MARQUETTE UNIVERSITY

Departmental Colloquium
Electrical and Computer Engineering

State-Dependent Communication Enhances Network Synchronization

Tuesday, October 8, 2024
2:00 pm – 3:00 pm
Olin 202

Reception to follow in Olin 204
3:00 pm – 3:30 pm

Dr. Francesco Sorrentino
Professor of Mechanical Engineering, University of New Mexico

ABSTRACT: Synchronization occurs in many natural and artificial systems, which are often described as networks. Although synchronization requires communication between the individual systems or oscillators that form the network, the communication strategies that are responsible for synchronization are not always well understood. Most models of network synchronization assume that the individual systems that are connected are either permanently or intermittently communicating with one another. However, in most biological systems communication occurs when the individual oscillators reach a particular state, for example neurons in the brain transmit signals to the other neurons after they "fire". We investigate analytically, numerically, and experimentally network synchronization strategies that depend on the "transverse reactivity" of a synchronous oscillation, i.e., the instantaneous rate of growth of a perturbation about an oscillation. We show great advantage of such strategies both in terms of coupling expenditure and energy efficiency and propose that similar strategies could be conveniently used in technological applications.

BIOGRAPHY: Francesco Sorrentino is full professor of Automatic Controls in the Department of Mechanical Engineering at the University of New Mexico. He received a master's degree in Industrial Engineering from the University of Naples Federico II (Italy) in 2003 and a Ph.D. in Control Engineering from the University of Naples Federico II (Italy) in 2007. His expertise is in dynamical systems and controls, with particular emphasis on nonlinear dynamics and optimal control. His work includes studies on dynamics and control of complex dynamical networks, adaptation in complex systems, sensor adaptive networks, and the dynamics of reservoir computers in machine learning. He is interested in applying the theory of dynamical systems to model, analyze, and control the dynamics of complex distributed energy systems, such as power networks and smart grids. Subjects of current investigation are evolutionary game theory on networks (evolutionary graph theory), the dynamics of large networks of coupled neurons, and the use of optimal control to design drug dosage schedules for biomedical applications. He has published more than 80 papers in international scientific peer reviewed journals. He is the awardee of the NIH Trailblazer award.