Title: Stability Analysis of Stochastically Switching Kuramoto Networks

Authors: Ratislav Krylov, Igor Belykh

Faculty Sponsor: Dr. Igor Belykh, Department of Mathematics, Georgia State University

Abstract: Motivated by real-world networks with evolving connections, we analyze how stochastic switching affects patterns of synchrony and their stability in networks of identical Kuramoto oscillators with inertia. Stochastic dynamical networks are a useful model for many physical, biological, and engineering systems that have evolving topology, but they have proven to be difficult to work with, and the analytical results are rare. These networks have two characteristic time scales, one is associated with intrinsic dynamics of individual oscillators comprising the network, and the other corresponds to switching period of on-off connections. In the limit of fast switching, the relation between the dynamics of the stochastic network and the static network can be obtained by replacing the switching connections with their mean. We use averaging and Lyapunov function methods to elucidate this non-trivial relationship. We prove that clusters of synchrony which stably appear in the averaged static network can also be observed in the original stochastic network and derive bounds on the switching frequency that guarantee, in a probabilistic sense, the convergence to a stable cluster solution. We also demonstrate the emergence and persistence of chimera states in these stochastic networks.