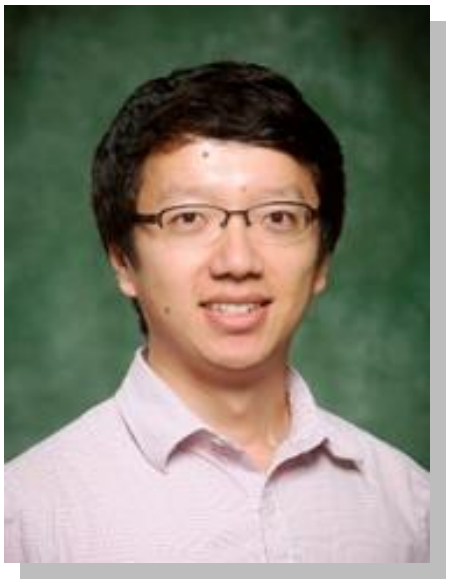
CoCo Seminar Series
Fall 2018

From Kuramoto Oscillators to Synchronous Generators, Searching the Regions of Attraction of Networked Nonlinear Systems



Dr. Ziang (John) Zhang
Assistant Professor of Electrical and Computer Engineering, Binghamton University

Wednesday August 29, 2018 11:00am-12:00pm
Engineering Building H-9 (Knoll-MacDonald Commons / Watson Commons)

From beats generated by cardiac pacemakers to the movement of planetary systems, the idea of distributed self-organizing oscillators that are coupled over networks links mathematics with natural phenomenon. Although this general idea was recognized decades ago, whether a particular system can synchronize and how to design controllers to help the synchronization remain unknown in many cases. There are thousands of independent generators across the nation, coupled by transmission lines, oscillate at the same frequency (60Hz); numerous studies suggest that a power system is a perfect example of coupled oscillators. However, several major barriers need to be removed in order to bridge the gap between classical phase coupled oscillators and a realistic power system.

This presentation will discuss a simulation-based generator-level stability index and demonstrates the use of the index to quantify the impact of different load scenarios, transmission line reactances, and generator parameters on transient stability. A Basin Stability concept is used that is based on recent works in the physics community on complex systems and power systems, which estimates the regions of attraction through time-domain simulation. The quantitative results generated by Basin Stability can provide a general ranking metric to reflect which generator or a group of generators is likely to become unstable after disturbances. A detailed sub-transient model with sixth-order sub-transient generators, second-order exciters, and third-order power system stabilizers has been used for discussion. Additionally, a multi-node basin stability study on a 16-machine 68-bus system with the swing-equation model is also included to demonstrate the replicability.

Dr. Ziang (John) Zhang received his B.S. degree from the Beijing Institute of Technology, an M.S. from Purdue University Calumet and a Ph.D. degree from North Carolina State University, all in Electrical Engineering. Before he joined Binghamton University, he worked at ABB US Corporate Research Center as a Postdoc Fellow. He is a member of the Smart Grid task force of the IEEE Industrial Electronics Society, an associated editor of the electronic magazines on Industrial Electronics Technology News, and a task force member on the Decision Support Tools for Energy Storage Investment and Operations of the IEEE Power and Energy Society. His current research includes distributed control algorithms, coupled oscillator modeling and control, renewable energy integration and battery modeling.

For more information, contact Hiroki Sayama (sayama@binghamton.edu). http://coco.binghamton.edu/