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DEPARTMENT OF MECHANICAL ENGINEERING

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Synchronization in Large-Scale Networks of Nonlinear Oscillators

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Research on large-scale complex networks has important applications in diverse systems of current interest, including the Internet, the World-Wide Web, social, biological, and chemical networks. The growing availability of massive databases, computing facilities, and reliable data analysis tools has provided a powerful framework to explore structural properties of such real-world networks. However, one cannot efficiently retrieve and store the exact or full topology for many large-scale networks. As an alternative, several stochastic network models have been proposed that attempt to capture essential characteristics of such complex topologies. Network researchers then use these stochastic models to generate topologies similar to the complex network of interest and use these topologies to test, for example, the behavior of dynamical processes in the network such as virus/rumor spreading, distributed consensus, or synchronization of oscillators in a network. In this talk, we review results concerning spectral properties of popular stochastic network models proposed in recent years and study implications on synchronization of large-scale networks of oscillators. In particular, we present a variety of techniques to extract relevant information in the study of synchronization from the topology of the network. Our ultimate objective is to use such results to understand and predict the dynamical behavior of synchronization in large-scale networks.

Victor M. Preciado received his PhD in Electrical Engineering and Computer Science in 2008 from the Massachusetts Institute of Technology. Currently, Victor is a Post-Doctoral Researcher in the Electrical and Systems Engineering Department at Penn. His current research is related with the analysis and design of large-scale complex networks. Victor's current work focuses on stochastic modeling and analysis of real-world large-scale networks and problems arising in this framework: analysis of their dynamical behavior (information flow, synchronization, consensus, decentralized control, etc.), resilience against failures and attacks, and design strategies from a mathematical point of view.

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