components were 3D printed and the soft finger structure is based on the principle of fluidic elastomer actuator;
- Three finger designs were investigated through FE analysis and experiments. Results showed that the soft gripper could grasp and lift objects with variable shapes and softness.

The 3D printed soft gripper grasping a paper container filled with 50g peanuts.

15:10–15:25	SuC03.3

Design, Fabrication and Kinematics of a 3D-motion Soft Robotic Arm

Zheyuan Gong, Zhexin Xie, Xingbang Yang, Tianmiao Wang and Li Wen*
Beihang University, Beijing, China



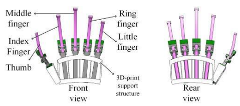
- Kinematic modeling and model revision for an entirely soft robotic arm.
- Location error and locomotion ability are improved under open loop control.

15:25–15:40	SuC03.4

Research of a Dual Stage Bending Dexterous Ro botic Hand with EMG Control

Wei Yao, Hu Jin, Chunshan Liu, Min Xu, Jie Yang and Erbao Dong
Department of Precision Machinery and Precision Instrumentation, University of Science and Technology of China, China

- A new dual stage bending dexterous robotic hand consisted of a soft composite structure and a solid hinge both driven by SMA wires.
- Various gestures are achieved by the dexterous robotic hand through controlling the kinestate of the actuators.
- Electromyography (EMG) was used to control the bionic hand.



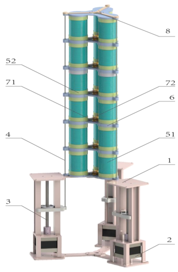
The schematic of the dexterous robotic hand

15:40–15:55	SuC03.5

The Fluid-Skeleton Elastic Manipulator (FSEM): A Novel Solution for Highly Maneuverable Robotic Arms

Sicheng Wang, Wenzeng Zhang
Dept. of Mechanical Engineering, Tsinghua University, China

- The Fluid-Skeleton Elastic Manipulator to be proposed in this paper contains a tendon-driven actuation system and several fluid-skeleton units.
- By changing the length of the tendon, the fluid capsule would deform passively, and may be then fixated through sealing certain junctions where the fluid is exchanged.
- The manipulator is therefore capable of deforming in multiple directions with fewer actuators and improved load capability.

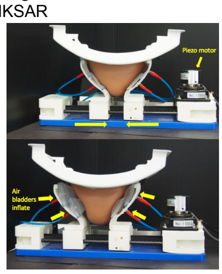


15:55–16:10	SuC03.6

A Novel Palm-Shape Breast Deformation Robot for MRI-Guided Biopsy

Tianxue Zhang, David Navarro-Alarcon, Kwun Wang Ng, Man Kiu Chow, and Yun-hui Liu
Dept. of MAE, The Chinese University of Hong Kong, HKSAR
Hayley Louise Chung,
Time Medical Limited, HKSAR

- A palm-shape robot is developed for MRI-guided biopsy to deform and immobilize the breast.
- A piezoelectric motor is used to move palm plates to the middle.
- A pneumatic system is applied to control the inflation of air bladders.
- Experiments were conducted to verify the feasibility of this breast deformation robot.



Grasping and Manipulation II

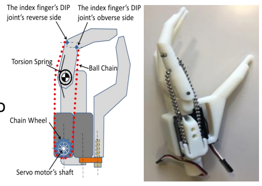
Chair *Wenzeng Zhang, Tsinghua University*
Co-Chair *Atsushi Kakogawa, Ritsumeikan University*

14:40–14:55	SuC04.1

Force-Magnification Mechanism with Artificial Tendon Sheath for Myoelectric Prosthetic Hand for Children

H. Ye, X. Feng, Y. Yabuki, S. Togo, Y. Jiang, and H. Yokoi
Department of Mechanical Engineering and Intelligent Systems,
The Univeristy of Electro-Communications, Japan

- The Force-Magnification Mechanism for Myoelectric Prosthetic Hand(MPH) consists of ball chain, chain wheel. The grasping force is proportional with the length of moment arm between the MP joint and the ball chain.
- The Artificial Tendon Sheath consists of two extension springs. It mimicking human ligaments of tendon sheath makes it possible that the MPH's finger can bend fast with small torque while approaching to the object, and slowly increase grasp torque after touching the object.



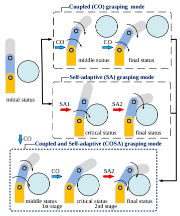
MPH with the Ball chain-driven force-magnification mechanism

14:55–15:10	SuC04.2

COSA-ET Finger: A Coupled and Self-adaptive Underactuated Robot Finger with Double Springs and an Empty-trip Mechanism

Xiaonan Chen
Dept. of Electrical and Computer Engineering, Lafayette College, USA
Wenzeng Zhang
Dept. of Mechanical Engineering, Tsinghua University, China

- An underactuated robot finger can perform coupled and self-adaptive hybrid grasping modes.
- The empty-trip mechanism is the trigger of transition of grasping modes.
- Kinematics and statics analysis show the distribution of contact forces and the switch condition of COSA-ET finger.

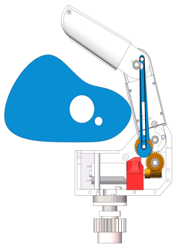


15:10–15:25	SuC04.3

COSA-E Hand: A Coupled and Self-adaptive Hand with Eccentric Wheel Mechanisms

Dayao Liang, Wenzeng Zhang
Dept. of Mechanical Engineering, Tsinghua University, China
Xiangrong Xu
School of Mechanical engineering, Anhui Univ. of Tech., China

- A coupled and self-adaptive underactuated hand (COSA-E hand) is designed.
- The hybrid mode is realized by the eccentric wheel and sliding chute mechanism.
- It is more humanoid compared to traditional self-adaptive hands and more secure compared to traditional coupled hands.
- Geometric analysis gives the self-adaptive and coupled zones of the COSA-E hand. Force analysis shows the force distribution based on the situation and location of objects.

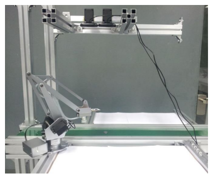


15:25–15:40	SuC04.4

Visual Servoing Based Pickup of Moving Objects with a Kinematically Controlled Manipulator

Fuquan Dai
School of Mechanical and Automotive Engineering, Fujian University of Technology, China
Kai Wang
R&D Department, Corechips Technology Co. Ltd, China

- A new kinematic controller is proposed for the visual servoing based pickup of moving objects by embedding two novel adaptive estimators into this controller to estimate the position of the manipulator end effector and that of the stationary object online
- It is proved by Lyapunov theory that the proposed controller with the embedded position estimators, leads to the asymptotic pickup of moving objects and the convergence of the estimated positions to the actual ones
- An experiment is conducted to validate the effectiveness of the proposed controller

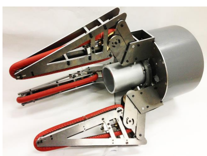

The experiment setup

15:40–15:55	SuC04.5

Underactuated Modular Finger with Pull-in Mechanism for a Robotic Gripper

Atsushi Kakogawa and Shugen Ma
Department of Robotics, Ritsumeikan University, Japan
Hiroyuki Nishimura
Yushin Precision Equipment Co., Ltd., Japan

- This paper presents an underactuated modular finger with a pull-in mechanism for a robotic gripper.
- A differential mechanism provides two outputs for grasping and retracting through a single actuator.
- It can eliminate sensor systems for detecting contact with the object.
- A grip force can be varied by using a resistance regulation mechanism.


Our proposed gripper

15:55–16:10	SuC04.6

A Motion Planning of Dual Arm-Hand Manipulators for Origami-Folding Based on a Probabilistic Model of Constraint Transitions within Human Behavior

Akira Nakashima*, Yoshihiro Iwanaga**, Yoshikazu Hayakawa***
*Faculty of Science and Engineering, Nanzan University, Japan
**Graduate School of Engineering, Nagoya University, Japan
***Faculty of Engineering, Aichi Institute of Technology, Japan

- Origami-folding task is performed by Dual arm-hand manipulators based on Human Behavior.
- The human behavior is modeled as a probabilistic model with HMM modeling to extract the contact transitions.
- The distributed human's fingertip trajectories are integrated into the manipulators via a nonlinear programing optimization.
- The folding is failed though the bending task is achieved in the experiment. Integration of the paper bending model is one of the future work.

Bending phase of paper in Folding task by Dual Arm-hand Manipulators

Robot Vision II

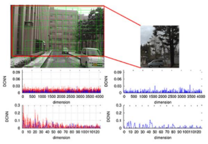
Chair *Kanji Tanaka, University of Fukui*
Co-Chair *Yazhe TANG, National University of Singapore*

14:40–14:55	SuC05.1

Mining DCNN Landmarks for Long-term Visual SLAM

Tsukamoto Taisho and Kanji Tanaka
Graduate school of engineering, University of fukui, Japan

- A novel bag-of-words scene representation and scene retrieval criteria is built on discriminative visual features from DCNN (deep convolutional neural network).
- Our scene representation and matching adopt NBNN (naïve Bayes nearest neighbor), which has proven to be robust in cross-domain scene recognition.
- Our approach is evaluated and compared against state-of-the-art scene retrieval techniques in cross-season scene recognition.

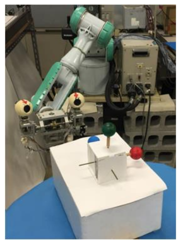

DCNN landmark mining + NBNN scene matching

14:55–15:10	SuC05.2

3D Evolutionary Pose Tracking Experiments of Eye-Vergence Visual Servoing in Lateral Motion and Arc Swing Motion

Hongzhi Tian, Ryuki Funakubo, Yejun Kou, and Mamoru Minami
Graduate school of Natural Science and Technology, Okayama University, Japan

- 3D pose tracking method is used to recognize the pose of a known 3D-ball-object
- Hand & eye visual servoing controller are used to control manipulator and dual eye
- The position and orientation tracking ability is evaluate by lateral motion and arc swing experiment

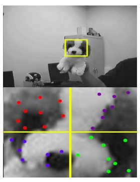

Arc Swing Motion Experiment

15:10–15:25	SuC05.3

Structural Keypoints Voting for Global Visual Tracking

[1,2]Yazhe Tang, [1]Mingjie Lao, [1]Feng Lin and [3]You-Fu Li
[1]Temasek Laboratories, National University of Singapore, Singapore
[2]Department of Precision Mechanical Engineering, Shanghai University, China
[3]Department of Mechanical and Biomedical Engineering, City University of Hong Kong, Hong Kong

- This paper presents a patch-based keypoints algorithm for global scope robust visual tracking
- A parallel framework with keypoints matching and tracking in optical flow is proposed
- The motion clustering is employed to focus the reliable keypoints patches and eliminate the outliers for improved tracking

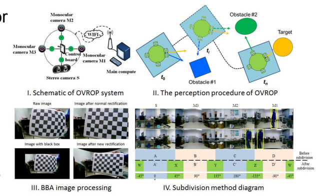

The patch-based keypoints motion clustering

15:25–15:40	SuC05.4

Calibration and Implementation of a Novel Omnidirectional Vision System for Robot Perception

Chang Li, Qing Shi, Qiang Huang and Toshio Fukuda
Intelligent Robotics Institute, Beijing Institute of Technology, China
Chunbao Wang
Shenzhen Institute of Geriatrics, Shenzhen Second People's Hospital, China

- Black-box algorithm and cylindrical coordinate transformation method for calibration and rectification;
- Subdivision method for omnidirectional tracking of moving objects;
- Able to show panoramic image and 3D reconstruction result;
- Able to be applied for different types of robots based on compatible hardware and software interfaces.

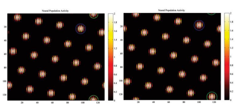


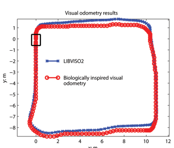
15:40–15:55	SuC05.5

Biologically Inspired Visual Odometry Based on the Computational Model of Grid Cells for Mobile Robots

Huimin Lu, Junhao Xiao, Lilian Zhang, Shaowu Yang
National University of Defense Technology, China
Andreas Zell
Department of Cognitive Systems, University of Tuebingen, Germany

- A biologically inspired visual odometry was proposed, where the continuous attractor network model of grid cells was used to integrate the robot's motion information estimated from the vision system
- A full visual SLAM system was realized by simply combining the proposed visual odometry with direct loop closure detection derived from the well-known RatSLAM
- Comparable results can be achieved in comparison with LIBVISO2 and RatSLAM



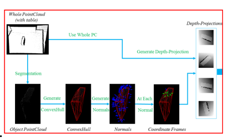


15:55–16:10	SuC05.6

Work Day and Night: A Learning Based Illumination Irrelevant Grasp Planning Method

Peng Wang, Dongxuan Li, Yue Wang, Rong Xiong*
State Key Laboratory of Industrial Control Technology and Institute of Cyber-Systems and Control, Zhejiang university

- A depth-projection method to describe the grasp pose, no need to model gripper and target objects.
- To be Illumination irrelevant with only depth data being used as the input of learning method.
- 83.3% accuracy, no matter how light intensity varies and whether rigid or deformable object.
- Theoretically more efficient than other algorithms using sliding window.



Path and Motion Planning

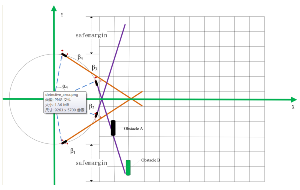
Chair *Chao Ren, Tianjin University*
Co-Chair *Yuichi Kobayashi, Shizuoka University*

14:40–14:55 SuC06.1

An Obstacle Avoidance Method based on Non-Radial Arrangement of Distance Sensors for Vacuum Cleaning Robot

Yongzhen Zhou, Rongchuan Sun, Shumei Yu, and Lining Sun
Robotics and Microsystems Center, Soochow University
Jianyu Yang
The School of Urban Trail Transportation, Soochow University

- Concept of non-radial arrangement of sensors
- Optimization of sensor's parameters
- Obstacle avoidance based on local grid map



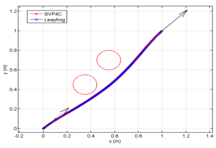
Concept of non-radial arrangement of sensors

14:55–15:10 SuC06.2

Path Planning with the Leapfrog Method in the Presence of Obstacles

B.T. Matebese and D.J. Withey
Council for Scientific and Industrial Research, Pretoria, South Africa
M.K. Banda
Department of Mathematics and Applied Mathematics,
University of Pretoria, South Africa

- Optimal paths for robot motion are generated while avoiding obstacles using Indirect method, Leapfrog.
- Simulations demonstrate optimal path formation and comparison is made with the BVP4C solver.
- Path following experiment was conducted on a Pioneer 3-DX robot using optimal paths produced by Leapfrog.



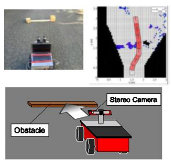
The optimal trajectories obtained from BVP4C and Leapfrog in the presence of two obstacles

15:10–15:25 SuC06.3

Motion Planning of Mobile Robot Considering Velocity-Dependent Cost and Time

Sho Matsunaga and Yuichi Kobayashi
Graduade School of Science and Technology, Shizuoka Univercity, Japan
Kazuki Matsumura
Yamaha Motor Electronics, Japan
Chyon Hae Kim
Faculty of Science and Engineering, Iwate University, Japan

- Planning motion including not only avoiding bumps but also crossing it considering their moving cost
- Crossing cost are estimated by result of prior learning by Gaussian Process
- Crossing cost depending on robot's velocity and bump's height could be properly reflected to trajectory.



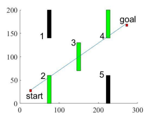
Prediction of vertical acceleration regarded as crossing cost

15:25–15:40 SuC06.4

An Improved RRT Algorithm Incorporating Obstacle Boundary Information

Jiankun Wang, Xintong Li and Max Q.-H. Meng
Electronic Engineering, The Chinese Universirty of HongKong, HongKong, China

- Classify obstacles in the environment into valuable and valueless obstacles.
- The random tree will grow more intentionally to the goal position
- Prove that obstacle boundary information really improves RRT algorithm
- Our algorithm can find a better feasible path faster than RRT



Obstacle Type

15:40–15:55 SuC06.5

Research on Trajectory Planning of a Robot Inspired by Free-Falling Cat Based on Numerical Approximation

Xingcan Liang
Automation, University of Science and Technology of China, China
Linsen Xu and Lu Li
Precision Manufacturing, Hefei Institute of Physical Science, CAS, China

- Dynamical model of the free-falling cat robot.
- Cost function based on spline approximation.
- Particle swarm optimization.
- Simulation result and future work.

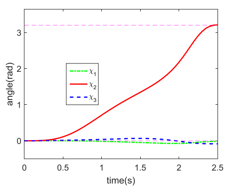


Figure 4. Optimal trajectory of Euler angle

Mobile Robotics IV

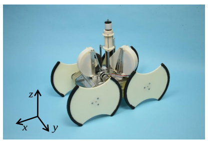
Chair *Hiroyuki ISHII, Waseda University*
Co-Chair *Haitao Yu, Harbin Institute of Technology*

16:30–16:45	SuD01.1

A Novel Extendable Arm Structure Using Convex Tapes for Improving the Strength of the Pipe on Tiny Mobile Robots

K. Tanaka[1], H. Yokoyama[1], H. Ishii[1], S. Inoue[1], Q. Shi[2], S. Okabayashi[3], Y. Sugahara[4], and A. Takanishi[1]
[1]Waseda University, Japan [2]Beijing Institute of Technology, China
[3]Bunka Gakuen University, Japan [4]Tokyo Institute of Technology, Japan

- The demand for monitoring from high points is increasing to support remote control and accurate monitoring.
- The new extendable arm structure for implementing to mobile robot is presented.
- Our results indicated that the robot could extend its arm up to 4 m at a wind speed of 10 m/s and its posture can be changed to 15°in all directions without the use of additional supports such as an outrigger.



Overview of Waseda Animal Monitoring robOT (WAMOT) with extendable arm

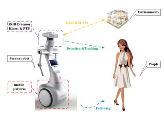
16:45–17:00	SuD01.2

17:00–17:15	SuD01.3

Human Comfort Following Behavior for Service Robots

Yue Sun, Lei Sun and Jingtai Liu*
Institute of Robotics and Automatic Information System and Tianjin Key Laboratory of Intelligent Robotics, Nankai University, China

- The necessary of future motion expectation and natural interaction for human following.
- An intelligent following system based on user comfortable feeling and human factors.
- A comprehensive performance evaluation index of human following system.
- The proposed model considering human comfort performs better than a traditional human following model.



Human Comfort Following Behavior

17:15–17:30	SuD01.4

Mechanical Property of a Articulated in-Pipe Locomotion Robot

Jun Chen, ZhengFeng Bai and Jian Li
Department of Mechanical Engineering, HIT at Weihai, China
ZongQuan Deng
School of Mechatronics Engineering, HIT, China

- Wheel-type in-pipe robot
- Force model of the in-pipe robot unit
- Statics analysis
- An example

Articulated multi-unit in-pipe robot system

17:30–17:45	SuD01.5

Design of a Health Care Platform for the Elderly

Jining Cui, Peipei Song, Wenyu Li, Shun Han, Liang Li, Zhenqiang Liu, and Feng Duan
Department of Intelligence Science and Technology, Nankai University, China
Yew Guan Soo
Universiti Teknikal Malaysia Melaka, Durian Tunggal, Malaysia
Chi Zhu
Department of System Life Engineering, Maebashi Institute of Technology, Japan

- We present a novel health care platform for the elderly.
- Providing walking assistant.
- Monitoring body's vital physiological indexes.
- Possessing the functions of navigation.

17:45–18:00	SuD01.6

A Study on Risk Assessment for Improving Reliability of Rescue Robots

Rachot Phuengsuk and Jackrit Suthakorn, PhD
Biomedical Engineering, Mahidol University, Thailand

- Rescue Robots
- Reliability
- Risk Assessment
- Low-Level Control System

Rescue Robot

Aerial Manipulator Systems

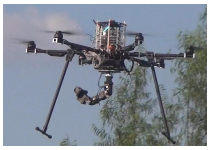
Chair *Jangmyung Lee, Busan National University, Busan, Korea*
Co-Chair *Yuqing He, Shenyang Institute of Automation, Chinese Academy of Sciences*

16:30–16:45	SuD02.1

Design and Implementation of Rotor Aerial Manipulator System

Xiangdong Meng[*°] , Yuqing He[°] , Feng Gu[°] , Liying Yang[°] , Bo Dai[*°] , Zhong Liu[*°] and Jianda Han[°]
[°] State Key Laboratory of Robotics, Shenyang Institute of Automation, CAS, China
[*] University of Chinese Academy of Sciences, China

- Rotor aerial manipulator system containing a hex-rotor aerial robot and a five-DOF manipulator system
- Parameter identification of single rotor model
- Flight experiment and dynamic grasping demonstration, including outdoor flight experiment and indoor grasping experiment



RAMS in SIA CAS

16:45–17:00	SuD02.2

Modeling and Characterization of a Canopy Sampling Aerial Manipulator

James R. Kutia, Weiliang Xu, Karl A. Stol
Department of Mechanical Engineering, University of Auckland, New Zealand

- Application: Aerial manipulation for cutting branch samples from above the canopy of forests
- Modeling and characterization methodology and results presented toward the development of physical interaction simulations
- Model structure: Aircraft + manipulator + environment (compliant tree branch)

17:00–17:15	SuD02.3

Modeling and Cascade PID Control of Six-Rotor Aircraft

Zhenyu Wu and Qiang Li
School of Innovation and Entrepreneurship, DUT, China
Yan Zhuang
School of Control and Engineering, DUT, China

- Dynamics model of Six-rotor aircraft
- Attitude estimation method based on quaternion differential equation
- Cascade PID control of six-rotor aircraft
- Simulation and experimental result

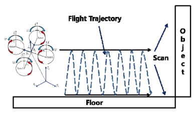
Six-Rotor Aircraft

17:15–17:30	SuD02.4

3D Map Building using the LRF and Sinusoidal Trajectory of a Quadrotor

Howon Lee, Yo-Seop Hwang, GyoungHun Jang, TaeEon Kim and Jang-Myung Lee, Member, IEEE
Department of Electronics Engineering, Pusan National University, Republic of Korea

- In this paper propose a 3D mapping system using Quadrotor using the LRF and the sinusoidal trajectory algorithm.
- Instead of the expensive and bulky 3D-laser scanner, the LRF can be utilized and installed on the Quadrotor for the map building and the autonomous navigation.



Sinusoidal trajectory and diagonal scan

17:30–17:45	SuD02.5

Varying Inertial Parameters Model Based Robust Control for An Aerial Manipulator

Guangyu Zhang, Yuqing He, Jianda Han and Zhiqiang Zhu
Shenyang Institute of Automation, Chinese Academy of Sciences, China
Guangjun Liu
Department of Aerospace Engineering, Ryerson University, Canada

- A varying inertial parameters model is built to describe influence of the moving manipulator on the whole system.
- A feedforward compensation H∞ controller is designed to implement the steady flight of the whole system with relative movement between the manipulator and the aerial robot.

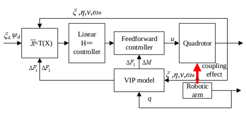


Figure1. Controller structure of the system

Soft Robotics II

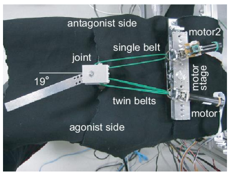
Chair *Chin-Yin Chen, Ningbo Institute of Material Technology and Engineering, CAS*
Co-Chair *Erbao Dong, University of Science and Technology of China*

16:30–16:45	SuD03.1

Static and Dynamic Performances of A Round-belt Twist Actuator

Takahiro Inoue
Dept. of Human Information Engineering, Okayama Pref. Univ., Japan
Shinichi Hirai
Dept. of Robotics, Ritsumeikan Univ., Japan

- Antagonistically twisted round belt actuator system is introduced
- High repeatability of contraction forces generated by twisting round belts
- Stress relaxation and force hysteresis appear, whereas they do not negatively affect the control performances
- A defined Young's modulus trends toward a decrease with respect to increase of twisting
- Position control can be easily realized, and the oscillation is suppressed by simple PI controller

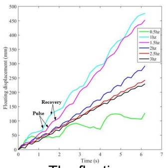


16:45–17:00	SuD03.2

A novel biomimetic jellyfish robot based on a Soft and Smart Modular Structure(SMS)

Yu Zhou, Hu Jin, Chunshan Liu, Erbao Dong, Min Xu and Jie Yang
Department of Precision Machinery and Precision Instrumentation, University of Science and Technology of China, China

- A biomimetic jellyfish robot that is inspired from the real jellyfish locomotion with pulse and recovery process was designed and fabricated.
- The vertical floating displacements of the jellyfish robot at different frequencies were measured.
- The jellyfish robot was able to accomplish three-dimensional locomotion with the input of sequential pattern.



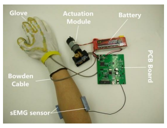
The floating displacements of the jellyfish robot for different configurations under different frequencies

17:00–17:15	SuD03.3

Soft Robotic Glove for Disabled Person with Hand Paralysis

Hongsheng Cao and Dingguo Zhang*
School of Mechanical Engineering, Shanghai Jiao Tong University, China
* dgzhang@sjtu.edu.cn

- This wearable soft robotic glove aims to restore basic hand function and improve quality of life for people with hand paralysis.
- Objects with various shapes can be grasped without active control due to the usage of cable system and under-actuated mechanism.
- Myoelectric signals are used as control source of the robotic glove.
- Proportional control method is adopted to improve the performance of this device.



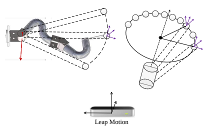
The complete realized system design

17:15–17:30	SuD03.4

A Practical, Fast, and Low-cost Kinematic Calibration Scheme for a Deformable Manipulator by Using Leap Motion

Gaofeng Li, Lei Sun, Xiang Lu, Jie Hao, and Jingtai Liu
Institute of Robotics and Automatic Information System,Nankai University,China

- We propose a practical, fast, and low-cost calibration scheme for a deformable manipulator by using the plane-of-rotation.
- We design a calibration tool for Leap Motion to reduce the difficulties in fabricating and mounting.
- RANSAC and Least-squares methods are used to obtain the initial values.
- A generic error model is used to optimize the kinematic parameters

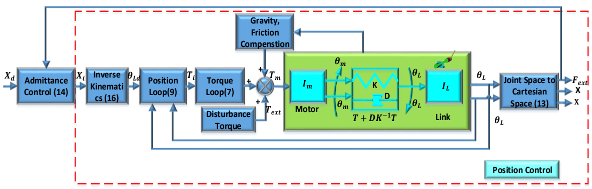


The Calibration Scheme and the Plane-of-Rotation

17:30–17:45	SuD03.5

Cartesian Admittance Control with On-line Gravity and Friction Observer Compensation for Elastic Joint Robots

Yanlei Ye[1,2], Chin-Yin Chen[1], Peng Li[1],
Guilin Yang[1], and Zhu Chang-an[2]
1. Zhejiang Key Laboratory of Robotics and Intelligent Manufacturing Equipment Technology, Ningbo, China
2.University of Science and Technology of China, Hefei, China



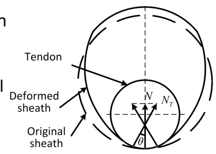
Cartesian admittance control of the elastic joint robot

17:45–18:00	SuD03.6

Analysis on the Force Propagation of the Tendon-sheath Actuation in Dexterous Surgical Robots

Yuanyuan Zhou, Hao Liu, Chongyang Wang
Shenyang Institute of Automation, CAS, China
Zhidong Wang
Dept. of Advanced Robotics, Chiba Institute of Technology, Japan

- The tendon pulling velocity have little effect on the force propagation of the tendon-sheath actuation
- The sheath curvature is inversely proportional to the friction of the tendon-sheath actuation
- The greater difference between the tendon and sheath size is, the smaller the friction is
- A modified model with a new parameter is presented in the paper to adjust the difference between the tendon and sheath size



Proposed modified friction model of the tendon-sheath actuation

Biomimicking Robots/Systems

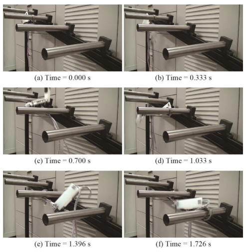
Chair *Yuji Yamakawa, University of Tokyo*
Co-Chair *Junzhi Yu, Institute of Automation, Chinese Academy of Sciences*

16:30–16:45 SuD04.1

Development of a Brachiation Robot with Hook-shaped End Effectors and Realization of Brachiation Motion with a Simple Strategy

Yuji Yamakawa, Yuki Ataka and Masatoshi Ishikawa
Graduate School of Information Science and Technology,
The University of Tokyo, Japan

- We developed a new 2-DOF brachiation robot with hook-shaped end effectors.
- We proposed a simple strategy for brachiation motion based on the pendulum motion of a rigid body.
- We explained the detailed motion strategy of the brachiation motion, and we suggested posture control during brachiation motion.
- We successfully achieved brachiation motion by using the developed robot and the proposed motion method.



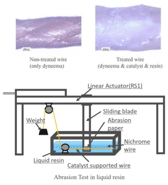
Experimental result of brachiation motion

16:45–17:00 SuD04.2

Development of a dipping wire method to improve the abrasion resistance of a plastic wire

Shunsuke Nagahama, Junichi Tanabe and Shigeki Sugano
Department of Modern Mechanical Engineering, Waseda University, Japan

- Catalyst is supported on a plastic wire by dipping method.
- A coating is formed on a surface of the wire in liquid resin.
- When the coating is removed, the coating is re-formed by reacting with surface catalysts.
- Our method provided a wire with abrasion resistance.



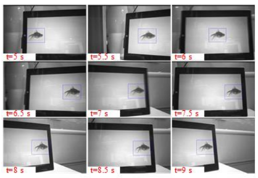
Abraded wire in liquid resin

17:00–17:15 SuD04.3

A Novel Active Tracking System for Robotic Fish Based on Cascade Control Structure

Xiang Yang, Zhengxing Wu, and Junzhi Yu
State Key Laboratory of Management and Control for Complex Systems,
Institute of Automation, Chinese Academy of Sciences, China

- A novel active tracking control approach for a self-propelled robotic fish with onboard vision system is proposed.
- A camera stabilizer is designed to reduce the instability of image caused by the swaying of the fish head.
- In order to effectively track a target object, the Kernelized Correlation Filters (KCF) is adopted and a relevant active tracking controller is also designed.



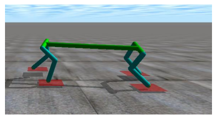
Images captured during the tracking process.

17:15–17:30 SuD04.4

Robust and directive quadruped locomotion on rough terrain without requiring sensing and actuation

Takashi Takuma and Wataru Kase
Dept. of Engineering, Osaka Institute of Technology, Japan

- Quadruped robot equipping with animal-like trunk mechanism supported by vertebra and intervertebral disks
- Record success rate of walking over random rough terrain by changing spring coefficient of the trunk joints
- Different number and position of the trunk joints are provided, and the success rate by a robot equipping with these trunks are recorded
- Peak of the success rate depends on the number and position of the joints



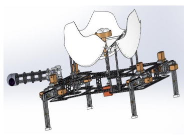
Quadruped robot equipping with animal-like spine structure

17:30–17:45 SuD04.5

Movement Stability Criterion and Its Application to Gait Planning of a Quadruped Robot

Liang Huang, Guisen Guan, Wenfu Xu*, *Senior*, IEEE
The School of Mechanical Engineering and Automation,
Shenzhen Graduate School, Harbin Institute of Technology

- Design of a quadruped turtle robot
- The effects of the weighty leg on the total gravity center
- Criterion of movement stability
- The method that adjusts the center of gravity to vary along desired path
- The calculation of stability margin
- Gait planning and experiment



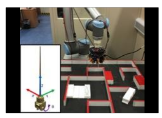
The 3-D model of the quadruped robot

17:45–18:00 SuD04.6

Advancing whisker based navigation through the implementation of Bio-Inspired whisking strategies

Mohammed Salman and Martin Pearson
Bristol Robotics Laboratory,
University of Bristol and University of West of England , UK

- Integration of RatSLAM with a tactile whisker array
- Novel metric for gauging performance of RatSLAM specifically
- Implementation of bio inspired whisking strategies for improving SLAM performance
- Results indicate whisking strategies improve precision of contact position estimation



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Robot Vision III

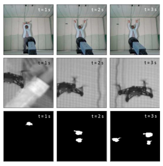
Chair *Huihuan QIAN, The Chinese University of Hong Kong, Shenzhen*
Co-Chair *Qi An, The University of Tokyo*

16:30–16:45 SuD05.1

Vibration Source Localization for Motion-blurred High-frame-rate Videos

Mingjun Jiang, Tadayoshi Aoyama, Takeshi Takaki, Idaku Ishii
Department of System Cybernetics, Hiroshima University, Japan

- Vibration source localization by implementing pixel-level digital filters on HFR videos
- Robust vibration region extraction against motion-blurs
- Implementation on a real-time mechanical tracking system with visual feedback control at 1000 fps



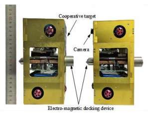
Real-time vibration source tracking with motion-blurred High-frame-rate videos

16:45–17:00 SuD05.2

Vision-based autonomous docking for self-reconfigurable CubeSats

Yimeng Fu and Chengli Su
School of Information and Control Engineering,Liaoning Shihua University,China
Jinguo Liu*, Qing Gao, Tian Zhang, Tongtong Tian
State Key Laboratory of Robotic,Shenyang Institute of Automation Chinese Academy of Sciences,China

- Vision-based autonomous docking for self-reconfigurable CubeSats
- An intelligent image processing method based on FO-DPSO algorithm
- Using the EPnP algorithm to solve the PnP problem



The prototype of self-reconfigurable CubeSat

17:00–17:15 SuD05.3

Self-tuning Underwater Image Fusion Method Based on Dark Channel Prior

Wen Zou, Xin Wang, Kaiqiang Li and Zebin Xu
School of Mechanical Engineering and Automation, Harbin Institute of Technology Shenzhen Graduate School, China

- Use underwater Dark Channel Prior to get a color restoration version of the input underwater image.
- Enhance the contrast of underwater image by V channel histogram equalization.
- Fuse the input underwater image with its color restoration version and contrast enhancement version through specific weight matrix.
- Use simplex search algorithm to get the model parameters spontaneously.
- Compared with other methods in specific scenes.

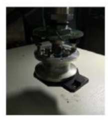
The input image (up) and our result (down).

17:15–17:30 SuD05.4

Grasping Point for Planar Workpiece Based on Fuzzy Connectedness Prior Knowledge

Jingyi Zheng, En Li, Zize Liang
Institute of Automation, Chinese Academy of Sciences
University of Chinese Academy of Sciences

- problem statements
- relative fuzzy connectedness constraints
- the initialization and the iterative segmentation
- the optimal grasping point for planar workpiece



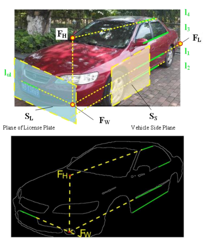
The optimal grasping point for planar workpiece

17:30–17:45 SuD05.5

Vehicle 3-Dimension Measurement By Monocular Camera Based on License Plate

Shuaijun Li
MAE Dep., The Chinese University of Hong Kong, Hong Kong, China
Xinyu Jiang, Huihuan Qian and Yangsheng Xu
CRAI, The Chinese University of Hong Kong, Shenzhen, China

- Measure Width, Height and Length of a vehicle from planar image
- Direct and fast measure approach that requires NO training process
- Mainly based on ROI extraction and hough-transform-based line detection
- 100 mm (5%) accuracy for W and H, 500 mm (9%) accuracy for L

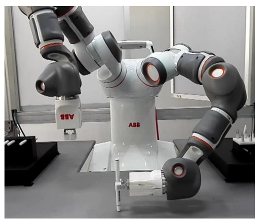


17:45–18:00 SuD05.6

Dual-arm Robot Assembly System for 3C Product Based on Vision Guidance

Siwen Fang, Xinlong Huang and Heping Chen
Shenzhen Academy of Robotics, China
Ning Xi
Emerging Technologies Institute, The University of Hong Kong, China

- Dual-arm robot with advantages of flexibility and collaboration is used for small parts assembly.
- Vision system is deployed to identify the parts location.
- Assembly process is analyzed for the small parts of 3C products.
- An experiment is preformed to demonstrate the effectiveness of this system.



Underwater Robots and Snake Robots

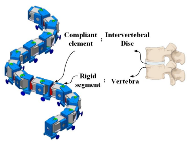
Chair *Xiaodong Wu, Shanghai Jiao Tong University*
Co-Chair *Shuo Wang, Institute of Automation,Chinese Academy of Sciences*

16:30–16:45 SuD06.1

Effects of the Compliant Intervertebral Discs in the Snake-like Robots: A Simulation Study

Guifang Qiao, Xiulan Wen, Di Liu, and Qi Wan
School of Automation, Nanjing Institute of Technology, China
Guangming Song
School of Instrument Science and Engineering, Southeast University, China

- A simulation study on the effects of the compliant intervertebral discs designed for the planar snake-like robot is carried out.
- The performances of the snake-like robot are associated with the stiffness and damped coefficients of the compliant elements.
- Results show that the introduction of compliant elements can evidently reduce the power consumption of the robot. Compared with the stiffness coefficient, the damped coefficient of the compliant elements has greater impact on the power consumption.



The proposed snake-like robot with the compliant elements.

16:45–17:00 SuD06.2

The resistance analysis of AUV based on Variable Buoyancy System

Qinggang Sun and Rong Zheng
Shenyang Institute of Automation
Chinese Academy of Sciences, University of Chinese Academy of Sciences, China

1、The structure design based on Variable Buoyancy System.

2、The division method of unstructured mesh.

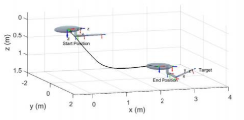
3、The calculation method of hydrodynamic force.

17:00–17:15 SuD06.3

Robust Iterative Multi-Task Control of the Underwater Biomimetic Vehicle-Manipulator System

Chong Tang, Shuo Wang, Yu Wang, and Min Tan
The State Key Laboratory of Management and Control for Complex Systems, Institute of Automation, Chinese Academy of Sciences, China

- An effective approach for multi-task control of the underwater biomimetic vehicle-manipulator system is presented.
- A direct kinematic model is built firstly, and the robust closed-loop iterative task-priority algorithm is designed, where kinematic singularity and algorithm singularity are modified.
- Simulations are conducted to apply this algorithm to solve the multi-task control problem of the underwater biomimetic vehicle-manipulator system for interventions.

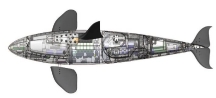


17:15–17:30 SuD06.4

Dynamics Modeling and Simulation for a Gliding Robotic Dolphin

Zhengxing Wu, Xiang Yang, Chao Zhou, Jun Yuan and Junzhi Yu
The State Key Laboratory of Management and Control for Complex Systems, Institute of Automation, Chinese Academy of Sciences, China

- A novel gliding robotic dolphin is developed to realize both high maneuverability and long endurance.
- The dynamic model of the gliding motion in the vertical plane for the robotic dolphin is built.
- CFD methods are adopted to determine some key hydrodynamic coefficients.
- Simulation results reveal the detailed gliding performance and verify an expected gliding ability of the developed gliding robotic dolphin.



17:30–17:45 SuD06.5

Design and Implementation of a Robotic Dolphin for Water Quality Monitoring

Jincun Liu Zhengxing Wu and Junzhi Yu
The State Key Laboratory of Management and Control for Complex Systems, Institute of Automation, Chinese Academy of Sciences, China

- A bio-inspired robotic dolphin is designed to implement water quality monitoring task.
- A Central Pattern Generators (CPGs) -based controller is utilized to realize multimodal locomotion.
- Field testing demonstrates the feasibility of the proposed bio-inspired water quality monitoring system.

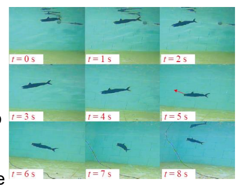
Prototype of the robotic dolphin

17:45–18:00 SuD06.6

Design and Implementation of a Robotic Shark with a Novel Embedded Vision System

Xiang Yang, Zhengxing Wu and Junzhi Yu
The State Key Laboratory of Management and Control for Complex Systems, Institute of Automation, Chinese Academy of Sciences, China

- An updated robotic shark with three joints and a pair of pectoral fins is developed.
- To eliminate the image degeneration caused by the robot head swaying, a particulate embedded vision system with a camera stabilizer is designed.
- A CPGs-based control strategy is adopted to realize shark-like locomotion and further analysis are executed to explore the relationship between propulsive performance and some characteristics of adopted CPGs.



Poster Session I

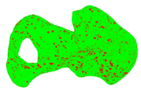
Chair *Chi Zhu, Maebashi Institute of Technology*
Co-Chair *Yong Yu, Kagoshima University*

14:40–17:00	SuPOS.1

Mesh Generation of Hip Joint Bones Model: Methods and Programs

Monan Wang, Ning Yang and Zhao Li
Mechanical & Power Engineering College, Harbin University of Science and Technology, China

- This work employed the silver decomposition method to eliminate the silvers
- 3D mesh of hip joint bones was generated successfully
- The method can rapid generate optimized tetrahedral grid
- The validated model can be applied to analyses biomechanics in virtual surgery systems


Post-optimal hipbone

14:40–17:00	SuPOS.2

3D Temperature Distribution Model Based on Vision Method

Tong Jia, Mo Tu, Yuli Jiang, Shuai Zhang
College of Information Science and Engineering, Northeastern University, China

- This paper studies the construction of 3D temperature distribution reconstruction system based on the binocular visual technology. First of all, since the thermal infrared camera is only sensitive to temperature, the traditional calibration method cannot be directly used in it. Therefore, the paper designs a thermal infrared camera calibration board to complete the calibration of the thermal infrared camera. Then, in terms of stereo matching, it further studies the traditional belief propagation algorithm and improves its smooth model, so as to optimize the mismatching rate greatly. Finally, in terms of the 3D model construction, it constructs the corresponding relationship between the points on the 3D model and the pixels on the temperature images based on the known thermal infrared camera and the space position information of the visible light camera and maps the temperature information to the 3D model. Experimental results show that the method can accurately construct the 3D temperature distribution model and the model has strong robustness.

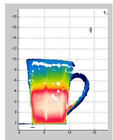


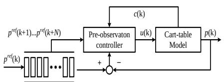
Figure: 3D temperature model

14:40–17:00	SuPOS.3

Omnidirectional Walking Based on Preview Control for Biped Robots

Wang Helin , Liu Chengju , Chen Qijun
Control Science and Engineering Department,Tongji University,China

- A novel preview control of zero moment point (ZMP) is proposed in the paper.
- A biped robot is modeled as a running cart on the table and the walking pattern is generated.
- Several patterns in the omnidirectional walking including support-foot and swing-foot are discussed respectively.
- The proposed approach is validated via webots simulations on NAO robot.
- The results verify the feasibility of the proposed control scheme in the stable and robust walking.



Walking pattern generator diagram based on Presented preview ZMP control

14:40–17:00	SuPOS.4

Semantic Segmentation Based on Aggregated Features and Contextual Information

Chuanxia Zheng, Jianhua Wang, Weihai Chen and Xingming Wu
School of Automation Science and Electrical Engineering, Beihang University

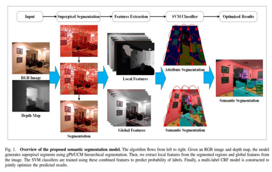
As shown in Fig.1, we introduce an approach that predicts multi-label. The proposed algorithm is performed in four parts:

•Superpixel segmentation ;

•Extraction of local features on regions and global features over scene;

•Training and learning parameters of the SVM classifier;

•Optimizing the predicted results by using a joint mutil-label CRF model



14:40–17:00	SuPOS.5

Structural Design and Performance Analysis for a Novel Wheel-Legged Rescue Robot

Zefeng Ma and Haibin Duan
School of Automation Science and Electrical Engineering, Beihang University, China

- A novel rescue robot with four-bar wheel-legged structure and other auxiliary structures is designed.
- Kinematics and mechanical property of the rescue robot are analyzed.
- The different motion modes are analyzed, which can make the robot achieve flexible movement.
- Experiment is conducted to prove the validity of the design for wheel-legged rescue robot.

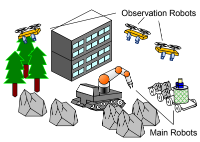

Wheel-legged rescue robot

14:40–17:00	SuPOS.6

Cooperative Multi-Robot Information Acquisition based on Distributed Robust Model Predictive Control

Shuhei Emoto
IHI Corporation, Japan
Ilge Akkaya and Edward A. Lee
EECS, UC Berkeley, USA

- A multi-robot system controlled by the robust model predictive control (MPC) is proposed.
- The proposed system can work under uncertain environments by carrying out information acquisition.
- This paper evaluates the system under various conditions on disturbance level and measurement range.
- Simulation results clarify the adequate number of robots and provide design guidelines about sensors.



Poster Session I

Chair *Chi Zhu, Maebashi Institute of Technology*
Co-Chair *Yong Yu, Kagoshima University*

14:40–17:00 SuPOS.7

A Fission Model for Analysing and Designing Omnidirectional Wheels

Jianhua Zhang, Shaokui Zhao, Xuan Liu,
Jinchang Liu and Minglu Zhang
Department of Mechanical Engineering, Hebei University of Technology, Tianjin
High Technology Research and Development Center of
the Ministry of Science and Technology, Beijing, China

- The wheel hub is abstracted as the base body in the model, and the disperse bodies are similar to rollers.
- The installation of rollers affects the DOF, velocity and driving force of omnidirectional wheels.
- The vibration, a main performance for the wheel, is decided by the arrangement and shape of rollers.

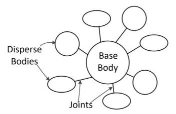


Figure Fission Model to Analyze Omnidirectional Wheels

14:40–17:00 SuPOS.8

Pilot Study of Single-Legged Walking Support using Wearable Robot based on Synchronization Control for Stroke Patients

Atsushi Tsukahara and Minoru Hashimoto
Dept. of Mechanical Engineering and Robotics,
Shinshu University, Japan

- Novel walking support using wearable robotic system curara® for stroke patients
- Curara supports their swinging motion of lower limb on one side based on synchronization control using neural oscillator
- We adopted the system to healthy person who simulates hemiplegia in preliminary walking test

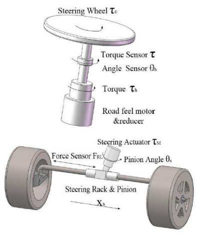
Wearable robot "curara®"

14:40–17:00 SuPOS.9

Adaptive Feedforward Control of the Steer-by-wire System Based on the Online Parameter Estimator

Mingming Zhang and Xiaodong Wu
Institute of Automotive Engineering, School of Mechanical Engineering,
Shanghai Jiao Tong University, China

- To get an accurate system model for steer-by-wire system, an online adaptive parameter estimator is proposed to realize parameter identification of the control model, based on the output error identification method.
- Meanwhile, the parameter gradient projection method is applied to eliminate the parameter drift, while a full order state observer is developed to weaken the effects of noise disturbance during the parameter identification.



Modeling and Control of Steer-by-wire System

14:40–17:00 SuPOS.10

Visual Predictive Control from Distance-based and Homography-based Features

Guoqiang Ye, Weiguang Li and Hao Wan
School of Mechanical and Automotive Engineering
South China University of Technology, China

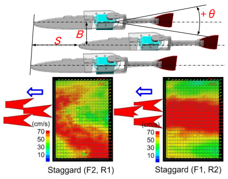
- A set of six independent visual features combining distance-based and Homography-based Features, is determined and the related feature Jacobian is calculated.
- Image based visual servoing (IBVS) is formulated into a constrained optimization problem by nonlinear model predictive control (NMPC) method. Visibility constraints, 3D velocities constraints and 3D task space constraints are all considered in the optimization problem.
- Simulations with a free-fly camera with respect to both planar and nonplanar objects have been provided to verify the significance of our proposed

14:40–17:00 SuPOS.11

Contracting Flow Pattern Induced by the Staggered Arrangement of Oscillating Fish-like Fin Propulsors

Kazunori Hosotani and Shota Ando
Dept. Integrated Science and Technology, NIT, Tsuyama College, Japan
Yoichi Ogata, and Souta Matsubara
Faculty of Engineering Mechanical system, Hiroshima University, Japan

- Flow pattern induced by these fish-like propulsors was measured using the 2D PIV technique.
- Staggered arrangements of twin/triple fin hulled propulsor achieved higher propulsion efficiency relative to the parallel arrangement.
- In particular, it was found that the triangular formation (F: 1, R: 2) in the triple-fin setting achieves the best propulsion performance.



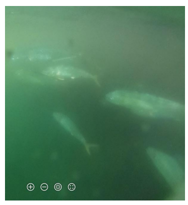
Averaged velocity distributions obtained by 2D PIV

14:40–17:00 SuPOS.12

Simple Underwater Monitoring of Shallow Water Using a Spherical Camera Mounted on a Radio-controlled Boat

Kazunori Hosotani
Dept. Integrated Science and Technology, NIT, Tsuyama College, Japan
Ryuichiro Nishi and Yoshihisa Tsurunari
Fac. Fisheries, Kagoshima University, Japan, Kagoshima Eng. College, Japan

- Effectiveness of a 360° camera mounted on a simple underwater monitoring equipment was evaluated through the demonstrative experiments conducted in an aquarium and in shallow coastal water.
- Even skewed images by refraction of the waterproof camera housing were obtained, the proposed simple correction method can assess underwater situations without focus control.



Clipped image of the 360° camera (Dolphin-fish)

Poster Session I

Chair *Chi Zhu, Maebashi Institute of Technology*
Co-Chair *Yong Yu, Kagoshima University*

14:40–17:00	SuPOS.13

Structural Impact Demodulation Method for Fault Diagnosis of Planetary Gear Box

Junshan Si, Xiaoxi Xu and Xianjiang Shi
Mechanical & Power Engineering College
Harbin University of Science and Technology
China

- The vibration response is more complex than the traditional fixed axis gear transmission, which is not conducive to the extraction and application of fault diagnosis characteristics.
- Amplitude demodulation of Hilbert transform for structural vibration shock.
- The method can get the characteristic frequency and frequency doubling of the planetary fault, and the fault characteristic frequency can also be used, for example, it can be a reference for fault diagnosis of wind power generator and other equipment.

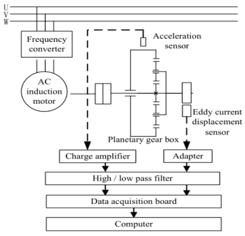


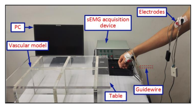
Diagram of test system

14:40–17:00	SuPOS.14

PCA-Based Muscle Selection for Interventional Manipulation Recognition

Xiao-Hu Zhou, Gui-Bin Bian and Zeng-Guang Hou*
The State Key Laboratory of Management and Control for Complex Systems, Institute of Automation, Chinese Academy of Sciences, China

- Principal component analysis (PCA) is used to select a sensitive and principal muscle subset.
- Surface electromyography (sEMG) of surgeons' hand and arm muscles is acquired for feature extraction.
- Six interventional manipulations are recognized with Back-Propagation (BP) neural network.
- The sensitive muscle subset with the recognition rate over 90% performs better than the insensitive one.



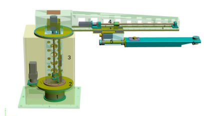
Experimental setup for interventional manipulation recognition

14:40–17:00	SuPOS.15

A Novel Kinematic Calibration Method for a Handling Robot Based on Optimal Trajectory Planning

Lei Ding, En Li, Zize Liang, Min Tan
Institute of Automation, Chinese Academy of Sciences, China

- This paper presents a novel kinematic calibration method of a 5-DOF handling robot based on optimal trajectory planning.
- The main idea lies on optimizing the trajectory of the handling robot for kinematic calibration.
- A low cost vision measurement system is designed with single camera and self-designed target.
- Two simulation experiments demonstrate the effectiveness and efficiency of the proposed method.



14:40–17:00	SuPOS.16

Study of human-like locomotion for humanoid robot based on Human Motion Capture Data

Daoxiong Gong, Jie Shao, Yuncheng Li, Guoyu Zuo
Beijing Key Lab of Computational Intelligence and Intelligent System
Beijing University of Technology, China

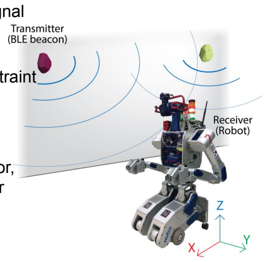
- analysis of the HMCD (Human Motion Capture Data)
- generate the motion patterns of human walking gait in the joint space
- ZMP is employed as a balance index to fine-tuning the motion of the humanoid

14:40–17:00	SuPOS.17

Low-Cost Indoor Positioning System using BLE (Bluetooth Low Energy) based Sensor Fusion with Constrained Extended Kalman Filter

Hyoin Bae, Jaesung Oh, KangKyu Lee, and Jun-Ho Oh
Korea Advanced Institute of Science and Technology (KAIST), Republic of Korea

- BLE (Bluetooth Low Energy) beacons' signal strength is used for the exteroceptive positioning sensor.
- Extended Kalman filter with equality constraint is used for the estimation framework.
- By relaxing the constraint, the positioning accuracy is increased.
- Optical flow sensors, magnetic field sensor, and rate gyro are also used for the sensor fusion algorithm.

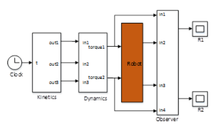


14:40–17:00	SuPOS.18

Sensorless Collision Detection and Contact Force Estimation Based on Torque Observer

Yingzhong Tian, Zhi Chen and Long Li
School of Mechatronic Engineering and Automation, Shanghai University, China
Tinggang Jia and Aiguo Wang
Shanghai Electric Group Co., Ltd, China

- This paper presented collision detection and contact force estimation methods without any extra sensors
- The proposed algorithm can eliminate the system model errors and identify the friction model parameters
- The results of simulation on MATLAB and ADAMS verified that the algorithm is valid and reliable



The simulation platform of ADAMS and MATLAB

Poster Session I

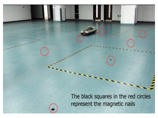
Chair *Chi Zhu, Maebashi Institute of Technology*
Co-Chair *Yong Yu, Kagoshima University*

14:40–17:00 SuPOS.19

A new method of AGV navigation based on Kalman Filter and a magnetic nail localization

Zhi Song
School of Optical and Electronic Information, Huazhong University of Science and Technology, China.
Xinyu Wu and Tiantian Xu
Guangdong Provincial Key Lab of Robotics and Intelligent System, Chinese Academy of Sciences, China

- Unmanned Automatic Guided Vehicle (AGV) is a critical part of advanced manufacturing system.
- The navigation method based on Kalman Filter and a magnetic nail localization.
- The magnetic nails localization method improves the navigation accuracy with low-cost.



The experiment area and the test vehicle

14:40–17:00 SuPOS.20

A Vessel Contour Detection and Estimation Method for Robot Assisted Endovascular Surgery

Li Wang[1,2], Dong-Jie Li[1], Xiao-Liang Xie[2], Gui-Bin Bian[2], and Zeng-Guang Hou[2]
[1]Automation Department, Harbin University Of Science And Technology, China
[2]State Key Laboratory of Management and Control for Complex Systems, Institute of Automation, Chinese Academy of Sciences, Beijing, China

- Vessel contous detetcion is a challenging task which palys an improtant role in PCI①.
- Mutiple Top-hat method can enhance **6** times for image SNR② effectively.
- Vessel contours are estimated with vessel contour detetcion results of adjacent frames.
- Our method achieves average accuracy of **92.6%**.

① PCI: Percutaneous Coronary Intervention;
② SNR: Signal to Noise Rate

Figure.1 Vessel enhancement (b) and contours detection (c).

14:40–17:00 SuPOS.21

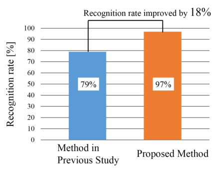
Laughing Voice Recognition Using Periodic Waveforms and Voice-likeness Features -- Toward Advanced Human-machine --

Taisuke Sakano, Takahiro Kigawa, and Hiroshi Mizoguchi
Mechanical Engineering, Tokyo University of Science, Japan
Masanori Sugimoto
Information Science and Technology, Hokkaido University, Japan
Fusako Kusunoki
Information Design, Tama Art University, Japan
Shigenori Inagaki
Human Development and Environment, Kobe University, Japan

•This paper proposes a laughing voice recognition method using periodic waveforms and voice-likeness features.

•To extract the voice-likeness the paper uses Mel-frequency cepstrum and higher-order local auto-correlation.

•In comparison with previous study, recognition rate of the proposed method improves by 18%.



14:40–17:00 SuPOS.22

Design of a Man-machine Interaction Robot Based on Visual Servo System

Yingzhong Tian, Zixiang Kong, Huijuan Hu and Long Li
School of Mechatronic Engineering and Automation, Shanghai University, China
Tinggang Jia
Shanghai Electric Group Co., Ltd, China
Aiguo Wang
Shanghai Electrical Apparatus Research Institute (Group) Co.,Ltd, China

- High-speed dynamic target acquisition and processing visual system
- A man-machine interaction robotic product
- Experiments proved that this system met the robots' requirements

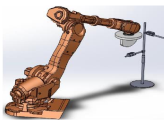
Three-dimensional model of the robot

14:40–17:00 SuPOS.23

Research on a Fast Measurement Equipment for Robot Repeatability

Yingzhong Tian, Liangchao Xu, and Long Li
School of Mechatronic Engineering and Automation, Shanghai University, China
Tinggang Jia
Shanghai Electric Group Co., Ltd, China
Aiguo Wang
Shanghai Electrical Apparatus Research Institute (Group) Co.,Ltd, China

- A portable measurement equipment and specially designed structure of reference block
- Sensors work in two directions instead of three
- It aims to calculate the target point's position in reference block to get repeatability



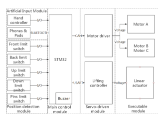
A Fast Measurement Equipment

14:40–17:00 SuPOS.24

Control System Design for Multi-Functional Bath Chair

Peng Zhang, Diansheng Chen, Linshan Zhao and Min Wang
School of Mechanical Engineering and Automation, Beihang University, China

- Realizes the functions, including lifting, posture adjusting and the armrest linkage
- Has the characteristics of strong logic and friendly human-computer interaction
- Make the bath safe and convenient



Control scheme

Poster Session I

Chair *Chi Zhu, Maebashi Institute of Technology*
Co-Chair *Yong Yu, Kagoshima University*

14:40–17:00 SuPOS.25

Design and Analysis of Underactuated Robotic Gripper with Adaptive Fingers for Objects Grasping Tasks

Bin Gao[12], Shuai Yang[12], Haiyang Jin[2], Ying Hu[2], Xiaojun Yang[12],Jianwei Zhang[3]
[1]Harbin Institute of Technology Shenzhen Graduate School, Guangdong, China
[2]Shenzhen Institutes of Advanced Technology, Chinese Academy of Sciences.
[3]University of Hamburg, Germany

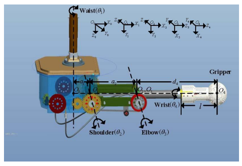
- The adaptive and underactuated mechanism without any driving system in the joints.
- We present the gripper design, grasping modes, performance evaluation and experiments of the underactuated hand.
- The results shows the self-adaptive and underactuated gripper can perform adaptive grasp.

14:40–17:00 SuPOS.26

Kinematics Analysis of an 4-DOF Underwater Manipulator Installed on the Vehicle

Yu Wang, Shuo Wang, Chao Zhou, and Min Tan
The State Key Laboratory of Management and Control for Complex Systems, Institute of Automation, Chinese Academy of Sciences, China

- The paper addresses kinematics analysis of a 4-DOF underwater manipulator, which can be installed on an Underwater Vehicle-Manipulator System (UVMS).
- First, the kinematic model of the manipulator is built. Next, the computation for the centers of weight and buoyancy is provided for the analysis of the coupling between the vehicle and the manipulator. Then the calibration including camera calibration and hand-eye calibration for its free-floating manipulation is introduced..

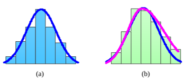


14:40–17:00 SuPOS.27

Non-Rigid Point Set Registration via Mixture of Asymmetric Gaussians with Integrated Local Structures

Mingliang Fu and Weijia Zhou
Shenyang Institute of Automation, Chinese Academy of Sciences, China

- A robust method for non-rigid point set registration
- A mixture of asymmetric Gaussian model (MoAG) is employed to capture spatially asymmetric distributions
- Local structures among adjacent points are integrated into the MoAG-based point set registration framework
- Expectation-Maximization (EM) algorithm is utilized to estimate parameters of the latent variable model



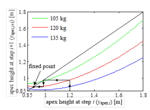
Fitting of univariate Gaussian (blue curve) and AG (violet curve) to data. (a) The histogram represents data obeys a normal distribution. (b) The histogram represents data obey an asymmetric distribution.

14:40–17:00 SuPOS.28

Influence of Leg Stiffness on Payload Capacity at High Speed

Runxiao Wang, Wentao Zhao, Shujun Li and Shunqi Zhang
School of Mechanical Engineering, Northwestern Polytechnical University, China

- Little research has focused on the relationship between leg compliance and payload capacity for fast running according to the SLIP model, the two-segment leg model with constant spring stiffness and with 'J'-curve spring stiffness (our model).
- In all three model our model shows the largest stability region in the high-payload case.
- For the same leg stiffness, our model can provide higher payload capacity for stable running compared with the other two models.



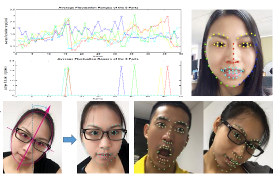
Return maps function $y_{i+1}(y_i)$ at different m in our model

14:40–17:00 SuPOS.29

Real-time Face Alignment Enhancement by Tracking

Fanyang Tang, Jianhua Zhang, Yujian Feng, Qiu Guan * and Xiaolong Zhou
College of Computer Science, Zhejiang University of Technology, Hangzhou, Zhejiang, China

- Enhance the stability of the feature points : Different limit ranges for different parts of the face.
- Alignment of the rolling face: Find the face angle by the face probability distribution.
- The certainty of the detected face: SVM is introduced to get the certainty of the detected face.



Feature points stability enhancement and Alignment of rolling faces

Monday, December 5th, 2016

Mobile Robotics V

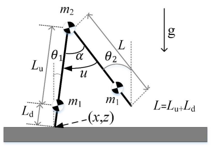
Chair *Xuan Xiao, Tsinghua University*
Co-Chair *Shuxiang Guo, Kagawa University*

14:10–14:25	MoC01.1

Analytical Solution of Target Walking Speed Generation by Underactuated Compass-like Bipedal Walker

Xuan Xiao[1] and Fumihiko Asano[2]
[1]Tsinghua University, Beijing, China
[2]Japan Advanced Institute of Science and Technology, Ishikawa, Japan

- The model of the underactuated CBW is proposed, and the gait properties are analysed by an approximate model.
- A feedback control system is designed for target speed generation through adjusting the parameters which are calculated by the approximate model.
- The approximate model is improved based on the system error analysis, and target walking speeds with 2% error are generated.



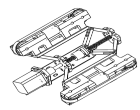
A planar underactuated compass-like bipedal walker (CBW)

14:25–14:40	MoC01.2

Motion Analysis and Verification of a Radial Adjustable Pipeline Robot

Lei Zhang
Department of Automation and Control, Ocean University of China, China
Xiao Wang
Qingdao Institute for Marine Technology of Tianjin University, China.

- This paper presents a design and stability analysis of a crawler-type pipeline robot
- The robot has the radial adjustment ability and can adapt to the changing of pipe diameter.
- To analysis the motion stability, the posture model of the robot is established, and some undesirable movements are analyzed
- Experiment results are consistent with the theoretical analysis, and the developed pipeline robot is suitable for the application of engineering pipe.



The model of pipeline robot

14:40–14:55	MoC01.3

A Tracking Method of an Omni-directional Assembling Mobile Robot

Changlong Ye, Xiduo Jiang, Suyang Yu, Chunying Jiang
School of Mechatronic Engineering, Shenyang Aerospace University, China

- Development a robot with omnidirectional mobility.
- Adapt to narrow environments and assembly operation.
- With Infrared self tracking and high precision alignment capability (0.1mm)
- With lifting, position and posture adjustment capacity (400kg).

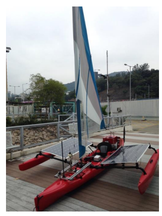
Robot prototype

14:55–15:10	MoC01.4

System Design and Control of a Sail-Based Autonomous Surface Vehicle

Tin Lun Lam[1], Huihuan Qian[2], Zhifeng[1] Wang, Hongjie Chen[1], Yu Li[1], Yangsheng Xu[2]
1. Smart China Research Institute, Hong Kong, China
2. The Chinese University of Hong Kong, Shenzhen, Guangdong, China

- Design of an autonomously surface vehicle (ASV) based on retrofitting a sail-propelled trimaran sailing boat
- Actuator and sail control modeling and simulation
- Trajectory control based on wind direction



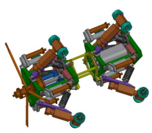
The sail-based ASV

15:10–15:25	MoC01.5

Effect of High Pressure Water Jet Cleaning Device on the Motion Stability of an In-pipe Cleaning Robot

Guanhua Feng and Tao Xue
Shenyang Ligong University, P.R. China
Zhigang Li, Zhen He, Yingbin Feng and Kaizhou Liu
Shenyang Institute of Automation, Chinese Academy of Sciences, P.R. China

- Structural design of a wheeled and wall-pressing type in-pipe cleaning robot
- Adopting the high pressure water jet cleaning technology
- Research on Multi-rigid-body dynamics of the proposed robot
- Simulations research of effect of jet device on motion stability of the proposed robot



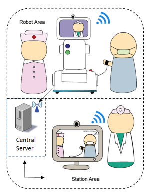
The proposed in-pipe cleaning robot

15:25–15:40	MoC01.6

Development of Differential Suspension Wheeled System for Telepresence Robot in Rural Hospital Area

Korn Borvornatanjanya, Pittawat Thiuthipsakul, Suwiphat Chalongwongse, Choladawan Moonjaita and Jackrit Suthakorn, Ph.D.
Department of Biomedical Engineering, Mahidol University, Thailand

- Design and development of telepresence robot platform based on hospital environment.
- System was evaluated by manual and self-autonomous control in uneven terrains.



System overview of Telemed Robot

Rehabilitation and Assistive Robotics I

Chair *Feng DUAN, Nankai University*
Co-Chair *Rongchuan Sun, Soochow University*

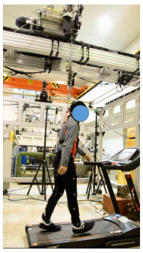
14:10–14:25 MoC02.1

A Novel Active Suspension Gravity Compensation System For Physically Simulating Human Walking In Microgravity

Sheng Xiang, Haibo Gao Zheng Liu, Haitao Yu and Zhongquan Deng

The State Key Laboratory of Robotics and System,
Harbin Institute of Technology, China

- A novel design and preliminary experiment of an active suspension gravity compensation system.
- The system can apply a desired constant vertical force at human body for physically simulating human walking in microgravity.
- The system composed of a passive static balancing mechanism to absorb high frequency impact and an active closed-loop controlled electric winch to provide the main compensation force.



14:25–14:40 MoC02.2

Deep Rehabilitation Gait Learning for Modeling Knee Joints of Lower-limb Exoskeleton

Du-Xin Liu

Center for Intelligent and Biomimetic Systems
Shenzhen Institutes of Advanced Technology (SIAT)
Chinese Academy of Sciences (CAS)

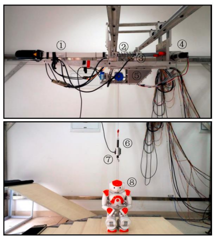
14:40–14:55 MoC02.3

Realization and Experimental Test of A Body Weight Support Unit for Simultaneous Position Tracking and Gravity Offloading

Zhuo Yang, Yubo Sun, Yuqi Lei, Zhe Wang, Wulin Zou, Ningbo Yu*

Institute of Robotics and Automatic Information Systems
Tianjin Key Laboratory of Intelligent Robotics
Nankai University, Tianjin 300353, China

- We are building an active body weight support system.
- A cable-driven series elastic actuator (SEA) was designed and realized to track the subject's motion and provide the supporting force simultaneously.
- Experiments with a NAO robot validated the feasibility and efficacy of our system and control methods.



14:55–15:10 MoC02.4

A Novel Upper Limb Training System Based on UR5 using sEMG and IMU Sensors

Zhenqiang Liu, Wennan Chang,
Shili Sheng, Liang Li and Feng Duan
Nankai University, China
Yew Guan Soo
Universiti Teknikal Malaysia Melaka, Malaysia
Che Fai Yeong
Universiti Teknologi Malaysia, Malaysia
Masato Odagaki
Maebashi Institute of Technology, Japan

- This system designed a system to manipulate robot arm applied for rehabilitations.
- Acquire upper limb motion data using IMU sensors.
- Acquire upper limb force data using MYO armband.
- Map the Relation between Upper Limb and UR5.
- Reconstruct movements of upper limb by controlling UR5 robot.

15:10–15:25 MoC02.5

Voluntary Motion Support by an Upper Limb Support System Based on Bioelectrical Signals for Heavy Overhead Tasks

Takehiro Fujita, Hiroaki Kawamoto, and Yoshiyuki Sankai
Graduate School of Systems and Information Engineering, University of Tsukuba, Japan

- We have developed a wearable upper limb support system (ULSS) for heavy overhead tasks
- We developed voluntary motion support algorithm of the system based on the bioelectrical signals
- The system supports the wearer in synchronization with the motor intention
- We confirmed that the system with the algorithm has the effectiveness for the task

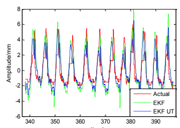
Overview of the ULSS

15:25–15:40 MoC02.6

UT Transform based Tumor Respiratory Motion Estimation and prediction for Radiosurgery Robot

Meng Dou, Shumei Yu*, Rongchuan Sun, Chuanyang Wang and Lining Sun
Robotics and Microsystems Center&Collaborative Innovation Center of Suzhou Nano Science and Technology, Soochow University, Suzhou,China

- A tumor location estimation framework based on extended kalman fiter is proposed for respiration tracking in radiosurgery robot.
- Traditional respiration motion correlation model is built using linear and polynial fitting.
- Respiratory motion correlation model based on UT is built to maintain the sensor noises of the model.
- Experiments have been done using open dataset and results proves the validity of our method.



Respiratory motion prediction results of patient 4

Robot Vision IV

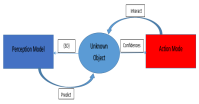
Chair *Haiyuan Wu, Wakayama University*
Co-Chair *Xueqian Wang, Tsinghua University*

14:10–14:25	MoC03.1

Interactive Perception based on Gaussian Process Classification for House-Hold objects Recognition & Sorting

Aamir Khan, Gerardo Aragon-Camarasaa, J. Paul Siebert
School of Computing Sciences, University of Glasgow, UK
Li Sun
Intelligent Robotics Lab, University of Birmingham, UK

- We present the first example of research to adapt non-parametric multi-class probabilistic classification (via Gaussian Processes) to the house hold object recognition problem.
- We demonstrate that the proposed GP-IPM(Gaussian Process based Interactive Perception Model) approach applied to a semi autonomous sorting task yields substantially improved performance over non-interactive alternatives.



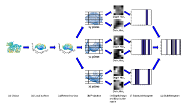
Interactive Perception Model

14:25–14:40	MoC03.2

BRoPH: A Compact and Efficient Binary 3D Feature Descriptor

Zou Yu, Zhang Tao, Wang Xueqian and Song Jingyan
Department of Automation, Tsinghua University, China
He Ying
Shenzhen Graduate School, Harbin Institute of Technology, China

- Proposed a binary 3D feature descriptor, BRoPH
- Turn the binary 3D description into a series of binarization of projected 2D image patches
- Outperform the state-of-the-art 3D feature descriptors in terms of compactness and efficiency
- Applicable for applications with strict limits on the computational complexity and storage requirement



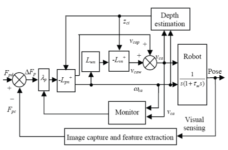
BRoPH Flowchart

14:40–14:55	MoC03.3

A New Image-Based Visual Servoing Method with Rotational Compensation

D. Xu, J. Lu, P. Wang, Z. Zhang, D. Zhang, Z. Liang
Institute of Automation, Chinese Academy of Sciences, Beijing 100190, China

- The orientation control is directly realized with point features and interaction matrix
- The corresponding translations resulting from rotational motions are introduced into the position control as compensation
- The linear and angular velocities are limited to the given ranges in order to ensure the objects being kept in the camera's field of view



The proposed image-based visual servoing system

14:55–15:10	MoC03.4

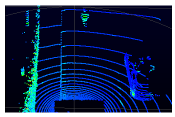
Pedestrian Detection and Localization Using 3D Range Data

Bin Li, Jiadong Shi, Minghe Cao, Rongkai Zhang and Jianzhong Wang
School of Mechatronical Engineering, Beijing Institute of Technology, China

•Three dimensional information is converted into two dimensional information

•Matching with motion detection and human model

•Multiple sample model to improve the accuracy of detection

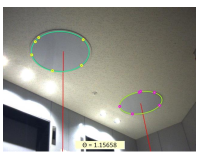


15:10–15:25	MoC03.5

Detection of co-planar circle pair of same radius from a single image

Mizokami Naoki, Haiyuan Wu, Qian Chen, Kazumasa Suzuki
Faculty of Systems Engineering, Wakayama University. Japan
Ryuuki Sakamoto
Yahoo Japan Corp.

- An unique method for detecting:
  two parallel circles of the same radius.
- RANSAC in wide angle range for detecting ellipses in cluttered images.
- Three constraint conditions for selecting parallel circles.
- The experimental results showed the effectiveness of our algorithm



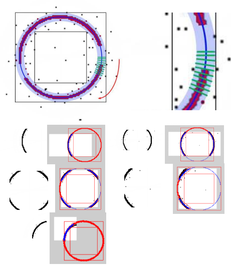
Correctly detected parallel circles and the normal vectors

15:25–15:40	MoC03.6

Scanning Line Based Random Sample Consensus Algorithm for Fast Arc Detection

Xiaoyu Song[1], *Ting Jing*[1], *Shuai Yuan*[1], *Song Guo*[1], *Yuxin Li*[1]
[1] Shenyang Jianzhu University. Shenyang, 110168, China

- To avoid invalid calculation of far black pixels away from hypothetical circle, this algorithm proposed the conception of rectangular region and annular region. To reduce calculation amount and accelerate detecting speed, a threshold T is obtained as the ratio of the amount of the black pixels in separately the annular region and the rectangular region to identify if the hypothetical circle lies in the correct area.
- Two groups of equal amount black pixels are chosen along both outer and inner borders of the rectangular regions that are equally distributed. These pixels are called interval pixels. Scanning lines are generated by joining every two corresponding interval points on the outer and inner borders of the regions with DDA.



Multi-Robot Systems

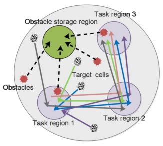
Chair *Xian GUO, Nankai University*
Co-Chair *Solvi Arnold, Shinshu Univeristy*

16:00–16:15 MoD01.1

Robot-Aided Biological Cell Transport and Obstacle Removal for Multiple Operation Steps

Hao Yang and Dong Sun
Department of Mechanical and Biomedical Engineering,
City University of Hong Kong, Hong Kong
Hao Yang and Xiangpeng Li
Robotics and Microsystems Center, Soochow University, China

- An automated cell transportation approach toward **multistep** cell operation processes is reported.
- A control system is developed based on a robot-aided **optical tweezers** manipulation platform.
- A group of target cells can be sequentially and continuously transferred to **different task regions** without interruption.
- **Collision** is avoided and the suspended **obstacles** are removed automatically.



Automated transport of multiple cells to different task regions sequentially integrated with obstacle removal

16:15–16:30 MoD01.2

Robot's Energy Consumption Based Multi-Robot Exploration Strategy

Abdenour Benkrid and Noura Achour
LRPE Laboratory, USTHB University , Algeria
Abdelaziz Benallegue
LISV Laboratory, Versailles University, France

- The paper addresses the problem of exploring an unknown environment with a team of mobile robots.
- We present a decentralized coordination approach that takes into account the structure of the explored environment and the energy consumption of each robot.
- The exploration target for each robot is defined as the segment of the environment including the frontiers between the unknown and the explored areas.
- Each robot is assigned to the segment for which it has the lowest rank in term of energy consumption to reach the exploration target.

16:30–16:45 MoD01.3

Sequence-modification Based Collision-free Motion Planning of Multiple Robots Workcell

Hongmin Wu, Huajian Deng, Longxin Chen, Yisheng Guan and Hong Zhang
School of Mechanical and Electrical Engineering
Guangdong University of Technology, China

- This work is inspired by the problem of planning multiple robots in a shared workspace. The goal is to find out a sequence order for coordinating the paths of robots so as to avoid conflicts among them and deadlocks;
- Path planning for manipulator that only consider avoiding collision with static obstacles and calculate the all possible colliding states;
- Translate the multiple robots conflict-free problem into path segments sequence planning problem

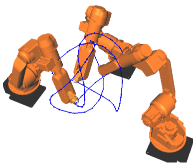


Fig. Conflict-free of multiple robots in a shared workspace

16:45–17:00 MoD01.4

An Improved Bacterial Foraging Algorithm with Cooperative Learning for Eradicating Cancer Cells Using Nanorobots

Jinge Cao, Min Li and Hanqing Wang
School of Mechatronic Engineering and Automation
Shanghai University, China

- This paper presents an Improved Bacterial Foraging Optimization Algorithm (IBFOA) with cooperative learning.
- The algorithm is used to reach and eradicate cancer cells in a blood vessel by cooperation.
- Compared with BFOA, IBFOA achieves increases in the efficiency and leads to better performance.
- The feasibility and availability of the proposed IBFOA have been verified by simulation results.

Performance of nanorobots using IBFOA to eradicate cancer cells

17:00–17:15 MoD01.5

Integrated Cooperative Control Scheme for Multiple Quadrotors Based on Improved Adaptive Disturbance Rejection Control

Han Du, Zhiqiang Pu, and Jianqiang Yi
Institute of Automation, Chinese Academy of Sciences, China

- Taking tracking errors and communication delay into multi-quadrotors formation modeling
- Extended State Observer(ESO) is constructed to reject the formation control disturbances
- The improved ADRC is constructed to cope with the communication time delay
- The formation of three quadrotors maintains well and switches smoothly during simulations.

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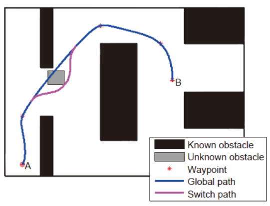
17:15–17:30 MoD01.6

Path Planning for the Mobile Robots in the Environment with Unknown Obstacles

Lishuang zhang, Lei Sun, Lu Zhou, Xuebo Zhang and Jingtai Liu
Institute of Robotics and Automatic Information System, Nankai University, Tianjin, 300071

- A method on path planning for mobile robots in the environment with some unknown obstacles;
- Global path planning with known environmental information;
- Threat assessment with sensors' information;
- Switch-path generation to bypass the obstacle.



A switch-path is generated to bypass the unknown obstacle.

Rehabilitation and Assistive Robotics II

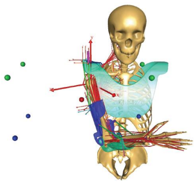
Chair *Jian Huang, Kindai Universoty*
Co-Chair *Qining Wang, Peking University*

16:00–16:15 MoD02.1

Design Optimization on Passive Exoskeletons through Musculoskeletal Model Simulation

Lelai Zhou and Yibin Li
School of Control Science and Engineering, Shandong University, China

- An approach of designing robotic exoskeletons on the basis of simulation a musculoskeletal model is proposed
- An exoskeleton model is integrated with the musculoskeletal model to evaluate design parameters
- Optimization method is adopted to determine optimal design parameters and performance of the exoskeleton.



A passive exoskeleton

16:15–16:30 MoD02.2

Passive Velocity Field Control with Discontinuous Desired Velocity Fields

Tomohiro KUNIMUNE, Yoshiro FUKUI and Takahiro WADA
College of Information Science and Engineering, Ritsumeikan University, Japan

- We propose extended PVFC with a discontinuous velocity field V.
- We can expect that
  - the proposed controller is a velocity field control
  - a closed loop system with the controller satisfies passivity.

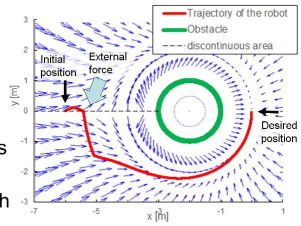


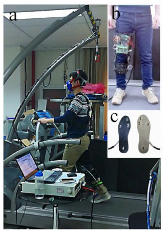
Fig. Obstacle avoidance of a holonomic mobile robot

16:30–16:45 MoD02.3

Preliminary Evaluation of Gait Assistance During Treadmill Walking with A Light-weight Bionic Knee Exoskeleton

Zhihao Zhou, Yang Liao, Chaoran Wang and Qining Wang*
College of Engineering, Peking University, China
*E-mail: qiningwang@pku.edu.cn

- In this paper, we present the preliminary evaluation of gait assistance during treadmill walking with a powered bionic knee exoskeleton (BioKEX) which is intended for gait rehabilitation of patients with knee joint movement disorder.
- The BioKEX system provides knee joint assistance for gait requirement, but not increases metabolic cost in spite of an extra weight (exoskeleton weight) on human.



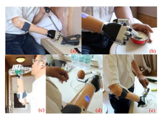
Treadmill walking with the BioKEX

16:45–17:00 MoD02.4

A Prosthetic Arm Based on EMG Pattern Recognition

Ke Xu, Weichao Guo, Lei Hua, Xinjun Sheng* and Xiangyang Zhu
State Key Laboratory of Mechanical System and Vibration,
Shanghai Jiao Tong University, China

- A pattern recognition based prosthetic arm capable of varying function is designed and implemented
- On board training and real time classification are achieved in an embedded system to drive a 5-finger anthropomorphic prosthetic hand
- This study has the potential for promoting the practical application of EMG pattern recognition based prosthetic arms



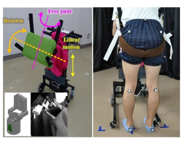
Clinical application of the prosthetic arm

17:00–17:15 MoD02.5

Evaluating the Assistance Effectiveness of a Newly Developed Rollator Mounted with a Freely Rotating Chest Support Pad

Jian Huang and Noriho Koyachi
Department of Robotics, Faculty of Engeering, Kindai University, Japan

- The freely rotating mechanism will beneficially assist walking.
- A rotary sensor was used to obtain the rotation angle of the chest pad.
- Measurements were performed for five young subjects using a motion capture system
- The effectiveness of walking assistance of the proposed rollator is also highlighted by the results of the relationship between rotation of the chest pad and other factors,



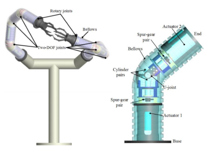
The developed rollator mounted with a freely rotating chest pad

17:15–17:30 MoD02.6

Design and Analysis of a Bionic Two-DOF Joint for Dual-Arm

He Huang, Erbao Dong*, Lin Zhou, Min Xu and Jie Yang
Department of Precision Machinery and Precision Instrumentation, University of Science and Technology of China, China

- A bionic two-DOF joint was presented for dual-arm manipulators to mimic the motion of human arm joints.
- Two special motion modes were presented to express the motion of the proposed mechanism.
- Simulations had been implemented to verify the higher performance in contrast to the general two-DOF joint.



3D drawing of the dual-arm manipulator and two-DOF joint

Actuators

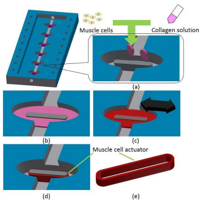
Chair *Koh Hosoda, Osaka University*
Co-Chair *Zhongkui Wang, Ritsumeikan University*

16:00–16:15	MoD03.1

Aligning Collagen Fibers by Cyclic Mechanical Stretch for Efficiently Muscle Cell Actuator

Keiji Seki and Masahiro Shimizu and Koh Hosoda
Graduate School of Engineering Science,Osaka University, Japan
Kota Miyasaka and Toshihiko Ogura
Department of Developmental Neurobiology, Institute of Development, Aging and Cancer(IDAC), TohokuUniversity, Japan

- Muscle cells adhere to collagen fiber and contract in muscle cell actuators.
- We align collagen fibers in muscle cell actuators for higher contraction force.
- We develop the automatic culture system which apply cyclic stretch to muscle cell actuators.



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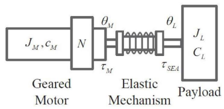
16:15–16:30	MoD03.2

Position Control of Series Elastic Actuator Based on Feedback Linearization and RISE Method

Wei Yin and Lei Sun
Institute of Robotics & Automatic Information System, Nankai University, China

- Series Elastic Actuator
- Position Control
- Feedback Linearization
- Robust Integral of Sign of Error



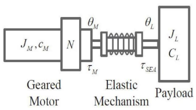
Schematic representation of the SEA system

16:30–16:45	MoD03.3

An Integral Sliding-Mode Control Approach for Series Elastic Actuator Torque Control

Weichao Sun and Lei Sun
Institute of Robotics & Automatic Information System, Nankai University, China

- Series elastic actuator
- Force control
- Integral sliding-mode control
- Human-robot interaction



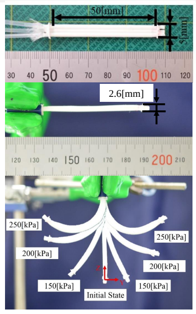
Schematic representation of the SEA system

16:45–17:00	MoD03.4

Development of thin pneumatic rubber actuator generating 3-DOF motion

Yu Toyama, Shuichi Wakimoto,
Okayama University, Japan

- The thin pneumatic soft actuator with 3-DOF motion is developed using three small McKibben artificial muscles.
- The actuator is 50 [mm] in length , 5 [mm] in width and 2.6 [mm] in thickness.
- The actuator can contract in the longitudinal direction and bend in several directions.

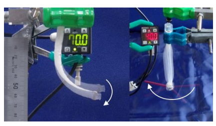


17:00–17:15	MoD03.5

Proposal of Pneumatic Rubber Muscles with Shape-Memory Polymer reinforcement fibers realizing desirable motion

Satoshi Maeda and Shuichi Wakimoto
Graduate School of Natural Science and Technology, Okayama Univ., Japan
Shigeyoshi Yahara
Faculty of Engineering, Okayama Univ., Japan

- SMP fibers are embedded in straight fiber type and McKibben type artificial muscles.
- SMP fibers work as reinforcement material and contribute to forming desirable initial shape of artificial muscles.
- These artificial muscles show the high potential to generate required additional motions by changing initial shape.



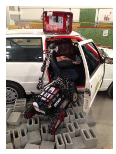
Driving motion of the artificial muscles using SMP fibers

17:15–17:30	MoD03.6

Battery Management for Rescue Robot Operation

Preedipat Sattayasoonthorn and Jackrit Suthakorn
Department of Biomedical Engineering and
Center for Biomedical and Robotics Technology, Faculty of Engineering, Mahidol University, THAILAND

- In a real-time rescue robot operation, the operator must avoid any mistakes during a mission.
- Effective robot operation requires the robot is supplied with the sufficient power for the entire duration of a mission.
- Our experience and knowledge is summarized into the topics of power consumption, battery selection, battery charging/ discharging and battery maintenance.



BART LAB rescue robot (Tele-Op IV) reaching the victim at red zone in World RoboCup 2014, Brazil.

Poster Session II

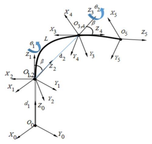
Chair *Yong Yu, Kagoshima University*
Co-Chair *Chi Zhu, Maebashi Institute of Technology*

14:40–17:00	MoPOS.1

Kinematic Analysis of the Catheter used in the Robot-assisted Catheter Operating System for Vascular Interventional Surgery

Shuxiang Guo
Intelligent Mechanical Systems Engineering Department Faculty of Engineering, Kagawa University, Japan
Wenxuan Du, Jian Guo* and Yang Yu
College of Automation, Tianjin University of Technology, Tianjin

- We analyzed the kinematics performance of the catheter tip, and obtained the movement rule
- We used the movement rule to control the position changes of the catheter
- Modeling approach was suitable for controlling catheter position and reducing the position error



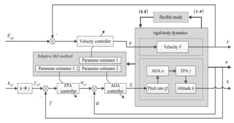
The kinematic model of catheter

14:40–17:00	MoPOS.2

Adaptive Immersion and Invariance Continuous Finite-time Control of Hypersonic Vehicles

Chao Han, Zhen Liu, Xiangmin Tan and Jianqiang Yi
Institute of Automation Chinese Academy of Sciences, Beijing, China

- Adaptive I&I continuous finite-time control for second-order nonlinear system
- Decompose the longitudinal model of AHV into three subsystems from control viewpoint
- Adaptive I&I continuous finite-time controller is designed for each subsystem
- Simulations shows the control system is characterized by fast tracking performance and strong robustness



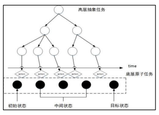
The Block Diagram of the Control System for AHV

14:40–17:00	MoPOS.3

Research on Automatic Decision Making of UAV Based on Plan Goal Graph

Dong Wang , Wei Zu and Hongxing Chang
Integrated Information System Research center, Chinese Academy of Sciences, China
Jie Zhang
Chengdu Aircraft Design and Research Insitute, China

- Aiming at the problem of UAV automatic decision making in air combat
- An algorithm based on Goal Graph Plan is proposed to solve the knowledge modeling in tactical decision making
- The heuristic knowledge in the field of air combat rules was introduced to help UAV make the reasonable maneuvering decision



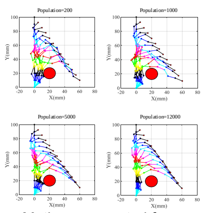
PGG State Change

14:40–17:00	MoPOS.4

Motion Planning of Hyper-Redundant Manipulators Based on Ant Colony Optimization

Jingdong Zhao, Liangliang Zhao and Hong Liu
State Key Laboratory of Robotics and System,
Harbin Institute of Technology, China

- Describe the structure of the hyper-redundant manipulator, and establish the kinematics equation.
- Write programs to calculate the optimization solution path, and generate a number of random paths.
- Introduces the strategy of collision checking.
- Implement the path selecting of the manipulator, and present the simulation results of motion planning experiment.



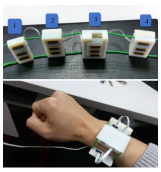
Motions generated for a 10 DOF manipulator.

14:40–17:00	MoPOS.5

Development of a real-time hand gesture recognition wristband based on sEMG and IMU sensing

Shuo Jiang, Bo Lv, Xinjun Sheng and Peter B. Shull
School of Mechanical Engineering, Shanghai Jiao Tong University, China
Chao Zhang and Haitao Wang
Samsung R&D Institute, China

- Hardware: EMG sensors and IMU; blue tooth for data transmission; data processing and algorithm running on PC
- Use LDA algorithm for classification
- Ten subjects took part in the experiment to validate this system
- Can classify 8 air gestures with average accuracy of 92.6% and 88.8% for 4 surface gestures with two different force levels



Gesture Recognition Wristband Prototype

14:40–17:00	MoPOS.6

A Proximity Touch Screen Using Mutual Capacitance Measurement

Satoshi Tsuji and Teruhiko Kohama
Department of Electrical Engineering, Fukuoka University

- We proposed a proximity touch screen that uses separation-type electrodes with mutual capacitance measurement to improve functionality.
- In this paper, we describe a prototype proposed proximity touch screen using indium tin oxide (ITO) electrodes.
- The prototype touch screen detects an object and its position before contact (within the proximity range).
- We think that the proposed proximity touch screen will be a functional and useful interface.

Poster Session II

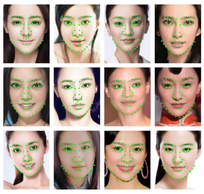
Chair *Yong Yu, Kagoshima University*
Co-Chair *Chi Zhu, Maebashi Institute of Technology*

14:40–17:00	MoPOS.7

A New Face Mesh Model based on Edge Attractor and Nonlinear Global Topological Constraints

Chen Dongyue and Luo Ziyi
College Of Information Science and Engineering, Northeastern University, Shenyang
Jia Tong
College Of Information Science and Engineering, Northeastern University, Shenyang

- This paper provides a new kind of excellent face mesh model in face feature description.
- We detect eyes and mouth and initialize face mesh based on the detected region.
- We use an iterative optimization based on Edge Attractor and Nonlinear Global Topological Constraints.



14:40–17:00	MoPOS.8

Recent Advances on Application of Deep Learning for Recovering Object Pose

Wanyi Li, Yongkang Luo, Peng Wang, Zhengke Qin, Hong Qiao
Institute of Automation, Chinese Academy of Sciences, China
Hai Zhou
Research Center of Laser Fusion, China Academy of Engineering Physics, China

- Some popular datasets for pose estimation together with their relevant attributes are introduced
- The deep learning based pose estimation methods with pros and cons are categorized and summarized
- Evaluation protocol and comparable performance of reviewed approaches are given
- We highlight the advantages of the surveyed methods and provide insights for future

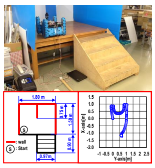
14:40–17:00	MoPOS.9

Development of an Autonomous Rescue Robot:

Achievement of Obstacle Avoidance and Stair Descent Using IMU Controls

Kouta Suzuki, Norihiro Suzuki and Yoshiaki Yamazaki
Department of Mechanical Engineering, Meisei University, Japan

- We developed a search-and-rescue robot to locate people in buildings following an earthquake disaster.
- An autonomous descending of the slope and stairs has achieved by the acceleration sensor feedback; that were not achieved in the previous report.
- Using the improved 3D scanning devices, the angle of the slope and stairs could be estimated within 20% error in the least-squares method.
- We proposed an algorithms which combining the acceleration feedback and the obstacle avoidance using SRLF, these were verified experimentally.



The autonomous moving test in a place that was surrounded by a wall and descending stairs

14:40–17:00	MoPOS.10

Point-Plane SLAM Based on Line-Based Plane Segmentation Approach

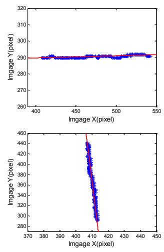
Lizhi Zhang,, Beihang University
Diansheng Chen, Beihang University
Weihui Liu, Beihang University

14:40–17:00	MoPOS.11

Automated Axis Alignment for a Nano Manipulator inside SEM

Chao Zhou, Zhengxing Wu, Yu Wang*, Zhiqiang Cao, Lu Deng, Min Tan
The State Key Laboratory of Management and Control for Complex Systems, Institute of Automation, Chinese Academy of Sciences, China

- An automated axis alignment method is proposed for a nano manipulator inside the SEM by recognizing the position of a closed-loop controlled the end-effector.
- The method in this paper can accelerate the process of axis alignment to avoid the electron beam induced deposition effect on the end tips.
- Experiment demonstration shows it can achieve a 0.1degree precision in 90seconds.

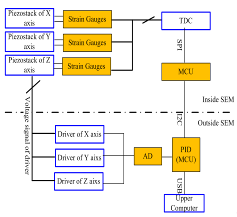


14:40–17:00	MoPOS.12

A TDC-Based nano-scale displacement measure method inside Scanning Electron Microscopes

Chao Zhou, Yu Wang, Lu Deng, Zhengxing Wu*, Zhiqiang Cao, Shuo Wang, Min Tan
The State Key Laboratory of Management and Control for Complex Systems, Institute of Automation, Chinese Academy of Sciences, China

- This paper focused on the end effectors measurement for a nano-manipulation robot, which is working in the scanning electron microscope's vacuum chamber.
- A standard capacitor are charged and discharged through the strain gauge, and the time are measured by time-digital convertor, which can be used to calculate the displacement.
- The power consumption is greatly reduced while the error is optimized.



Poster Session II

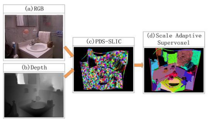
Chair *Yong Yu, Kagoshima University*
Co-Chair *Chi Zhu, Maebashi Institute of Technology*

14:40–17:00	MoPOS.13

Scale Adaptive Supervoxel Segmentation of RGB-D Image

Peng Xu, Jie Li, Juan Yue and Xia Yuan
School of Computer Science and Engineering,
Nanjing University of Science and Technology, China

- Firstly, we use Poisson disk sampling based SLIC (PDS-SLIC) to produce evenly distributed and regularly shaped supervoxels of uniform size.
- Secondly, we construct a neighborhood graph over supervoxels.
- Lastly, merging the supevoxels using an adaptive threshold based on the degree of variability in neighboring regions.



14:40–17:00	MoPOS.14

Kinematic Analysis and Its Applications of a Novel Spherical Parallel Manipulator

Tongchen Zhang, Bin Li, Daxing Wang, Linkai Ma and Xinhua Zhao
Tianjin Key Laboratory for Advanced Mechatronic System Design and Intelligent Control, Tianjin University of Technology, China

- A novel spherical parallel manipulator, named Riflex, is presented.
- The inverse and forward kinematic problem analyses of the mechanism are solved.
- The potential applications of the mechanism are addressed.
- A novel type multi-section continuum robot is designed based on Riflex SPM.
- Some numerical examples are presented.

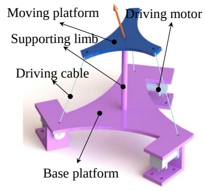


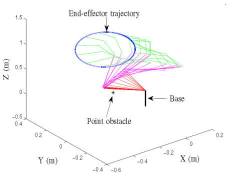
Figure 1. CAD model of Riflex SPM

14:40–17:00	MoPOS.15

Acceleration-Level Obstacle-Avoidance Scheme for Motion Planning of Redundant Robot Manipulators

Dongsheng Guo[1] and Kene Li[2]
[1]College of Information Science and Engineering, Huaqiao University, China
[2]School of Electrical and Information Engineering, Guangxi University of Science and Technology, China

- An acceleration-level inequality constraint is presented and investigated to achieve the obstacle-avoidance purpose
- The algorithmic detail of such a constraint is also provided in the paper
- The acceleration-level obstacle-avoidance scheme is developed for motion planning of redundant robot manipulators
- Simulation results substantiate the efficacy of the presented obstacle-avoidance scheme



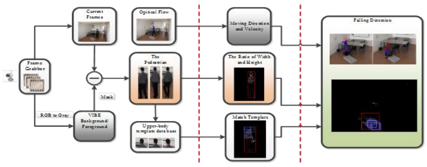
Point Obstacle Avoidance

14:40–17:00	MoPOS.16

A Novel Multi-cue Integration System for Efficient Human Fall Detection

Xue Wang, Hong Liu, Mengyuan Liu
Key Laboratory of Machine Perception, Shenzhen Graduate School, Peking University, China

- Build the background and extract foregrounds.
- Detect the contours and build an upper-body template data base.
- A multi-cue integration detection based on optical flow and template matching.

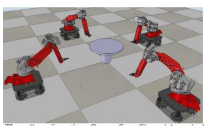


14:40–17:00	MoPOS.17

Task-oriented decentralized adaptive control of cooperative manipulators

Alessandro Marino and Pasquale Chiacchio
Department of Information Eng., Electrical Eng. and Applied Mathematics, University of Salerno, Italy

- A distributed architecture for cooperative control of Euler-Lagrangian systems is devised
- The task depends on the full state of the system
- An observer is devised to estimate the full state of the system
- The estimate is used to compute the local control law for each manipulator
- An adaptive control is used to counteract dynamic uncertainties



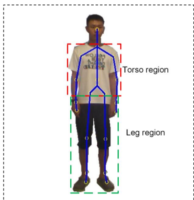
Cooperative setup

14:40–17:00	MoPOS.18

Human Recognition for Following Robots with a Kinect Sensor

Shiying Sun, Ning An, Xiaoguang Zhao and Min Tan
The State Key Laboratory of Management and Control for Complex Systems, Institute of Automation, Chinese Academy of Sciences, China

- A human recognition method based on soft biometrics for the human following robot
- Two soft biometric traits (clothes color and body size) are calculated as features of the human
- Color feature is extracted by segmented regions and body size is calculated by the skeleton
- The proposed method is implemented on the human following robot



Segmented regions and skeletons

Poster Session II

Chair *Yong Yu, Kagoshima University*
Co-Chair *Chi Zhu, Maebashi Institute of Technology*

14:40–17:00 MoPOS.19

An Speech and Face Fusion Recognition Method Based on Fuzzy Integral

Binxiang Tong and Yong Liu
School of Computer Science and Engineering,
Nanjing University of Science and Technology, China

- •Speaker recognition and face recogniton
- •Single modal matching score and acceptance rate
- •Audio-visual information fusion based on fuzzy measure and fuzzy integral

Modality	Error	Recognition rate (%)
Speech (K=32)	21	94.75
Face (N=10)	27	93.25
Fusion	11	97.25

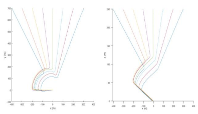
Comparion of multiple and single feature

14:40–17:00 MoPOS.20

Multi-phase Homing Optimal Control for Parafoil System

Liying Yang, Xiaoguang Zhao, Feng Gu, Yuqing He
Shenyang Institute of Automation Chinese Academy of Sciences, China

- Optimal control method for parafoil system homing planning
- Bezier curves based path planning for parafoil terminal guidance
- L1 nonlinear algorithm is adopted to make trajectory tracking
- Optimal homing path calculation using genetic algorithm(GA)



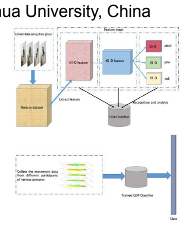
Simulation of Multi-phase homing

14:40–17:00 MoPOS.21

Gesture Recognition Using Data Glove: An Extreme Learning Machine Method

Danling Lu and Yuanlong Yu
Mathematics and Computer Science, Fuzhou University, China
Huaping Liu
Computer Science and Technology, Tsinghua University, China

- (1) Extract 54-dimensional features from a novel low-cost data glove, and analyses which features play an important role in classification.
- (2) In this work, we prefer to choose ELM as a machine learning algorithm based on gesture recognition.
- (3) We collect data of static gestures and establish a gesture dataset which includes 10 kinds of static gestures.



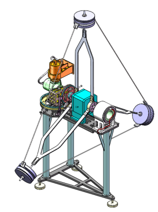
Architecture of the gesture recognition based on data glove using ELM.

14:40–17:00 MoPOS.22

An Optimal Structure Design of Artificial Load Based On Certain Frequency

Guoyong Yang, Hongguang Wang, Yong Jiang, Yong Chang, Zuowei Wang
State Key Laboratory of Robotics, Shenyang Institute of Automation, Chinese Academy of Sciences, Shenyang, China
University of Chinese Academy of Sciences, Beijing, China

- An air bearing gravity unloading facility for the antenna pointing mechanism (APM) is presented to simulate micro-gravity environment.
- An artificial load for the APM is presented to simulate the inertia, mass and frequency
- This structure design solves the inertia coupling problem of two axes and fits the given frequency.
- The design method is summarized and it is suitable for multi-target structure design based on certain frequency.

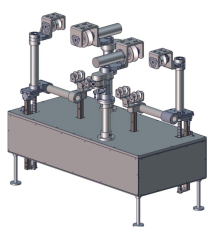


14:40–17:00 MoPOS.23

Research on a Novel Bionic Robot Mechanism for Power Transmission Lines Inspection

Shiyu Xiao, Hongguang Wang
Shenyang Institute of Automation, Chinese Academy of Sciences, China

- A novel bionic inspection robot with robust maneuverability, great grade-ability and good obstacle-negotiate-ing performance is introduced.
- The robot mechanism are described in detail. And the obstacle negotia-tion process is analyzed.
- Finally, some simulations are carried out and the results prove that the robot can work well and accomplish the inspetion task on the power transmission line.



The novel bionic inspection robot

14:40–17:00 MoPOS.24

The Multi-robot Task Planning based on Improved GA with Elite Set Strategy

Yiqun Bao, Huaiyu Wu, Yang Chen
School of Information Science and Engineering, Wuhan University of Science and Technology, China

- An improved GA is proposed to study the MRS task planning of the similar Multiple Traveling Salesman Problem.
- The completion time and overall routes are optimized by the tunable optimization objectives.
- A n elite set strategy with swapping, sliding and flipping operations is applied to accelerate the convergence and increase the diversity.

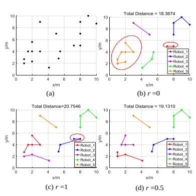


Figure 1. Optimal planning results based on different optimization mechanisms

Poster Session II

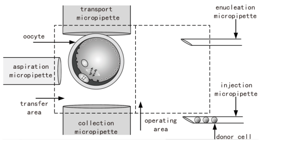
Chair *Yong Yu, Kagoshima University*
Co-Chair *Chi Zhu, Maebashi Institute of Technology*

14:40–17:00	MoPOS.25

Pipelined Batch-operation Process of Nuclear Transplantation Based on Micro-Manipulation System

Xuefeng Wang,Na Li,Yaowei Liu,Mingzhu Sun and Xin Zhao
Institute of Robotics and Automatic Information System (IRAIS)
and the Tianjin Key Laboratory of Intelligent Robotic (tjKLIR),
Nankai University, Tianjin, China

- Nuclear Transplantation
- Micro-manipulation system
- Computer vision



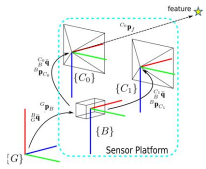
Micropipette distribution

14:40–17:00	MoPOS.26

Stereo-Inertial Pose Estimation and Online Sensors Extrinsic Calibration

Fumin Pang and Tianmiao Wang
School of Mechanical Engineering and Automation, Beihang University, China

- Accurate 6DOF pose estimation in unknown environment is a critical task in autonomous navigation.
- A stereo-inertial VIO based on Multi-State Constraint Kalman Filter (MSCKF).
- Online extrinsic calibration of sensors is included to improve the performance.
- The proposed method attains substantially higher accuracy than monocular MSCKF.



Stereo-Inertial sensor platform and visual feature

14:40–17:00	MoPOS.27

Monocular Visual Object-Localization Using Natural Corners for Assembly Tasks

Jingchen Gu, Hesheng Wang and Weidong Chen
Department of Automation, Shanghai Jiao Tong University, China
Ruimin Wu
R&D Center, Baoshan Iron & Steel Co. Ltd, China

- Use only monocular camera in the eye-in-hand system to plug in Net interfaces
- Use SURF detection and matching for initial localization
- Use probability based natural right angle corner detection for pose estimation
- Deal with targets of different scales and rotations

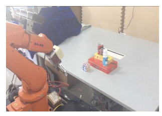

Camera view of eye-in-hand system

14:40–17:00	MoPOS.28

A Novel Occlusion-free Active Recognition Algorithm for Objects in Clutter

Duofan Jiang, Hesheng Wang, Weidong Chen
Department of Automation, Shanghai Jiao Tong University, China
Ruimin Wu
R&D Center, Baoshan Iron & Sdteel Co. Ltd

- A new active recognition algorithm based on object re-placing
- We analyze the visual occlusion relationships among objects in the scene.
- A fast object recognition system combining different algorithms

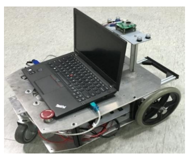


14:40–17:00	MoPOS.29

An Improved Indoor Localization System for Mobile Robots Based on Landmarks on the Ceiling

Gongwen Lan, Jingchuan Wang, Weidong Chen
Department of Automation, Shanghai Jiao Tong University, China

- An indoor localization system using passive landmarks and an infrared sensor is introduced.
- A sensor model is built after the analysis to the properties of the infrared sensor.
- Based on the sensor model, we incrementally place landmarks and create a global coordinate system.
- Combined with the aboved method and the data fusion method ,the location accuracy is improved.


The mobile robot equipped with StarGazer

14:40–17:00	MoPOS.30

A High-frame-rate High Dynamic Range Imaging from Virtual Multi-thread Automatic Exposures

Xianwu Jiang, Qingyi Gu, Tadayoshi Aoyama, Takeshi Takaki, Idaku Ishii
Graduate school of engineering, Hiroshima university, Japan

- High speed HDR imaging at real-time 500 fps
- Overcome the static scene assumption for HDR imaging
- Automatic exposure control is introduced for each virtual multi-thread LDR images
- GPU based parallel algorithm implementation


HDR image from 4 different LDR exposures

Tuesday, December 6th, 2016

Autonomous Underwater Tracking and Navigation

Chair *Shuo Li, Shenyang Institute of Automation, Chinese Academy of Sciences*
Co-Chair *Ji-Hong Li, Korea Institue of Robot and Convergence*

10:20–10:50	TuA01.1

The Development Trend of Underwater Robots in China

Shuo Li, Shenyang Institute of Automation, Chinese Academy of Sciences

10:50–11:05	TuA01.3

3D Path Following Control Method for Torpedo-type AUVs with Uncertainty Terms in their Dynamics

Ji-Hong Li[1], Hyung-Joo Kang[1], Sung-Mun Hong[1], Jin-Ho Suh[1]
[1] Korea Institute of Robot and Convergence, South Korea
Shuo Li[2]
[2] Shenyang Institute of Automation, the Chinese Academy of Sciences, China

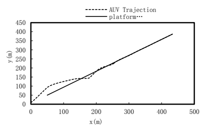
- A 3D path following scheme for a class of torpedo-type underwater vehicles, where only three control inputs are available for the vehicle's 6DOF motion, has been discussed in this paper
- Two spherical coordinate transformations are introduced to transform the vehicle's kinematics and dynamics model into three-inputs-three-outputs 2nd order strict-feedback form
- An asymptotic modification of orientation concept is also introduced to avoid possible singularity problem in the recursive control design
- Proposed control scheme can guarantee the UUB of closed-loop system in the spherical coordinate frame

11:05–11:20	TuA01.4

UUV Trajective Tracking Control Based on ADRC

Guocheng Zhang and Chengrong Du
Science and Technology on Underwater Vehicle Laboratory,
Harbin Engineering University, China

- An AUV tracking controller is designed for docking task.
- target trajectory is calculated to determine AUV expected velocity and heading angle
- An AUV heading angle and velocity controller is designed based on active disturbance rejection controller (ADRC) considered the perturbation of system model establishment and external disturb.
- target trajectory is tracked effectively by trajectory tracking controller.



Trajection of AUV and platform

11:20–11:35	TuA01.5

Active Disturbance Rejection Control for diving motion of Autonomous Underwater Vehicles

Zhibin Jiang and Tiejun Liu
State Key Laboratory of Robotics, Shenyang Institute of Automation, Chinese Academy of Sciences

- Design a controller based on active disturbance rejection control for the active variable buoyancy system (VBS) actuator.
- Two improved extended state observers are employed and made comparative researches.
- The sea and lake trial results illustrate the effectiveness of the proposed control scheme.

"Explorer 1000" AUV

Humanoid Robots I

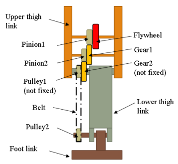
Chair *Masaki Yamakita, Tokyo Inst. of Technology*
Co-Chair *Keli Shen, Okayama University*

10:20–10:35 TuA02.1

Analysis of Biped Running with Rotational Inerter

Rin Takano and Masaki Yamakita
Dept. of Mechanical and Control Systems Engineering,
Tokyo Institute of Technology, Japan
Qiuguo Zhu
Dept. of Control Science and Engineering, Zhejiang University, China

- The rotational inerter was proposed as one of the mechanisms to increase robot's inertia.
- It was showed that the rotational inerter has the effect to improve performance of locomotion.
- We investigate biped running of humanoid robot applying the rotational inerter with different ways.



Rotational inerter

10:35–10:50 TuA02.2

Fast Human Whole Body Motion Imitation Algorithm for Humanoid Robots

Liang Zhang, Zhihao Cheng,Yixin Gan,Guangming Zhu,Peiyi Shen, Juan Song
School of Software, Xidian University, China

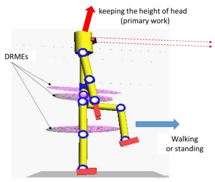
- we propose a real-time imitation algorithm for humanoid robots to mimic human's eight-chain whole-body motions .
- postures of robot are generated by fitting corresponding eight kinematic chains .
- the center of mass is controlled over the support polygon by adjusting ankle joints and hip joints for balance control, and balance analysis is made for each frame to build a stable action.

10:50–11:05 TuA02.3

Application and Analyses of DRMSI into Humanoid Biped Walking

Keli Shen, Xiang Li, Hongzhi Tian, Daiji Izawa and Mamoru Minami, Takayuki Matsuno
Graduate school of Natural Science and Technology,
Okayama University, Japan

- A new concept named DRMSI is proposed
- The DRMSI measures dynamic flexibility during primary work assigned
- DRMSI is used to evaluate the flexibility of humanoid biped walking
- Our humanoid robot model is reliable and effective



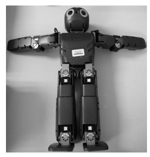
Application of DRMSI to humanoid robot

11:05–11:20 TuA02.4

Kinematic Analysis and Gait Planning for a DARwIn-OP Humanoid Robot

Xiao Li, Yangmin Li, and Xinzhe Cui
Department of Electromechanical Engineering
University of Macau

- The kinematics analysis and gait planning issues of DARwIn-OP are investigated.
- In trajectory generation, based on foothold point locations, this paper utilizes three-dimensional linear inverted pendulum model for a biped walking pattern generation to obtain center of mass (COM) trajectory and zero moment position (ZMP) trajectory.
- The 4th spline interpolation method to obtain correct COM trajectory



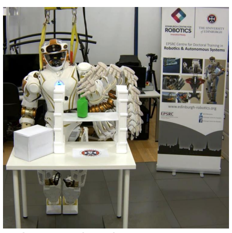
DARwIn-OP

11:20–11:35 TuA02.5

Scaling Sampling-based Motion Planning to Humanoid Robots

Yiming Yang, Vladimir Ivan, Wolfgang Merkt, Sethu Vijayakumar
School of Informatics, University of Edinburgh, UK

We propose an extension to sampling-based motion planning algorithms that
•Scales up for high DoF humanoid robots
•Generates collision-free full body motions in complex environments in seconds
•Can be easily applied and reused on different robot platforms
•Has been validated on the 38-DoF NASA Valkyrie humanoid robot



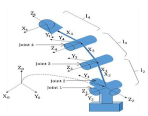
Collision-free full body motion executed on NASA Valkyrie

11:35–11:50 TuA02.6

A Power Series Based Inverse-Kinematics Solution of A Humanoid Robot Hand With Coupled Joints

Li Jiang, Bingqian Sun*, Shaowei Fan, and Qi Zhang
The State Key Laboratory of Robotics and System,
Harbin Institute of Technology, China

- An inverse-kinematics algorithm based on the power series is presented.
- The nonlinear equation including trigonometric transcendental function can be converted into an algebraic equation.
- The accurate solution can be achieved via 1-D linear interpolation for errors compensating.



Link coordinate system

Rehabilitation and Assistive Robotics III

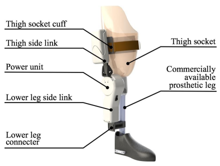
Chair *Shuro Nakajima, Wakayama university, Japan*
Co-Chair *Xia Zhang, Chongqing Jiaotong University*

10:20–10:35	TuA03.1

Attachable Cybernic Unit for Above-Knee Prosthesis to Realize Stair Ascent and Descent

Kento Inuzuka
Graduate School of Systems and Information Engineering, University of Tsukuba, Japan
Hiroaki Kawamoto and Yoshiyuki Sankai
Faculty of Engineering Information and Systems, University of Tsukuba, Japan

- The Attachable Cybernic Unit is able to be attached with the prosthetic leg, and operate the prosthetic leg.
- The ACU that can operate without strictly adjustment of the rotation axes by using thigh socket cuff.
- We confirmed that the participant with CAL was able to ascend and descend stairs as able-bodied person.



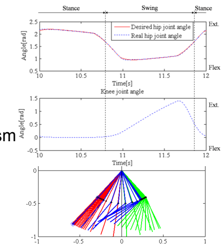
The structure of the Attachable Cybernic Unit

10:35–10:50	TuA03.2

A Human-robot Interaction Based Coordination Control Framework for Walking Assist

Xia Zhang and Tianhong Luo
Department of Mechatronics and Automobile Engineering, Chongqing Jiaotong University, China
Minoru Hashimoto
Department of Bioscience and Textile and Technology, Shinshu University, Japan

- Proposing a HRI-based coordination control method
- Combining Bionic motion control with traditional impedance control
- Designing a hip-knee joint linkage mechanism
- A new assistive method avoiding kinematic and dynamic modeling
- Computer simulations verifying the effectiveness

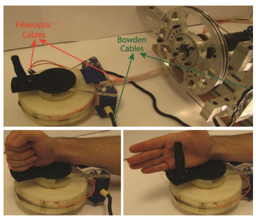


10:50–11:05	TuA03.3

Design and Control of an MRI Compatible Series Elastic Actuator

Yusuf Mert Senturk and Volkan Patoglu
Sabancı University, Istanbul, Turkey

- Design and control of a Bowden cable-actuated, MRI-compatible series elastic actuator is presented.
- Ideal bidirectional compatibility is achieved by using fiberoptic sensors and placing all MRI incompatible parts outside the imaging room.
- Closed-loop torque control of the device is realized through series elastic actuation.

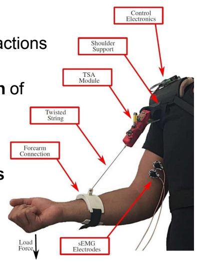


11:05–11:20	TuA03.4

Early Evaluation of sEMG-Driven Muscle Modelling for Rehabilitation and Assistive Applications based on Wearable Devices

R. Meattini, M. Hosseini, G. Palli and C. Melchiorri
DEI - Università di Bologna, Viale Risorgimento 2, Bologna, Italy

- **EMG-driven** muscle **modelling** for isometric contractions
- Experimental session protocol for the **identification** of the muscle model internal **non-linear fitting**
- The proposed model is used to control a **wearable elbow support device** such that the **biceps exerts an arbitrary residual tendon force** while an external load is applied to the user's forearm

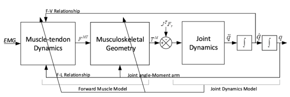


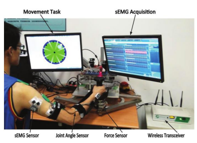
11:20–11:35	TuA03.5

An sEMG-Driven Neuromuskeloskeletal Model of Upper Limb for Rehabilitation Robot Control

Liang Peng, Zeng-Guang Hou, Lincong Luo, Long Peng, Weiqun Wang, and Long Cheng
Institute of Automation, Chinese Academy of Sciences

- This study proposes a new method for modeling the complicated dynamics between sEMG and corresponding joint torque.
- Muscle activation dynamics and contraction dynamics are built based on Hill-type muscle model.
- Subject-specific parameters are identified using the genetic algorithm.



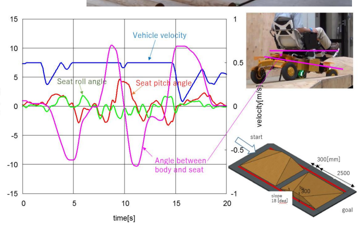


11:35–11:50	TuA03.6

Concept of a personal mobility vehicle for daily life

Shuro Nakajima, Wakayama University, Japan

This paper describes the concept of a Personal Mobility Vehicle (PMV) for daily life. Although powered wheelchairs, which is one category of PMVs, already exist commercially, some capabilities of them are not adapted for a certain scenarios of our daily life. In this paper, we pick up the necessary features that are not performed enough by conventional wheelchairs and discuss how to solve them. We developed a brand new PMV, named RT-Mover PType WA, and show its primitive motions.



SLAM & Sensor Networks I

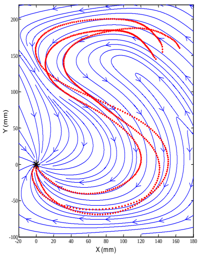
Chair *JIE CHEN, The University of Hong Kong*
Co-Chair *Yuichi Kobayashi, Shizuoka University*

10:20–10:35	TuA04.1

Programming Human-like Point-to-Point Approaching Movement by Demonstrations with Large-Scale Direct Monocular SLAM

Peng Sun, Jie CHEN,
Henry Y.K. Lau
University of Hong Kong, Hong Kong

- A novel motion planning technique, programming by demonstrations (PbD), is used to transfer human approaching skills to the robot.
- Gaussian Mixture Models (GMM) and Gaussian Mixture Regression (GMR) are used to encode human demonstrations
- LSD-SLAM is implemented to model the surrounding environment of a three degrees-of-freedom robot manipulator



10:35–10:50	TuA04.2

ROBIO 2016
Paper 249
--A Novel and Effective Moving-Objects Detection Method Combined with Stereo Localization and Mapping System

Detailed Powerpoint will be replaced soon.

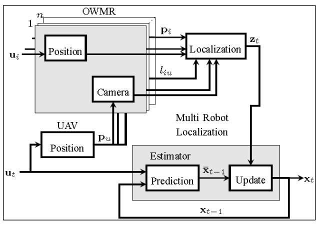
Author:
Libo Sun
Long Chen
Lei Fan

10:50–11:05	TuA04.3

Real Time Multi Robot 3D Localization System Using Trilateration

Luis Ruiz and Zhidong Wang
Department of Advanced Robotics, Chiba Institute of Technology, Japan

- Localization in indoor environments is important.
- OWMR are used to aid in UAV localization.
- Errors propagate from measurements to tracked object position.
- 3D implementation in real time using multi robot formations.



Control Architecture of UAV 3D Localization by using Multi Mobile Robot System

11:05–11:20	TuA04.4

Robust Dense Visual Odometry with Boundary Pixel Suppression

Yijia He,Yue Guo, Aixue Ye, Feng Wen, and Kui Yuan
Institute of Automation, Chinese Academy of Sciences, China

- Present a modified robust dense visual odometry with boundary pixel suppression.
- Analyze how the depth noise affects the photometric error and geometric error.
- Point out how to remove uncertain pixels from the motion estimation process.
- Evaluate our method on TUM benchmark datasets and show improvements comparing with DVO.

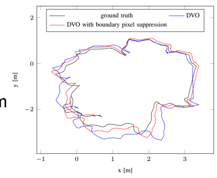


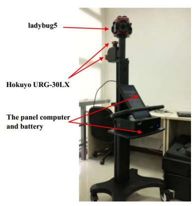
Fig. Camera trajectory from experiment on fr2/desk dataset.

11:20–11:35	TuA04.5

Visual and LiDAR-based for The Mobile 3D Mapping

Qiao Wu and Chaobing Huang ,Xiaochun Wu
Wuhan University of Technology, China
Kai Sun and Wenjun Zhang
The Leador Spatial Information Technology Corporation, China

- Calibration between 2D LiDAR and panoramic camera
- Use horizontal 2D LiDAR to finish 2D SLAM.
- Multimethod optimization and data fusion to get 3D RGB map



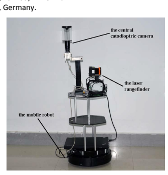
Our equipment for 3D mapping

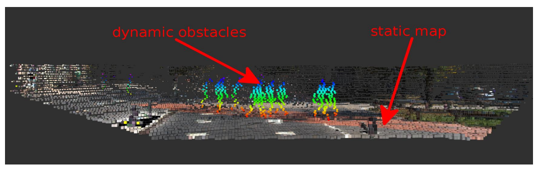
11:35–11:50	TuA04.6

An automatic calibration approach for an omni-directional system and applying for dynamic scenes reconstruction

Cheng Zou[1,2] Bingwei He[1,2] Liwei Zhang[1,2] Jianwei Zhang[2] Zhen Deng[2]
1 School of Mechanical Engineering and Automation, Fuzhou University, Fujian, Fuzhou, P.R.China.
2 TAMS, Department of Informatics, University of Hamburg, Hamburg, Germany.

- We improved the laser-camera calibration approach to make it adjust to omni-directional camera automatically.
- A Gaussian mixture model (GMM) proposed for updating the color feature and detecting the dynamic obstacles for fusing of color and 3D data.





Micro/Nano Robotics

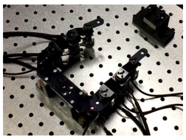
Chair *U-Xuan Tan, Singapore University of Techonlogy and Design*
Co-Chair *Masaru Kojima, Osaka University*

10:20–10:35	TuA05.1

Development of a High-speed, High-accuracy Robot Hand for Micromanipulation

Hiroshi Sato, Yuji Yamakawa,
Taku Senoo and Masatoshi Ishikawa
Department of Information Physics and Computing, Graduate School of Information Science and Technology, The University of Tokyo, Japan

- A high-speed, high-accuracy robotic hand was developed for flexible and fast micromanipulation.
- The rapidity of the hand approximated that of the conventional high-speed robotic hands.
- The positioning accuracy was sufficient to quickly manipulate objects of submillimeter size.
- Positioning accuracy of submicrometer order was also attained by utilizing a high-resolution laser displacement sensor.



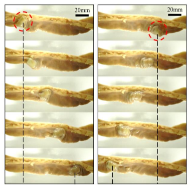
The high-speed high-accuracy robot hand developed in this research.

10:35–10:50	TuA05.2

Feasibility Study of Electromagnetic Guidance System for Intestinal Capsule Endoscope

Cheong Lee, Gwangjun Go, Viet Ha Le,
Jong-Oh Park and Sukho Park
School of Mechanical Engineering, Chonnam National University, Korea
Hyunchul Choi
Robot Research Initiaive, Chonnam National University, Korea

- Proposal of magnetic capsule endoscope and Electromagnetic Actuation System for motion of capsule endoscope.
- With the helical motion of capsule endoscope, pursuit of effective diagnosis using capsule endoscope.
- Through the FPV Control of magnetic Capsule endoscope, verification for the feasibility of magnetic capsule endoscope.

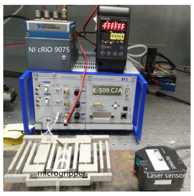


10:50–11:05	TuA05.3

Variable Structure Control Combined With Adaptive Iterative Learning Control for Motion Tracking of a Piezoelectric Microgripper

Yulong Zhang and Qingsong Xu
Department of Electromechanical Engineering, University of Macau, China

- A new controller is designed to overcome both vibration and hysteresis nonlinearity
- An adaptive iterative learning control and discrete-time sliding mode control are combined to design a new control algorithm
- Experimental study on a piezoelectric microgripper has been conducted to verify the effectiveness of the proposed controller

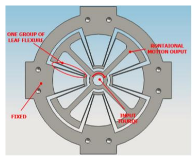


11:05–11:20	TuA05.4

Design and Analysis of a New Rotary Precision Micropositioning Stage

Hanyu She, Hanlun Zhang, and Qingsong Xu
Department of Electromechanical Engineering, University of Macau, China

- Design and modeling of a new rotary state are presented
- Stage parameters are determined to meet the requirements on rotary angle and driving torque
- Finite-element analysis simulation is conducted to verify the statics and dynamics performance of the designed stage



11:20–11:35	TuA05.5

A Feedforward Controller With Neural-Network Based Rate-Dependent Model For Piezoelectric-Driven Mechanism

Yunfeng Fan and U-Xuan Tan
Engineering Product Development
Singapore University of Technology and Design, Singapore

- Piezoelectric-driven mechanism are known for its precision and repeatability.
- Lack of tracking controller for wide-bandwidth and non-periodic motions.
- Neural-Network based rate-dependent controller is design to address the limitation.
- Experiments are conducted to demonstrate the capability

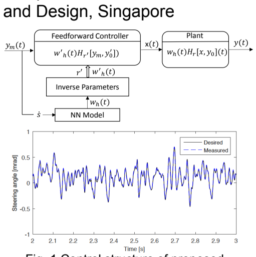


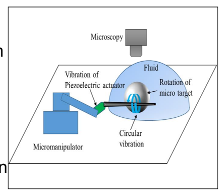
Fig. 1 Control structure of proposed approach and the experimental result for non-periodic motions

11:35–11:50	TuA05.6

Non-contact High-Speed Rotation of Micro Targets by Vibration of Single Piezoelectric Actuator

X. Liu, Q. Shi, H. Wang, T. Sun, Q. Huang, T. Arai and T. Fukuda
School of Mechatronical Engineering, Beijing Institute of Technology, CHINA
M. Kojima, Y. Mae, and T. Arai
Department of Systems Innovation, Osaka University, JAPAN

- Circular vibration induced by piezoelectric actuator
- Local swirl flow generated by circular vibration
- Non-contact high-speed rotation of micro target
- Analysis of generated local flow through CFD simulation
- On-off control and speed control of the rotation
- Potential in complex micro-assembly and single cell manipulation



Robot Modeling & Control

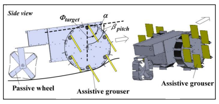
Chair *Chao Ren, Tianjin University*
Co-Chair *Yangmin Li, University of Macau*

10:20–10:35	TuA06.1

Development of Wheeled Rover for Traversing Steep Slope of Cohesionless Sand with Stuck Recovery using Assistive Grousers

Ahmad Najmuddin Ibrahim
Graduate School of Science and Engineering, Ibaraki University, Japan
Yasuhiro Fukuoka and Shinichi Aoshima
Intelligent Systems Engineering, Ibaraki University, Japan

- Typical rovers with conventional grouser attached wheels face danger of being stuck in sandy slopes
- Rotational movement direction of grousers move sand from under of wheel
- We propose an assistive grouser mechanism that maintains a uniform angle independent of wheel rotation
- Experimental results show rover produce smaller sinkage and current consumption on slope angles 0 to 30 degrees



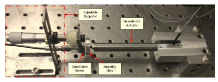
Wheeled rover with assistive grouser attached

10:35–10:50	TuA06.2

Optimized PID Tracking Control for Piezoelectric Actuators based on the Bouc-Wen Model

Bingxiao Ding, Yangmin Li, Xiao Xiao, and Yirui Tang
Department of Electromechanical Engineering
University of Macau

- A PID controller with self tuning parameters is designed to track the trajectory of piezoelectric actuator with hysteresis.
- The dynamic model of the system with Bouc-Wen hysteresis is established and PSO algorithm is adopted to identify the parameters of this model.
- The simulation results validate the good performance of the controller.



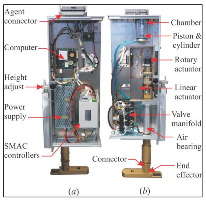
The scheme of experimental setup

10:50–11:05	TuA06.3

A 2-DOF Manipulator for Micro-Assembly in a Minifactory

Jun Zhang and Ralph Hollis
The Robotics Institute, School of Computer Science, Carnegie Mellon University, USA

- A 2-DOF Manipulator SMACbot with z and θ direction motions is implemented
- Gravity compensator and air bearing system are used to improve the motion precisions
- Average error of z-direction 5 mm fixed distance repeated motion is 8.4 μm; average error of 0.5º fixed angle repeated rotation is about 0.12º
- SMACbot can be used in micro-assembly applications in a Minifactory by cooperation with 2-DOF planar robots



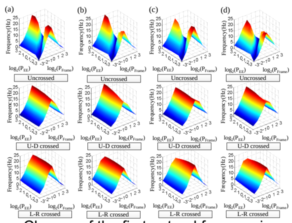
Components of a SMACbot: (a) right side, (b) left side

11:05–11:20	TuA06.4

Analysis of Configuration of Planar Cable-Driven Parallel Robot on Natural Freqency

Jinlong Piao, Jong_Oh Park, Seong Young Ko, and Sukho Park
Department of Mechanical Engineering & Robot Research Initiative, Chonnam National University, South Korea
Jinwoo Jung
Robot Research Initiative, South Korea

- Modeling of equation and calculating natural frequency
- Simulation for difference cable robot configuration
- Vibration analysis of difference robot configuration
- Giving guidelines to design high capacity to reduce vibration



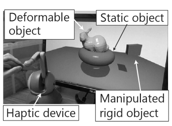
Change of the first natural frequencies according to end-effector positions

11:20–11:35	TuA06.5

Haptic Rendering of Contact Between Rigid and Deformable Objects Based on Penalty Method with Implicit Time Integration

Kazuya Sase and Atsushi Konno
Graduate School of Information Science and Technology, Hokkaido University, Japan
Teppei Tsujita
Department of Mechanical Engineering, National Defense Academy, Japan

- A stable contact handling for the haptic rendering of virtual compliant environments is proposed.
- The penalty-based contact force is integrated using the backward Euler method (implicit time integration).
- The implicit time integration enhances the numerical stability even in large time step.
- Using precomputed signed distance field, the calculation of the penetration depth is accelerated.



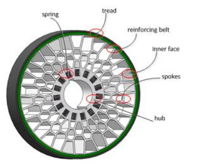
Overview of our experimental setup

11:35–11:50	TuA06.6

A New Kind of Non-Pneumatic Tire for Attenuating Vibration

Yinghao Ning, Shuai Wang, and Bing Li
Harbin Institute of Technology Shenzhen Graduate School, Shenzhen, China
Ruochen Niu
School of Astronautics, Harbin Institute of Technology, Harbin, China

- Non-Pneumatic tire with honeycomb structure equipped with spring is introduced to absorb energy and attenuate vibration for jumping robots.
- The constituent material of tire is polyurethane which have high tear strength and other unique properties.
- Natural frequency of this new kind of tire can be changed by choosing proper structural parameters of honeycomb structure, as well as the stiffness of spring.



Non-Pneumatic Tire with Honeycomb Structure Equipped with Spring

Autonomous Cognition and Control for Underwater Robots

Chair *Sanming Song, Shenyang Institute of Automation, Chinese Academy of Sciences*
Co-Chair *hai Huang, Harbin Engineering University*

13:00–13:15 TuB01.1

Inversion of the Sound Speed Profiles with an AUV Carrying Source Using Improved Ensemble Kalman Filter

Xiaoyu Chen, Chen Sun and Jianlong Li
College of Information Science and Electronic Engineering
Zhejiang University, China

- Inversion problem is formulated as a state-space model and a measurement equation
- Using EnKF framework to solve the inversion problem
- Markov Chain Monte Carlo method is presented to improve the performance
- Improvement is supported by simulation and experiment

13:15–13:30 TuB01.2

Forward-looking Sonar Image Mosaicking by Feature Tracking

Sanming Song, Kaizhou Liu, Shuo Li, Xisheng Feng
Shenyang Institute of Automation, Chinese Academy of Sciences, China
J. Michael Herrmann
Institute of Perception, Action & Behavior, University of Edinburgh, UK

- A method to register sonar sequences is proposed that is based on the feature tracking using the particle filtering.
- (1) Feature tracking is feasible for the forward-looking sonar image mosaicking.
- (2) Fusion of the texture and the shape feature lead to a robust feature extraction method for more precise motion estimation.
- (3) The prior information on the AUV's movement is necessary for the tracking of highlighted regions.

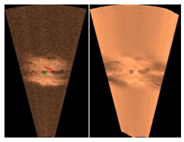


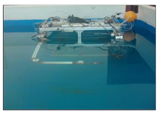
Figure 1. Sonar Image mosaicking by shadow tracking

13:30–13:45 TuB01.3

Underwater Vehicle Servo and Target Grasp Control

Huang Hai, Zhou Hao, Qin Hong-de, Sheng Ming-wei
The National Key Laboratory of Underwater Vehicle, Harbin Engineering University, China

- The improvement on underwater camera calibration.
- Harris corner detection algorithm is modified to adjust to detect corner of underwater images.
- Daisy operator are being used to describe the key point detected by SIFT algorithm.
- The underwater target grasp experiment demonstrates the effectiveness of the above-mentioned improvement.

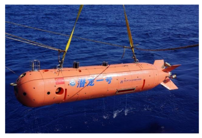

The experimental platform

13:45–14:00 TuB01.4

An Integrated Navigation Algorithm for AUV Based on Pseudo-range Measurements and Error Estimation

Yiqun Wang , Chunhui Xu, Huixi Xu, Hongyu Zhao, and LiuJian
Shenyang Institute of Automation, Chinese Academy of Science, China

- Quantitative Description of LBL error:
  (1) Analyze Pseudo-range influence to navigation
  (2) Analyze calibration errors of beacons
- Navigation algorithm used by Qianlong-1:
  P-SLAM EKF algorithm is proposed to solve the errors of Pseudo-range and beacons.


Navigation algorithm used by Qianlong-1

14:00–14:15 TuB01.5

Hydrodynamic Performance Analysis of a Biomimetic Manta Ray Underwater Glider

Zhenyu Wang[1,2],Jiancheng Yu[1],Aiqun Zhang[1]
1 State Key Laboratory of Robotics, Shenyang Institute of Automation, Chinese Academy of Sciences, 110016, Shen Yang, China
2 University of Chinese Academy of Sciences, Beijing 100049, China

- The hydrodynamic performance of a biomimetic manta ray underwater glider actuated by buoyance is analysis.
- (1) The hydrodynamic structure shape of the glider is established.
- (2) The steady motion of the glider in the vertical plane is analyzed.
- (3) The biomimetic manta ray underwater glider has the characteristics of high gliding speed and small gliding angle.

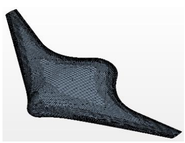


Figure 1. 3D geometry model of Biomimetic Manta Ray Underwater Glider

Humanoid Robots II

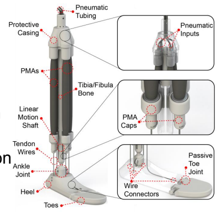
Chair *Jia-Yeu Lin, Waseda University*
Co-Chair *George Andrikopoulos, Luleå University of Technology*

13:00–13:15	TuB02.1

On the Design, Development and Motion Control of a Humanoid Robotic Leg via Pneumatic Artificial Muscles

George Andrikopoulos and George Nikolakopoulos
Department of Computer Science, Electrical and Space Engineering, Luleå University of Technology, Sweden

- Design and implementation stages of a HUmanoid Robotic Leg (HURL)
- Ankle motion achieved via pneumatic muscle actuators, a pneumatic form of actuation that mimics the motion characteristics of a human muscle
- HURL's 2-DoF motion capabilities (dorsiflexion - plantar flexion, eversion - inversion) are experimentally evaluated via an advanced nonlinear PID-based control algorithm



HURL's design specifics

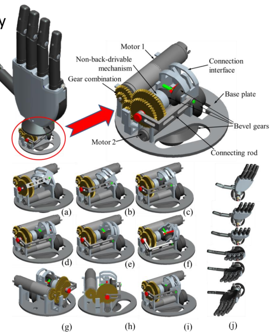
13:15–13:30	TuB02.2

A Design of a Miniaturized Prosthetic Wrist Based on Repetition Rate of Human Wrist Daily Tasks

Shaowei Fan, Shiran Fan*, Li Jiang, Hong Liu
State Key Laboratory of Robotics and System, Harbin Institute of Technology, China

- Based on the wrist function, we divided daily activities into 4 scenarios, 12 behaviors and 30 wrist daily tasks in total.
- The 4 simplified trajectory, wrist repetition patterns(WRP), were obtained.
- We presented a method of estimating repetition rate of human wrist daily tasks(RHWDT) direct at one certain WRP using collection data from questionnaires.
- With the guideline of RHWDT, we finally obtained a mechanical structure and the design was verified by analyzing the performance of the structure.

WRP	Oblique Axis	Analogous Glyph I	Analogous Glyph C	Analogous Glyph D
RHWDT	84.70%	76.35%	85.79%	93.16%

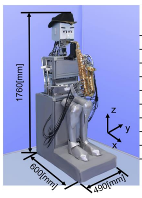


13:30–13:45	TuB02.3

The Development of Intraoral Pressure Control System on Humanoid Saxophone Playing Robot

J. LIN[1], K. YOSHIDA[1], K. MATSUKI[1], K. TAKIKAWA[1], S. COSENTINO[1], S. SESSA[1], A. TAKANISHI[2]
[1] Faculty of Science and Engineering, Waseda University, Tokyo, Japan.
[2] Department of Modern Mechanical Engineering, Waseda University; Humanoid Robotics Institute (HRI), Waseda University , Tokyo, Japan

- By combining air flow model and assessment tests, random sound termination during performance is investigated
- An intraoral pressure control system for humanoid saxophone-playing robot WAS-4 is developed to solve problem
- Experimental results confirm that the system improves WAS-4 musical performance allowing continuous sound production



Body Parts	DoF
Lips	2
Oral Cavity	1
Tongue	1
Lung	2
Fingers	19
Waist	1
Gaze	2
Eyebrow	1
Eyelid	2
Total	31

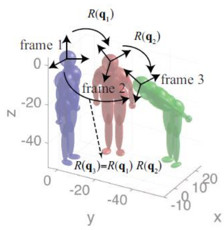
WAS-4 Waseda Anthropomorphic Saxophonist robot Ver.4

13:45–14:00	TuB02.4

Symmetrical Rigid Body Parameterizations For Humanoid Robots

Sipu Ruan, Jin Seob Kim and Gregory S. Chirikjian
Department of Mechanical Engineering, Johns Hopkins University, USA

- Symmetrical parameterizations describe relative motions of a group of humanoid robots in the same way.
- Possible forms of symmetrical parameterizations for rotations and rigid body motions are discussed.
- Product formulas for symmetrical parameterizations in SO(3) and SE(2) are specifically presented.
- Potential benefits in the study of humanoid robots by using symmetrical parameterizations are briefly discussed.



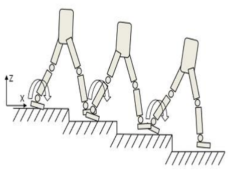
Symmetrical parameterization for 3D rigid body motion

14:00–14:15	TuB02.5

Foot Placement Estimator for Stepping Down Movement

Yeoun-Jae Kim and KwangGi Kim
Biomedical Research Division, National Cancer Center, South Korea

- A novel methodology is proposed for a biped robot to step down stairs using FPE (Foot Placement Estimator).
- The objective of the proposed method is for the planar biped robot not to falling down during stepping down motion.
- The authors divided the stepping down motion as 4 consecutive motions.
- Numerical simulations are performed to verify the proposed methodology.


Overview of the stepping down of the biped robot

Intelligent Systems

Chair *Shuxiang Guo, Kagawa University*
Co-Chair *Guohui Tian, Shandong University*

13:00–13:15	TuB03.1

An Improved VR Training System for Vascular Interventional Surgery

Shuxiang Guo, Xiaojuan Cai, Baofeng Gao
the Key Laboratory of Convergence Medical Engineering System and Healthcare Technology, the Ministry of Industry and Information Technology, School of Life Science, Beijing Institute of Technology, China
Yuhua, Jiang
Tiantan Hospital, China

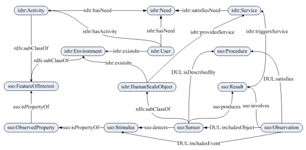
- An improved Marching cubes algorithm was adopted to simplify the mathematical modeling of vessels by merging the re-lated points of the mesh model.
- A hybrid collision detection algorithm was proposed and implemented, so that the primitives of the vessel model can be reduced for visual rendering and computation.
- The CPU-GPU parallel computing architecture was adopted, which improved the real-time performance of the proposed system.

13:15–13:30	TuB03.2

The Introduction of Ontology Model based on SSO Design Pattern to the Intelligent Space for Home Service Robots

Cici Li, Guohui Tian and Huanzhao Chen
Department of Control Science and Engineering, Shandong University, China

- To eliminate the heterogeneity between devices, we construct the ontology model for the intelligent space.
- The existing ontology models lack standards and systematicness.
- To make the ontology model more standard and systematic, we construct the ontology model based on SSO design pattern.
- The SSO design pattern is originally designed for semantic sensor web and recommended by W3C.



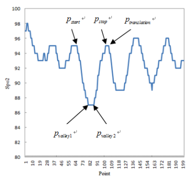
The ontology model for the intelligent space for home service robots based on SSO design pattern

13:30–13:45	TuB03.3

An Oxygen Desaturation Event Recognition Algorithm Based on Local Feature Extraction

Hanqing Wang, Min Li, Jinge Cao
School of Mechatronic Engineering and Automation
Shanghai University, Shanghai, China

- An oxygen desaturation event detection algorithm based on local feature extraction is proposed.
- Six feature points and four characteristic parameters are proposed to isolate actual oxygen desaturation event.
- The feasibility and reliability of the proposed algorithm are verified by comparing with polysomnography (PSG).



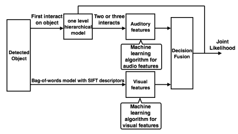
Part of the feature points proposed in this paper

13:45–14:00	TuB03.4

Multi-sensory based novel household object categorization system by using interactive behaviours

Haojun Guan and Jianwei Zhang
Department of Informatik, University of Hamburg, Germany

- Novel method of collecting and presenting features
- 5 Interactive behaviours are used to generate sound
- Non-semantic auditory features are used to improve the performance
- Deep learning on auditory data processing



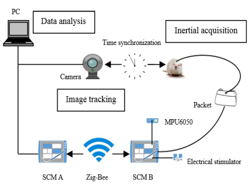
Overview of the system

14:00–14:15	TuB03.5

Automatic Motion Tracking and Data Analysis System for a Rat

Zhiwen Zhang, Jingtao Guan, Wennan Chang, Wenjuan Wang, Mingwei Sun and Feng Duan
Nankai University, P. R. China
MasatoOdagaki
Maebashi Institute of Technology, Japan
Tianming Liu
University of Georgia, USA

- This system includes three subsystems: inertial data acquisition, image tracking and data analysis.
- The inertial subsystem collects the motion data.
- The image tracking subsystem recognizes and tracks the rat by the camera.
- The data analysis subsystem conducts real-time data analysis based on Matlab.

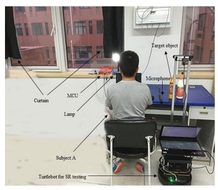


14:15–14:30	TuB03.6

Development of a Voice-Control Smart Home Environment

Wenkai Zhang, Zihao An, Zhendong Luo, Wenyu Li, Zhao Zhang, Yimei Rao, and Feng Duan
College of Computer and Control Engineering, Nankai University, China
Che Fai Yeong
Universiti Teknologi Malaysia, Malaysia

- A smart home system controlled by speech signals with a family service robot in it.
- Collect and analyze speech signal, then convert it to text message.
- The robot achieves the identification of the target object through SURF.
- The success rate of system is 93.3%, which means that it has a good behavior.



The environment of smart home

SLAM & Sensor Networks II

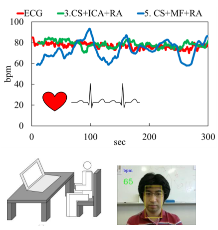
Chair *Xian GUO, Nankai University*
Co-Chair *Guohui Tian, Shandong University*

13:00–13:15	TuB04.1

Non-contact, Real-time Monitoring of Heart Rate with a Webcam with Application during Water-Bed Massage

Akihito Seki, Changqin Quan, and Zhiwei Luo
Graduate School of System Informatics, Kobe University, Japan

- We propose a new technique for measuring HR which allows the subject head movements during water-bed massage.
- For comparison purpose, HR was measured simultaneously using an electrocardiography (ECG) device during all sessions of the experiment.
- The result shows that our proposed technique is able to improve the accuracy of HR measurement and reduce the processing time to nearly one-third of the existing method.

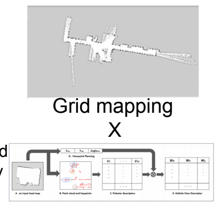


13:15–13:30	TuB04.2

Combining Grid Mapping with Local Map Descriptor for Fast Succinct Map Retrieval

Enfu Liu and Kanji Tanaka
Graduate school of engineering, University of fukui, Japan

- Unlike previous Bag-of-words scene model which lacks spatial layout information, we have been developing a holistic local map descriptor which is view-independent and highly discriminative.
- The current study is based on of the proposed method. The key observation is that accuracy of the spatial layout should be improved by introducing an accurate local mapping technique.

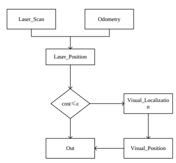


13:30–13:45	TuB04.3

A Hybrid Lidar-based Indoor Navigation System Enhanced by Ceiling Visual Codes for Mobile Robots

Jiongtao Xiong
Technology in Guangdong University of Technology, China
Long Han
Chinese University of Hong Kong, China

- Indoor autonomous mobile robotics ;
- Fusion localization：low-cost lidar localization and 2D-codes localization;
- Autonomous relocalization when kidnapping occurs;



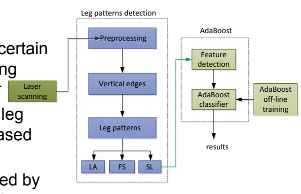
Localization System Overview.

13:45–14:00	TuB04.4

Fast People Detection in Indoor Environments Using a Mobile Robot with a 2D Laser Scanner

B. Zhou, C. Y. Zhong, K. Qian and X. Z. Dai
Key Laboratory of Measurement and Control of CSE(School of Automation, Southeast University), Ministry of Education, Nanjing 210096, China

- Real-time people detecting in high uncertain and dynamic indoor environments using mobile robots with a 2D laser scanner
- A multi-level algorithm combined with leg pattern classification and AdaBoost based online-learning/speeding approach
- Leg patterns are detected and classified by laser data segmentation, edge extraction
- The AdaBoosting algorithm is used for furthur classification to remove ambiguous patterns



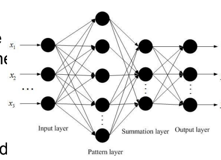
Flowchart of fast people detection algorithm

14:00–14:15	TuB04.5

Load Identification of University Dormitory Based on Probabilistic Neural Network

Qingtian Wu, Tingxin Wu and Yimin Zhou
Shenzhen Institutes of Advanced Technology, Chinese Academy of Sciences, Shenzhen, China

- A malignant load identification method for the university dormitory is developed based on the improved probabilistic neural network.
- Various types of electric loads are numbered and the load code libraries are established.
- The typical electrical parameters are collected and used for PNN training.
- The particle swarm optimization algorithm is studied to optimize the smoothing factor of the PNN.



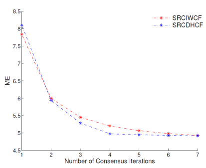
The network structure of the PNN

14:15–14:30	TuB04.6

Distributed Object Tracking Using a Derivative Free Nonlinear Information Consensus Filter

Guoliang Liu and Guohui Tian
School of Control Science and Engineering, Shandong University, China

- We present a derivative free information consensus filter for distributed object tracking using camera network, which is based on the square-root cubature rules for linearization of nonlinear system models, and an novel consensus weighting scheme for faster convergence rate.
- The proposed method can keep the consistence of local filters, and achieve faster convergence rate when only a limited number of consensus iterations is performed.



The comparison of mean error of the proposed SRCDHCF and the state of the art SRCIWCF

Industrial Robotics

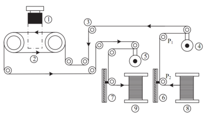
Chair *zaojun Fang, Chinese Academy of Sciences*
Co-Chair *Hongguang Wang, Shenyang Institute of Automation, Chinese AcademyofSciences*

13:00–13:15	TuB05.1

Constant Wire Tension Control Using Fuzzy Method in Multi-Wire Saw Machine

Zaojun Fang, De Xu, Min Tan
Institute of Automation, Chinese Academy of Sciences, China

- The work principle of the multi-wire saw machine is described
- The wire tension is analyzed based on the torque equilibrium of the motor
- The tension controller is presented using fuzzy method
- The detail design procedure for the fuzzy controller is given


The configuration of the multi-wire saw machine

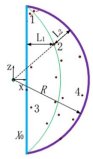
13:15–13:30	TuB05.2

SHENYANG INSTITUTE OF AUTOMATION
CHINESE ACADEMY OF SCIENCES

Configuration Analysis of a 6R Manipulator Based on an Improved Performance Index

Yong Tian, Hongguang Wang, and Xin'an Pan
State Key Laboratory of Robotics, Shenyang Institute of Automation, China

- A boundary distribution index of singular points in workspace is proposed.
- An improved performance index is constructed with the global performance index and the boundary distribution index.
- An optimized configuration is obtained with the improved performance index and GA.

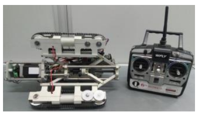

The distribution of the singular points

13:30–13:45	TuB05.3

Analysis of Traveling-capability and Obstacle-climbing Capability for Radially Adjustable Tracked Pipeline Robot

Lei Zhang and Shan Meng
School of Engineering, Ocean University of China, China

- Design a kind of tracked pipeline robot with three-axis driving structures
- Introduce the structure and the working principle of robot, analyze the mechanical properties of adjustable mechanism
- Analyze the traveling-capability and obstacle-climbing capability of robot and the driving force of robot
- The experimental results of the prototype


The prototype of robot.

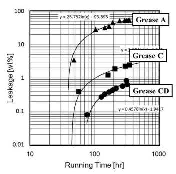
13:45–14:00	TuB05.4

Effect of Grease Structure on Leakage of Grease from Speed Reducing Gear for Robot

Akihiro SHISHIKURA and Fumihiko KUSUYAMA
Lubricants R & D Center, Idemitsu Kosan Co., Ltd., JAPAN

The most serious issue in all industrial robot user was a leakage of grease from the reducer of robot. Therefore, in order to develop "Zero Leakage Grease", grease structure was studied.

Grease structure was affect to grease leakage from speed reducing gear of robot. The amount of grease leakage was depended on the fiber length of thickener. The grease leakage can be reduced to 1/100 of conventional grease by using novel hybrid grease which was composed of high shear stability and long fiber shape thickener.



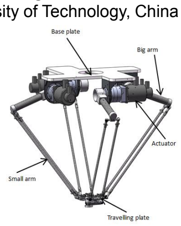
GREASE LEAKAGE DURING DURABILITY TEST OF RV REDUCER.

14:00–14:15	TuB05.5

Workspace analysis considering various parameters of the Quattro parallel robot

Huadong Zheng, Ming Cong, Dong Liu
School of Mechanical Engineering, Dalian University of Technology, China

- The principle and structure of the Quattro parallel robot
- The analysis inverse kinematic model
- Influence of the Quattro parallel robot parameters on the workspace



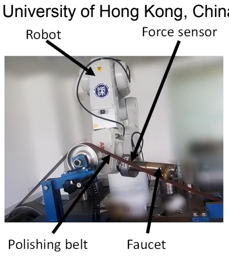
The structure of Quattro parallel robot

14:15–14:30	TuB05.6

Industrial Robot Path Planning for Polishing Applications

Jiang Liu, Xinlong Huang, Siwen Fang, and Heping Chen,
henzhen Academy of Robotics, China
Ning Xi
Emerging Technologies Institute, The University of Hong Kong, China

- Propose a polishing path planning method with easy use.
- Partition a complex part into simple surfaces, like flat surface and curved surface.
- Propose a path connection method to generate a whole path.



Computational Intelligence

Chair *Jingtai Liu, Nankai University*
Co-Chair *Uriel Martinez-Hernandez, University of Leeds*

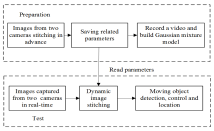
14:40–14:55	TuC01.1

Dynamic Image Stitching for Moving Object

○Xiaoyan Gu[1], Peipei Song[1], Yimei Rao[1], Yew Guan Soo[2], Che Fai Yeong[3], Jeffrey Too Chuan Tan[4], Hajime Asama[1], *Feng Duan[1]

1 Department of Automation, College of Computer and Control Engineering, Nankai University, China.
2 Universiti Teknikal Malaysia Melaka, Malaysia.
3 Universiti Teknologi Malaysia, Malaysia.
4 The University of Tokyo, Japan.

- Image stitching by surf matches, adjusting intensity and seeking optimal seam line.
- Dynamic stitching to solve stitching parallax.
- Robot control and localization.

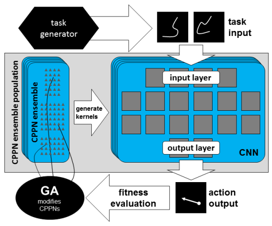


14:55–15:10	TuC01.2

Implicit Policies for Deformable Object Manipulation with Arbitrary Start and End States: A Novel Evolutionary Approach

Solvi Arnold and Kimitoshi Yamazaki
Mechanical Systems Engineering, Shinshu University, Japan

- We generate CNNs (convolutional neural networks) from CPPNs (compositional pattern producing networks) evolved with a genetic algorithm.
- We apply this approach to a deformable object manipulation task on 2D threads with arbitrary start and end states.
- Initial results for tasks requiring one or two manipulations illustrate the potential of this novel approach.



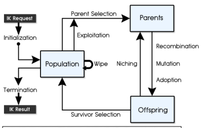
System schematic

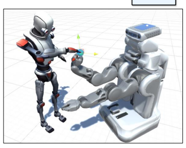
15:10–15:25	TuC01.3

An Efficient Hybridization of Genetic Algorithms and Particle Swarm Optimization for Inverse Kinematics

Sebastian Starke, Norman Hendrich, Sven Magg, Jianwei Zhang
Department of Informatics, University of Hamburg, Germany

- Complex inverse kinematics problems are solved by encoding different joint variable configurations as individuals
- The evolution iteratively generates new individuals until a desired accuracy is reached
- Fast convergence for full pose objectives with real-time capability
- Multimodal optimization with high dimensional scalability and robustness to suboptimal extrema





15:25–15:40	TuC01.4

Kinematics Modeling for Tele-Observation Robotic Camera

Danhua Han, Hongpeng Wang and Jingtai Liu
Institute of Robotics and Automatic Information System, Nankai University, China
Tianjin Key Laboratory of Intelligent Robotics, Nankai University, China

- A PTZ camera can be regarded as a Tele-Observation robot with three degrees of freedom.
- A Kinematics model of the Tele-Observation robotic camera is proposed.
- The zoom model is introduced that reflects how focal length vary as a function of zoom scale.
- The Kinematics model has higher accuracy compared with existing method.

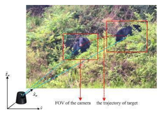


Illustration of Robotic Tele-Observation System deployed in nature environment

15:40–15:55	TuC01.5

ROBIO 2016
An integrated probabilistic framework for robot perception, learning and memory

Uriel Martinez-Hernandez, Andreas Damianou, Daniel Camilleri, Luke W. Boorman, Neil Lawrence and Tony J. Prescott
Sheffield Robotics Lab, University of Sheffield, UK

- Computational Synthetic Autobiographical Memory model that mimics human memory.
- Bayesian probabilistic formulation for perception and learning in robotics.
- Integration of multiple sensing modalities in our probabilistic framework. These sensing modalities are vision, hearing and touch.
- Implementation and testing in offline and real-time with the iCub human robot.

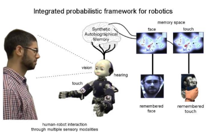


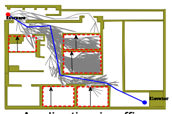
Figure: Integrated probabilistic framework for robot perception, learning and memory, using Bayesian probabilistic.

15:55–16:10	TuC01.6

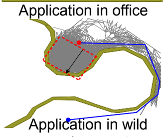
A strategy to escape from local traps for sparse A algorithm

Shuai Guo
School of Information Engineering, Zhengzhou University, China
Shumei Yu
Robotics and Microsystems Research Center, Soochow University, China

- Advantages of Sparse A* algorithm (SAS) has been analyzed by comparing with naive A*.
- The limitation of efficiency of SAS has been revealed when dealing with local traps.
- Based on a measurement of local traps, a combined strategy to improve the performance in dealing with local traps is proposed:
  - Proper step length selection
  - Pruning of open list (candidates of path selection, also diversity of path exploring)
  - Optimization of path by deleting unnecessary nodes.



Application in office



Application in wild environment

Robot Design & Control

Chair *Changlong Ye, Shenyang University of Aerospace*
Co-Chair *Yisheng Guan, Guangdong University of Technology*

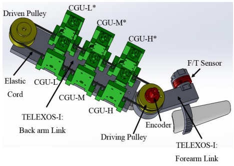
14:40–14:55	TuC02.1

Novel Passive Discrete Variable Stiffness Joint (pDVSJ): Modeling, Design, and Characterization

M.I. Awad[*1], D. Gan[1], A. Az-zu'bi[1], J. Thattamparambil[1], C. Stefanini[1], J. Dias[1,2], L. Seneviratne[1,3]

[1]Khalifa University, UAE [2]University of Coimbra, Portugal, [3]King's Collage , UK

- This work proposed a discrete variable-stiffness joint concept using elastic cords
- The new joint was used for an elbow exoskeleton for haptics interface
- Three levels of stiffness were implemented and verified in both simulation and experimental results
- The new concept is believed to be light-weight, low-energy-consumption and low cost.

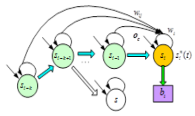


14:55–15:10	TuC02.2

Robotic Cognitive Map Building Based on Biology-Inspired Memory

Qiang Zou, Dong Liu, Ming Cong and Yingxue Cui
School of Mechanical Engineering, Dalian University of Technology, China
Yu Du
School of Mechanical Engineering, University of British Columbia, Canada

- Describes cognitive map building based on episodic memory for mobile robots
- Model episodic memory with a sequence of observations, state neurons, behaviors and pose perceptions
- Competitive attractor network model
- TurtleBot2 and Robot Operating System(ROS)



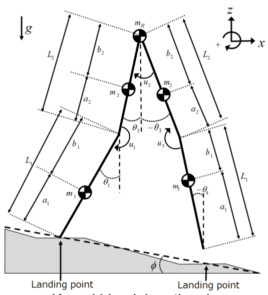
Organization process of state neurons for episodic memory

15:10–15:25	TuC02.3

Underactuated Bipedal Walker Traveling Steep Downhill with Bending Stance Knee

Yasunori Kikuchi and Fumihiko Asano
School of Information Science, JAIST, JAPAN

- The feasibility of stable underactuated bipedal walking on steep slope is discussed.
- A planar four-linked underactuated kneed bipedal walker is considered for analysis.
- The stance knee joint is controlled to greatly bent angle at collision.
- The fundamental properties of the generated gaits are analyzed through numerical simulations.



Kneed bipedal on the slope

15:25–15:40	TuC02.4

Design and Control of a Miniature Rolling Robot for Entertainment

Kewei Lin , Yajun Liao and Yisheng Guan
School of Electro-mechanics, Guangdong University of Technology, China

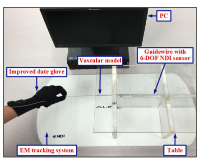
- Design principle
- Dynamics
- Stabilization and control
- Experiments

15:40–15:55	TuC02.5

Tracking Natural Guidewire Manipulations with an Improved Data Glove

Xiao-Hu Zhou, Gui-Bin Bian and Zeng-Guang Hou*
The State Key Laboratory of Management and Control for Complex Systems, Institute of Automation, Chinese Academy of Sciences, China

- Guidewire manipulation models are proposed using an improved data glove.
- The tracking functions between the surgeon's manipulations and guidewire motions are established according to the models.
- Radial rotation tracking error is 20.24±8.38 (°) and axial advancement tracking error is 0.99±0.81 (mm) at a medium delivery speed.



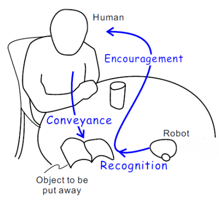
Experimental setup for tracking natural guidewire manipulations

15:55–16:10	TuC02.6

Can object-exclusion behavior of robot encourage human to tidy up tabletop ?

Manabu Gouko
Dept. of Mechanical Engineering and Intelligent Systems, Faculty of Engineering, Tohoku Gakuin University, Japan
Chyon Hae Kim
Dept. of Electrical Engineering and Computer Science, Faculty of Engineering, Iwate University, Japan

- Development of a robotic system that assists in tidying up a table through cooperation with a human.
- In this system, the robot encourages people to tidy up the disordered objects.
- Investigation of the influence of a robot's behavior on participants' tidying up motivation.



Concept of our system

Flying Robots & Biologically Inspired Robot

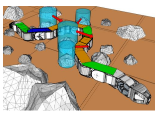
Chair *Filippo Sanfilippo, Norwegian University of Science and Technology (NTNU) in Trondheim*
Co-Chair *Xian GUO, Nankai University*

14:40–14:55	TuC03.1

Virtual Functional Segmentation of Snake Robots for Perception-Driven Obstacle-Aided Locomotion

Filippo Sanfilippo[1], Øyvind Stavdahl[1], Giancarlo Marafioti[2], Aksel Andreas Transeth[2], Pål Liljebäck[1]
[1]Dept. of Engineering Cybernetics, NTNU, Norway
[2]Dept. of Applied Cybernetics, SINTEF ICT, Norway

- A simplified snake robot model is proposed to deal with a lower-dimensional system that allows for establishing the foundation elements of perception-driven obstacle-aided locomotion.
- A virtual partitioning of the snake into parametrised virtual functional segments (VFS) is presented based on the concept of virtual constraints (VC).
- The robot joint space can be reduced into a lower-dimensional space for articulation.



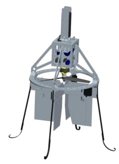
Parameterised virtual functional segments (VFS) for perception-driven obstacle-aided locomotion.

14:55–15:10	TuC03.2

Controller Design and Experiment of the Ducted-Fan Flying Robot

Shangqiu Shan and Zhongxi Hou
College of Aerospace Science and Engineering, National University of Defense Technology, China
Senlin Wang
Quanzhou Institute of Equipment Manufacturing, Haixi Institutes, Chinese Academy of Sciences, China

- The ducted-fan UAV dynamics model is built
- An attitude controller is designed based on the robust servomechanism linear quadratic regulator
- Simulation results show that the closed system performs excellently in terms of the time and frequency domain
- An open-source hardware is utilized to conduct the flight experiment



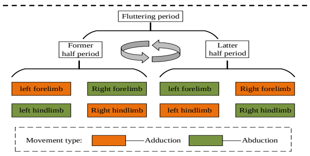
Miniature Ducted-Fan UAV

15:10–15:25	TuC03.3

A Research on Air Posture Adjustment of Flying Squirrel Inspired Gliding Robot

LI Xuepeng, WANG Wei, WU Shilin, ZHU Peihua, WANG Linqing
Robotics Institute, Beihang University, China

- A novel air posture adjustment manner, WGG model, inspired by flying squirrels is proposed .
- The concept prototype is built and the experiment is carried out to testify feasibility of WGG model.



Gait movement principle in the WGG model

- The results show acceptable feasibility of the air posture adjustment manner. But, the aerodynamics in roll and yaw directions of WGG model have a coupling effect on the pitch moment.
- In the future work, the deformation of flexible membrance will be analyzed and the feedback control for the posture adjustment will be considered.

15:25–15:40	TuC03.4

A Stereo Camera-Equipped Quadrotor Platform for Vision Based Nonlinear Control

Fuquan Dai
School of Mechanical and Automotive Engineering, Fujian University of Technology, China
Kai Wang
R&D Department, Corechips Technology Co. Ltd, China
Penghong Lin
Control and Simulation Center, Harbin Institute of Technology, China

- A stereo camera-equipped quadrotor platform is introduced in this paper, which is suitable for showing the engineering students how the vision based nonlinear controller can be theoretically designed and practically implemented
- A new dynamic visually servoed trajectory tracking controller is proposed by embedding a novel adaptive estimator into this controller to estimate the position of the quadrotor online
- Through the detailed theoretical derivation and a related experiment, the students can be thoroughly taught how to apply the vision based nonlinear control laws to the introduced quadrotor platform, and how to develop an original idea and design experiments to validate it

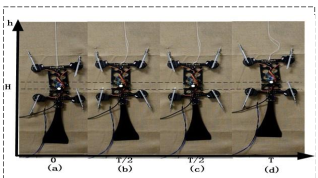
The experiment setup

15:40–15:55	TuC03.5

Configuration and Trajectory Optimization for a Gecko Inspired Climbing Robot with a Pendular waist

Peihua Zhu, Wei Wang, Shilin Wu, Xuepeng Li, Fanguang Meng
Robotics Institute, Beihang University, China

- The waist joint elastic coefficient has significant effect on the driving force.
- Configuration and trajectory optimization is verified by the prototype experiments .



The prototype crawl diagonal gait

- The results indicate that the rationality of the big gecko bionic configuration.
- Further studies should be focus on analysis energy consumption for a climbing process.

15:55–16:10	TuC03.6

Manipulation & Workspace Analysis of Dexclar: A Newly formed Dexterous Gripper

Nahian Rahman, Luca Carbonari, Darwin G. Caldwell and Ferdinando Cannella
Advanced Robotics Department of Istituto Italiano di Tecnologia, Genoa, Italy

- Dexclar (***DEX****terous,* ***re******C****onfigurable, modu****LAR***) is developed to solve Grasp, Manipulation, Release problems.
- In-hand manipulation such as **twist, flip, re-grasp** are difficult to achieve from a **RIGID gripper structure.** *(Where flexible hands are good at)*
- Dexclar is consists of 4 modular fingers in two pairs.
- Each modular finger has 4 degree of freedom**. Five bar mechanism** (2 DOF) and a **ball screw mechanism** (2 DOF) are conceived for grasping and manipulation.

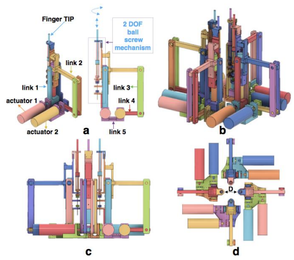


Fig. a) One modular finger b) the four fingered Dexclar gripper and c) front view d) top view of Dexclar

Human-Machine Interface

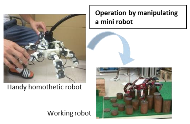
Chair *Junji Takahashi, Aoyama Gakuin University*
Co-Chair *Chi Zhu, Maebashi Institute of Technology*

14:40–14:55	TuC04.1

Direct Tele-teaching with Handy Homothetic Robot for Multi-limbed Working Robot

Toshihiko Inoue, Yasushi Mae,
Masaru Kojima and Tatsuo Arai
Department of Systems Innovation, Osaka University, Japan

- Proposes a direct motion tele-teaching system for tele-operation of multi-limbed working robots
- The system is divided into the two phase: operating swing limbs and operating supporting limbs
- In operating supporting limbs, we constructed the limb-controlling system to keep constraint conditions



Concept of direct tele-teaching

14:55–15:10	TuC04.2

A Novel Approach for Assessing Prospective Memory using Immersive Virtual Reality Task

Dong Dong, Lawrence KF Wong, Zhiwei Luo and Changqin Quan
Graduate School of System Informatics, Kobe University

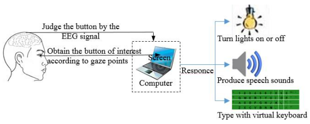
- Uses immersive virtual reality technology to develop a more real-life like prospective memory test environment, and ask the subjects to perform common shopping task in it.
- Comparing the VR Task with the standard slide- based task.
- Results suggested that our VR task has the potential to evaluate the perspective memory performance in daily life condition more accurately.

15:10–15:25	TuC04.3

Development of a Human Computer Interaction System Based on Multi-Modal Gaze Tracking Methods

Shuning Han, Rensong Liu and Feng Duan
Nankai University, P. R. China
Chi Zhu
Maebashi Institute of Technology, Japan
Yew Guan Soo
Universiti Teknikal Malaysia Melaka, Malaysia
Haoyong Yu
National University of Singapore, Singapore
Tianming Liu
University of Georgia, USA

- A **HCI** system for the **locked-in syndrome** patients is presented which combines the **eye movement signals** and **EEG signals**.
- The system can respectively realize the light switch **control**, voice **interaction** and **typing** by a virtual keyboard.
- The system can **eliminate user's fatigue** to a degree and has rather high accuracy.



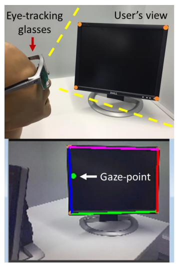
The HCI system structure diagram

15:25–15:40	TuC04.4

Development of an Eye-Gaze Controlled Interface for Surgical Manipulators Using Eye-Tracking Glasses

<u>Hiu Man Yip</u>, David Navarro-Alarcon, and Yun-hui Liu
Dept. of MAE, The Chinese University of Hong Kong, HKSAR

- An eye-controlled interface is developed for the hand-busy surgeon to control the robot
- The monitor which provides the endoscopic or laparoscopic feedback is used as the control landmark
- The user's commands are determined based on the distance between the gaze-point and the monitor's features
- Experiments were conducted to verify the feasibility of this eye-controlled interface

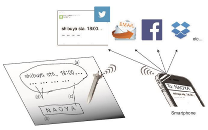


15:40–15:55	TuC04.5

Trajectory Reconstruction Algorithm based on Sensor Fusion between IMU and Strain Gauge for Stand-alone Digital Pen

Naoya Toyozumi, Junji Takahashi and Guillaume Lopez
Graduate School of Science and Engineering, Aoyama Gakuin University, Japan

- There are still some people who do not fit in with digital environment such as using keyboard, mouse, touch-pad and so on.
- To resolve the problem, we have proposed the pen based interface system.
- The system enables the digital operation such as sending mails and posting on SNS with handwriting.
- We develop trajectory reconstruction algorithm using IMU(Inertial Measurement Unit) and strain gauge for pen based digital operation.



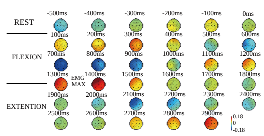
The concept of digital operation through pen based interface system

15:55–16:10	TuC04.6

Investigation of the EEG Scalp Distribution for Estimation of Shoulder Joint Torque in the Upper-Limb Power Assistant System

H. Liang, C. Zhu, M. Yoshioka, N. Ueda, Y. Tian, Y. Iwata
Department of Environment and Life Engineering, Maebashi Institute of Technology, Japan
H. Yu, Department of Bioengineering, National University of Singapore,
Y. Yan, Department of Bioengineering, Santa Clara University,
F Duan, Department of Automation, Nankai University

- The contribution of each electrode is analyzed by Principal Component Analysis.
- Independent Components Analysis is used to extract the source information of neural components.
- The transition of the EEG signals with time is analyzed.
- The results show that the changes of EEG signals are distributed throughout the brain cortex.
- The locations of electrodes at C3, C4, Cz, P3, P4 are the best ones for the measurements.



The EEG transition with time

Human-Robot Interaction

Chair *Takafumi Matsumaru, Waseda University*
Co-Chair *Liwei Zhang, Fuzhou University*

14:40–14:55	TuC05.1

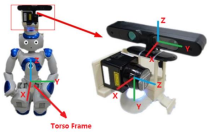
Task Execution Based-on Human-Robot Dialogue and Deictic Gestures

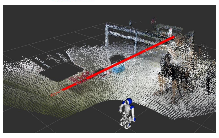
Peiqing Yan, Bingwei He, Liwei Zhang
School of Mechanical Engineering and Automation, Fuzhou University, China
Jianwei Zhang
Department of Informatics, University of Hamburg, Hamburg, Germany

- We use a sequence of verb clauses as the representation of natural language. Each verb clause informally represents an atomic natural language command dictated by the main verb; more formally, a verb clause C is a tuple:

$$C=(v,[mod]\ pati,r,recip)$$

- containing the verb v, a patient object [pati] to be manipulated, a recipient subject/object [recip], and relationship r (e.g. "to", "for", "on" and so on) between [pati] and [recip].



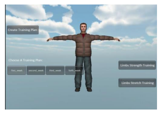


14:55–15:10	TuC05.2

A Personalized Limb Rehabilitation Training System for Stroke Patients

Weibin Wu[1,2], Deli Wang[1], Tianyunyang Wang[1] and Ming Liu[2,3]
[1]EIE College, Tongji, China
[2]MBE Department, CityU, Hong Kong, China
[3]ECE Department, HKUST, Hong Kong, China

- A cost-effective and personalized VR system for rehabilitation training
- Rehabilitative physicians can set different training plans for different patients
- Guide patients on limb stretching training and strength training
- Detect people's limb movements by wearable devices with small sensors and wireless communication modules



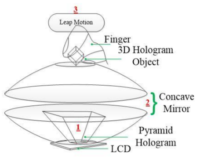
Main Interface of Our System

15:10–15:25	TuC05.3

Interactive Aerial Projection of 3D Hologram Object

Mahfud Jiono and Takafumi Matsumaru
Graduate School of Information, Production and System, Waseda University, Japan

- The reconstruction of 3D hologram object is realized by using pyramid hologram with LCD display.
- The projection of 3D hologram object in the mid-air is achieved with the parabolic mirror hologram.
- Interactive manipulation of 3D hologram object by using Leap Motion sensor (to detect user finger movement).



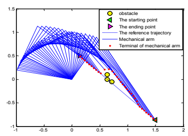
Design Principle of Aerial projection system

15:25–15:40	TuC05.4

A closed loop control algorithm for obstacle avoidance based on the transformation of master and slave tasks

Ping Hu, Xuan Liu, Kexiang Li, Jinchang Liu, Jianhua Zhang, Minglu Zhang
Department of Mechanical Engineering Hebei University of Technology, Tianjin
High Technology Research and Development Center of the Ministry of Science and Technology, Beijing, China

- The algorithm is based on the transformation of master-slave task
- The algorithm is a closed loop control algorithm
- The end of the mechanical arm can track the desired trajectory with high accuracy
- The algorithm is also effective for many obstacles and dynamic obstacle.



The new algorithm for many obstacles

15:40–15:55	TuC05.5

Body Activity Interaction for a Service Robot

Kang Li, Ning An, Xiaoguang Zhao, Shiying Sun, and Min Tan
the State Key Laboratory of Management and Control for Complex Systems, Institute of Automation, Chinese Academy of Sciences, Beijing, China.

- In this paper, we have developed a novel body activity interaction system for a service robot to implement human-robot interaction friendly.
- This system consists of human action recognition module and robot arm motion control module.
- Human action recognition depends on the RGBD and skeleton information from Kinect.
- Robot arm motion control includes kinematic modeling and motion planning.

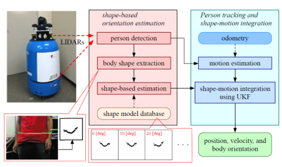
Handshaking interaction

15:55–16:10	TuC05.6

LIDAR-based Body Orientation Estimation by Integrating Shape and Motion Information

Masanobu Shimizu*, Kenji Koide*, Igi Ardiyanto**, Jun Miura*, and Shuji Oishi*
*Department of Computer Science and Engineering
Toyohashi University of Technology, Japan
**Department of Electrical Engineering and Information Technology
Faculty of Engineering, Universitas Gadjah Mada, Indonesia

- We propose a method of estimating human body orientation with LIDAR.
- It integrates shape and motion information obtained by a LIDAR and a UKF tracker for more reliable body orientation estimation.
- The method is also implemented on a real robot and successfully applied to a following robot scenario.



Outline of tracking and orientation estimation

Latest I (Vision)

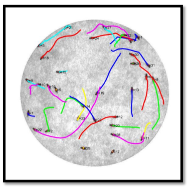
Chair *Yasushi Iwatani, Hirosaki University*
Co-Chair *Kundong Wang, Shanghai Jiaotong University*

16:30–16:45 TuD01.1

Multiple Drosophila Tracking with Heading Direction in Crossover and Touching Scenarios

Pudith Sirigrivatanawong and Koichi Hashimoto
Department of System Information Sciences, Tohoku University, Japan

- Drosophila Melanogaster (fruit fly) tracking in crossover and touching scenarios is discussed.
- Heading direction by wing detection is used to deal with the crossover and touching scenarios.
- Combination of assignment methods is applied in order to assign a unique identity to each fly.
- Having a video of multiple flies in a circular arena as an input, the output provides trajectories of each fly that can be used for further analysis.


Drosophila tracking trajectories

16:45–17:00 TuD01.2

On the Calibration of Active Binocular and RGBD Vision Systems for Dual-Arm Robots

Aamir Khan, Gerardo Aragon-Camarasaa, J. Paul Siebert
School of Computing Sciences, University of Glasgow, UK
Li Sun
Intelligent Robotics Lab, University of Birmingham, UK

- Integrating an active binocular robot head within a dual-arm robot.
- An overall sub millimetre accuracy of less than 0.3 millimetres while recovering the 3D structure of a scene.
- A comparative study between current RGBD cameras and our active stereo head within two dual-arm robotic testbeds that demonstrates the accuracy and portability of our proposed methodology.


Binocular Robot Head Mounted on Yaskawa Robot

17:00–17:15 TuD01.3

Position and Direction Estimation of Wolf Spiders, *Pardosa astrigera*, from Video Images

Yasushi Iwatani
Department of Science and Technology, Hirosaki University, Japan
Kaori Tsurui
Center for Strategic Research Project, University of the Ryukyus, Japan
Atsushi Honma
Okinawa Prefectural Plant Protection Center/University of the Ryukyus, Japan

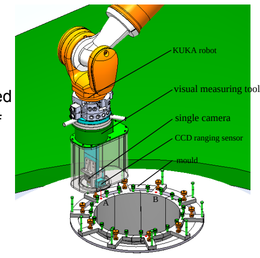
- The final objective in this research is to characterize hunting locomotion of the wolf spider.
- This paper proposes an image processing procedure to estimate the position and direction of a wolf spider from video images.
- The position and direction are estimated by using image moments of the whole body and some parts of the body.

17:15–17:30 TuD01.4

The Research on Attitude Correction Method of Robot Monocular Vision Positioning System

Feilong Zhang
Shenyang Institute of Automation, Chinese Academy of Sciences, Shenyang 110016, China

- A correction method based on DLS for the monocular vision positioning system is proposed
- The attitude correction angle $\phi(\alpha,\beta,\gamma)$ of the monocular vision positioning system is solved
- The experiment has verified the reliability of attitude correction method for monocular vision positioning system
- A depth measurement error compensation method for attitude correction is proposed



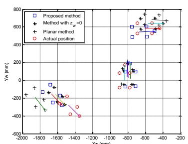
Attitude Correction

17:30–17:45 TuD01.5

A Monocular Vision System for Pose Measurement in Indoor Environment

Lingyi Xu
Department of Electrical and Computer Engineering, Rutgers University, USA
Zhiqiang Cao, Xilong Liu
Institute of Automation, Chinese Academy of Sciences, Beijing 100190, China

- The camera is mounted on the ceiling, its optical axis is not limited to be perpendicular to the ground
- The world frame is defined by a reference chessboard, whose pose relative to the camera is calibrated
- It is able to give the orientation angle and 3D position of the specified arrow target in the world frame using a single image


Actual position and measured position of landmarks

Latest II (Hand & Manipulation)

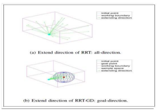
Chair *Fuchun Sun, Tsinghua University*
Co-Chair *Akio Namiki, Chiba University*

16:30–16:45	TuD02.1

RRT-GD: An Efficient Rapidly-exploring Random Tree Approach with Goal Directionality

Junxiang Ge and Fuchun Sun
Computer Science & Technology, Tsinghua University, China
Chunfang Liu
Computer Science & Technology, Tsinghua University, China

- RRT-GD uses much less time and iteration times compared to RRT
- RRT-GD can perform the path planning real-timely.
- Within our experiments, RRT-GD could succeed as long as RRT method succeed.



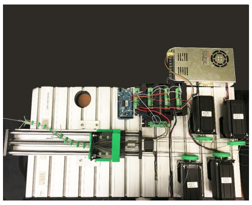
16:45–17:00	TuD02.2

Motion Control of a Bio-Inspired Wire-Driven Multi-backbone Continuum Minimally Invasive Surgical Manipulator

Tingyu QU[1], Jie Chen[1], Shen Shen[1],
Zhen Xiao[2], Zhe Yue[2] and Henry Y.K. Lau[1]
[1]The University of Hong Kong, Hong Kong
[2]Xi'an Jiaotong University, China

The Two-section Continuum Surgical Manipulator is Characterized with Three Major Priorities:

1. Nonlinearity is cancelled by introducing the spaced thin disks;
2. Bending of the distal section introduces a less significant interference on the proximal section;
3. The super-elastic backbone enables the manipulator to bend in an arbitrary direction without the blind zone.

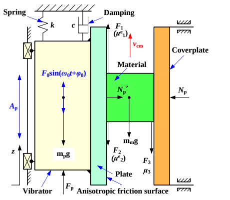


17:00–17:15	TuD02.3

Analysis of Material Movement on a Vertically Vibratory Plate with Anisotropic Friction Surface

Huazhi Chen, Shengyuan Jiang, Peng Li, Yi Shen and Weiwei Zhang
School of Mechatronics Engineering, Harbin Institute of Technology, China

- A vertical vibration conveying method based on the anisotropic friction surface (AFS) is proposed
- The larger difference value of equivalent coefficient of sliding friction, maximal exciting force and vibration frequency lead to higher conveying speed
- The initial phase φ_0 slightly affects conveying velocity while brings a relatively maximal value when φ_0 = π/2 or 3π/2



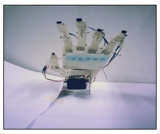
Vertical vibration conveying model based on anisotropic friction surface

17:15–17:30	TuD02.4

Design Analysis and Development of Low Cost Underactuated Robotic Hand

Parag Khanna, Khushdeep Singh
K.M.Bhurchandi, and S.Chiddarwar.
Visvesvaraya National Institute of Technology, Nagpur, India

- Development of a Cost efficient, 3D printed, Light weight Robotic hand.
- Fingers are Under-actuated and Adaptiveness achieved through Tendon compliance based on Kinematic and Dynamic Analysis.
- Proximity sensors on Finger Tips for object detection which enables Finger Actuation for User Controlled Grasping.



IVLABS Robotic Hand

Latest III (Humanoid & Mobile Robot)

Chair *Yantao Shen, University of Nevada, Reno*
Co-Chair *Keitaro Naruse, University of Aizu*

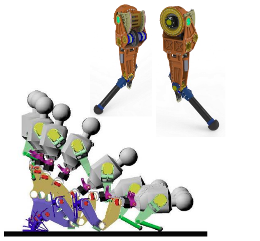
16:30–16:45	TuD03.1

Falling Protective Method for Humanoid Robots using Arm Compliance to Reduce Damage

Yuhang ZHOU, Xuechao CHEN, Huaxin LIU, Zhangguo YU, Weimin ZHANG and Qiang HUANG

Intelligent Robotics Institute, Beijing Institute of Technology
Beijing, China

- Compliant protective arms are designed to make up the mechanical protection during falling down.
- A falling protective method is proposed to reduce the touchdown damage during falling forward.
- Simulations have been achieved using compliance control.



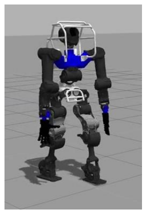
The Falling Protective Method with Arm Compliance

16:45–17:00	TuD03.2

Straight Leg Walking Strategy for Torque-controlled Humanoid Robots

Yangwei You, Songyan Xin, Chengxu Zhou, Nikos Tsagarakis
Department of Advanced Robotics, Istituto Italiano di Tecnologia

- Desired CoM height is set slightly over the maximum reachable one for LIPM planning
- The legs are straightened by low-level controller to reach vertical reference meanwhile ensure kinematic and dynamic feasibility.
- A human-like straight leg walking is realized with low torque requirement in knee joints and high energy efficiency.



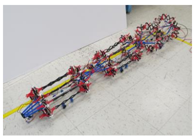
WALK-MAN straight leg walking

17:00–17:15	TuD03.3

Scissor Mechanisms Enabled Compliant Modular Earthworm-like Robot: Segmental Muscle-Mimetic Design, Prototyping and Locomotion Performance Validation

Yudong Luo, Na Zhao and Yantao Shen
Dept. of Electrical and Biomedical Engineering, University of Nevada, Reno, USA
Kwang J. Kim
Dept. of Mechanical Engineering, University of Nevada, Las vegas, USA

- Presented a compliant modular earthworm-like robot based on scissor mechanisms
- Demonstrated the novel segmental muscle-mimetic design unit
- Described the actuation and transmission mechanisms of the robot
- Simulation and experimental results verified the peristaltic locomotion performance of robot



Scissor Mechanisms Enabled Compliant Modular Earthworm-like Robot

17:15–17:30	TuD03.4

Collision Identification in Weeding Robot with Acceleration Standard Deviation

Haruna Nakazawa
Graduate School of Computer Science and Engineering, University of Aizu, Japan
Keita Nakamura
Revitalization Center, LiCTiA, University of Aizu, Japan
Keitaro Naruna
Graduate School of Computer Science and Engineering, University of Aizu, Japan

- Our research group has developed a weeding robot for the rice field.
- We define collision identification equation for the robot based on acceleration standard deviation.
- Experimental results show the robot can identify whether collision state or not by only moving direction acceleration.

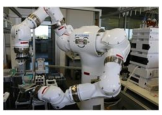
Aigamo robot collides with the wave sheet.

17:30–17:45	TuD03.5

Flexible Robot Platform for Sample Preparation Automation with a User-friendly Interface

Xianghua Chu, Thomas Roddelkopf and Kerstin Thurow
Center for Life Science Automation, University of Rostock, Germany
Heidi Fleischer and Norbert Stoll
Institute of Automation, University of Rostock, Germany
Michael Klos
Yaskawa Europe GmbH, Germany

- Dual-arm robot platform for automated sample preparations
- The robot handles conventional manual tools to prepare samples
- A user-friendly interface enables the designing of processes
- Concept of motion element is defined



Robot platform for sample preparation automation

Latest IV (Flying Robots & Intelligent Systems)

Chair *De Xu, Institute of Automation, Chinese Acdamy of Sciences*
Co-Chair *Zhigang Xu, Chinese Academy of Sciences*

16:30–16:45	TuD04.1

Design and Analysis of Physical Simulation System for Satellite Rotating Panels

Meng Yin and Yun He
Shenyang Institute of Automation, Chinese Academy of Sciences, China

1.A method of flexible solar simulator based on air flotation.
2.Physical simulation system based on equivalent spindle inertia and flexible frequency.
3.Reduces the difficulty to simulate ground microgravity environment.
4. The rationality of the scheme is verified by the simulation results.

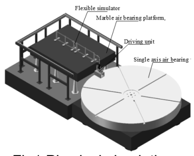


Fig1.Physical simulation experiment system

16:45–17:00	TuD04.2

Vision Based Emergency Landing Field Auto-selecting Method for Fixed-wing UAVs

Xilong Liu, Mingyi Zhang, Zhiqiang Cao, De Xu
Institute of Automation, Chinese Academy of Sciences, China
School of Computer and Control Engineering, University of Chinese Academy of Sciences, China

- A vision based method is proposed for fixed-wing UAV's emergency landing field auto-selecting and security analyzing
- A strip structure detector is designed to detect candidate landing fields.
- The relationship of image position, direction, the real length of a strip on the ground and its length in image is deduced.

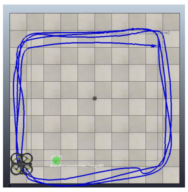

Fig. landing field auto-selecting

17:00–17:15	TuD04.3

A tracking error control approach for model predictive position control of a quadrotor with time varying reference

Jan Dentler, Somasundar Kannan,
Miguel Angel Olivares Mendez, Holger Voos
SnT, University of Luxembourg, Luxembourg

- Standard MPC control of constantly moving targets lead to a constant tracking error
- This tracking error can be reduced by adjusting the target position given to the MPC
- The desired behavior has been validated experimentally on a AR.Drone 2.0 quadrotor with a PI target position controller



17:15–17:30	TuD04.4

Effect of Bending Deformation on Flight Dynamics of a High-Aspect-Ratio Flying Wing

Zhaowei Liu, Zhongxi Hou, Wenkai Wang
College of Aerospace Science and Engineering,
National University of Defense Technology, China

- Investigation the effect of bending deformation on flight **longitudinal** dynamics based on small perturbation approach.
- Short period merge into two real roots as the deformation increases.
- The larger real root keeps increasing with the augment of deformation.
- The aircraft should prevent form being in large dihedral deformation to avoid the instability.

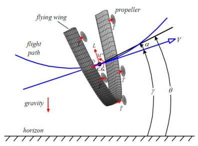


Figure Longitudinal motion of flying wing with large dihedral deformation

Latest V (Intelligent Cotrol)

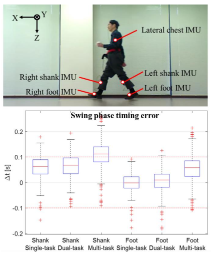
Chair *Yimin Zhou, Chinese Academy of Sciences*
Co-Chair *Ker-Jiun Wang, University of Pittsburgh*

16:30–16:45	TuD05.1

Comparison of Gait Event Detection from Shanks and Feet in Single-task and Multi-task Walking of Healthy Older Adults

W. Kong, J. Lin, S. Sessa, S. Cosentino, A. Takanishi
Waseda University, Japan
L. Waaning, D. Magistro, M. Zecca
Loughborough University, UK
R. Kawashima
Tohoku University, Japan

- Two algorithms were implemented to detect gait events from angular velocity of feet and shanks respectively.
- Experiments were conducted under single-task, dual-task, and multi-task scenario.
- Both algorithms were accurate in stride duration. But both overestimated the swing phase duration in dual- and multi-task.
- Shank-based algorithm had a better sensitivity but suffered from larger overestimation on swing phase duration.



16:45–17:00	TuD05.2

Analyzing the driving method for the ball tensegrity robot

Ani Luo, Heping Liu and Yuxuan Liu

17:00–17:15	TuD05.3

Influence of Loads and Design Parameters on Closed-Loop Performance of SEAs

Steffen Schütz, Atabak Nedjadfard, and Karsten Berns
Robotics Reserach Lab, University of Kaiserslautern, Germany

- Series Elastic Actuator are often deployed as a two-port system floating between two links.
- The Influence of actuator dynamics and two loads on closed-loop performance is investigated analytically.
- The analysis is based on an electric circuit model where the influential elements are highlighted.
- Two of the findings are validated in experiments using the RRLAB SEA.

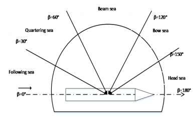
RRLAB SEA

17:15–17:30	TuD05.4

Ship Heading Control using LESO with Wave Disturbance

Yimin Zhou and Qingtian Wu
Shenzhen Institutes of Advanced Technology, CAS, China
Ronghui Li and Dongxing Zhao
Dalian Maritime University, China

- A linear extended state observer (LESO) is designed for ship heading control with wave disturbance via linear active disturbance rejection control (LADRC).
- The tracking ability and disturbance rejection capability of LESO has been analyzed.
- The tradeoff between the closed-loop stability and the system requirements, i.e., rudder, input actuator, can be achieved via parameter tuning and active disturbance filtering.



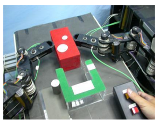
The diagram of the encountered angle of the ship

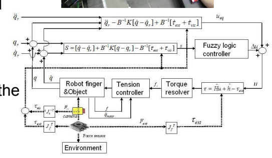
17:30–17:45	TuD05.5

Fuzzy Sliding Mode Joint Impedance Control for a Tendon-Driven Robot Hand Performing Peg-in-Hole Assembly

Ker-Jiun Wang
Department of Bioengineering, University of Pittsburgh, USA

- Design and implement Fuzzy Sliding Mode Joint Impedance Control (FSMJIC) combining visual and force feedback
- Realize compliance control in finger joint space to achieve the manipulated object compliance with guaranteed bandwidth and stability performance
- The Visual Impedance can enhance the impedance control performance
- The proposed control method can achieve the specified compliance, deal with model uncertainties, reject external disturbances, and solve the chattering problem





Poster Session III

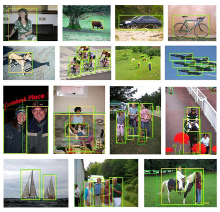
Chair *Chi Zhu, Maebashi Institute of Technology*
Co-Chair *Yong Yu, Kagoshima University*

14:40–17:00	TuPOS.1

Improved Saliency Detection based on Bayesian Framework for Object Proposal

Jie Li, Xia Yuan and Chunxia Zhao
School of Computer Science and Engineering,
Nanjing University of Science and Technology, China
Wei Xu
Digital Media Department, Huawei Software Technologies Co., Ltd., China

- Formalize the problem as an inference problem within a Bayesian framework.
- First a method to measure the global spatial compact distribution of the color components is proposed.
- Then by using a soft segmentation to get the prior probability map, the observation likelihood can be more accurately calculated.
- From this produced saliency map, an object proposal is performed using Non-Maximum Suppression sampling strategy.

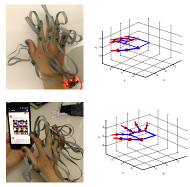


14:40–17:00	TuPOS.2

A novel data glove for fingers motion capture using inertial and magnetic measurement units

Bin Fang, Fuchun Sun, Huaping Liu, Di Guo
Department of Computer Science and Technology, Tsinghua University,China

- we propose a novel data glove embedded low cost MEMS inertial and magnetic measurement units for fingers motion capture..
- The data glove is equipped with fifteen units to measure each joint angle of the fingers.
- The fingers motion capture experiments are implemented to acquire the characteristics of the fingers and teleoperate the robotic hands.

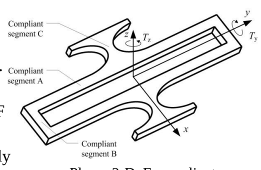


14:40–17:00	TuPOS.3

Modeling and Optimization of Planar 2-DoF Compliant Rotational Hinge

Kai Liu[1], Yi Cao[1, 2*], Shu-yi Ge[1], Rui Ding[1]
1. College of Mechanical Engineering, Jiangnan University,China
2. Jiangsu Key Laboratory of Advanced Food Manufacturing Equipment and Technology, Jiangnan University,China

- Design a new compliant rotational hinge for Lamain Emergent Mechanisms
- The planar 2-DoF compliant rotational hinge can realize rotation in-plane and out-of-plane.
- An optimization model is established to increase the rotating property of planar 2-DoF compliant.
- The rotating property is improved significantly with the rotational stiffness around y-axis and z-axis are decreased by 80.5% and 89.4%.



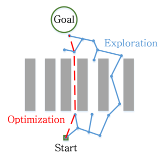
Planar 2-DoF compliant rotational hinge

14:40–17:00	TuPOS.4

Fast Convergence RRT for Asymptotically-optimal Motion Planning

Hong Liu, Risheng Kang and Zhi Wang
Key Laboratory of Machine perception and Intelligence, Peking University, Shenzhen Graduate School, CHINA

- It is of vital importance for a planner to quickly explore the C-space, especially for manipulations with multiple DoFs.
- Current optimal planning methods show inferior exploration rate.
- A novel optimal method with high exploration rate is proposed by decoupling the exploration and optimization procedure.
- Lazy-RRG method is introduced to accelerate the convergence rate of optimization procedure.

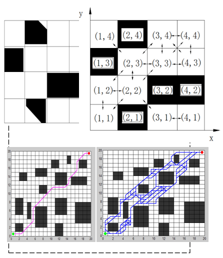


14:40–17:00	TuPOS.5

A Method of Trajectory Planning for Ground Mobile Robot Based on Ant Colony Algorithm

Yan Li, Yang Yang, Hao Xu, Xiangrong Xu
School of Mechanical Engineering
Anhui University of Technology, Ma'anshan, Anhui, China

- **We present a method of trajectory planning for mobile robots under an environment with obstacles.**
- **It is based on the improved ant colony algorithm approach.**
- **The mobile robot can autonomously avoid obstacles during the motion.**
- **With the method we can get an optimal or suboptimal motion trajectory based on rasterization environment model.**



14:40–17:00	TuPOS.6

An Approach to Restaurant Service Robot SLAM

Jinglin Zhang and Guolai Jiang
Shenzhen College of Advanced Technology, UCAS, P.R.China
Yongsheng Ou and Yimin Zhou
Shenzhen Institutes of Advanced Technology, CAS, P.R.China

- Creating a virtual laser scan from the depth camera
- Building motion model and measurement model
- Using Rao-Blackwellized particle filter to estimate robot pose
- Computing grid occupancy probabilities by log-odds ratio


The restaurant service robot platform

Poster Session III

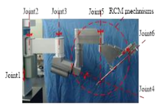
Chair *Chi Zhu, Maebashi Institute of Technology*
Co-Chair *Yong Yu, Kagoshima University*

14:40–17:00 TuPOS.7

Extended High-gain Observer based Adaptive Control of Flexible-joint Surgical Robot

Shuizhong.Zou, Bo.Pan, Yili.Fu, and Shuxiang.Guo
State Key Laboratory of Robotics and Systems, Harbin Institute of Technology, Harbin, China

- gravity and friction are fed forward to reduce the nonlinearity of the robotic manipulator.
- an extended high gain observer(EHGO) is used to estimate the velocity and acceleration.
- EHGO based adaptive controller is used achieve high precision position tracking control.



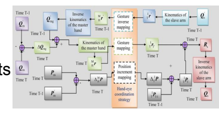
The celiac minimally invasive surgical robot systems

14:40–17:00 TuPOS.8

Master-slave Control Technology of Isomeric Surgical Robot for Minimally Invasive Surgery

Yue Ai, Bo Pan, Guojun Niu, Yili Fu and Shuguo Wang
State Key Laboratory of Robotics and System,
Harbin University of Technology, China

- Solving workspace and structure mismatch problems between master hands and slave robotic arms;
- Realizing position and gesture readjustments of the master manipulators;
- Realizing exchange function between the instrument-holding arm and laparoscope-holding arm;
- Realizing hand-eye coordination control ;



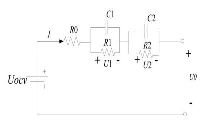
Master-slave control strategy

14:40–17:00 TuPOS.9

Modeling and SOC Estimation of LiFePO4 Battery

Peng Cheng, Yimin Zhou, Zhibin Song and Yongsheng Ou
Shenzhen Institutes of Advanced Technology,
Chinese Academy of Sciences, Shenzhen, China

- An improved Extended Kalman Filter (EFK) algorithm is proposed to estimate the parameters in the least squared identification model.
- To estimate the state of charge (SOC) of LiFePO4 battery more accurately;
- A second-order RC equivalent circuit is used as the battery model.
- A fuzzy controller is applied to online adjust measurement noise variance.



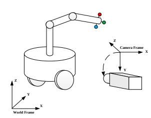
The battery equivalent circuit model

14:40–17:00 TuPOS.10

Uncalibrated Visual Servoing of Mobile Manipulators with an Eye-to-hand Camera

Hao Xu ,Hesheng Wang and Weidong Chen
School of Electronic Information and Electrical Engineering,
Shanghai Jiaotong University, China

- The depth-independent Jacobian matrix is combined with the non-holonomic Jacobian matrix of the mobile manipulator
- Dynamical visual servoing scheme without the prior knowledge of depth regulating a mobile manipulator to a desired pose
- Parameter updating rule is developed to estimate the intrinsic and extrinsic parameters
- Asymptotic convergence of the image errors are proved theoretically and verified in the simulation



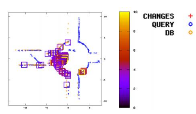
System Configuration

14:40–17:00 TuPOS.11

Local Map Descriptor for Compressive Change Retrieval

Kanji Tanaka
Graduate school of engineering, University of fukui, Japan

- A novel task of simultaneous localization and change detection is addressed for applications of long-term autonomy.
- The task is formulated as a combination of map retrieval and anomaly detection subtasks, which employs compressed bag-of-words model.
- Both subtasks are based on our novel compressed map representation, termed local map descriptor, which was originally presented in SII2014.



Simultaneous localization and change detection

14:40–17:00 TuPOS.12

A Novel Navigation System for Indoor Cleaning Robot

Zheng Zhao, Weihai Chen, Jingmeng Liu, Xingming Wu
School of Automation Science and Electrical Engineering, Beihang University, Beijing, China

- A novel navigation system for indoor cleaning robot is proposed.
- Localization algorithm, stereoscopic vision, wireless network, and human-machine interaction are integrated together.
- Experiments are conducted to validate this novel navigation system.

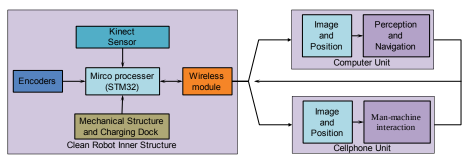


Fig 1. Structure of the novel navigation system

Poster Session III

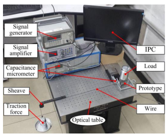
Chair *Chi Zhu, Maebashi Institute of Technology*
Co-Chair *Yong Yu, Kagoshima University*

14:40–17:00	TuPOS.13

Design of a piezoelectric wheelbarrow applicable to stick-slip motion study

Shupeng Wang and Weibin Rong
State Key Laboratory of Robotics and System,
Harbin Institute of Technology, China

- A piezoelectric wheelbarrow based on stick-slip principle is proposed
- A series of experiments are carried to investigate the performance of the wheelbarrow
- The wheelbarrow can achieve various velocities by changing driving voltage and frequency.
- The wheelbarrow is applicable to study stick-slip motion.



The established experimental system.

14:40–17:00	TuPOS.14

Operation Assistance Using Visual Feedback with Considering Human Intention on Master-Slave Systems

Kenta NEGISHI, Yang LIU, Tomohiro MARUYAMA,
Yosuke MATSUMOTO, and Akio NAMIKI
Faculty of Engineering, Chiba University, Japan

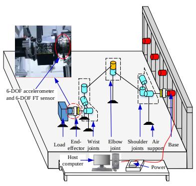
- **A method for improving maneuverability of master-slave systems.**
- **Assist control for reaching motion**
  - **Visual recognition of target object**
  - **Prediction of operator's motion**
  - **Estimation of operator's intention**
  - **Operation assistance of reaching**

14:40–17:00	TuPOS.15

Design of 6-DOF Accelerometer and Application in Impedance Control of Manipulators with Flexible Joints

Tian Zou, Fenglei Ni*, Chuangqiang Guo, Kui Li, Hong Liu, *Member, IEEE*
State Key Laboratory of Robotics and System(HIT),Harbin, China

- A 6-DOF acceleration sensor based on 8 dual-axis linear accelerometers was proposed
- Error model of the sensor was, experimental results in static indicated the validity of the error
- A Kalman Filter was designed to fuse the information of 6-DOF accelerometers and 6-DOF FT sensor to compensate the inertial force during the during the contact transition of impedance control

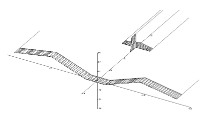

Experimental setup for the impedance control

14:40–17:00	TuPOS.16

Modelling and Simulation of Flight Dynamics for a Gull-wing

Tianhao Guo, Zhongxi Hou and Zhaowei Liu
College of Aerospace Science and Engineering,
National University of Defense Technology, Changsha, China

- Decoupled **quasi-rigid body** dynamic model for morphing aircrafts are developed.
- **Additional forces and moments** caused by the morphing are expressed analytically for gull-wings.
- Aerodynamic parameters are calculated by the **vortex lattice** approach.
- Simulation responses show that asymmetric wing morphing largely **increases the lateral maneuverability**.

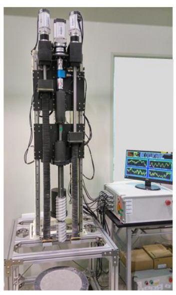

Aerodynamic Model of Gull-Wing in AVL

14:40–17:00	TuPOS.17

Development of an Inchworm-type Drilling Test-bed for Planetary Subsurface Exploration and Preliminary Experiments

Weiwei Zhang and Shengyuan Jiang
School of Mechatronics Engineering, Harbin Institute of Technology, China

- An Inchworm Boring Robot(IBR) was proposed for planetary subsurface exploration.
- For testing the drilling load characteristics of IBR, an inchworm-type drilling test-bed was proposed and developed.
- Drilling experiments with different drilling parameters had been conducted to test drilling moments of the tools.
- The effect of drilling parameters on tools moments were discussed and the recommend parameters are given.


Prototype of the test-bed

14:40–17:00	TuPOS.18

Prototype stationery holder robot that encourages office workers to maintain a tidy desktop

Akihiro Ogasawara and Manabu Gouko
Division of Engineering, Tohoku Gakuin University, Japan

- We describe a tidying up robot that is expected to improve work efficiency.
- This robot is developed based on human-robot interaction and encourages a user to tidy up their desktop when it is disorderly.
- We report the results of a preliminary experiment to determine if orderly conditions increase work efficiency.

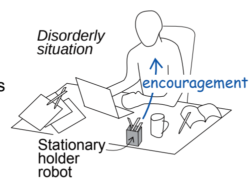


Fig. Proposed system

Poster Session III

Chair *Chi Zhu, Maebashi Institute of Technology*
Co-Chair *Yong Yu, Kagoshima University*

14:40–17:00 TuPOS.19

IEEE International Conference on Robotics and Biomimetics 2016

Stereo reconstruction error analysis for spatial circle based on calibration parameters disturbance model

Tian Zhang
Shenyang Institute of Automation (SIA)
Chinese Academy of Sciences

State Key Laboratory of Robotics, Chinese Academy of Science

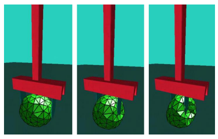
14:40–17:00 TuPOS.20

Implementation of a Soft-Rigid Collision Detection Algorithm in an Open-Source Engine for Surgical Realistic Simulation

Francesco Fazioli, Fanny Ficuciello,
Giuseppe Andrea Fontanelli, Luigi Villani, Bruno Siciliano

Interdepartmental Center for Advances in Robotic Surgery
University of Naples Federico II

- Implementation of a fast soft-rigid collision detection algorithm in an open source engine
- The algorithm is able to find the collisions between generic convex and thin rigid objects and soft objects
- An haptic device is used to provide haptic feedback to the surgeon

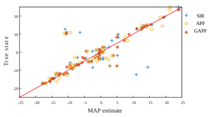


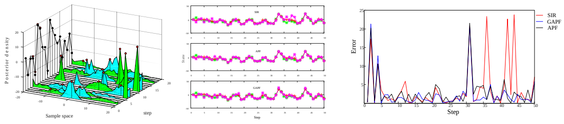
14:40–17:00 TuPOS.21

Gauss based Auxiliary Particle Filter

Shuai Yuan, Haolin Song, Monkam Patrice, Fenglong Kan and Feng Zhang
[1] Shenyang Jianzhu University. Shenyang, 110168, China

Gauss based Auxiliary Particle Filter algorithmintroduces the observed information of the current time into the importance probability density function and makes full use of the current observation value to estimate the actual state. During the resampling step, the particles are redistributed by using a Gaussian transformation. At the same time the weights of particles are adjusted to improve the diversity and accuracy of the samples.





14:40–17:00 TuPOS.22

STD: A Stereo Tracking Dataset for Evaluating Binocular Tracking Algorithms

Zheng Zhu, Wei Zou, Qingbin Wang, and Feng Zhang
1. Institute of Automation, Chinese Academy of Sciences
2. University of Chinese Academy of Science

- A Stereo Tracking Dataset is proposed for evaluating binocular tracking algorithms
- The dataset contains stereoscopic videos which are collected by our mobile platform in different scenarios and videos that are available publicly
- All sequences are carefully synchronized and rectified, and the ground truth of object is annotated by authors

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C, CC: Session Chairs

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