SEMINAR NOTICE

Preston M. Green Department of Electrical and Systems Engineering

GEOMETRIC DYNAMIC LEARNING AND CONTROL OF ENSEMBLE SYSTEMS

PhD Preliminary Research Examination

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Abstract: The ability to finely manipulate a collection of structurally identical dynamical systems is important for diverse applications in science and engineering. There may exist sophisticated mathematical models to describe the dynamics of such large-scale systems; however, it is also often the case that such models are elusive but the measurement data of such systems are available. In this talk, I will present my work on analyzing and controlling collective behavior of ensemble systems using both model-based and data-driven approaches. In particular, I will present novel methods for analyzing controllability of linear ensemble systems based on the techniques of polynomial approximation and the notion of separating points. In addition, a new algebraic framework for investigating controllability of bilinear systems will be created through symmetric groups, and provide a necessary and sufficient controllability condition in terms of permutation orbits by mapping Lie bracket operations to permutation compositions. Moreover, I will also present control design methods inspired by such controllability analyses to design optimal selective pulses in magnetic resonance imaging.

In addition to these model-based approaches, I will also present data-driven methods for learning dynamics and topology of dynamical systems from data. This includes the development of local and global geometric embeddings of periodic and non-periodic data. In particular, I will illuminate the geometry of synchronization of networked oscillators, and introduce novel geometric methods, involving computational homology, algebraic topology, and the recurrence qualification analysis, to learn the topology of the state space of dynamical systems from their measurement data. I will also present the utilization of Koopman operator theory with machine learning for extracting dynamic information with applications to visual cognition.

DATE: Thursday, October 12, 2017
TIME: 10:00 a.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