SEMINAR NOTICE

Preston M. Green Department of Electrical and Systems Engineering

DATA-DRIVEN AND MODEL-BASED APPROACHES FOR INFERENCE AND CONTROL OF DYNAMIC POPULATION SYSTEMS

PhD Preliminary Research Examination

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Abstract: Complex systems in which a population of dynamic units interact with each other are prevalent in nature and human society in different scales. These systems often require an appropriate excitation, an optimal hierarchical organization, or a periodic dynamical structure, such as synchrony, to function as desired or operate optimally. In many emerging applications, such as brain stimulation and quantum pulse design, the dynamics of such population systems can only be regulated by the application of a single or sparsely distributed external inputs in order to alter their state configurations or dynamic structures. This control paradigm gives rise to challenging problems regarding robust control and computation for underactuated ensembles.

In this talk, we will address theoretical and computational challenges for engineering dynamic structures in population and networked systems, using both data-driven and model-based perspectives. In particular, we will introduce a unified data-driven method to efficiently reveal the dynamic topology and learn mathematical models of population systems when a reliable model is not available. We will also present an iterative method to find optimal controls for driving ensemble systems, e.g., for pattern formation. We will demonstrate the robustness and applicability of these methods by implementing them, numerically and experimentally, to several cutting-edge applications. This includes revealing time-varying topology of oscillatory networks for understanding functional connectivity of circadian cells or social synchronization of groups of mice, designing optimal broadband quantum pulses in NMR spectroscopy and imaging, and devising optimal stimuli for spiking neuron ensembles. This will be followed by the discussion of related topics and future research plans of our research program.

DATE: Wednesday, September 27, 2017
TIME: 3:00 p.m.
PLACE: Green Hall, Room 0120

Dissertation advisor:
Dr. Jr-Shin Li

This seminar is in partial fulfillment
of the Doctor of Philosophy degree

Washington University in St. Louis
School of Engineering & Applied Science