# Advances in Network Dynamics

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**Abstract**

An increasing number of complex systems are now modeled as networks of coupled dynamical entities. Nonlinearity and high-dimensionality are hallmarks of the dynamics of such networks but have generally been regarded as obstacles to control. In first part of this talk, I will discuss recent advances on mathematical and computational approaches to control high-dimensional nonlinear network dynamics under general constraints on the admissible interventions. I will present applications to the stabilization of power grids, identification of new therapeutic targets, mitigation of extinctions in food webs, and control of systemic failures in socio-economic systems.

In the second part of the talk, I will discuss fundamental new discoveries in the area of network synchronization, which has long served as a paradigm for behavioral uniformity that can emerge from network interactions. When the interacting entities are identical and their coupling patterns are also identical, the complete synchronization of the entire network is the state inheriting the system symmetry. As in other systems subject to symmetry breaking, such symmetric states are not always stable. In this presentation, I will report on the recent discovery of the converse of symmetry breaking—the scenario in which complete synchronization is not stable for identically coupled identical oscillators but becomes stable when, and only when, the oscillator parameters are judiciously tuned to nonidentical values, thereby breaking the system symmetry to preserve the state symmetry.