Luigi Iannelli
Curriculum Vitæ et Studiorum
Updated November 11, 2024

Personal data

Associate Professor of Automatic Control at the University of Sannio in Benevento, Italy

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He was born on April 5, 1975

Languages: Italian, native; English, fluent.

IEEE (Institute of Electrical and Electronic Engineers) Senior Member.

IEEE Control Systems Society Member.

IEEE Circuits and Systems Society Member.

Education

February 12, 2003
Ph.D. degree in Information Engineering (curriculum in Automatic Control) at the University of Napoli Federico II (Italy). Thesis title:"Dithering for smoothing relay feedback systems: an averaging approach"; advisors: Prof. Franco Garofalo and Prof. Francesco Vasca.

June 30, 1999
"Laurea" degree in Computer Engineering obtained from the University of Sannio in Benevento (Italy) with full marks ("summa cum laude"). Thesis title: "A new technique for the dynamic compensation of SAR converters nonlinearities"; advisors: Prof. Pasquale Daponte and Prof. Pasquale Arpaia.

Academic appointments

May 2024 —
Professor of Automatic Control at the University of Sannio in Benevento, Italy, Department of Engineering.

May 2016 — April 2024
Associate Professor at the University of Sannio in Benevento, Italy, Department of Engineering.

December 2004 — May 2016
Assistant Professor (Ricercatore Universitario) at the University of Sannio in Benevento, Italy, Department of Engineering.

July 2003 — December 2004
PostDoc position at the Department of Computer and Systems Engineering, University of Napoli Federico II.

March — May 2003
Postdoc researcher and teacher at the Royal Institute of Technology (KTH), Stockholm, Sweden.

January — July 2002
Visiting student at the Royal Institute of Technology (KTH), Stockholm, Sweden.

Professional and scientific appointments

October 2018
Full Professorship qualification (call 2016) obtained from the Italian Ministry of University and Research.

January 2014
Associate Professorship qualification (call 2012) obtained from the Italian Ministry of University and Research.

March 2012
IEEE Senior Membership obtained from Institute of Electrical and Electronics Engineers.

January 2005
Co-founder of the company Mosaico Monitoraggio Integrato s.r.l., a small enterprise working in the field of industrial automation.

February 2000
Qualification as Italian professional engineer obtained from the University of Napoli Federico II, Italy.

Research areas

Autonomous systems; distributed control and optimization over networks; nonsmoooth systems; piecewise quadratic stability; smart grids; power electronics; automotive control.

Other skills and expertise

Programming languages: C, Matlab/Simulink, Python. LaTeX. Distributed version control systems: Git, Mercurial.

Research projects and collaborations

Scientific responsibility for the Univeristy of Sannio of the network agreement for establishing a professional and technical regional (Molise) center for manufacturing and artisanship (**Accordo di Rete per la costituzione del Polo Tecnico Professionale "Manifattura e Artigianato 4.0"**). January 2024 – today.

Participation and scientific co-responsibility of the research collaboration between Ricerca sul Sistema Energetico (RSE) S.p.A and the Engineering Department of University of Sannio. Title: **"Sviluppo di modelli misto-interi e formalizzazione di un problema di ottimizzazione per la pianificazione della ricarica in contesti V2G"** ("Mixed-Integer modeling and formalization of an optimization problem for planning electric vehicles recharging in V2G systems"). Project amount: 30 kEuros. April 2023 - March 2024.

Participation and scientific responsibility (local unit) within the H2020-ECSEL-2018-2-RIA European research project, project number 826610. Title: **"COMP4DRONES, Framework of key enabling technologies for safe and autonomous drones' applications"**. October 2019 — January 2023. Project amount: 285 kEuros (only related to University of Sannio activities).

Participation and operative responsibility within the FP7 European research project ICT-2011-8, project number 318184. Title: **"I3RES, ICT-based intelligent management of Integrated RES for the smart grid optimal operation"**. November 2012 — October 2015. Project amount: 429 kEuros (only related to University of Sannio activities).

Participation and operative responsibility of the research collaboration between FIAT PowerTrain Technologies S.p.A. and the Engineering Department of the University of Sannio. Title: **"TMS controls: transmission modeling for HIL simulation"**. Project amount: 40 kEuros. May 2012 — December 2014.

Participation and operative responsibility within the research project PON01_01878 LOW-NOISE co-funded by Ministero per l'Università e la Ricerca, PON 2007-2013. Title: **"Nuove tecnologie e materiali per l'abbattimento del rumore degli autoveicoli"** ("New technologies and materials for the noise reduction in vehicles"). June 2012 — November 2015. Project amount: 235 kEuros (only related to University of Sannio activities).

Participation and operative responsibility within the research project PON01_01517 METODOLOGIE co-funded by Ministero per l'Università e la Ricerca, PON 2007-2013. Title: **"Metodologie innovative di sviluppo di motopropulsori automobilistici"** ("Innovative methodologies for the development of automotive engines"). January 2011 — June 2014. Project amount: 478 kEuros (only related to University of Sannio activities).

Participation and operative responsibility within the research project PON01_00595 SFERE co-funded by Ministero per l'Università e la Ricerca, PON 2007-2013. Title: **"Sistemi ferroviari: ecosostenibilità e risparmio energetico"** ("Railway systems: eco-sustainability and energetic efficiency"). January 2011 — October 2015. Project amount: 858 kEuros (only related to University of Sannio activities).

Participation and scientific co-responsibility within the research collaboration between AnsaldoBreda S.p.A. and the Engineering Department of University of Sannio. Title: **"Simulatore del transito di veicoli ferroviari per il calcolo dei relativi consumi energetici"** ("Simulation platform aimed to the evaluation of efficiency and consumption of railway vehicles"). March 2011 — July 2012. Project amount: 38.5 kEuros (only related to University of Sannio activities).

Participation and scientific co-responsibility within the research collaboration between AnsaldoBreda S.p.A. and the Engineering Department of University of Sannio. Title: **"Studio di impedenze equivalenti per convertitori elettronici e di tecniche di sincronizzazione per inverter in parallelo"** ("Analysis of equivalent impedances for electronic converters and synchronization techniques for parallel inverters"). October 2009 — September 2010. Project amount: 21.5 kEuros (only related to University of Sannio activities).

Participation and operative responsibility within the research project **POSTRAIN** co-funded by Ministero per lo Sviluppo Economico, IPI2015. Topic: railway vehicles. March 2009 — July 2010. Project amount: 210 kEuros (only related to University of Sannio activities).

Participation and operative responsibility within the research project VIRNET-MEF co-funded by Regione Campania, POR 2000-2006, 3.17 activity. Title: **"VIRtual NETwork**

for Marketing and Loyalty Programs". August 2008 — March 2010. Project amount: 46 kEuros (only related to University of Sannio activities).

Participation and operative responsibility within the research collaboration between ELASIS S.c.p.A. and the Engineering Department of the University of Sannio. Title: **"Transmissibility characteristics of the dry clutch, learning algorithms and pattern tests for validation in a HIL environment"**. Project amount: 35 kEuros. May 2008 — December 2008.

Participation and scientific responsibility of the research collaboration between Ansaldo Sistemi Industriali S.p.A and the Engineering Department of University of Sannio. Title: **"Sistema di simulazione per l'analisi e la validazione real-time hardware in the loop di convertitori di potenza"** ("Simulation platform for analysis and real-time hardware-in-the-loop validation of control systems for power electronics converters"). Project amount: 26.4 kEuros. September 2007 - August 2008.

Participation and operative responsibility within the research collaboration between Ansaldo Breda S.p.A and the Engineering Department of the University of Sannio. Title: **"Real-time hardware-in-the-loop simulation for railway traction control systems"**. November 2006 — February 2008.

Participation and scientific co-responsibility of the research collaboration between ELASIS S.c.p.A. and the Engineering Department of the University of Sannio. Title: **"Electro-hydraulic actuation system for dry clutches"**. Project amount: 30 kEuros. May 2006 — March 2007.

Participation and scientific responsibility of the research collaboration between CSM S.p.A and the Engineering Department of University of Sannio. Title: **"Dynamic model for the estimation of the actuation capacity of electric motors for a stretch reducing mill plant"**. Project amount: 45 kEuros. November 2005 — March 2006.

Participation and operative responsibility within the research collaboration between CSM S.p.A and the Engineering Department of the University of Sannio. Title: **"Simulation models and simulators for complex production processes in the steel-making field"**. May 2004 — July 2007.

Participation at the FP5 European Research Project IST2001-37172. Title: **"SICONOS, SImulation and COntrol of NOnsmooth Systems"**. September 2002 — August 2006. Within the project he actively participated at the coordinating and research spending some periods at the European research partners.

Research visits[1]

October — December 2015, *University of Groningen*, Groningen, The Netherlands, Prof. Kanat Camlibel.

February 2014, *California Institute of Technology*, Pasadena CA, USA. Prof. Steven Low.

April 2013, *Doğuş University*, Istanbul, Turkey. Prof. Cem Göknar.

February 2013, *INRIA*, Grenoble, France. Dr. Vincent Acary and Dr. Bernard Brogliato.

October 2005, *Royal Institute of Technology*, Stockholm, Sweden. Prof. Karl Johansson.

[1] At least one week.

Invited talks

December 3rd, 2015 "The I3RES EU project: ICT based management for the smart grid optimal operation", University of Groningen, Groningen, The Netherlands.

November 25th, 2015 "A receding horizon approach for the optimal power in storage equipped electrical grids", University of Groningen, Groningen, The Netherlands.

November 19th, 2015 "A colored Gauss-Seidel approach for the distributed network flow problem", University of Groningen, Groningen, The Netherlands.

June 13th, 2015 "IoT technologies: new frontiers for scientific research", Make & Share event, Benevento, Italy.

May 16th, 2014 "Modeling and control of storage equipped electrical grids", (in teleconference) Universidad Industrial de Santander, Bucaramanga, Colombia.

September 13th, 2013 "Computation of oscillations through a complementarity approach", 8th SICC International School on Bifurcations in Piecewise Smooth Systems: Perspectives, Methodologies and Open Problems, Urbino, Italy.

April 17th, 2013 "Linear complementarity models for switched electronic systems", Doğuş University, Istanbul, Turkey.

February 7th, 2013 "Linear complementarity models for switched electronic systems", INRIA, Grenoble, France.

November 30th, 2006 "Complementarity and passivity for piecewise-linear feedback systems", Università degli Studi di Napoli Federico II, Napoli, Italy.

November 17th, 2005 "Cooperative control of multi-agent systems", KTH, Stockholm, Sweden.

October 24th, 2005 "Dynamic complementarity systems for modelling power converters", Università degli Studi del Sannio di Benevento, Italy.

January 7th, 2005 "Simulation of a voltage controlled buck converter", INRIA, Grenoble, France.

April 26th, 2004 "Modeling and control for automated manual transmissions with dry clutch", Università degli Studi di Palermo, Palermo, Italy.

May 24th, 2002 "Pricing techniques for network congestion control", KTH, Stockholm, Sweden.

March 22nd, 2002 "Network congestion control: pricing techniques", KTH, Stockholm, Sweden.

January 17th, 2002 "Automatic control of dry clutch engagement", KTH, Stockholm, Sweden.

Scientific and editorial activity

Editorial Board

Associate Editor of the IEEE Open Journal of Control Systems. June 2022 — today
Associate Editor of the IEEE Control Systems Society Conference Editorial Board. June 2014 — today

Editor of edited books

F. Vasca, L. Iannelli, "Dynamics and Control of Switched Electronic Systems", Springer-Verlag, May 2012.

Editorial Advisory Board

F. Flammini, "Railway Safety, Reliability, and Security: Technologies and Systems Engineering", Information Science Reference, May 2012 (from November 2010 till May 2012).

Scientific Council

Member of the Scientific Council of the Honors Center of Italian Univeristies (H2CU) (from October 2016 till today).

PhD defense committee member

Member of the committee for the final doctoral exam (XXXIV cycle) of Mario Immacolato IANNONE, Università del Sannio, June 2023.
Member of the committee for the final doctoral exam (XXXIV cycle) of Antonio ACERNESE, Università del Sannio, May 2023.
Member of the committee for the final doctoral exam (XXXIV cycle) of Domenico NATELLA, Università del Sannio, May 2023.
Member of the committee for the final doctoral exam (XXXIV cycle) of Muhammad Bakr Ahmad ABDELGHANY, Università del Sannio, November 2022.
Member of the committee for the final doctoral exam (XXXII cycle) of Amol Kerba YERUDKAR, Università del Sannio, April 2021.
Member of the committee for the final doctoral exam (XXXI cycle) of Daniel Kyle MCNEILL , Politecnico di Bari, February 2021.
Member of the committee for the final doctoral exam (XXIX cycle) of Elisabetta CATALDI, Università di Cassino e Lazio Meridionale, June 2017.
Member of the committee for the final doctoral exam of Niliana Andreina CARRERO CANDELAS, Universitat Politècnica de Catalunya, Barcelona, July 2014.

Expert Reviewer for Funding Agencies

Reviewer for the Italian Ministry for Education, University and Research (MIUR), (reviewing activities in 2013, 2014, 2016).

International journals reviewer

- Automatica (2005 — today)
- IEEE Transactions on Automatic Control (2005, 2006, 2009 — today)
- IEEE Transactions on Circuits and Systems, Part I (2005, 2009, 2013 — today)
- IEEE Transactions on Circuits and Systems, Part II (2004, 2006, 2007, 2009)
- IEEE Transactions on Control Systems Technology (2008 — 2010, 2012 — today)
- ASME Journal of Dynamic Systems, Measurement and Control (2009)
- IEEE/ASME Transactions on Mechatronics (2009)
- Control Engineering Practice (2006, 2013 — today)

International conferences reviewer

- IEEE Conference on Decision and Control
- American Control Conference
- Mediterranean Conference on Control and Automation
- IEEE Conference on Control Applications

Conferences services

Program Committees

- Member of the Program Committee of the Annual National Meeting of the SIDRA (Italian Society of Automatic Control), AUTOMATICA.IT 2022, University of Cagliari, September 1–3, 2022.
- Member of the Program Committee of the Annual National Meeting of the SIDRA (Italian Society of Automatic Control), AUTOMATICA.IT 2020, University of Cagliari, September 9–11, 2020.
- Publications co-chair of the European Control Conference, June 2019.
- Member of the Program Committee of the IEEE First International Conference on Control, Measurement and Instrumentation, January 8–10, 2016.
- Member of the Program Committee of the IEEE International Conference on Mechatronics, March 6–8, 2015.
- Member of the Program Committee of the IEEE Conference on Automation Science and Engineering, August 23–26, 2008.

Organizing Committee

- Member of the Organizing Committee of the Informal Workshop on Automotive Clutch Control, University of Sannio in Benevento, May 2006.

Local Organizing Committee

- Member of the Local Organizing Committe of the Annual National Meeting of the SIDRA (Italian Society of Automatic Control), AUTOMATICA.IT 2012, University of Sannio in Benevento, September 12–14, 2012.
- Member of the Local Organizing Committee of the International Workshop on the Future of Control in Transportation Systems, University of Sannio in Benevento, May 27–29, 2010.

Invited and tutorial sessions

- Organizer of the tutorial session "New Modeling and Control Challenges Inspired by Switched Electronic Systems", Mediterranean Conference on Control and Automation, June 2014, together with Prof. Francesco Vasca, University of Sannio in Benevento, Italy, and Dr. Sebastien Mariéthoz, ETH Zurich, Switzerland.
- Organizer of the invited session "Switched Electronic Systems", IEEE Conference on Decision and Control, December 2009, together with Prof. Francesco Vasca, University of Sannio in Benevento, Italy.

Chairman or co-chairman of international conference sessions

- IEEE Conference on Decision and Control, 2015
- Mediterranean Conference on Control and Automation, 2014
- IFAC World Congress, 2008
- American Control Conference, 2004

Conference contributions

- "An educational simulation platform for GPS-denied unmanned Aerial Vehicles aimed to the detection and tracking of moving objects", IEEE Conference on Control Applications, Buenos Aires, Argentina, September 2016, *Oral presentation*.
- "On dissipative time-varying monotone evolution equations", Conference on Open Problems in Nonsmooth Dynamics, Bellaterra, Spain, February 2016, *Oral presentation*.
- "A colored Gauss-Seidel approach for the distributed network flow problem", IEEE Conference on Decision and Control, Osaka, Japan, December 2015, *Oral presentation*.
- "On robust one-leader multi-followers linear quadratic dynamic games", IEEE Conference on Decision and Control, Osaka, Japan, December 2015, *Oral presentation*.
- "A colored Gauss-Seidel approach for the distributed network flow problem", SIDRA (Italian Society of Automatic Control) National Meeting, Bari, September 2015, *Oral presentation*.
- "An overview of averaging results with applications to power converters", IEEE Mediterranean Conference on Control and Automation, Palermo, Italy, June 2014, *Oral presentation in a* TUTORIAL SESSION.
- "Computation of limit cycles in Lur'e systems", American Control Conference, San Francisco, CA, USA, July 2011, *Oral presentation*.
- "Computation of limit cycles and forced oscillations in discrete–time piecewise linear feedback systems through a complementarity approach", IEEE Conference on Decision and Control, Cancun, Mexico, December 2008, *Oral presentation*.
- "Analysis of periodic solutions in piecewise linear feedback system via a complementarity approach", IFAC World Congress, Seoul, South Korea, June 2008, *Oral presentation*.
- "Rate admission control for hard real-time task scheduling", International Confer-

ence on Hybrid Systems: Computation and Control, Pisa, Italy, April 2007, *Oral presentation*.

- "Complementarity and passivity for piecewise linear feedback systems", IEEE Conference on Decision and Control, San Diego, CA, USA, December 2006, *Poster presentation*.
- "Sensor fusion by using a sliding observer for an underwater breathing system", IEEE Conference on Decision and Control, Seville, Spain, December 2005, *Interactive presentation*.
- "Dither shape in the averaging of switched systems", American Control Conference, Boston, MA, USA, July 2004, *Oral presentation*.
- "Effects of dither shapes in nonsmooth feedback systems: experimental results and theoretical insight", IEEE Conference on Decision and Control, Maui, HI, USA, December 2003, *Oral presentation*.
- "Practical Stability and Limit Cycles of Dithered Relay Feedback Systems", European Control Conference, Cambridge, UK, September 2003, *Oral presentation*.
- "Analysis of dither in relay feedback systems", IEEE Conference on Decision and Control, Las Vegas, NV, USA, December 2002, *Oral presentation*.
- "Analysis of dither in relay feedback systems", CIRA (Italian Consortium of Automatic Control) National Meeting, Perugia, Italy, September 2002, *Oral presentation*.
- "Participation Factors and their Connections to Residues and Relative Gain Array", IFAC World Congress, Barcelona, Spain, July 2002, *Oral presentation*.
- "Analysis of dither in relay feedback systems", Reglermöte, Linköping, Sweden, May 2002, *Oral presentation*.
- "Smooth engagement for automotive dry clutch", IEEE Conference on Decision and Control, Orlando, FL, USA, December 2001, *Oral presentation*.
- "Participation factors, residues and RGA", CIRA (Italian Consortium of Automatic Control) National Meeting, Lecce, Italy, September 2001, *Oral presentation*.

Teaching activity

Academic Years: 2023/2024

PhD Course **"Experimental and Operative Modal Analysis of Structures, Infrastrctures and Plants"**, (4 ECTS credits) PhD programme in Information Technologies for Engineering, Department of Engineering, University of Sannio in Benevento, Italy.

Academic Years: 2023/2024

Graduate Course **"Dynamics and Control of Switched Electronic Systems"**, (9 ECTS credits) second year of the Master (*Laurea Magistrale*) degree in Electronics Engineering for Automation and Sensing, Department of Engineering, University of Sannio in Benevento, Italy.

Academic Years: Since 2010/2011 — today

Undergraduate Course **"Automatic Control"**, (6 ECTS credits) second year of the Laurea degree in Computer and Electronics Engineering, Department of Engineering, University of Sannio in Benevento, Italy.

Academic Years: Since 2020/2021 — today

Undergraduate Course **"Automatic Control"**, (6 ECTS credits) third year of the Laurea degree in Medical Engineering, Department of Medicine and Health Sciences, University of Molise, Italy.

Academic Years: 2022/2023

Graduate Course **"Analysis and Control of Cyberphysical Systems"**, (9 ECTS credits) first year of the Master (*Laurea Magistrale*) degree in Computer Engineering, Department of Engineering, University of Sannio in Benevento, Italy.

Academic Years: Since 2016/2017 till 2021/2022

Graduate Course **"Discrete Systems"**, (9 ECTS credits) first year of the Master (*Laurea Magistrale*) degree in Computer Engineering, Department of Engineering, University of Sannio in Benevento, Italy.

Academic Year: 2010/2011

Undergraduate Course **"Modelling and Simulation"**, (4 ECTS credits) third year of the Laurea degree in Computer Engineering, Faculty of Engineering, University of Sannio in Benevento, Italy.

Academic Years: Since 2005/2006 till 2009/2010

Graduate Course **"Nonlinear Dynamics"**, (4 ECTS credits) first year of the Master degree in Automation Engineering, Faculty of Engineering, University of Sannio in Benevento, Italy.

Academic Years: Since 2004/2005 till 2009/2010

Graduate Course **"Process Control"**, (6 ECTS credits) first year of the Master degree in Automation Engineering, Faculty of Engineering, University of Sannio in Benevento, Italy.

Academic Years: 2004/2005 and 2005/2006

Undergraduate Course **"Automatic Control"**, (3 ECTS credits) second year of the Laurea degree in Energetic Engineering, Faculty of Engineering, University of Sannio in Benevento, Italy.

March — May 2003

Undergraduate course **"Automatic Control Project Course"** (12 ECTS credits) at the Royal Institute of Technology (KTH), Stockholm, Sweden, academic year 2002/2003.

Academic Years: 2001/2002 and 2002/2003

Undergraduate course **"Control Engineering"** (4 ECTS credits) third year of the Laurea degree in Computer Engineering, Faculty of University of Sannio in Benevento.

Academic Year: 2000-2001

Tutoring activity for the undergraduate course "Systems Theory" (Prof. F. Garofalo) at the Engineering Faculty of University of Napoli Federico II, Napoli, Italy.
Tutoring activity for the Laurea degree course "Automatic Control II" (Prof. F. Garofalo) at Engineering Faculty of University of Sannio in Benevento, Italy.

Academic Years: 1999/2000 and 2000/2001

Tutoring activity for the Laurea degree "Process Control" (Prof. F. Garofalo) at the Engineering Faculty of University of Napoli Federico II, Napoli, Italy.

Luigi Iannelli is also co-author of the lectures notes "Systems identification" (written in Italian language) together with Prof. Franco Garofalo and Prof. Francesco Vasca. Such lecture notes are used by students of the courses "Models identification" (University of Sannio in Benevento) and "Identification and optimal control" (University of Napoli Federico II).

PhD students supervision

2022 —

Mahsa Ghavami, University of Sannio in Benevento, Italy. Topic: "Game Theory approach for electric vehicles charging" (co-supervision with the tutor Prof. Francesco Vasca.)

2016 — 2020

Giuseppe Silano, University of Sannio in Benevento, Italy. Thesis: "Software-in-the-loop Methodologies for the Analysis and Control Design of Small UAV Systems"

2013 — 2016

Alessio Maffei, University of Sannio in Benevento, Italy. Thesis: "Optimization Based Distributed Control for Electrical Networks", July 2016. (co-supervision with the tutor Prof. Luigi Glielmo.)

2011 — 2014

Daniela Meola, University of Sannio in Benevento, Italy. Thesis: "Modeling and Optimization of Distribution Networks: a Smart Grid Approach", July 2014. (tutor with the co-supervisor Prof. Luigi Glielmo.)

2010 — 2013

Valentina Sessa, University of Sannio in Benevento, Italy. Thesis: "Periodic oscillations in piecewise linear Lur'e systems: a complementarity approach", July 2013. (co-supervision with the tutor Prof. Francesco Vasca.)

2010 — 2013

Carmen Pedicini, University of Sannio in Benevento, Italy. Thesis: "Averaging techniques for switched systems", July 2013. (tutor with the co-supervisor Prof. Francesco Vasca.)

2009 — 2012

Silvio Baccari, University of Sannio in Benevento, Italy. Thesis: "Photo-electro-thermal Model Predictive Control for Light Emitting Diode", July 2012. (co-supervision with the tutor Prof. Francesco Vasca.)

2008 — 2011

Gianluca Angelone, University of Sannio in Benevento, Italy. Thesis: "Steady-state Analysis for Switched Electronic Systems Through Complementarity", July 2011. (co-supervision with the tutor Prof. Francesco Vasca.)

2003 — 2007

Roberto Frasca, University of Sannio in Benevento, Italy. Thesis: "Modeling and Simulation of Switched Electrical Networks: a Complementarity Systems Approach", May 2007. (co-supervsion with the tutor Prof. Francesco Vasca.)

2002 — 2006

Maria Carmela De Gennaro, University of Sannio in Benevento, Italy. Thesis: "Decentralized Formation Control for Multi-Agent Systems", May 2006. (co-supervision with the tutor Prof. Francesco Vasca.)

Research activities responsibility

November 2017 – September 2018

Scientific responsibility of a research assistant fellowship (holder Valentina Sessa) titled "Modeling for hybrid systems analysis".

May 2016 – November 2016

Scientific responsibility of a scholarship (holder Giuseppe Silano) titled "Advanced control systems for the coordination among terrestrial autonomous vehicles and UAVs".

March 2015 – November 2015
Scientific responsibility of a scholarship (holder Damiano Leone) titled "Advanced control algorithms for the control of an actuator aimed to the active reduction of engine vibrations".

March 2014 – March 2015
Scientific responsibility of a postdoc fellowship (holder Daniela Meola) titled "Modeling, control and optimization of power flows over smart electrical grids".

March 2013 – March 2015
Scientific responsibility of a postdoc fellowship (holder Valentina Sessa) titled "Modeling and control for nonlinear dynamical systems".

University service

November 2019 —
Deputy Head of the Department of Engineering, University of Sannio in Benevento, Italy.

November 2023 —
Member of the board for the Doctorate in "Information Technologies for Engineering", University of Sannio in Benevento, Italy.

November 2023 — December 2023,
Member of the university committee for the university regulations regarding conferences and workshops contributions, University of Sannio in Benevento, Italy.

June 2023 — December 2023
Member of the examining committee for the qualification as Italian professional engineer, 1st and 2nd session 2023, University of Sannio in Benevento, Italy.

July 2022
Member of the electoral commission for the representatives elections in the governing bodies at the University of Sannio in Benevento, Italy.

July 2022
Member of the evaluation committee for one Automatic Control Assistant Professor (tenured) position, University of Sannio in Benevento, Italy.

October 2020 – June 2022
Member of the Groups of evaluation experts (GEV) in the Italian Evaluation of Research Quality 2015-2019 (VQR).

November 2019 — January 2020
President of the examining committee for the qualification as Italian professional engineer, 2nd session 2019, University of Sannio in Benevento, Italy.

February 2019 — April 2019
Member of the evaluation committee for two Automatic Control Associate Professor positions, University of Rome La Sapienza, Italy.

January 2018 — October 2019
Rector's delegate for communication between central and departmental student's careers offices, University of Sannio in Benevento, Italy.

December 2013 — October 2021
: Member of the board for the Doctorate in "Information Technologies for Engineering", University of Sannio in Benevento, Italy.

November 2017, October 2022, September 2023
: Adjunct (expert) member of the examining committee for the admission at the Doctorate course in "Information Technologies for Engineering", University of Sannio in Benevento, Italy.

October 2016 — November 2016
: Member of the examining committee for the admission at the Doctorate course in "Information Technologies for Engineering", University of Sannio in Benevento, Italy.

June 2016 — July 2016
: Member of the electoral commission for the students representatives elections in the governing bodies at the University of Sannio in Benevento, Italy.

February 2013 — February 2014
: Member of the committee for the new department rules, Department of Engineering, University of Sannio in Benevento, Italy.

November 2008 — December 2009
: Member of the examining committee for the qualification as Italian professional engineer, 2nd session 2008 and 1st and 2nd session 2009, University of Sannio in Benevento, Italy.

2008 — 2013
: Elected representative of assistant professors at the Engineering Faculty Board, University of Sannio in Benevento, Italy.

References

Prof. Kanat Camlibel, Johann Bernoulli Institute for Mathematics and Computer Science, University of Groningen, Bernoulliborg 382, Nijenborgh 9, 9747 AG Groningen, The Netherlands, `m.k.camlibel (at) rug.nl`

Prof. Karl Henrik Johansson, School of Electrical Engineering, Royal Institute of Technology, SE–100 44, Stockholm, Sweden, `kallej (at) kth.se`

Prof. Francesco Vasca, Department of Engineering, University of Sannio in Benevento, Piazza Roma, 21, 82100 Benevento, Italy, `vasca (at) unisannio.it`

Prof. Mario di Bernardo, University of Napoli Federico II, 80125, Naples, Italy, `mario.dibernardo (at) unina.it`

Research activity

Stability of piecewise-linear systems [IJ5, IJ13], [IC34, IC38, IC39, IC21]

A specific research activity has been carried out with the aim of investigating the stability of piecewise-linear systems by using modern computational tools that might give less conservative results with respect to classical approaches. In particular the complementarity framework (see the research line below) has been applied for deriving stability results of a class of Lur'e systems [IC38, IC39] while new computational tools based on the concept of cone-copositivity have been successfully applied to the stability analysis of piecewise-linear differential inclusions [IC38] and conewise linear systems [IJ13], also in the presence of sliding modes [IC21]. Such ideas have been applied for analyzing quadratic and piecewise-quadratic stability of linear complementarity systems [IJ5].

Differential inclusions with maximal monotone operators [IJ1, IC17]

Dynamical systems interconnected with set-valued mappings give rise to a class of differential inclusions. In some cases the inclusion can be described by a maximal monotone operator and that allows to derive results on the existence and uniqueness of solutions. Such research activity is aimed to study conditions on the dynamical system and the set-valued mapping that imply the well-posedness of the differential inclusion through the maximal monotone operator theory. Results have been extended to differential algebraic equations [IC17] and nonstationary differential inclusions[IJ1].

Linear complementarity systems [IB1],[BC3],[IJ5, IJ6, IJ12, IJ14, IJ15, IJ18, IJ20, IJ21],[IC27, IC30, IC36, IC37, IC41, IC42, IC43, IC44, IC46, IC47, IC48, IC57]

Complementarity systems are dynamical systems described in the state space, where state dynamics are affected by the so-called complementarity variables, which are variables under nonnegativity and mutual orthogonality constraints. Complementarity systems have been proposed as a framework for modeling and analyzing discontinuous, and in general nonsmooth, dynamic systems. The research activity has been carried on linear complementarity systems and the generalization of switched cone complementarity systems. It has been shown how complementarity models can represent and model switching electronic devices (diodes, thyristors, transistors, MOSFETs) allowing to analyze power electronics converters [BC3],[IJ6, IJ21],[IC37, IC41, IC42, IC57, IC47]. Furthermore it has been shown the effectiveness of the complementarity formalism in the solving of state jumps due to ideal switches commutations in electrical networks. In particular it has been shown how such an approach allows to obtain the same solution given by classical approaches based on the principle of the charge/flux conservation [IJ20],[IC46]. One of the advantages of the complementarity formalism consists in obtaining an explicit solution in a systematic way and, so, easily implementable through an algorithm. The study has been extended to the analysis of a class of systems in the Luré form, in particular dynamic linear systems with a piecewise linear feedback. Results coming from the circuit theory have been exploited for getting a linear complementarity model preserving, whenever possible, the fundamental property of passivity [IC46] that has been proved to have an important role for well-posedness of such class of systems [IJ15]. Cone-copositive programming has been applied for analyzing quadratic and piecewise quadratic stability of linear complemnetaruty systems [IJ5]. The complementarity approach has been shown to be effective for detecting in a numeric way the existence of periodic solutions in the class of piecewise linear Lur'e systems [IC36, IC43, IC44] and in a class of power electronic converters [BC3],[IJ18],[IC37, IC41, IC42]. Further advancements, based on formulating the existence of periodic solutions as a mixed linear complementarity problem, allowed to simplify the computation and getting more accurate numeric solutions [IC30] as well as computing oscillations with unknown period [IJ12],[IC27]. Based on those results, a complete modeling framework of switching electronic devices has been proposed, thus allowing to model closed-loop controlled power converters as simple linear complementarity systems rather than more complex switched cone complementarity systems [IJ14].

Modeling, estimation and identification of Li-Ion batteries [IC2, IC4, IC6, PT2]

Nowadays energy storage systems and batteries in particular play a fundamental role in many engineering applications. Simple and accurate models, state of charge (SOC) estimation and parameters identification of batteries characteristics are challenging and relevant problems across several disciplines. This research activity started from the proposal of a novel model of Li-Ion batteries together with a procedure for identifying

its parameters [IC6]. Thus, the research focused on the co-estimation problem [IC2, IC4] aimed to identify some parameters of the battery model toegther with the SOC. An Italian patent has been released [PT2].

Flight control of Unmanned Aerial Vehicles [IJ2, IJ3, IJ4],[RB2], [IC3, IC7, IC8, IC12, OC1, OC2, IC14, IC18, RB6, IC29], [OC3]

Recently some activities dealing with UAVs, in particular multirotor drones [IC7, OC1, IC14, IC18], [OC3] have been carried out. Their use in different applications has been investigated [IJ2, IJ3]. Software-in-the-loop simulation has been investigated as an effective tool for analyzing the behaviour of the closed loop control [IJ4, RB2, OC2] and for helping in the design of control strategies [IC8]. Such activities follow previous contributions [RB6, IC29] that have been given to the flight control design within an international research cooperation aimed to implement control laws for small-size UAVs built-up with COTS.

Modeling, simulation and control of power electronics systems [IJ11], [IC1, IC2, IC6, IC11, IC10, IC9, IC15, IC31], [PT3], [OC4]

This research activity deals with the general problem of modeling and simulating complex power electronics systems with the aim of designing or verifying specific control techniques. Several kind of applications have been considered like power systems for low earth orbit satellites or power converters for controlling high power LEDs for illuminating applications.

Dealing with small satellites, a methodology for modeling the electrical power system have been proposed and it has been implemented a simulator capable to verify the behavior of a power management strategy [IC1, IC11, IC10, IC9, IC15], [OC4].

As regard as high power LEDs applications, a photo-thermal model of the LED has been derived and a model predictive control approach has been used for regulating the luminous flux taking into account thermal and electrical constraints [IJ11],[IC31]. An Italian patent has been released [PT3].

Real time implementation of Model Predictive Control [IC5, IC32]

Some work has been carried out regarding the implementation of model predictive control laws. In particular, in [IC32] a strategy for solving in a parallel way the implicit MPC through barrier functions has been proposed. More recent technological developments related to processors and optimization solvers, allowed to investigate the possibility of implementing nonlinear model predictive control laws for racing cars [IC5].

Control and optimization of networks and smart grids [IJ7, IJ10, RB3, IC16, IC22, IC23, IC19, IC24]

Nowadays networks and cyberphysical systems [IJ7, RB3] represent a class of systems that give rise to very challenging control problems. This recent research activity has been focused on the optimal management and control of smart grids where renewable energy sources, economic issues and physical network constraints must be considered together with the aim of improving the working behavior of real power networks. Communication infrastructure and specific middleware allow to implement smart control strategies [IJ10]. A model predictive control approach has been used in order to cope with the problem [IC24]. The control strategy exploits the grid model and the forecast of renewable sources [IC22, IC23] in order to optimize the overall operating behavior.

From a more theoretical point of view, a novel algorithm for solving of the minimum cost network flow problem in a fully distributed way has been proposed [IC19]. Such

algorithm has been extended to propose a method for solving a class of distributed model predictive control problems [IC16].

Averaging techniques for nonlinear and discontinuous systems [IJ16], [IB1], [BC2], [IC25],[IC33], [IJ22, IJ24, IJ26], [IC26, IC28, IC35, IC52, IC58, IC60, IC65, IC63, IC66], [TH1]

The dithering technique (injection of high frequency signals) in control loops that have discontinuous nonlinearities (e.g., the relay) gives rise to interesting phenomena that do not appear when nonlinearities are smooth. The research activity has been of a methodological type, without neglecting applicative and experimental aspects that validated theoretical results and highlighted subtleties of the analysis of interest in the application. In particular it has been shown in a rigorous way that averaging theory can be applied to a wide class of dynamic systems [IC25],[BC2], even nonsmooth, where the injected dither signal satisfies some conditions related to the waveform shape, in particular the Lipschitz condition on the amplitude distribution function [IJ24, IJ26],[IC66, IC65, IC63, IC58],[TH1]. It has been highlighted how dither signals that do not satisfy such conditions (e.g., the square wave signal) could give rise to complex phenomena when discontinuous nonlinearities are in the control loop. Such effects have been shown through experiments applying theoretical results in the power electronics converters field [IC60, IC58, IC52], [IJ22]. Further research activity has been aimed to investigate different approaches for analyzing nonlinear systems through averaging techniques [IC35] and to surveying how such techniques have been used in control applications [IC33]. Moreover the averaging has been applied to switched systems whose dynamics is described by differential algebraic equations [IJ16],[IC26, IC28].

Optimization in dynamic games [IJ9, IC20]

Some research activity has been conducted regarding multi-agents perspective in dynamic games. In particular, in [IC20] it has been investigated the problem of linear quadratic optimization for a hierarchical and multi-agent dynamic game and those initial results have been extended and further problems have been addressed in [IJ9].

Control of magnetic and magnetostrictive actuators [PT1, IJ17]

Research contributions have been provided for the analysis and control of magnetostrictive actuators that suffer from strong hysteretic phenomena. In [IJ17] a simple but effective two-degrees-of-freedom controller has been proposed and compared with more standard control schemes through real time experiments. Furthermore an Italian patent has been released dealing with a permanent magnetic peristatltic pumping device [PT1].

Nonlinear dynamics in power electronics converters, DC/DC type [IC25],[IB1], [IJ23, IJ27], [IC51, IC55, IC61, IC62, IC69]

During such research activity complex behaviors have been investigated, by considering the nonlinear dynamics intrinsic into the operating principles of DC/DC power electronics converters. It has been shown how such phenomena can be classified by the bifurcation theory of piece-wise smooth systems. Experimental results have supported the theoretical analysis [IC69],[IJ27]. Furthermore theoretical results coming form the dithering and averaging analysis for nonsmooth systems have been applied to the sliding mode control technique. In particular dithering has been proposed as an implementation method of the boundary layer control at fixed switching frequency for DC/DC power electronics converters [IC62, IC61, IC55, IC51]. Moreover experimental activities have been carried out aiming to show the effectiveness of the approach [IJ23]. The expertise in this field, together with the research activities dealing with sys-

tems and control theory, have been combined towards the editorship of a recent book on modeling and control of switched electronics systems [IB1].

Modeling and control of automated manual transmission systems [RB1, RB4], [IJ8], [RP1], [BC1, BC4], [IJ19, IJ25], [IC13, IC45, IC50, IC59, IC64, IC67, IC70]

The research activity dealt with an important automotive system, the automated manual transmission [BC1]. In particular it has been studied how to model transmissions with dry clutches for controlling the engagement phase during a gear shift. Some control strategies have been proposed for tracking reference speed signals (flywheel and dry clutch) in order to obtain fast and comfortable engagements [IC70, IC67, IC64]. The proposed control architecture has been validated on numerical models identified by experimental data [IC59],[IJ25]. Moreover a robustness and sensitivity analysis has been carried out, thus formulating a controller designed by the robust control technique named QFT [IC50]. Further research activity has been aimed to defining a detailed model of the transmissibility characteristic of the clutch torque taking into account variations of the friction coefficient depending on the slipping speed, the temperature between friction surfaces [IC13], the distribution of the radial and tangential pressures [IJ19],[IC45]. The expertise gained in such field, together with other automotive control topics, has allowed the automatic control group of University of Sannio (GRACE) to organize an International Workshop on the Future of Control in Transportation Systems. A report of the workshop has been published on the IEEE Control Systems Society web site [RP1]. Finally, a survey paper on the topic has been published in 2018 [IJ8].

Real time simulation and scheduling [RB5, RB7]

During the last years significant work has been dedicated to the real time hardware-in-the-loop simulation of complex control systems. Such methodology is aimed to the verification and validation of electronic control units (ECUs): the hardware device, together with its running firmware, is inserted into the loop completed with mathematical models that emulate other parts of the equipment under control. The models must react in real-time to the inputs coming from the device under test so as they operate in the real world. The research activity, in particular, has dealt with traction control in railway system [RB5].

A further related research activity dealt with control techniques applied to scheduling problems in real-time systems. It has been proposed a hybrid model describing the scheduling policy named Earliest Deadline First with the presence of aperiodic tasks. After deriving a Mixed Logical Dynamical model, it has been designed a controller for optimizing the choice of the execution period by exploiting prediction information related to the use of the processor [RB7].

Synchronization of parallel connected inverters [IC40]

The aim of the research consists of controlling parallel inverters connected to a common load in a decentralized way, achieving synchronization among them [IC40].

Underwater breathing apparatus with air recirculation (rebreather) [IC53, IC54]

The research activity dealt with the development of a nonlinear observer for estimating the partial pressure of the oxygen in underwater breathing apparatus [IC54]. The designed sliding mode observer has been used with a sensor fusion technique aimed to the fault diagnosis of sensors. In particular the analyzed scenario consisted of hardware redundancy of the pressure sensor (usually three sensors are used) that does not allow the detecting and isolation of the fault by classical voting logic techniques [IC53].

Modeling of steel-making processes [IC49]

Such research activity has been strongly connected to a research collaboration with the Centro Sviluppo Materiali S.p.A., aimed to deriving a model able to describe the process of stretch reducing for seamless tube production. The model, based on the analysis of the pressure distribution and tangential stresses on the contact area, allows to compute in a fast way a good estimation of the power needed by the process. The model has been validated on experimental data, highlighting the easier application compared to finite element methods, without suffering from too many approximations [IC49].

Multi agent systems and formation control [IC56]

It has been investigated a class of multi agent systems consisting of a set of agents moving on a plane and interacting among them exchanging local information with the aim of reaching a common objective or executing a task in a coordinated way. A typical task is the achieving and maintaining of a desired formation, where each agent maintains a desired distance from its neighbors. The used approach is the artificial potentials, investigating the feasibility in terms of formation reaching avoiding to get in local minima configurations. Indeed it has been shown the existence of such configurations and some techniques for getting out of such undesired configurations have been proposed [IC56].

Participation factors and model order reduction for dynamic systems [IC68]

It has been investigated the model order reduction technique based on participation factors (Selective Model Analysis) and connections with residues of the dynamic matrix have been illustrated. Moreover a new interpretation of participation factors, based on a particular relative gain array associated to the linear system, has been given [IC68].

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