

Seminar

Wednesday, 21 February 2024

16:30, D030

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Title: [Mathematics, Control and Mechanisms](#)

Abstract: Systems and control theory has developed many techniques borrowing tools from different branches of mathematics. Interestingly, many of the techniques conceived and routinely used to solve control problems can be quite successfully adapted to solve new relevant problems, both practical and curiosity-driven, in other fields.

In this talk we discuss how the mathematical analysis of systems can be very effective in explaining how mechanisms work, why they work in a certain way and to which extent they perform their task properly even in the presence of perturbations and disturbances.

The first part of the talk briefly introduces some preliminary motivating examples of mechanisms, borrowed from other disciplines alien to control theory, to show how a control approach can be very powerful to understand fundamental principles.

The second part introduces the definitions of structural versus robust properties, discussing paradigmatic case studies from the literature. These include a discussion about robust stability/instability analysis, presented in an inverse form: "We know this is stable, but why is it so incredibly stable?". Other fundamental concepts such as adaptation, oscillations, bistability and graph loop analysis are considered.

The third part discusses application examples from biology and biochemistry, to showcase the potential impact that the mathematical approach of control and system theory, suitably revised, can have in these disciplines and how interdisciplinary research can bring fresh ideas to theorists.



Franco Blanchini is a Professor of Automatic Control and the Director of the Laboratory of System Dynamics at the University of Udine. His research interests are related to robust control via Lyapunov techniques, control of systems with constraints, robustness analysis, L_1 and multi-objective control, control of production-distribution systems.

He has been involved in the organization of several international events: in particular, he was Program Vice-Chairman of the conference Joint CDC-ECC 2005, Seville, Spain; Program Vice-Chairman of the Conference CDC 2008, Cancun, Mexico; Program Chairman of the Conference ROCOND, Aalborg, Denmark, June 2012 and Program Vice-Chairman of the Conference CDC 2013, Florence, Italy.

He is co-author of the book "Set theoretic methods in control", Birkhauser. He is the recipient of 2001 ASME Oil Gas Application Committee Best Paper Award as a co-author of the article "Experimental evaluation of a High-Gain Control for Compressor Surge Instability". He is the recipient of the 2002 IFAC prize survey paper award as author of the article "Set Invariance in Control-a survey", Automatica, November 1999. He later received the High Impact Paper Award for this work. He received the 2017 Nonlinear Analysis and Hybrid Systems Best Paper Award for the paper "A switching system approach to dynamic race modeling, Nonlinear Analysis and Hybrid Systems, vol. 21, no. 8, pp. 37-48, 2016.

He has been speaker for the plenary lecture "Lyapunov and invariance methods in control design", IFAC Joint Conference, Grenoble, February 2013; for the plenary lecture "Set invariance and Lyapunov methods", 32nd Benelux Meeting on Systems and Control; for the semi-plenary lecture "Structural Analysis: The Control Language to Understand Mechanisms", 59th Conference on Decision and Control - Jeju Island, Republic of Korea - December 14th-18th 2020.

He has been an Associate Editor for Automatica, from 1996 to 2006, and for IEEE Transactions on Automatic Control, from 2012 to 2016. He has been an Associate Editor for Automatica, from 2017 to 2020. He has been Editor for IEEE CSS Letters from 2016 to 2018.