

# Curriculum Vitae of Pierdomenico Pepe

## July 21<sup>st</sup>, 2021



P. Pepe, 2005

### GENERALITIES

Born in Sant'Omero (province of Teramo, Italy), on 17 May 1965. Resident in L'Aquila, Italy, via Solaria 22. Family: Maria Paola Di Ciccio (common-law spouse), Lucrezia Pepe (daughter).

### EDUCATION

- 1) Master Degree in Electronic Engineering (five years degree course), 110/110 cum laude, University of Ancona, Ancona, Italy. Thesis title: Approximation and Simplification of Mathematical Models of Robots (in Italian, Approssimazione e semplificazione di modelli matematici di robots). Advisor T. Leo, co-Advisor S. Longhi, 14 November 1990.
- 2) Ph.D in Electronic Engineering, University of L'Aquila, Advisor A. Germani, final dissertation University of Genova, 15 November 1996. Thesis title: LQG Control of Retarded Ssystems (in Italian, Il Controllo LQG dei Sistemi con Ritardo).

### FURTHER ON EDUCATION

- 1) Course on Flexible Production Systems (in Italian), University of Ancona and Industries of Marche, Ancona, Italy, April-May 1988.
- 2) Course on Programming Robot Kuka, Able Robots, Bologna, Italy, (3 days), September 1996.
- 3) Summer School on Delay Differential Equations and Control Theory, University of Trieste and University of Ancona, Dobbiaco, Italy, 25-29 June 2001.
- 4) Auditor EECI Course, F.H. Clarke, Optimality, Stabilization, and Feedback in Nonlinear Control, L'Aquila, 20-24 May 2013.
- 5) Auditor EECI Course, L. Praly, Convergence theory for observers: Necessary, and Sufficient conditions, L'Aquila, Italy, 14-19 April 2014.
- 6) Auditor EECI Course, F. Mazenc, Tools for nonlinear control, Lyapunov function, positivity, applications, L'Aquila, Italy, 21-25 March, 2016.
- 7) Auditor EECI Course, R. Sanfelice, Hybrid Control Design, L'Aquila, Italy, 13-17 May, 2019.

## CURRENT POSITION

- 1) Associate Professor in Automatic Control (Scientific Disciplinary Sector SSD Automatica ING-INF/04, Competition Sector 09/G1), from 1 October 2013, at the Department of Information Engineering, Computer Science, and Mathematics. Member of the Center of Excellence for Research DEWS (from 2008), L'Aquila.

## PAST POSITIONS IN ITALIAN INSTITUTIONS

- 1) Italian Army, Student for Complementary Second Lieutenant, Technical Corp of the Italian Army, Scuola Tecnici Elettronici dell'Esercito, Rome, 9 April 1991 – 8 July 1991, and Second Lieutenant, Technical Corp of the Italian Army, Centro Tecnico Militare Armi e Munizioni, Servizio Ricerche Studi Esperienze Materiali Elettronici Ottici Optoelettronici e Missilistici, 9 July 1991 – 8 July 1992, dismissed with Excellent as final grade. Currently lieutenant, Technical Corp of the Italian Army, on leave.
- 2) Statutory personnel, full-time, SINCAD Technology, ROLAND Digital Group, Martinsicuro (province of Teramo), member of the Technical and Scientific Division, in charge for Special Projects, 1 September 1992 – 30 May 1993.
- 3) Ph.D. Student, Advisor A. Germani, Department of Electrical Engineering, University of L'Aquila, Italy, academic years 1992/1993, 1993/1994, 1994/1995.
- 4) Technical personnel, Technical Collaborator, VII level, Laboratory of Automatics and Robotics, Department of Electrical Engineering, University of L'Aquila, Italy, 2 December 1996 – 28 February 2001.
- 5) Subject expert ("cultore della materia") in Automatic Control, Department of Electrical Engineering, University of L'Aquila, 9 May 1996 – 28 February 2001.
- 6) Assistant Professor (tenured position) in automatic control (ING-INF/04), University of L'Aquila, Italy, 1 March 2001 – 30 September 2013.
- 7) Research Associate (2010-2018) at the Institute of Systems Analysis and Informatics of the Italian National Research Council, Rome, Italy.

## OTHER PAST POSITIONS IN ITALIAN INSTITUTIONS

- 1) High-school temporary professor of mathematics and physics, Liceo Scientifico Rosetti, San Benedetto del Tronto (province of Ascoli Piceno), 9 January 1991 - 23 March 1991.
- 2) High-school temporary professor of electronics, Istituto Tecnico Industriale Montani, Fermo (province of Ascoli Piceno), 9 July 1992 – 31 August 1992.
- 3) High-school temporary professor of mathematics, Liceo Scientifico Bafile, L'Aquila, 5 May 1996 - 31 May 1996.

## VISITING POSITIONS IN FOREIGN UNIVERSITIES

- 1) Visiting Scholar (Italian National Research Council CNR grant fellowship), Faculty Sponsor A.L. Sangiovanni-Vincentelli, Department of Electrical Engineering and Computer Science, University of California, Berkeley, California, USA, 2 July 2000 – 2 January 2001.
- 2) Visiting Scholar (FILAURO grant fellowship), Faculty Sponsor E.I. Verriest, School of Electrical and Computer Engineering, Georgia Institute of Technology, Atlanta, Georgia, USA, 18 August 2001 – 30 December 2001.

- 3) Visiting Scholar (supported with NSF funds by Z.-P. Jiang, USA), Faculty Sponsor Z.-P. Jiang, Department of Electrical and Computer Engineering, Polytechnic University, Brooklyn, New York, USA, 14 February 2004 – 4 June 2004 (return to Italy for a week, for students' exams).
- 4) Visiting Scholar (supported with research funds of H. Ito), Faculty Sponsor H. Ito, Kyushu Institute of Technology, Fukuoka, Japan, 10 -17 November 2007.
- 5) Visiting Scientist (supported with French DIGITEO funds), Centrale-SUPELEC, Gif-sur-Yvette, France, Faculty Sponsor Silviu-Iulian Niculescu, 15 - 29 November 2015.
- 6) Visiting Professor, (supported with French funds of SUPELEC), Centrale-SUPELEC, Gif-sur-Yvette, France, Faculty Sponsor P. Mason, 7-10 June 2016.
- 7) Visiting Professor (supported with French funds of ENSEA), Faculty Sponsor I. Haidar, Ecole Nationale Supérieure de l'Electronique et de ses Applications (ENSEA), Cergy, France, 14–27 June 2018.
- 8) Visiting Scientist (supported with German funds of Universitat Passau), University of Passau, Germany, 29-30 April 2019, research meeting with A. Mironchenko, F. Wirth, A. Chaillet.

#### FOREIGN Ph.D STUDENTS, RESEARCHERS AND PROFESSORS IN VISIT

- 1) H.Ito (associate professor), Kyushu Institute of Technology, Fukuoka, Japan, 3-7 September 2011.
- 2) A.Mesbahi (Ph.D. student), Sharif University of Technology, Iran, October 2012 – February 2013.
- 3) M. Ataei (associate professor), University of Isfahan, Iran, 7 August – 4 November 2015.
- 4) A. Chaillet (associate professor), Centrale-SUPELEC, Paris, France, 3-6 May 2016.
- 5) I. Haidar (associate professor), ENSEA, Paris, France: i) 15-25 January 2017; ii) 2-31 July 2018; iii) 18-26 July 2019.

#### EDITORIAL ACTIVITY FOR JOURNALS

- 1) Associate Editor IEEE Transactions on Automatic Control, [2011-2014].
- 2) Associate Editor Systems & Control Letters (Elsevier), [2012-2016].
- 3) Associate Editor Journal on Control and Decision (Taylor & Francis), [2014-present].
- 4) Associate Editor SIAM Journal on Control and Optimization, [2016-present].
- 5) Associate Editor IEEE Control Systems Letters, [2017-present].

#### EDITORIAL ACTIVITY FOR INTERNATIONAL CONFERENCES

- 1) International Committee member First Italy Kazakhstan Working Symposium on Modeling and Control of Nonlinear Deterministic and Stochastic Systems, Almaty, Kazakhstan, 1999.
- 2) International Program Committee Member, and co-Editor (with C. Manes), 6<sup>th</sup> IFAC Workshop on Time-Delay Systems, L'Aquila, Italy, 2006.
- 3) International Program Committee member, 7<sup>th</sup> IFAC Workshop on Time-Delay Systems, Nantes, France, 2007.
- 4) International Program Committee member, 8<sup>th</sup> IFAC Workshop on Time-Delay Systems, Sinaia, Romania, 2009.
- 5) International Program Committee member, 9<sup>th</sup> IFAC Workshop on Time-Delay Systems, Praha, Czech Republic, 2010.

- 6) International Technical Program Committee member, 23<sup>rd</sup> IEEE Chinese Control and Decision Conference, Mianyang, China, 2011.
- 7) International Program Committee member, 10<sup>th</sup> IFAC Workshop on Time-Delay Systems, Boston, USA, 2012.
- 8) Committee member (with T. Vyhlidal and S. Mondié) for the young best paper award, 10<sup>th</sup> IFAC Workshop on Time-Delay Systems, USA, 2012.
- 9) International Technical Program Committee member, 24<sup>th</sup> IEEE Chinese Control and Decision Conference, Taiyuan, China, 2013.
- 10) International Program Committee member, IFAC Joint Conference 5<sup>th</sup> Symposium on System Structure and Control, 11<sup>th</sup> Workshop on Time-Delay Systems, 6<sup>th</sup> Workshop on Fractional Differentiation and Its Applications, Grenoble, France, 2013.
- 11) International Program Committee member, 3<sup>rd</sup> IFAC International Conference on Intelligent Control and Automation Science, Chengdu, China, 2013.
- 12) International Technical Program Committee member, 25<sup>th</sup> IEEE Chinese Control and Decision Conference, Guiyang, China, 2013.
- 13) International Program Committee member, 13<sup>th</sup> European Control Conference, Strasbourg, France, 2014.
- 14) International Technical Program Committee member, 26<sup>th</sup> IEEE Chinese Control and Decision Conference, Changsha, China, 2014.
- 15) International Program Committee member, 15<sup>th</sup> SIAM Conference on Control and its Applications, Paris, France, 2015.
- 16) International Program Committee member, 12<sup>th</sup> IFAC Workshop on Time-Delay Systems, Ann Arbor, USA, 2015.
- 17) International Technical Program Committee member, 27<sup>th</sup> IEEE Chinese Control and Decision Conference, Qingdao, China, 2015.
- 18) International Program Committee member, 13<sup>th</sup> IFAC Workshop on Time-Delay Systems, Istanbul, Turkey, 2016.
- 19) International Program Committee member, 28<sup>th</sup> IEEE Chinese Control and Decision Conference, Yinchuan, China, 2016.
- 20) International Program Committee member, 16<sup>th</sup> SIAM Conference on Control and its Applications, Pittsburgh, USA, 2017.
- 21) International Technical Program Committee member, 29<sup>th</sup> IEEE Chinese Control and Decision Conference, Chongqing, China, 2017.
- 22) International Program Committee member, 14<sup>th</sup> IFAC Workshop on Time-Delay Systems, Budapest, Hungary, 2018.
- 23) International Technical Program Committee member, 30<sup>th</sup> IEEE Chinese Control and Decision Conference, Shenyang, China, 2018.
- 24) International Program Committee member, 15<sup>th</sup> IFAC Workshop on Time-Delay Systems, Sinaia, Romania, 2019.
- 25) Technical Program Committee member, 31<sup>st</sup> Chinese Control and Decision Conference, Nanchang, China, 2019.
- 26) Program Committee member, International Conference on Control, Decision and Information Technologies, Paris, 2019.
- 27) Technical Program Committee member, 32<sup>nd</sup> Chinese Control and Decision Conference, Hefei, China, 2020.
- 28) Technical Program Committee member, 33<sup>rd</sup> Chinese Control and Decision Conference, Kunming, China, 2021.

- 29) International Program Committee member, 16<sup>th</sup> IFAC Workshop on Time-Delay Systems, Guangzhou, China, 2021.

#### EDITORIAL ACTIVITY FOR NATIONAL CONFERENCES

- 1) National Program Committee member, Italian Conference SIDRA Automatica.it, Rome, Italy, 2016.
- 2) Committee member for best presentation award, Italian Conference SIDRA Automatica.it, Milan, Italy, 2017.
- 3) Committee member for SIDRA Award for Ph.D. Theses in the field of Systems and Control Engineering, 2021.

#### EDITORIAL ACTIVITY FOR MULTI-AUTHOR VOLUMES AND CONFERENCE PROCEEDINGS

- 1) Proceedings of the 6th IFAC Workshop on Time-Delay Systems, L'Aquila, Italy, July 10-11-12th, 2006, IFAC-PapersOnline (www.ifac-papersonline.net), Vol. 6, Part 1, ISBN 978-3902661-11-1, posted online October 5th, 2007, C. Manes, P. Pepe Editors.
- 2) Time Delay Systems: Methods, Applications and New Trends, Series Lecture Notes in Control and Information Sciences, Vol. 423, Springer, ISBN 978-3-642-25220-4, pp. 470, 2012, R. Sipahi, T. Vyhliadal, S.-I. Niculescu, P. Pepe Editors.
- 3) Recent Results on Nonlinear Delay Control Systems, in Honor of Miroslav Krstic, Vol. 4, Springer, Series Advances in Delays and Dynamics, 2016, I, Karafyllis, M. Malisoff, F. Mazenc, P. Pepe Editors.

#### ORGANIZATION OF INTERNATIONAL CONFERENCES AND CONFERENCE SESSIONS

- 1) National Organizing Committee Chairman, 6<sup>th</sup> IFAC Workshop on Time-Delay Systems, L'Aquila, Italy, 2006.
- 2) Co-organizer (with A. Germani and C. Manes), sessions "Time Delay Systems I", "Time Delay Systems II", 6<sup>th</sup> IEEE Mediterranean Conference on Control and Systems, Alghero, Italy, 1998.
- 3) Co-organizer (with A. Germani and C. Manes), of the session "Nonlinear Delay Systems", at the 2<sup>nd</sup> IFAC Workshop on Time-Delay Systems, Ancona, Italy, 2000.
- 4) Co-organizer (with E.I. Verriest) of the miny-symposium "New Approaches for Analysis and Observation of Infinite Dimensional Systems (PDE and FDE)", at the 16<sup>th</sup> International Symposium on Mathematical Theory of Networks and Systems (MTNS), Leuven, Belgium, 2004.
- 5) Co-organizer (with H. Ito) of the session "Lyapunov Tools for ISS and Stabilization", at the 54<sup>th</sup> IEEE Conference on Decision and Control, Osaka, Japan, 2015.
- 6) Local organizer of a course of the International Graduate School on Control, EECl (European Embedded Control Institute), L'Aquila, Italy, 5-9 February, 2018. Speakers: E. Fridman and P. Pepe. Course title: Time-Delay and Sampled-Data Systems.
- 7) Co-organizer (with H. Ito) of the session "Advances in Constructive Techniques and Use of Lyapunov Functions", at the 58<sup>th</sup> IEEE Conference on Decision and Control, Nice, France, 2019.

## REVIEW OF PAPERS, BOOKS, PROJECTS

Reviewer of over 400 papers for international journals, books and conferences on automatic control. Reviewer of two books on automatic control published by Birkhauser. Assignments for the evaluation of several research projects, with payment for the service, presented for calls by Italian and non Italian Financing Institutions.

## INVITED TALKS AT CONFERENCES

- 1) Plenary speaker, IFAC Joint Conference 5<sup>th</sup> Symposium on System Structure and Control, 11<sup>th</sup> Workshop on Time Delay Systems, 6<sup>th</sup> Workshop on Fractional Differentiation and its applications, Grenoble, France, 2013. Plenary title: Input-to-State Stability of Nonlinear Functional Systems.
- 2) INdAM (Istituto Nazionale di Alta Matematica) Workshop on Recent Trends in Delay Differential Equations - Models, Theory and Numeric (Organizer N. Guglielmi), Cortona, Italy, 2012. Talk title: On the Actuator Disturbance Attenuation for Stabilizable, Retarded, Nonlinear Systems.
- 3) 3<sup>rd</sup> DELSYS Workshop on Delay Systems, Observers and Controllers for Complex Dynamical Systems. Talk Title: Stabilization in the Sample-and-Hold Sense of the Glucose-Insulin System (P. Palumbo, P. Pepe, S. Panunzi, A. De Gaetano), GIPSA LAB, Grenoble, France, 2014.
- 4) 4<sup>th</sup> DELSYS Workshop on Delay Systems, Observers and Controllers for Complex Dynamical Systems, emphasizing Delays and Interconnections Methodology, Algorithms and Applications. Talk Title: Decentralized Nonlinear Control for a Class of Interconnected Time-Delay Systems (P. Pepe, H. Ito, Z.-P. Jiang), Centrale-Supelec, Gif-sur-Yvette, France, 2015.
- 5) Workshop Mathematical Modeling of the Glucose/Insulin System, Modeling and Control of Glucose Homeostasis. Talk title: State and output feedback control of plasma glycemia (P. Palumbo, P. Pepe, S. Panunzi, A. De Gaetano), Lipari, 2009.
- 6) Fukuoka Workshop on Nonlinear Control Theory (organized by H. Ito). Talk title: Sampled-data control of nonlinear retarded systems, 2015, Fukuoka, Japan.
- 7) Workshop Stability and Control of Infinite-Dimensional Systems (Organizers S. Dashkovskiy, B. Jacob, A. Mironchenko, F. Wirth), 12-14 October 2016, Passau, Germany. Talk title: Practical Stabilization of Nonlinear Retarded Systems: Continuous-Time and Sampled-Data Controllers.
- 8) 1<sup>st</sup> DECOD Workshop on Delays and Constraints on Distributed Parameter Systems, Centrale-Supelec, Paris, 2017. Talk title: Global and Semi-Global Stabilization by Sampled-Data Emulation of Global Stabilizers for Time-Delay Systems (P. Pepe, M. Di Ferdinando).
- 9) Gran Sasso Science Institute, invited as visiting scientist, workshop "New trends in control of evolution systems", organizers R. Guglielmi and P. Cannarsa, April 20-21, 2018. Talk title: Stabilization of Retarded Systems: a Lyapunov-Based Sampled-Data Approach.
- 10) Workshop Stability and Control of Infinite-Dimensional Systems (Organizers S. Dashkovskiy, B. Jacob, A. Mironchenko, F. Wirth), Universitat Wurzburg, Wurzburg, Germany, 10-12

October 2018, Germany. Talk title: Converse Lyapunov Theorems for Systems with Delays: the Continuous-Time and the Discrete-Time Case.

- 11) Workshop in Control Theory and Applications, (Organizers A. Festa, R. Guglielmi, A. Marigonda, M. Palladino), GSSI, L'Aquila, 28-29 March 2019. Talk title: Converse Lyapunov Theorems for Discrete-Time Switching Systems with Given Switches Digraphs,

#### INVITED SEMINARS

- 1) Séminaire Automatique et Énergie renouvelable du Laboratoire QUARTZ, Ecole Nationale Supérieure de l'Electronique et de ses Applications (ENSEA), Cergy (Paris), France, 26 June 2018 (Guest I. Haidar). Seminar title: Converse Lyapunov Theorems for Nonlinear Functional Systems.
- 2) Séminaire d'Automatique du Plateau de Saclay, CENTRALE-SUPELEC, Gif-sur-Yvette (Paris), France, 8 June 2016, (Guests Y. Chitour, P. Mason, A. Chaillet). Seminar title: On Control Lyapunov-Krasovskii Functionals and Stabilization in the Sample-and-Hold Sense of Nonlinear Time-Delay Systems.
- 3) Kyushu Institute of Technology, Fukuoka, Japan, and RACOT (Research Committee for control theory in Kyushu area). Seminar title: Input-to-State Stability of Retarded Nonlinear Systems, November 12<sup>th</sup>, 2007 (Guest H. Ito).
- 4) The Institute of Statistical Mathematics, Tokyo, Japan, and SICE Research Committee ICDND (Innovative Control via Diversity of Nonlinear Dynamics). Seminar title: ISS of Nonlinear Systems Described by Coupled Delay Differential and Difference Equations, November 16<sup>th</sup>, 2007 (Guest H. Ito).

#### SEMINARS AS VISITING SCHOLAR

- 1) Polytechnic University, New York, Laboratory of Communications and Control. Seminar title: Stability of Coupled Delay Differential and Difference Equations, February 17<sup>th</sup>, 2004.
- 2) Georgia Institute of Technology, Atlanta, Department of Electrical and Computer Engineering Systems and Control Seminar, and School of Mathematics Center for Dynamical Systems and Nonlinear Studies. Seminar title: Nonlinear Time Delay Control Systems: Observers, Adaptive Regulators, Internal Stability, November 19<sup>th</sup>, 2001.
- 3) University of California, Berkeley, Department of Electrical Engineering and Computer Sciences Seminar. Seminar title: Estimation and Control of Time Delay Systems: LQG Regulator, Nonlinear Control, Nonlinear Observers, December 20<sup>th</sup>, 2000.

#### SEMINARS IN NATIONAL INSTITUTIONS

- 1) Italian National Research Council (CNR), Istituto di Analisi dei Sistemi e Informatica, Rome, Italy, 1998. Seminar title: Controllo di Sistemi Nonlineari con Ritardo (Control of nonlinear systems with delay).
- 2) Italian National Research Council (CNR), Istituto di Analisi dei Sistemi e Informatica A. Ruberti, Colloquia IASI, Rome, Italy, 2008. Seminar title: Stabilizzazione Ingresso-Stato di Sistemi Ritardati Nonlineari Stabilizzabili (Input-to-state stabilization of stabilizable retarded nonlinear systems).

## LECTURES AT INTERNATIONAL GRADUATE SCHOOLS AND PRE-CONGRESS WORKSHOPS

- 1) University of Grenoble, 34<sup>th</sup> International Summer School of Automatic Control, Stability of Time-Delay Systems and its Applications (Scientific Coordinators A. Seuret, W. Michiels, S.-I. Niculescu, Organizer A.I. Bratcu), Grenoble, France, July 1-5, 2013. Lecture (three hours) title: Input-to-state Stability of time-delay systems.
- 2) Ph.D. Summer School SIDRA (Scientific Coordinators and Organizers M.E. Valcher and C. Melchiorri), Bertinoro, Italy, July 3-5, 2017. Formal methods for the control of large-scale networked nonlinear systems with logic specifications (coordinators G. Pola and M.D. Di Benedetto). 1<sup>st</sup> lecture (1h 30m) title: Review on internal and external stability notions of nonlinear systems. 2<sup>nd</sup> lecture title (2h): Nonlinear time-delay systems: basic theory and stability.
- 3) International Graduate School on Control, EECI (European Embedded Control Institute). E. Fridman (seven lectures, each one of 1h 30m) and P. Pepe (seven lectures, each one of 1h 30m), L'Aquila, Italy, 5-9 February 2018. Course title: Time-Delay and Sampled-Data Systems.
- 4) IFAC World Congress, Toulouse, France, 2017. Pre-Congress half-day Workshop: Tutorial on time-delay and sampled-data systems, organized by A. Seuret and E. Fridman. Speakers: E. Fridman, A. Seuret, L. Hetel, P. Pepe, F. Mazenc, K. Liu, A. Selivanov. Title of talk (30min): Nonlinear time-delay and sampled-data systems.
- 5) IFAC World Congress, Berlin, Germany, 2020. Pre-Conference full-day Workshop: Input-to-state stability and control of infinite-dimensional systems, organized by A. Mironchenko and C. Prieur. Speakers: M. Krstic, H. Lhachemi, A. Mironchenko, P. Pepe, C. Prieur, F. Wirth. Title of the talk (50min): Input-to-state stability of time-delay systems: Lyapunov-Krasovskii characterizations and feedback control redesign.
- 6) International Graduate School on Control, EECI (European Embedded Control Institute). E. Fridman (seven lectures, each one of 1h 30m) and P. Pepe (seven lectures, each one of 1h 30m), scheduled in Paris CENTRALE SUPELEC, held in remote for Covid-19 issues, 7-11 September 2020. Course title: Time-Delay and Sampled-Data Systems.

## LECTURES AT ITALIAN GRADUATE SCHOOLS

- 1) Dipartimento di Ingegneria Informatica, Automatica e Gestionale, Università La Sapienza, Rome, cycle of 8 seminars (each one of 1h) on Basic theory of Retarded Systems, for Ph.D. Students in Systems Engineering (organized by S. Monaco and C. Califano), 2/7 May 2012.

## WORK IN AND WITH INDUSTRIES

- 1) As a permanent personnel, from 1-9-1992 to 30-5-1993, in the Technical and Scientific Division of SINCAD Technology, ROLAND Digital Group, Martinsicuro (province of Teramo, Italy), main activity in the development of new hardware and software applications for ROLAND machine tools. In particular, in charge for special projects, coordinator for the realization of a three dimensional copying systems, which was presented in 1993 at the SMAU exhibition of software and communications, Milan, Italy.



- 2) In the framework of a cooperation contract between the Department of Electrical and Information Engineering of the University of L'Aquila and Marconi Selenia Communications, main activity in the simulation of aircrafts scenario for the validation of scheduling algorithms.
- 3) Participant at the Cooperation Agreement between the Department of Information Engineering, Computer Science and Mathematics, University of L'Aquila, and TELECOM ITALIA, for the experimentation of Systems MDT (Minimization of Drive Tests), 2020.

#### SCIENTIFIC COOPERATION WITH ITALIAN AND FOREIGN UNIVERSITIES

- 1) University of L'Aquila, L'Aquila, Italy (G. Antonini, M. Bottini, C. Buccella, C. Cecati, F. Cesarone, M. Dalla Mora, E. De Santis, M.D. Di Benedetto, M.P. Di Ciccio, M. Di Ferdinando, S. Di Gennaro, A. D'Innocenzo, P.U. Foscolo, A. Germani, M.T. Grifa, N. Guglielmi, A. Impicciatore, A. Iovine, J.D. Kong, S.S. Kumar, H. Latafat, C. Manes, F. Parasiliti, G. Pola, K. Razi).
- 2) Istituto di Analisi dei Sistemi e Informatica, Consiglio Nazionale delle Ricerche, Rome, Italy (A. Borri, F. Carravetta, A. De Gaetano, S. Panunzi, P. Palumbo).
- 3) Università Campus Biomedico, Rome, Italy (F. Cacace).
- 4) University of Genova, Italy (F. Conte).
- 5) Georgia Institute of Technology, Atlanta, USA (E.I. Verriest).
- 6) Polytechnic Institute of New York University, Brooklyn, NY, USA (Z.-P. Jiang).
- 7) Technical University of Crete, Chania, Greece (Iasson Karafyllis).
- 8) National Technical University of Athens, Athens, Greece (I. Karafyllis).
- 9) Kyushu Institute of Technology, Fukuoka, Japan (H. Ito).
- 10) Ecole Central de Lille, Lille, France (N. Yeganefar).
- 11) Université de Valenciennes, Valenciennes, France (M. Dambrine).
- 12) Centrale-SUPELEC, Gif-sur-Yvette, France (G. Valmorbida, F. Mazenc, S.-I. Niculescu).
- 13) Northeastern University, Boston, USA (R. Sipahi).
- 14) Czech Technical University, Prague, Czech Republic (T. Vyhliđal).
- 15) Tel Aviv University, Tel Aviv, Israel (E. Fridman).
- 16) Grenoble Institute of Technology, Grenoble, France (O. Sename).
- 17) Università Tor Vergata, Rome (L. Zaccarian).
- 18) University of Melbourne, Melbourne, Australia (D. Netic).
- 19) University of Louisiana, Baton Rouge, USA (M. Malisoff).
- 20) Ecole Nationale Supérieure de l'Electronique et de ses Applications (ENSEA), Paris, France (I. Haidar).
- 21) Katholieke Universiteit Leuven, Leuven, Belgium (W. Michiels).
- 22) University of Isfahan, Isfahan, Iran (M. Ataei, S. Talebi).

#### ADVISOR and THESIS ADVISOR of Ph.D. STUDENTS

- 1) Nonlinear Control of a Reactor CSTR (in Italian, Controllo Nonlineare di un Reattore CSTR), Dr. M.P. Di Ciccio, Advisor P. Pepe, Co-Advisor P.U. Foscolo, Dottorato di Ricerca in Ingegneria Elettrica e dell'Informazione, Academic Years 2007/2008--2009/2010.

- 2) Sampled-data Control of Nonlinear Time-Delay Systems, Dr. Mario Di Ferdinando, Advisor P. Pepe, Dottorato di Ricerca in Ingegneria e Scienze dell'Informazione, Academic Years 2015/2016—2017/2018.
- 3) Sampled-Data Controller and Robustness Analysis of Consensus Problems, Dr. Francesco Cesarone, Advisor and Thesis Advisor N. Guglielmi, Thesis Advisor P. Pepe, Dottorato di Ricerca in Matematica e Modelli, AA 2015/2016-2017/2018.
- 4) Stability Analysis of Discrete-Time Systems with Constrained Delays by Novel Nonlinear Halanay-Type Inequalities, Maria Teresa Grifa, Advisor A. De Masi, Thesis Advisor P. Pepe, Dottorato di Ricerca in Matematica e Modelli, AA. 2019/2020, 2020/2021.

## PRIZES AND HONORS

- 1) 2000, recipient of a CNR research grant for 6 months at Cal Berkeley, California, USA.
- 2) 2001, recipient of Filauro grant for research activity at Georgia Tech, Atlanta, USA.
- 3) On September 2005, one of the eleven Italian researchers to obtain the CIRA (now SIDRA, former Italian Society of Automatic Control Professors and Researchers) certificate of scientific merit for the position of associate professor in automatic control (Committee: E. Fornasini, R. Genesio, N. Schiavone, L. Sciavicco, A. Vicino).
- 4) On 24 June 2006, elevation to the grade of IEEE Senior Member.
- 5) In 2010, one of the two winners (out of 37 Candidates) of the competition for a position of associate professor in automatic control, at the University Campus Biomedico of Rome (Committee G. Celentano, P. Chiacchio, P. Colaneri, A.M. Perdon, L. Sciavicco).
- 6) Recipient, with F. Carravetta and P. Palumbo of *Kybernetika Editor's Award 2013*, for the paper *F. Carravetta, P. Palumbo, P. Pepe, Memoryless Solution to the Optimal Control Problem for Linear Systems with Delayed Input, Kybernetika, Vol. 49, N. 4, pp. 568-589, 2013.*
- 7) In 2014, January 31<sup>st</sup>, recipient of the Italian scientific qualification for the position of full professor in automatic control. ANVUR parameters: number of normalized articles 29.56 (ANVUR lower bound 18); number of normalized citations 36.36 (ANVUR lower bound 21.02); H-C Index 12 (ANVUR lower bound 8). Committee: B. De Moor, G. De Nicolao, A. Germani, S. Savaresi, S. Zampieri.
- 8) In 2013 evaluation 1 (excellent) of all the three works presented to VQR 2004-2010.
- 9) In 2017 evaluation 1 (excellent) and evaluation 0.7 (elevate) of the two works presented to VQR 2011-2014, respectively.
- 10) In 2017, recipient of MIUR-FFABR financial support (3000 Euro), given to top level 25% of candidates associate professors, on the basis of bibliometric measures.
- 11) In 2019, May 10<sup>th</sup>, recipient (for the second time) of the Italian scientific qualification for the position of full professor in automatic control. ANVUR parameters: number of articles 44 (ANVUR lower bound 17); number of citations 1429 (ANVUR lower bound 497); H Index 21 (ANVUR lower bound 12). Committee: P.P. Arena, S. Chiaverini, A. Chiuso, C. Melchiorri, L. Villani.
- 12) In 2020, July 6, Recipient of qualification for position of full professor in automatica at the Dipartimento di Ingegneria dell'Informazione, Università di Pisa. Committee: A. Bicchi, L. Chisci, M.L. Corradini, E. De Santis, D. Naso.
- 13) In 2020, September 11, best contribution award at the Italian Conference on Automatic Control SIDRA Cagliari 2020 (evaluation criteria: clarity, organization and effectiveness of the oral presentation; potential impact of the contribution), for the work *M. Di Ferdinando, P.*

- Pepe, S. Di Gennaro, A Converse Lyapunov–Krasovskii Theorem for the Global Asymptotic Local Exponential Stability of Nonlinear Time–Delay Systems* (publication in IEEE-LCSS, 2021), speaker M. Di Ferdinando. Committee: G. Antonelli, F. Basile, L. Menini, M. Tanelli.
- 14) Outstanding Associate Editor 2020, IEEE Control Systems Letters.

#### COMMITTEE MEMBER OF Ph.D DISSERTATIONS DEFENDS

- 1) Committee Member (with M.E. Valcher, President, and P. Valigi), final exam for the attribution of the Ph.D. degree in Systems Engineering (XXV cycle), Dipartimento di Ingegneria Informatica, Automatica, e Gestionale, Università degli Studi di Roma La Sapienza, Rome, 25 March 2013. Ph.D. Student Guido Oddi, Advisor F. Delli Prisco, Titolo tesi: Reinforcement Learning and Cooperative Receding Horizon approaches for the routing problem. Ph.D Student Andrea Fiaschetti, Advisor F. Delli Prisco, Titolo tesi: Control Algorithms and Architectures for Resource Management in Multi-Layered Systems: Application to SatCom, Security and Manufacturing Domains.
- 2) Reviewer and Committee Member (with F. Lamnabhi-Lagarrigue, President, M. Adimy, C. Bonnet, J. Clairambault, R. Itzykson, F. Mazenc, A. Medvedev), Ph.D. Walid Djema, Advisors C. Bonnet, J. Clairambault, F. Mazenc, French Institute for Research in Computer Science and Automation (INRIA) and Université Paris-Sud, University Paris-Saclay, CENTRALE-SUPELEC, Paris, France, Ecole Doctorale Sciences et Technologies de l'Information et de la Communication, 21 November 2017. Dissertation title: Understanding Cell Dynamics in Cancer from Control and Mathematical Biology Standpoints – Particular Insights into the Modeling and Analysis Aspects in Hematopoietic Systems and Leukemia.
- 3) Reviewer and Committee Member (with M. Maggiore, President, A. Astolfi, J.-P. Richard, C. Califano, R. Ortega, S. Monaco, D. Normand-Cyrot), Ph.D. Mattia Mattioni, Advisors S. Monaco and D. Normand-Cyrot, Thèse de doctorat de L'Université Paris-Saclay, Préparée à Université Paris Sud CENTRALE-SUPELEC Paris, France, et University La Sapienza, Rome, Italy, Ecole Doctorale Sciences et Technologies de l'Information et de la Communication, Spécialité de doctorat Automatique, 25 May 2018. Dissertation (in English) title: Stabilisation des systemes échantillonnées en cascade et avec retards.
- 4) Reviewer and Committee Member (with J.-P. Richard, President, and A. Seuret, F. Plestan, E. Moulay, V. Léchappé), Ph.D. Yang Deng, Advisor F. Plestan, Co-Advisors E. Moulay, V. Léchappé, L'Ecole Centrale de Nantes, France, Ecole Doctorale Mathématiques et Sciences et Technologies de l'Information et de la Communication, Spécialité: Automatique, Productique et Robotique, 8 July 2020. Dissertation title: Delay Estimation and predictor-based control of time-delay systems with a class of various delays.

#### DIDACTIC ACTIVITY

- 1) Teacher of mini-course (10 hours lectures) on Control with delays, Master in Sistemi, Servizi Spaziali ed Applicazioni, Università degli Studi dell'Aquila e Telespazio: A.A. 2001/2002;
- 2) Co-Teacher (with P. Caravani) of the Course Automatic Control, Corso di Diploma in Ingegneria Elettronica, Università degli Studi dell'Aquila: A.A. 2000/2001;

- 3) Teacher of the Course Teoria dei Sistemi, five-years Laurea in Electronic Engineering, Università degli Studi dell'Aquila: A.A. 2001/2002;
- 4) Teacher of the Course Teoria dei Sistemi, Undergraduate course in Engineering of Management, Master Course in Electrical Engineering, Università degli Studi dell'Aquila, 6 CFU: A.A. 2002/2003, 2003/2004, 2004/2005, 2005/2006, 2006/2007, 2007/2008;
- 5) Teacher of the Course Complementi di Teoria dei Sistemi, Undergraduate Course in Engineering of Management, Master Course in Electrical Engineering, 3 CFU: A.A. 2007/2008.
- 6) Teacher of the Course Teoria dei Sistemi, Undergraduate Course on Engineering of Management, Università degli Studi dell'Aquila, 9 CFU: A.A. 2008/2009, 2009/2010, 2010/2011, 2011/2012, 2012/2013, 2013/2014;
- 7) Teacher of the Course Sistemi di Regolazione e Controllo, Undergraduate Course in Electrical Engineering, Università degli Studi dell'Aquila, 6 CFU: A.A. 2004/2005, 2005/2006, 2006/2007, 2007/2008;
- 8) Teacher of the Course Complementi di Sistemi di Regolazione e Controllo, undergraduate Course in Electrical Engineering, Università degli Studi dell'Aquila, 3 CFU: A.A. 2007/2008;
- 9) Co-Teacher (with P. Caravani) of the Course Controlli Automatici, Undergraduate Course in Engineering of Management, Università degli Studi dell'Aquila, 3 CFU of total 6 CFU of the course: A.A. 2002/2003, 2003/2004, 2004/2005;
- 10) Co-Teacher (with P. Caravani) of the Course Controlli Automatici, Master Course in Engineering of Management, Università degli Studi dell'Aquila, 6 CFU of total 9 CFU of the course: A.A. 2010/2011;
- 11) Co-Teacher (with P. Caravani) of the Course Controlli Automatici, Master Course in Engineering of Management, Università degli Studi dell'Aquila, 3 CFU of total 9 CFU of the course: A.A. 2011/2012, 2012/2013;
- 12) Co-Teacher (with A. Germani) of the Course Complementi di Automatica, Master Course in Ingegneria Informatica-Automatica, Università degli Studi dell'Aquila, 3 CFU of total 6 CFU of the course: A.A. 2011/2012, 2012/2013;
- 13) Teacher of the Course Modellistica e Simulazione, Master Course in Ingegneria Informatica-Automatica, Università degli Studi dell'Aquila, 9 CFU, AA. 2013/2014, 2014/2015, 2015/2016, 2016/2017;
- 14) Teacher of the Course Fondamenti di Automatica, Undergraduate Course in Ingegneria Industriale (including reduced course for Master Mechanical Engineers), Università degli Studi dell'Aquila, 9 CFU, AA 2014/2015, 2015/2016, 2016/2017, 2017/2018, 2018/2019;
- 15) Teacher of the Course Complementi di Automatica, Master Course in Ingegneria Informatica-Automatica, Università degli Studi dell'Aquila, (6 CFU), AA 2017/2018;
- 16) Teacher of the Course Complementi di Automatica, Master Course in Ingegneria Informatica-Automatica, Università degli Studi dell'Aquila, (9 CFU), AA 2018/2019.
- 17) Teacher of the Course Sistemi di Controllo, Master Course in Ingegneria Meccanica, Università degli Studi dell'Aquila, (6 CFU), AA 2019/2020, 2020/2021;
- 18) Teacher of the Course Advanced Control Systems, Master Course in Ingegneria Informatica-Automatica, Università degli Studi dell'Aquila, (9 CFU), AA 2019/2020, 2020/2021.

## OTHER DIDACTIC ACTIVITIES

- 1) Advisor or co-Advisor of over 90 degree dissertations in Engineering (Industriale, Ambiente e Territorio, Elettrica, Elettronica, Gestionale, Informatica-Automatica, Matematica), A.A. 1996/1997 - present; trainer of 13 Students, final pre-Laurea F credits, total of 121 CFU;
- 2) Teaching Assistant Course Metodi Matematici per l'Ingegneria, Five Years Laurea in Electronic Engineering, Università degli Studi dell'Aquila: A.A. 1996/1997;
- 3) Teaching Assistant Course Teoria dei Sistemi, Five Years Laurea in Electronic Engineering, Università degli Studi dell'Aquila: from A.A. 1995/1996 to A.A. 1999/2000.
- 4) Teacher of a course on automatic control (in English, 20 hours lectures), Università degli Studi dell'Aquila, to Teachers and Students of the University of Kazakhstan, Alma-Aty, in the framework of the European Project Tempus Tacis: A.A. 1995/1996, 1996/1997, 1997/1998.

## SERVICES TO THE UNIVERSITY OF L'AQUILA

- 1) From 1-11-96 to 1-12-96 (as subject expert, culture della materia, in automatic control, from 9-5-96), didactic assistance, research activity.
- 2) From 2 December 1996 to 1 July 2000, logistic-technic management of the new born didactic Laboratory of Automatic Control and Robotics, consisting of desk computers, a three tanks system, an inverted pendulum, a magnetic suspension system, a robot, and other technological devices.
- 3) Member Council of Teachers, Ph.D school in Electrical and Information Engineering (coordinator A. Germani), Dipartimento di Ingegneria Elettrica e dell'Informazione, Università degli Studi dell'Aquila, from 2004 to 2007.
- 4) Member Council of Teachers, Ph.D school in Electrical and Information Engineering (coordinator P. Tognolatti), Dipartimento di Ingegneria Elettrica e dell'Informazione, Università degli Studi dell'Aquila, 2008.
- 5) Member Council of Teachers, Ph.D school in Electrical and Information Engineering (coordinator G. Ferri), Dipartimento di Ingegneria Elettrica e dell'Informazione, Università degli Studi dell'Aquila, from 2009 to 2011.
- 6) Member Council of Teachers (selected), Ph.D. school in Information Engineering and Computer Science, (coordinator M.D. Di Benedetto), Dipartimento di Ingegneria e Scienze dell'Informazione e Matematica, Università degli Studi dell'Aquila, from 2012 to 2018.
- 7) Member Council of Teachers (selected), Ph.D school in Information Engineering and Computer Science, (coordinator V. Cortellessa), Dipartimento di Ingegneria e Scienze dell'Informazione e Matematica, Università degli Studi dell'Aquila, 2019, 2020.
- 8) Elected member of the executive council of the Department of Electrical and Information Engineering, University of L'Aquila, from 22 March 2007 to 1 July 2012;
- 9) Elected Member of the executive council of the Department of Information Engineering, Computer Science, and Mathematics, University of L'Aquila, from 15 October 2012 to 15 November 2016;

- 10) Elected Member of the Didactic Council of the Course in Engineering of the Management, from A.A 2002/2003 to October 2007;
- 11) Elected Member of the Didactic Council of the Course in Electrical Engineering, from November 2007 to November 2010;
- 12) Co-Editor, with A. Germani and M. Feliziani, and Secretary of Edition, of a triennial report on the research activity at the Department of Electrical and Information Engineering, University of L'Aquila, 132 pages, 1997;
- 13) Member of the Committee for courses scheduling (with F. Parasiliti and B. Rubino, presidents), Faculty of Engineering, University of L'Aquila, from January 2002 to May 2007;
- 14) Member of the Committee (with G. Di Stefano and D. Frigioni) for Students Matters and Study Plans, October 2003 - February 2004, June 2004 - April 2005;
- 15) Aggregate Member for the electronic and the information engineering, of the Committee for State Examination of Doctors in Engineering, sessions November 2002, May 2007, November 2007.
- 16) Member of Committee (with F. Alfani and P. Di Stefano) for the regulation of Didactic Councils, June 2001;
- 17) Member of the Image Committee (President F.L. Villante), for the publication of research results from the University of L'Aquila on the newspaper Il Messaggero: may 2000 - October 2001.
- 18) Member of the Committee (with M. Flammini and S. Cicerone) for the selection of Ph.D. Students in Information Engineering and Computer Science, University of L'Aquila, November 2012.
- 19) Member of the Committee (with M.D. Di Benedetto and L. Benvenuti), for selection of a Tenure-track Assistant Professor in automatic control, Department of Electrical and Information Engineering, University of L'Aquila, 2009.
- 20) Member of 3 Committees for post-doc positions, Department of Electrical and Information Engineering, Department of Information Engineering, Computer Science, and Mathematics, from 2010.
- 21) Member of Committee for Students Orientation, for Didactic Council in Information Engineering (President G. Di Stefano), from 12-11-2015 to 16-11-2018.
- 22) Member Reference Group on Modelling and Control of Cyber-Physical Systems (with E. De Santis, president, S. Di Gennaro, G. Pola), Ph.D. School in Information Engineering and Computer Science, from 5-11-2015 to 20-5-2019.
- 23) Member Committee (with M.L. Fania, President, H. Muccini, S. Cicerone) for the public selection of contract teachers for eight courses at the Department of Information Engineering, Computer Science, and Mathematics, for the A.A. 2016/2017, 12 July 2016.
- 24) Member Committee VQR (Coordinator N. Gavioli) Dipartimento di Ingegneria e Scienze dell'Informazione e Matematica, from 1-10-2015 to 12-3-2017, and member Committee Evaluation of Research and Internal Regulations (Coordinatrice B. Nelli), from 13-3-2017 to 30/7/2018.
- 25) Member Research Committee (Coordinator C. Arbib), Dipartimento di Ingegneria e Scienze dell'Informazione e Matematica, from 31/7/2018.
- 26) Member Committee (with G. Antonini, president, and D. Frigioni) for the ranking and the selection of Tutor Students, for the assignment of 49 grants, University of L'Aquila, September 2017.
- 27) Scientific Advisor Reference Group on Modelling and Control of Cyber-Physical Systems (advisor members E. De Santis, S. Di Gennaro, G. Pola), Ph.D. School in Information Engineering and Computer Science, from 20-5-2019 to present.

- 28) Scientific Responsible, with G. Pola, of the laboratory EECI-DEWS-LAB of the Center of Excellence for Research DEWS, Department of Information Engineering, Computer Science, and Mathematics, University of L'Aquila, from 16 October 2020.
- 29) On charge of the management for support activity to research, concerning Focus Periods and Cross-Fertilization, Center of Excellence for Research DEWS, Department of Information Engineering, Computer Science, and Mathematics, University of L'Aquila, from 9 April 2020.
- 30) Committee Member (with F. Lamnabhi-Lagarrique, M. Feliziani) for the selection of one Student grant for the Path-to-Excellence Program (PEP) in Cyber-Physical Systems, Master in Informatics and Automatics Engineering, Department of Information Engineering, Computer Science, and Mathematics, University of L'Aquila, Academic Year 2020/2021, 2021/2022.
- 1) Elected Member of the executive council of the Department of Information Engineering, Computer Science, and Mathematics, University of L'Aquila, from 24 June 2021.

#### OTHER SERVICES TO THE UNIVERSITY OF L'AQUILA

- 1) Collaborator for a three months stage at the University of L'Aquila of professors and Students of the University of Kazakhstan, 1996, 1997, 1998.
- 2) Collaborator for a ten-days stage of Professors and Students of the University of L'Aquila visiting the University of California at Berkeley, the Stanford University, and some Companies of the Silicon Valley (Intel, Logitech), December 2000;
- 3) Tutor for Robotics and Systems, week of scientific culture, for students of high school visiting the Laboratories of the University of L'Aquila, from 1997 to 2000.
- 4) Member of the Committee at polling station for the elections of students representations, Faculty of Engineering, University of L'Aquila, 25-26 May 2005.
- 5) Orientation activity for high school Students: *salone dello Studente GOing*, Istituto Tecnico Commerciale e per Geometri Umberto I, Ascoli Piceno, 2014, 2015, 2016, 2017, 2018, 2019; *Istituto Tecnico Industriale Fermi*, Ascoli Piceno, 2014, 2016; *salone dello Studente*, Istituto Tecnico Statale Economico e Tecnologico Carducci e Galileo, Fermo, 2015; *Val Vibrata College Liceo Scientifico D'Annunzio*, Corropoli, 2016; *Istituto Tecnico Superiore*, Istituto Tecnico del Settore Economico e Liceo Linguistico Capriotti, 2019, *Istituto Istruzione Superiore Alessandrini-Marino*, Teramo, 2018.

#### SERVICES AT OTHER ITALIAN UNIVERSITIES

- 1) Committee Member (with T. Leo, President, and G. Oriolo) for the selection of a tenured Assistant Professor in Automatic Control, Faculty of Engineering, University of Salento, Lecce, 2003;
- 2) Committee Member (with R. Marino, president, and C. Rossi) for the selection of a tenured Assistant Professor in Automatic Control, Faculty of Engineering, University of Rome Tor Vergata, 2006.

## IFAC TECHNICAL COMMITTEE AND SOCIETY ASSOCIATIONS

- 1) Member of IFAC Technical Committee 2.2 (Linear Control Systems), December 2020, member of the Working Group on Time-Delay Systems, member of the Committee (with R. Sipahi, president, and K. Gu) for the IFAC Lifetime Achievement Award in Delay Systems Area, 2020/2023.
- 2) Member of the IFAC Technical Committee 2.6 (Distributed Parameter Systems), from December 2014.
- 3) Member IEEE, from 2001, senior Member from 2006.
- 4) Member SIAM, from 2001.
- 5) Member SIDRA, from 2008.

## RESEARCH PROJECTS

- 1) Research Project "Teoria dei Sistemi e del Controllo" (Systems and control theory), Ministero dell'Università e della Ricerca Scientifica e Tecnologica, National Coordinator S. Monaco, local Coordinator A. Germani, 1995-1997, participant.
- 2) Research Project "TEMPUS-TACIS", European Project for didactic and scientific cooperation with the University of Kazakhstan, Almaty, 1995-1998, participant.
- 3) Research Project "Sottosistemi modulari intelligenti per l'automazione e la robotica spaziale" (Intelligent modular subsystems for automation and robotics), ASI (Agenzia Spaziale Italiana), 1999-2001, National Coordinator S. Monaco, local Coordinator A. Germani, participant.
- 4) Research Project "HYBRIDGE", European Project, 2001-2004, Local Coordinator M.D. Di Benedetto, participant.
- 5) Research Project MIUR-PRIN, "Progettazione di controllori per sistemi ibridi" (Control design for hybrid systems), National and Local Coordinator M.D. Di Benedetto, 2002-2005, participant.
- 6) Research Project MIUR-PRIN "Metodologie per lo studio dei sistemi ibridi per la movimentazione e il telecontrollo" (Methodologies for the study of hybrid systems for movement and telecontrol), 2003-2005, National Coordinator L. Fortuna, Local Coordinator C. Manes, participant.
- 7) Research Project MIUR-PRIN "Modellistica, identificazione e controllo di sistemi basati su IMPC (ionic polymer-metal composites) interconnessi" (Modelling, identification and control of systems based on interconnected IMPC), 2006-2008, National Coordinator L. Fortuna, local Coordinator C. Manes, participant.
- 8) Research project MIUR-PRIN "Metodologie Innovative per la Modellistica, l'Identificazione e il Controllo di Sistemi Microfluidici" (Innovative methodologies for modelling, identification and control of microfluidic systems), 2011-2013, National Coordinator M. Bucolo, local Coordinator C. Manes, participant.
- 9) "Controller Synthesis for Time-Delay Systems", 2006, Atheneum RIA Project, University of L'Aquila, in charge of scientific leadership;



- 10) "Digital Control of Time-Delay Systems", 2007, Atheneum RIA Project, University of L'Aquila, in charge of scientific leadership;
- 11) "Observation and Control of Time-Delay Systems", 2008, Atheneum RIA Project, University of L'Aquila, in charge of scientific leadership;
- 12) "ISS Attenuation of the Actuation Disturbance for Time-Delay Systems", 2009, Atheneum RIA Project, University of L'Aquila, in charge of scientific leadership.
- 13) "Control of Nonlinear Systems in Presence of Disturbances, Saturation, Time-Delays", 2010, Atheneum RIA Project, University of L'Aquila, in charge of scientific leadership.
- 14) "Universal Formulas for the Stabilization of Nonlinear Retarded Systems", 2011, Atheneum RIA Project, University of L'Aquila, in charge of scientific leadership.
- 15) "Converse Liapunov Criteria for Neutral Nonlinear Systems", 2012, Atheneum RIA Project, University of L'Aquila, in charge of scientific leadership.
- 16) "Stabilization with Sampled-Data Measures and Zero-Order Holder of Nonlinear Functional Systems", Atheneum RIA Project, University of L'Aquila, 2013, 2014, in charge of scientific leadership.
- 17) "Digital Robust Control of Nonlinear Systems Affected by Discontinuities and Nonconstant Time-Delays", Atheneum RIA Project, University of L'Aquila, 2015, 2016, in charge of scientific leadership.
- 18) "System for house energy rationalization with integration of summer conditioning", 2010, Italian Ministry of Production Activities, Local Coordinator F. Muzi, participant.
- 19) Project FFABR, Italian Ministry of Instruction and Research, 2017, provided to top level 25% of candidate Associate Professors, "Sampled-Data Control of Nonlinear Systems", in charge of scientific leadership.
- 20) CNRS, L2S, LAAS, INRIA, CentraleSUPELEC Progetto GdRI-SPaDisCo, Projet de Creation Demande de Renouveau d'un Groupement de Recherche, local coordinator team of the Department of Information Engineering, Computer Science, and Mathematics, University of L'Aquila.
- 21) Research Project ASSIOMI (Algoritmi, Sistemi e dispositivi per monitoraggio e diagnostica di macchine per le fabbriche Intelligenti), Fondo per la Crescita Sostenibile, Sportello "Fabbrica Intelligente" PON, Scientific Leader V. Stornelli, participant [2019-present].

## SCIENTIFIC ACTIVITY

The research activity has concerned above all internal and external stability analysis and many techniques for observation and control for the large class of retarded functional systems (that is, described by retarded functional differential equations), both of stochastic and deterministic type. Furthermore, contributions have been given for flexible mechanical systems, discrete-time switching systems, nonlinear discrete-time systems, consensus problems with digital controllers, and on robustification of digital controllers for nonlinear systems described by ordinary differential equations. Many results have been obtained for applications, such as chemical reactors, electrical converters, partial element equivalent circuits, artificial pancreas. In the following the scientific activity is reported in detail. Quoted papers refer to just ISI Journal ones (see the related part in the list of publications reported below).

- 1) *Linear quadratic gaussian control of linear systems described by retarded functional differential equations [1]*. A first linear quadratic gaussian finite-horizon controller has been designed for linear retarded functional systems, described by ordinary differential

equations which approximate the infinite dimensional Kalman filter and the feedback from the estimated state. The convergence of the approximated to the optimal one has been proved, as the approximation index increases to infinity. Results have been validated by simulations on the well-known National Transonic Facility, the liquid nitrogen wind tunnel at NASA Langley Research Center in Hampton, Virginia, USA.

- 2) *Optimal and predictive control ([35],[44]).* An optimal controller has been designed for linear systems with constant input delay of arbitrary size [35], by memoryless feedback of the system internal variable in finite dimensional spaces, and by predictor which makes use the dynamic matrices of the closed-loop system. The stabilization of nonlinear systems in strict feedback form with time-varying input delay of arbitrary size has been studied in [44]. A stabilizing controller has been designed by means of a chain of sub-controllers, making use of the dynamic matrix of the closed-loop system which were obtained with known state and zero delay.
- 3) *Observation and nonlinear control of nonlinear retarded functional systems with differential geometry tools ([2], [3], [4], [6], [11], [51], [61]).* Differential geometry tools for nonlinear functional systems with single discrete delay have been studied. Input-output linearizing feedbacks have been designed, and the internal stability has been analysed. Pioneering results have been obtained for the observation of nonlinear systems with delays in state and/or output, with the notable feature of arbitrary delay size in the output signal. The algorithm is based on the construction of a first ring by which the state of the system, at the time the output signal is received, is estimated, and then by a predictor towards to time of current state. Convergence problems due to the delay size have been solved by means of a chain of those rings, for the estimation of the state in intermediate times between the one of the current state and the one of the output signal.
- 4) *Stabilization of nonlinear retarded functional systems by means of control Lyapunov functionals. ([37], [47]).* Universal Sontag's formulas have been obtained for the stabilizing controller of nonlinear functional systems, with suitable modifications in order to overcome discontinuity problems which can involve subsets of infinite cardinality of infinite dimensional spaces.
- 5) *Internal stability and input-to-state stability of nonlinear retarded functional systems. ([7], [8], [10], [12], [14], [15], [16], [17], [18], [19], [20], [22], [30], [34], [39], [48], [63]).* General Lyapunov criteria have been obtained for nonlinear systems described continuous-time difference equations and hybrid systems described by coupled delay differential and continuous-time difference equations. The input-to-state stability of systems described by retarded functional differential equations, continuous-time difference equations, and coupled, has been studied. The work [12] is the first in the literature which provides Lyapunov-Krasovskii criteria for the input-to-state stability of nonlinear retarded functional systems. All technical problems for considering Lebesgue measurable locally essentially bounded inputs have been solved, as far as the use of Dini/Driver directional derivatives which do not involve, not even formally, the system solution, and the absolute continuity, necessary when the functional derivative is not always negative, but just almost

everywhere, given the input feature, are concerned. Full characterization of the input-to-state stability, that is by necessary and sufficient conditions, has been obtained for different types of nonlinear functional systems (described by continuous-time difference equations, retarded functional differential equations, neutral functional differential equations). Relationships between internal exponential stability and input-to-state stability have been studied. Necessary and sufficient conditions have been provided for the global asymptotic local exponential stability of nonlinear retarded functional systems described by locally Lipschitz functionals.

- 6) *Input-to-state stabilization with respect to actuation disturbances of stabilizable nonlinear retarded functional systems ([23], [28], [32]).* The problem of the actuation disturbance has been solved by the use of the Lyapunov-Krasovskii functional for the disturbance-free stabilized system. An alternative controller has been found by which the actuation disturbance, Lebesgue measurable and locally essentially bounded, cannot cause instabilities (the closed-loop system is disturbance-to-state stable), and furthermore whose effect can be arbitrarily attenuated at the prize of an increased control effort. Problems of discontinuous right-hand side of the function describing the dynamics and of input saturation have been addressed and solved by means of the convexification process with inclusions, in the case of essentially bounded disturbance.
- 7) *Adaptive control of nonlinear retarded functional systems ([9]).* An adaptive control for nonlinear functional systems has been provided, in the case of a single discrete delay. This work is the first step in the literature towards the application of the adaptive control methodologies, based on tools of differential geometry, for nonlinear finite dimensional systems, also to retarded functional systems.
- 8) *Construction of Liapunov-Krasovskii functionals for internal and input-state stability by means of small-gain arguments ([26], [36]).* Small-gain techniques allow to simplify the construction of Liapunov-Krasovskii functionals for complex systems. Such techniques have been studied for interconnected systems and for network systems described by nonlinear retarded functional differential equations, for both the internal and the input-to-state stability, also of the integral type. The methodology allows to construct the functional for the entire system, on the basis of the functionals of each subsystem, thus reducing the computational complexity.
- 9) *Digital control of nonlinear retarded functional systems ([5], [38], [46], [49], [50], [52], [55], [59], [60]).* The problem of digital control of nonlinear retarded functional systems has been addressed. Solutions have been found, by both state feedback and discrete-dynamic output feedback, and the the practical semi-global convergence to arbitrarily small neighborhoods of the origin has been proved by means of sufficiently small sampling period. In the case of globally Lipschitz systems, it has been proved that the global exponential stability is preserved with sufficiently small sampling period. Also problems due to quantization and actuation disturbances and small measure errors have been addressed and solved. Problems due to infinite dimensional state feedback, for instance

due to non availability in the buffer of values of the internal variable in suitable delayed times, because of sampling in finite dimensional spaces, have been solved.

10) *Formal methods ([25], [41], [45], [54])*. Techniques of formal discretization by means of symbolic methods can solve sophisticated control problems such as temporal logics, safety with respect to state constraints, particular desired trajectories. Such techniques have been applied to nonlinear retarded functional systems and to networks of nonlinear discrete-time systems. Decentralized controllers have been studied for networks of discrete-time systems based on formal methods for complex specifications expressed by regular languages. Assumptions of incremental type stability have been exploited.

11) *Robustification of digital nonlinear controllers for nonlinear finite dimensional systems ([43])*. Digital controllers have been found for dealing with actuation disturbances of arbitrary size, bounded with known bound, and with bounded measure errors with limited effect on the additive controller, which is continuous. Also discontinuous digital controllers as state feedback have been studied, so measure errors could be dangerous even if very small. It has been proved that the stabilization in the sample-and-hold sense is preserved also in presence of such measure errors and actuation disturbances, by means of suitably small sampling period.

12) *Consensus of nonlinear finite dimensional systems ([67])*. The consensus problem has been addressed by digital methodologies. The class of agents with drift dynamics described by bounded and globally Lipschitz functions has been considered. Exploiting the transformation into a stabilization problem by suitable change of coordinates, available in the literature, a digital controller as sampled-data emulation of available continuous-time state feedbacks, described also by discontinuous functions, with an additive robustifying term, has been studied. Consensus convergence has been proved with arbitrarily small error, even in presence of bounded actuation disturbances and suitably small observation errors, by means of sufficiently small sampling period. The well known graph theory for agents interactions has been exploited.

13) *Infinite horizon linear quadratic gaussian regulator for flexible structures described by partial differential equations ([13])*. A finite dimensional controller for an undamped flexible beam, clamped at one end and with a tip mass at the free end has been developed, which approximates an infinite dimensional Kalman filter and estimated state feedback. The Galerkin method of projection into finite dimensional subspaces has been exploited, by using as generators the eigenfunctions of the system. The convergence of the approximated solution to the optimal one has been proved for an arbitrary finite horizon, in the  $L_2$  norm. A notable coincidence of the Bode diagrams of the exact transfer function and of the approximated one has been observed, as the approximation index increases. The method allows to avoid the well known "spillover" problem which often arises when the system is approximated, instead of the controller as in this work.

14) *Internal stability and input-to-state stability of nonlinear discrete time systems with uncertain and constrained delays. ([53], [58], [65])*. The Lyapunov-Krasovskii

characterization (that is by necessary and sufficient conditions) has been established for the uniform global asymptotic stability and the input-to-state stability of discrete-time nonlinear systems with uncertain time-varying bounded delays. Such systems play a key role in the applications of networked control, which involve uncertain transmission delays, though often reasonably assumed to belong to bounded sets. In the case some informations were available for delay signals, for instance coming from the natural increasing property of all involved time arguments or for instance from limited variation properties, necessary and sufficient conditions have been established by means of multiple Liapunov functions, formally depending on the unknown delays. It is worth to highlight that in both works [53], [58] Lyapunov-Krasovskii conditions have been given in the same weak form, as far as involved norms are concerned, as in the Lyapunov-Krasovskii theorem for continuous-time systems described by retarded functional differential equations. Finally, new Halanay-type inequalities have been obtained for the global uniform asymptotic stability, easy to use at the price of more conservativeness with respect to Lyapunov-Krasovskii methods.

- 15) *Internal stability and input-to-state stability of nonlinear discrete-time switching systems with constrained switching signals ([56]).* It is well known that the global uniform asymptotic stability of a switching system with arbitrary switching signals taking values in a finite set is equivalent to the existence of a common Lyapunov function. Nevertheless, in the case switching signals are constrained, as for instance by a switches digraph, such equivalence is clearly no more valid, as the system could be stable though in presence of one or more unstable subsystems. In this work necessary and sufficient Lyapunov conditions are given for the global uniform asymptotic stability and for the input-to-state stability of nonlinear discrete time switching systems with constrained switching signals. Multiple Lyapunov functions, as the number of subsystems, are exploited and the number of involved conditions depends on the quantity of information provided by the switches digraph.
- 16) *Stability of nonlinear switching retarded functional systems ([62]).* Necessary and sufficient Lyapunov-Krasovskii conditions have been established for the global uniform asymptotic stability of nonlinear switching retarded functional systems (continuous-time). Links between the global exponential stability and the input-to-state stability have been established for the case the dynamics of the subsystems are described by globally Lipschitz functionals.
- 17) *Event-triggered control of nonlinear retarded functional systems ([46], [64], [66]).* Event triggered digital control algorithms have been established for nonlinear retarded functional systems. The semi-global asymptotic stability towards an arbitrarily small neighborhood of the origin has been proved, with a sufficiently small sampling period. The contribution with respect to the literature on retarded functional systems is the non necessary continuous monitoring of the state (infinite dimensional) of the system, but just at the sampling times. Furthermore, the event function involves just a finite number of most recent sampled-data measures of the internal variable of the system (in finite dimensional spaces).

18) *Chemical reactors with and without recycle* ([27], [29], [31]). New controllers have been designed for the actuation disturbance attenuation, and new controllers have been designed by the use of nonlinear observers for the estimation of the reactant concentration. The local convergence to the working point, chosen by means of a choice of the reaction conversion, has been proved theoretically and validated by an elevate number of simulations.

19) *Partial element equivalent circuits (PEEC)* ([21]). Partial element equivalent circuits describe electromagnetic interactions in electronic devices, and are modelled by functional differential equations of neutral type. The stability of such circuital models is a first prerequisite in adherence to the physics of the considered systems. In this work tools based on solvability of linear and bilinear matrix inequalities, as obtained by above developed techniques for the input-to-state stability of neutral functional differential equations, are exploited. It has been shown that such techniques can solve efficiently large dimension problems, and provide uniform (with respect to bounded sets of initial states) asymptotic stability as well as input-to-state stability for PEECs. It is worth noticing that for linear neutral systems, the asymptotic stability does not imply the uniform asymptotic stability nor the input-to-state stability.

20) *Artificial pancreas* ([24], [33], [40], [51], [57]). Many controllers have been developed, also of digital type, exploiting a continuous-time state observer for the estimation of the insulin blood concentration, difficult and expensive to be measured, or discrete time dynamics with feedback from the sampled-data measured glucose concentration. The research is devoted to the case of endovenous insulin administration. The provided controllers have been proved theoretically on a minimal model of the system. Furthermore, such controllers have been validated with the UVA/Padua (University of Virginia/Padova) simulator, accepted by the Food and Drug Administration (FDA) as a substitute to animal trials for insulin administration therapies.

21) *Electrical converters* ([42]). An observer-based controller has been designed for a DC/DC converter operating under wide input voltage and load variations, implemented on a digital processor. Laboratory tests have shown the efficacy of such controller, and experimental results have shown the performance superiority with respect to conventional PID controllers normally used for converters.

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