



## Marco Storace

Full professor

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### *Education and training*

1997

#### **Ph.D. in Electrical Engineering**

Circuit modelling of nonlinear systems

University of Genoa - Genova - IT

1994

#### **M.Sc. 5-year degree in Electronic Engineering**

First class honours (110 e lode)

University of Genoa - Genova - IT

### *Academic experience*

2011 - ONGOING

#### **Full Professor**

University of Genoa - Genova - IT

2000 - 2003

#### **Lecturer**

Politecnico di Milano - Milano - IT

1999 - 2011

#### **Research Assistant and then Associate Professor**

University of Genoa - Genova - IT

### *Language skills*

#### **Italian**

Mother tongue

#### **English**

Independent

#### **French**

Basic

### *Teaching activity*

Current teaching activity: see <https://unige.it/staff/persona/m/UEZEXV0=>

### *Postgraduate research and teaching activity*

**Supervision of PhD students, residents and post-doctoral**

## **fellows**

- *Matteo Lodi*: started his PhD in October 2015
- *Flavio Stellino*: PhD (2014-2016)
- *Alice Saracco*: PhD (2013-2015)
- *Alberto Oliveri*: PhD and two-years PostDoc on Digital circuit implementation of PWA functions in embedded control systems (2010-2014)
- *Matteo Biggio*: PhD and one-year PostDoc on Modelling of nano-electro-mechanical systems (NEMS) (2011-2014)
- *Daniele Linaro*: PhD (2008-2010)
- *Tomaso Poggi*: PhD and one-year PostDoc on Digital circuit implementation of PWA functions in embedded control systems (2007-2010)
- *Daniele Stellardo*: PhD and one-year PostDoc on Identification of the connectivity in networks of biological neurons (2005-2008)
- *Lorenzo Repetto*: PhD - jointly supervised with Prof. Mauro Parodi – (2001-2004)
- *Federico Bizzarri*: PhD - jointly supervised with Prof. Mauro Parodi – and five-years PostDoc on Bifurcation analysis of smooth and nonsmooth dynamical systems (2000-2008)

## **PhD committees membership**

Member of the Scientific Board of the PhD program in 'Science and Technology For Electrical Engineering, Marine Engineering, Complex Systems for Mobility' (2013-today)

Member of the Scientific Board of the PhD program in 'Electrical Engineering' (1999-2015)

## **Postgraduate (PhD) teaching activity**

'Analysis of nonlinear dynamical systems' ('Analisi di sistemi dinamici non lineari') (20 hours) in the framework of the PhD program in 'Science and Technology For Electrical Engineering, Marine Engineering, Complex Systems for Mobility' (and 'Electrical Engineering' in the past).

This subject aims to provide the students with mathematical and numerical tools for the analysis of nonlinear dynamical systems, with either fixed or changing parameters (in the latter case the lessons' topic is the so-called bifurcation analysis). In particular, the lessons are focused on both geometrical methods for qualitative analysis and the most diffused numerical methods for quantitative analysis. The main theoretical results are applied to dynamical systems arising from different fields and are illustrated through computer demos in the MATLAB programming environment.

## Research interests

Current research interests:

- Mathematical modelling of nonlinear dynamical systems (e.g., neurons, networks of neurons, hysteresis)
- Identification of nonlinear dynamical systems from data
- Bifurcation analysis of smooth and non-smooth systems
- Piecewise-linear (PWL) approximation techniques and circuit implementation of PWL n-variate functions for engineering applications (e.g., emulation of nonlinear dynamical systems, nonlinear control systems)
- Circuit synthesis of devices and systems for engineering applications (e.g., circuit implementation of models of biological neurons)
- Electronic oscillators: design optimization based on bifurcation analysis

## Grants

2009 - 2012

### **MOBY-DIC Model-based synthesis of digital electronic circuits for embedded control (FP7-INFISO-ICT-248858)**

EU - BE

2.140.000Euros (Genoa's share approx EUR 500.000) - Pricipal investigator

**Main goal: to develop a unique paradigm for the design of embedded control systems that will reduce the gap between control and circuit worlds and reduce the costs in automotive products**

Embedded integrated circuits (ICs) are a larger market segment than embedded software and embedded boards. A functionality of paramount importance in embedded systems is their capability to connect with various sensors, actuators, and human interfaces to provide autonomous intelligence in the physical system they are embedded into, such as mobile phones, digital cameras, automobiles, printers, pacemakers, etc. This embedded control functionality is the core element for the combination of the embedded and embedding system to behave properly. As such, highly pervasive and embedded control systems are enablers for much of the high-tech infrastructure that facilitates the lives of many citizens and contributes to their prosperity. Consumer products in our homes, professional equipment, health care, and automotive and transportation systems all heavily rely on embedded control technologies.

In spite of the importance of embedded control in daily life, there is a surprising lack of methods to design and deploy embedded control systems in a systematic and efficient manner. There is an abundance of methods for the separate design of the control algorithms eventually embedded into a hardware platform, or to create a suitable hardware platform for the implementation of a given function. However, an automated and integrated design flow from mathematical models of the embedding physical system to electronic circuits is not available at present.

The MOBY-DIC project will research and develop a unique paradigm and supporting tool chain for the design of embedded control systems, with the aim of reducing both design costs and time to market, thus helping to provide European manufacturers a competitive advantage. Such reductions are dependent on the characteristics of the final product, but in average a 30%-50% could be achieved for a general purpose case.

## ***Editorial activity***

2008-2009 Associate Editor of the IEEE Transactions on Circuits and Systems II

Reviewer for many international journals, among which:

- IEEE Transactions on Circuits and Systems (I and II)
- International Journal of Circuit Theory and Applications
- IEEE Transactions on Neural Networks
- International Journal of Bifurcation and Chaos
- Chaos
- Physica D
- PLoS ONE
- Physics Letters A
- IEICE Transactions
- Nonlinear Analysis
- Digital Signal Processing
- IEE Proceedings
- Journal of Circuits Systems and Computers
- Journal of Dynamic Systems Measurement and Control
- Neural Networks
- Mathematical and Computer Modelling
- Mathematical Problems in Engineering
- Computer Methods and Programs in Biomedicine

Reviewer/Review Committee Member/Program Committee Member for many international conferences, among which:

- IEEE International Symposium on Circuits and Systems (ISCAS)
- European Conference on Circuit Theory and Design (ECCTD)
- IEEE International Workshop on Nonlinear Dynamics of Electronic Systems (NDES)
- International Symposium on Nonlinear Theory and its Applications (NOLTA)
- IEEE Latin American Symposium on Circuits & Systems (LASCAS)

Reviewer for national and international Research Grants Councils and for publishers (McGraw-Hill, Springer)

Other editorial activities for workshops and meetings:

- Technical Program co-Chair of the IEEE Second New Generation of Circuits and Systems Conference (NGCAS2018), Valletta, Malta, November 20-23, 2018.
- Co-chair of the 'Linear and Non-linear Circuits and Systems' sub-

committee of the 25th IEEE International Conference on Electronics Circuits and Systems (ICECS2018), Bordeaux, France, December 9-12, 2018

- Technical Program co-Chair of the IEEE First New Generation of Circuits and Systems Conference (NGCAS2017), Genova, Italy, September 7-9, 2017.
- Chairman of the session 'Nonlinear Dynamics in Circuits and Systems', ISCAS2017 (Baltimore, MD, USA).
- Chairman of the session 'Nonlinear CAS IV', ISCAS2016 (Montreal, Canada).
- Chairman and organizer of the XXXI National meeting of the Italian Electrical Engineering Group (ET2015), Genova, Italy, 17-19 June 2015.
- Co-chairman of the session 'Nonlinear Circuits and Systems I', ISCAS2015 (Lisbon, Portugal).
- Chairman and organizer of the workshop "Explicit MPC: from specifications to circuit implementations," Noordwijkerhout, The Netherlands, August 23, 2012 (pre-conference workshop, 2012 IFAC conference on Nonlinear Model Predictive Control).
- Co-Chair and co-organizer of the *invited sessions* 'MPC on Embedded Systems (I and II)' World Congress of the International Federation of Automatic Control (IFAC2011), 28 August – 2 September 2011 (Milan, Italy).
- Chairman and co-organizer of the *invited session* 'Piecewise Linear Circuits and Systems: Bridging Electronics and Control Systems', ISCAS2010 (Paris, France).
- Invited speaker at 'International Workshop on Multi-Rate Processes & Hysteresis', University College Cork, Ireland, March 31- April 5, 2008. Title: 'Piecewise-linear Approximation of the Hindmarsh-Rose Neuron Model'.
- Invited speaker at 'International Workshop on Multi-Rate Processes & Hysteresis', University College Cork, Ireland, April 3-8, 2006. Title: 'Codimension-2 Bifurcations in a Circuit Oscillator Based on Hysteresis'.
- Invited speaker at 'International Workshop on hysteresis & multi-scale asymptotics', University College Cork, Ireland, March 17-21, 2004. Title: 'PWL approximation of nonlinear dynamical systems. Part-I: structural stability'.
- Co-chairman of the *invited session* 'Piecewise Linear Circuits and Systems', ISCAS2003 (Bangkok, Thailand).
- Invited speaker at the Int. Workshop 'Bifurcations in Nonsmooth Dynamical Systems', Milan, 22-23 April 2002. Title: 'Bifurcation analysis of a 3D piecewise-linear continuous flow through a 1D discontinuous map: a circuit example'.