



Escola Politécnica da Universidade de São Paulo

Av. Prof. Luciano Gualberto, 380  
Cidade Universitária, São Paulo, Brasil  
05508-010

January 25, 2024

Research seminars on nonlinear dynamics to be delivered Christophe Letellier (Rouen Normandie Université, France) and Prof. Luis Antonio Aguirre (Federal University of Minas Gerais). The talks will take place at room S-28, Civil Engineering Building.

**A taxonomy for generalized synchronization between flat coupled systems, by Christophe Letellier. January 31 (Wednesday), at 14:30.**

Among the different types of synchronization, generalized synchronization is certainly the most complex to characterize. It was shown that a few different types of generalized synchronization can be distinguished: for instance, depending on the coupling strength, the synchronization can be weak or strong, or the two coupled systems can be characterized by first-return maps which are topologically conjugate or not. Generalized synchronization can be obtained in a systematic way by using a flat control law. In this contribution, we will clarify the differences between these different types of generalized synchronization depending on the coupling strength (or the efficiency of the control law) when the coupled systems strongly differ by their nature, namely their dimensionality and/or their contracting property (dissipative or conservative).

**Using Auxiliary Information in Model Building for Nonlinear Dynamics: An Application in Robotics, by Luis Aguirre. February 2 (Friday) at 14:30**

Model building from data consists of a few steps: data collection, choice of model class, structure selection, parameter estimation and model validation. In this talk, after a brief mention of such steps, the main ideas of using auxiliary information will be discussed. In the sequel, examples taken from the field of robotics will be presented where building nonlinear models was found helpful. The data are either taken from public repositories or collected in the laboratory. The model class is multivariate nonlinear autoregressive (NAR) polynomial models. As discussed, structure selection is simplified in the present context. The main difference compared to more standard procedures is the use of auxiliary information about fixed points. This influences the stages of structure selection and of parameter estimation. The final models should be helpful to produce trajectories for robots. Laboratory tests show that the models are helpful.

**A short bios of the speakers**

Christophe Letellier received a PhD degree in 1994 from the University of Paris VII, France and is a full professor at the Department of Physics at Rouen Normandie University. He is the author of five books among which *The Symmetry of Chaos* (with Robert Gilmore, Drexel University –

Oxford University Press, 2007), Chaos in Nature (World Scientific Publishing, 2nd edition, 2019) and Chaos (with Otto E. Rössler, Springer, 2020). He served as the head of the national group of research DYCOEC in complex sets for 8 years. His research includes topological characterization of chaotic attractors, symbolic dynamics, identification of nonlinear system, observability and controllability of chaotic systems and network, flat control, synchronization and analysis of biomedical data (heart variability, noninvasive mechanical ventilation, follow-up for patients with lung cancer...).

Luis A. Aguirre received a PhD degree in 1994 from the University of Sheffield, England and is a full professor at the Department of Electronics Engineering at UFMG. He is the author of five brazilian books and was the Editor-in-Chief of Enciclopédia de Automática (3 volume set), sponsored by the Brazilian Society of Automation (SBA) and published by Editora Blücher. From 2009 to 2012 he served as the Editor-in-Chief of Controle & Automação: Revista da Sociedade Brasileira de Automática, currently published by Springer Verlag under the name Journal of Control, Automation and Electrical Systems. His research includes the identification of nonlinear system, nonlinear dynamics, control systems, synchronization and analysis of dynamical networks.