Gianmaria De Tommasi

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Biosketch

Gianmaria De Tommasi was born in Milano, Italy, in 1975. He received the Laurea degree (*summa cum laude*) in *Electronic Engineering* from the University of Naples Federico II in 2001.

From September 2000 to September 2001 he worked for a Siemens Industrial Services company located in Torre Annunziata (Naples, Italy), where he designed and developed control systems for industrial automation.

From October 2001 to April 2002 he won the MARS Scholarship Programme and he worked for the Microgravity Advanced Research and Support Center in Naples, where he designed and developed control and data acquisition software.

Since 2002 he is with Department of Electrical Engineering and Information Technologies of the University of Naples Federico II, where he received the *Research Doctorate* degree in *Computer and Automation Engineering* in 2005, and where he is currently *Full Professor* in *Automatic Control*.

Since 2002 he has been visiting researcher at the Joint European Torus (JET, UK), at the ITER Organization (France), at the Naka Fusion Institute (Japan), and at the Institute of Plasma Physics of the Chinese Academy of Science (People's Republic of China), where he has participated to various projects connected to plasma magnetic control. In May 2019, Gianmaria De Tommasi has been nominated *Deputy Coordinator* for the European contribution to the Integrated Commissioning of the JT-60SA tokamak.

Gianmaria De Tommasi is member *IEEE Member* since 2006, and he has been elevated to *Senior Member* in March 2011.

His current research interests include control of nuclear fusion devices; fault detection, opacity and identification of discrete event systems modelled with Petri nets; stability of hybrid systems. On these subjects he has published more than 250 journal and conference papers (the complete list of publications can be found at http://wpage.unina.it/detommas/publications.html).

Education

[**Dec. 2005**]   *Research Doctorate degree* - University of Naples Federico II.

[**2002-2005**]   *Research Doctorate* in Computer and Automation Engineering at the University of Naples Federico II (curriculum in Control and Systems Engineering):

Advisor: Prof. Alfredo Pironti

Thesis: *Plasma magnetic and kinetic control in a tokamak*

[**Jun. 2001**]   *Professional Engineer* certificate.

[**Mar. 2001**]   *Laurea degree* in Electronic Engineering, *summa cum laude* – University of Naples Federico II.

IEEE Service

[**2006-pres.**]   IEEE Member, Member no. 80406097:

member of the *IEEE Control System Society* since 2006

member of the *IEEE Control System Society Conference Editorial Board* since 2010

member of the *IEEE Nuclear and Plasma Sciences Society* - 2011-2019

University Employment

[**2020-pres.**]   *Full Professor* of Automatic Control at the Department of Electrical Engineering and Information Technologies, University of Naples Federico II.

[2014-2020.] *Associate Professor* of Automatic Control at the Department of Electrical Engineering and Information Technologies, University of Naples Federico II.

[2006-2014] *Assistant Professor* of Automatic Control at the Department of Electrical Engineering and Information Technologies, University of Naples Federico II; tenured since March 2009.

Other Employments

[2014-pres.] *Visiting Researcher* at the EAST tokamak, Institute of Plasma Physics of the Chinese Academy of Sciences (Hefei, PRC), as member of the *EUROfusion Consortium*.

[2013-pres.] *Visiting Researcher* at the International Fusion Energy Research Centre in Rokkasho (Japan) and at the Naka Fusion Institute (Japan) as part of the European team for the ITER Remote Experiment Centre.

[2013-2015] *Seconded National Expert* at the European Agency Fusion for Energy, Barcelona, Spain.

[2009-pres.] *Visiting Researcher* at the ITER Organization, St. Paul-lez-Durance (France).

[2002-pres.] *Scientific consultant* as expert in control systems analysis and design for the *CREATE Consortium*, Naples (Italy).

[2002-2018] *Visiting Researcher* at the JET tokamak, Culham Science Centre (UK), as member of the *EURATOM-ENEA-CREATE Association* and for the *EUROfusion Consortium*.

[Oct. 2001-Apr. 2002] Winner of the *MARS Scholarship Programme 2001* at the *Microgravity Advanced Research & Support Center*, Naples (Italy).

[Sep. 2000-Sep. 2001] *Scholarship winner* employed in a research project for *PdA Impianti* a company of the Siemens Industrial Services group locate in Torre Annunziata (Italy).

Scientific Activity

Grants & Projects

[2020-pres.] Member of the JT-60SA *Integrated Project Team (IPT)*.

[2019-pres.] Deputy Coordinator for the European contribution to the Integrated Commissioning of the JT-60SA tokamak.

[2018] Participation to the task titled "Control laws and observers to improve runaway electrons beam stabilization" at the JET tokamak for the 2018-2019 experimental campaign.

[2018] *Chair* of the EU Remote Experimentation Centre for JT-60SA Working Group setup by EUROfusion.

[2015-2017] Participation to the EUROfusion Enabling Research project titled "Fast Model Predictive Control for Magnetic Plasma Control".

[2013-2015] *Responsible Officer* of the European contribution to the following tasks of the ITER Remote Experimentation Centre (REC) (activity carried out as Seconded National Expert at Fusion For Energy): Remote Experiment System; Remote Data Access Software; Plasma Simulator.

[2013-2020] Member of the ITER REC *Integrated Project Team (IPT)*.

[2013-2016] Participation to the National Research Project *Effetti tridimensionali, non lineari e multiphysics nella modellistica e nel controllo dei dispositivi per la fusione termonucleare controllata*, supported by the Ministry of University, Scientific Research and Technology.

[2013] Participation to the task *T13-12: Develop and promote the use of Extreme Shape Controller (XSC) and Current limit avoidance (CLA) in JET scenarios* during the JET experimental campaign.

[2011-2012] *Scientific Coordinator* of the experiment titled "Application of the Current Limit Avoidance (CLA) in condition of low disruption probability and low forces at disruption" during the JET experimental campaign.

[2010-2012] *Project Leader* of the *Current Limit Avoidance Implementation Project* for the JET tokamak.

[2010-pres.] Expert member of the *ITER Plasma Control Group (PCG)*.

[2007-2009] Participation to the *Plasma Control Upgrade* project for the JET tokamak.

[2006-2008] Participation to the National Research Project *Modelling and Control of Resistive Wall Modes in toroidal fusion devices in presence of 3D conductors*, supported by the Ministry of University, Scientific Research and Technology.

[2002-2003] Participation to the *eXtreme Shape Controller* project for the JET tokamak.

Research Collaborations

[2013-pres.] Institute of Plasma Physics of the Chinese Academy of Science (People's Republic of China) on the following topic: design of advanced plasma magnetic control.

[2013-pres.] National Institutes for Quantum and Radiological Science and Technology (Japan) on the following topics: remote experimentation systems; plasma magnetic modelling and control.

[2012-pres.] Institut Jožef Stefan in Ljubljana (Slovenia) on the following topic: design of model predictive control for fusion devices.

[2009-pres.] ITER Organization, St. Paul-lez-Durance (France) on the following topics: modelling support for the design of the safety and interlock systems; design of the plasma control system.

[2009-pres.] Istituto Superior Técnico of Lisbon (Portugal) on the following topic: design of real-time systems for fusion devices, plasma magnetic control.

[2009-pres.] University of Rome Tor Vergata (Italy) on the following topics: anti wind-up systems for magnetic control in fusion device, control of runaway electrons.

[2007-pres.] University of Naples Parthenope (Italy) on the following topic: finite time stabilization of hybrid systems.

[2007-pres.] University of Catanzaro (Italy) on the following topic: finite time stabilization of hybrid systems.

[2005-pres.] University of Salerno (Italy) on the following topics: fault detection and diagnosability of discrete event systems; identification of discrete event systems modeled with timed Petri nets.

[2002-pres.] JET (Joint European Torus) tokamak, Culham Science Centre, Abingdon (UK) on the following topics: design and development of plasma current, position and shape controller; development of a flexible and reusable software architecture for portable real-time applications; plasma control support during the experimental campaigns.

Teaching Activity

Academic Courses - Current Classes

[2005/2006-2018/2020] *Industrial Automation Technologies* (Tecnologie dei Sistemi di Automazione e Controllo), 1st Level *Laurea* in Automation Engineering at University of Naples Federico II.

[2019/2020] *Discrete Event Systems and Supervisory Control*, 2nd Level *Laurea Magistrale* in Automation Engineering at University of Naples Federico II.

Academic Courses - Past Classes

[2017/2018-2019/2019] *IT Technologies for Industrial Automation* (Tecnologie Informatiche per l'Automazione Industriale), 1st Level *Laurea* in Computer Science Engineering at University of Naples Federico II.

[2013/2014-2018/2019] *Discrete Event Systems* (Sistemi ad Eventi Discreti), 2nd Level *Laurea Magistrale* in Automation Engineering at University of Naples Federico II.

[2008/2009-2010/2011] *Supervisory Control* (Controllo di Supervisione), 2nd Level *Laurea* in Automation Engineering at University of Naples Federico II.

[2010/2011] *System Theory* (Teoria dei Sistemi), 1st Level *Laurea* in Automation Engineering at University of Naples Federico II.

[2008/2009] *Digital Control* (Controllo Digitale), 2nd Level *Laurea* in Automation Engineering at University of Naples Federico II.

[2007/2008] *Fundamentals of Dynamical Systems* (Fondamenti di Sistemi Dinamici), 1st Level *Laurea* in Electronic Engineering at Italian Air Force Academy.

[2006/2007] *Fundamentals of Automation* (Elementi di Automazione), 1st Level *Laurea* in Computer Engineering at University of Naples Federico II.

Other Courses

[June 2019]   Lecturer at the *Advanced Course on Plasma Diagnostics and Control* held at the University of Padova and Consorzio RFX, Padova, Italy.

[Dec. 2017]   Seminars on Plasma Magnetic Control in Tokamaks at Instituto Superior Técnico/IPFN, Lisboa, Portugal.

[May 2017]   Lecturer at the *Advanced Course on Plasma Diagnostics and Control* held at the University of Padova and Consorzio RFX, Padova, Italy.

[Apr. 2017]   Lecturer at *International School of Fusion Reactors Technology* held at the *Ettore Majorana Centre*, Erice, Italy.

[Apr. 2016 and May 2017]   Seminar on Real-time control systems in fusion experimental devices held at the *University of Salerno*, Salerno, Italy.

[Oct. 2012]   Training course on *Digital control* and *Nonlinear simulations* for ANSALDO BREDA, Naples, Italy.

[Jan. 2012]   Seminars on Plasma Control in Tokamaks at Department of Systems and Control held at *Institut Jožef Stefan*, Ljubljana, Slovenia.

[Jun. 2010]   Lecturer at the *4th ITER International Summer School* held at the University of Texas at Austin.

[Nov. 2009]   Lecturer at the *EFDA Goal Oriented Training in Theory on Magnetic Control of Tokamak Plasmas* held at University of Naples Federico II.

Boards and Committees

[**Mar. 2020**]   Member of the Exam Committee for the Ph.D. course titled Fusion Science and Engineering - University of Padova (Italy).

[**Jul. 2018**]   Member of the Exam Committee for the Ph.D. programme of Dr. Martynas Prokopas - Instituto Superior Técnico - Univeridade Técnica de Lisboa (Portugal).

[**Jul. 2018**]   Member of the Exam Committee for the Ph.D. programme of Dr. Miguel da Gama Falcão Correia - Instituto Superior Técnico - Univeridade Técnica de Lisboa (Portugal).

[**Apr. 2018**]   Member of the Exam Committee for the Ph.D. course titled Fusion Science and Engineering - University of Padova (Italy).

[**Mar. 2018**]   Member of the Exam Committee for the Ph.D. course titled Information Engineering - University of Naples "Parthenope" (Italy).

[**Jun. 2017**]   Member of the Exam Committee for the Ph.D. programme of Mr. Luca Boncagni - University of Rome "Tor Vergata" (Italy).

[**Apr. 2014**]   Member of the Exam Committee for the Ph.D. course titled *Biomedical and Computer Science Engineering* at the University of Catanzaro (Italy).

[**2013-pres.**]   Member of the *Accademic Board* of the Ph.D. course "Fusion Science and Engineering" held by University of Padova (Italy).

[**Apr. 2011**]   Member of the *panel for the evaluation* of the Ph.D. programme of Dr. André Neto - Istituto Superior Técnico of Lisbon (Portugal).

[**2011-pres.**]   Referee for the Evaluation of research projects on behalf of the Italian Ministry of Education, University and Research.

[**Mar. 2011**]   Member of the Exam Committee for the Ph.D. course titled *Electrical and Automation Engineering* at the University of Reggio Calabria (Italy).

[**Jan. 2010**]   Member of the Exam Committee for the Ph.D. course titled *Biomedical and Computer Science Engineering* at the University of Catanzaro (Italy).

[**Feb. 2009**]   Member of the Exam Committee for the Ph.D. course titled *Electrical and Automation Engineering* at the University of Reggio Calabria (Italy).

Editorial Service

[**2018**]   *Editor* of the 14th IFAC Workshop on Discrete Event Systems (WODES'18) held in Sorrento, Italy, May 2018.

[**2014**]   *Guest Editor* of the Fusion Engineering and Design special issue titled "Design and implementation of real-time systems for magnetic confined fusion devices"

Conference Service

[**2010-pres.**]   Member of the IEEE Control System Society Conference Editorial Board.

[**2019**]   Associate Editor of 2019 European Control Conference

[**2019**]   Co-chair of the tutorial committee of the 3rd IEEE International Conference on Robotic Computing (IEEE IRC 2019)

[**2018**]   Associate Editor of 2018 European Control Conference

[**2018**]   Member of the Program Committee of the IEEE International Conference on Systems, Man, and Cybernetics 2018 - IEEE SMC 2018.

[**2017**]   Member of the Program Committee of 14th IEEE International Conference on Networking, Sensing and Control 2017, ICNSC 2017.

[**2016**]   Member of the Program Committee of the IEEE International Conference on Systems, Man, and Cybernetics 2016 - IEEE SMC 2016.

[**2016**]   Associate Editor of IEEE CASE/ISAM 2016.

[**2014**]   Member of the Program Committee of the IEEE International Conference on Systems, Man, and Cybernetics 2014 - IEEE SMC 2014.

[**2013**]   Member of the Program Committee of the IEEE International Conference on Systems, Man, and Cybernetics 2013 - IEEE SMC 2013.

List of 5 Selected Publications

1. R. Albanese, R. Ambrosino, A. Castaldo, **G. De Tommasi**, Z. P. Luo, A. Mele, A. Pironti, B. J. Xiao, Q. P .Yuan, "ITER-like vertical stabilization system for the EAST tokamak," *Nuclear Fusion*, vol. 57, no. 8, pp. 086039, August 2017

   A ITER-like vertical stabilization (VS) algorithm has been successfully deployed and commissioned at EAST. The proposed algorithm decouples the VS from the plasma shape control, while the algorithms previously implemented to stabilize the EAST plasma exhibit a strong coupling with plasma shape control system. As a consequence, the VS algorithms previously implemented at EAST prevent the deployment of advanced multi-input-multi-output (MIMO) plasma shape control schemes. Indeed, such MIMO controllers rely on the decoupling with the VS system. The proposed ITER-like stabilizes the plasma column (i.e. it controls to zero the plasma vertical speed) on the fastest possible time scale, while leaves the control of the plasma vertical position to the plasma shape controller. In this paper we present the implementation details of the adopted solution for the EAST vertical stabilization, together with the results obtained during the 2016 experimental campaign

2. F. Amato, G. Carannante, **G. De Tommasi**, A. Pironti "Input-Output Finite-Time Stability of Linear Systems: Necessary and Sufficient Conditions," *IEEE Transactions on Automatic Control*, vol. 57, no. 12, pp. 3051-3063, December 2012

   Bounded Input Bounded Output (BIBO) stability is usually studied when only the input-output behavior of a dynamical system is of concern. This paper investigates the analogous concept in the framework of Finite Time Stability (FTS), namely the Input-Output FTS (IO-FTS). In this context, this paper presents several novel contributions. First, by using an approach based on the reachability Gramian theory, we prove to necessary and sufficient conditions for IO-FTS. One condition is based on the existence of a suitablesolution to a differential Lyapunov equality (DLE), while the other one is based on the solution of an optimization problem involving a certain differential linear matrix inequality (DLMI). Moreover, it is also shown that the first condition is computationally more efficient; however, the formulation via DLMI allows to solve the problem of the IO finite-time stabilization via output feedback.

3. F. Basile, P. Chiacchio, **G. De Tommasi**, "On $\mathcal{K}$-diagnosability of Petri nets via integer linear programming," *Automatica*, vol. 48, no. 9, pp. 2047-2058, September 2012

   This paper deals with the problem of diagnosability of a fault after the firing of a finite number events (i.e., $\mathcal{K}$-diagnosability). This problem corresponds to diagnosability of a fault within a finite delay in the context of discrete event systems. The main contribution of this paper is a necessary and sufficient condition for $\mathcal{K}$-diagnosability of bounded nets. The proposed approach exploits the mathematical representation of Petri nets and the Integer Linear Programming optimization tool. In particular no specific assumptions are made on the structure of the net induced by the unobservable transitions, since the proposed approach permits to detect also the undiagnosability due to the presence of unobservable cycles.

4. **G. De Tommasi**, R. Albanese, G. Ambrosino, M. Ariola, M. Mattei, A. Pironti, F. Sartori, F. Villone, "XSC Tools: a software suite for tokamak plasma shape control design and validation," *IEEE Transactions on Plasma Science*, vol. 35, no. 3, pp. 709-723, June 2007

   This paper describes a set of graphic tools for the design and validation of the eXtreme Shape Controller (XSC), which has been implemented at the Joint European Torus (JET) tokamak in 2002/2003. The XSC enables operation with high elongation and high triangularity plasmas. The software suite, which is called XSC Tools, has been developed to automate the design procedure of the XSC. These tools make use of graphic user interfaces to allow the nonspecialist users to prepare for new operative scenarios, without the help from modelling and control specialists. An additional effort has been made in order to make the XSC Tools machine independent, i.e., to enable their use on the different tokamaks.

5. **G. De Tommasi**, F. Piccolo, A. Pironti, F. Sartori, "A flexible software for real-time control in nuclear fusion experiments," *Control Engineering Practice*, vol. 14, no. 11, pp. 1387-1393, November 2006

   JETRT is a software framework particularly suited for implementation of both real-time control and data acquisition systems. It is especially designed to work in a complex experimental environment such as the JET nuclear fusion facility. This new architecture maximizes the software reusability. The project-specific algorithm is compiled into a separate software component, in order to achieve a separation from the plant interface code. *JETRT* provides a set of tools to perform most of the validation phase on a Windows running desktop PC. Thanks to these design choices, both the development costs and the commissioning time have been reduced and even nonspecialist programmers can easily contribute to the deployment of a new real-time system.