



University of Pavia

Ph.D. School of Electronics, Computer Science and Electrical Engineering

Seminar

What basic dynamical modeling and control concept can do to better understand and manipulate biomedical systems. Some new perspectives

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November 10th, 2022 – h 11:00

Aula Seminari Magenta (ex Dip. di Elettronica – D floor)

Department of Electrical, Computer and Biomedical Engineering

Abstract: In this presentation, some dynamical systems and control concepts are revisited to rethink biomedical (and similar) problems, with the objectives of improving their understanding and designing new methods to manipulate them. Four basic concepts will be discussed:

- i) Self-generation and convergence. Rethink the ubiquitous concept of feedback, which are the true building blocks of which dynamical systems are made, far before our will to manipulate them.
 - ii) Part and the Whole. Rethink the methods to isolate subsystems according to time scales, and hidden/latent feedbacks. Rethink the methods to decide when a variable is internal or external and can be manipulated.
 - iii) How to control a system that is already under control? Rethink the concept of control objectives, explicitly accounting for the internal feedback and the limitations every real-life system has. Rethink the way to put it all as a dynamic optimization problem.
 - iv) 'Mathematizing' the problem. Rethink the way to formally characterize dynamical systems by their structure (structural and robust properties, generalized equilibria, bifurcations, invariant sets, stability, time-scale separation, etc.). Rethink how to formally pose an optimal control problem, by defining reasonable (multi)objectives and constraints.
- Finally, some recent contributions, concerning the modeling and control of some biomedical systems of interest will be introduced.

Bio: Alejandro Hernán González is a Titular Professor at the National University of Litoral (UNL) in Argentina and an Independent Researcher at the Argentine National Scientific and Technical Research Council (CONICET). After getting his Ph.D. from the UNL in 2006, he became a Postdoctoral fellow at the Chemical Engineering Department at the "Universidade de São Paulo", São Paulo-Brazil and, subsequently, at the "Departamento de Ingeniería y Automática de la Escuela Técnica Superior de Ingenieros" of the University of Seville, Seville-Spain. After concluding his Postdoctoral activities, he returned to Argentine to work as a lead researcher in the Dynamical System and Control Group of the Institute of Technological Development for the Chemical Industry (INTEC), which depends on CONICET and UNL, and as Professor at the University, as well as to supervise Ph.D. research projects and students. He is the author and co-author of more than 100 publications and serves as Associate Editor for the Optimal Control Applications and Methods journal. His research interests include Dynamical Systems under Constraints, Optimal and Model Predictive Control, and Biomedical/Biological Application, with emphasis on hybrid systems and stability analysis.

Organizers

Prof. Chiara Toffanin
Prof. Lalo Magni

Ph.D. Coordinator

Prof. Ilaria Cristiani

The seminar will be taught in English

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