SEMINAR NOTICE

Preston M. Green Department of Electrical and Systems Engineering

CONTROL OF DETERMINISTIC AND STOCHASTIC LINEAR ENSEMBLE SYSTEMS

DISSERTATION DEFENSE
By

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Abstract: The behavior of physical, chemical, and biological systems can exhibit significant sensitivity to uncertainty or variation in system parameters. This factor arises in practical control problems in many areas of science and engineering when there is uncertainty in the parameters of a single control system, or when a collection of structurally similar systems with variation in common parameters must be steered using a common control signal. Analysis of these cases has given rise to the subject of ensemble control, which was motivated by practical control design problems in the fields of nuclear magnetic resonance spectroscopy and imaging, neuroscience, and sensorless robotic manipulation.

The focus of this dissertation work is on the investigation of fundamental properties and the development of optimal controls for deterministic and stochastic linear ensemble systems. Although the ensemble controllability for deterministic linear ensemble systems has been characterized in previous studies, explicit controllability conditions remain undiscovered. In this dissertation, explicit controllability conditions for a class of time-invariant linear ensemble systems with linear parameter variation are constructed. This class of ensemble control systems arises from practical engineering and physical applications, such as transport of quantum particles and control of uncertain harmonic systems. The construction is based on the notion of polynomial approximation, and the conditions are related to the rank of the system matrices and are easy to be checked.

In addition to the study of deterministic ensemble control systems, we extend our work to a stochastic case where the ensemble systems are subject to random dynamic disturbances. Such disturbances can greatly affect the behavior of systems, which can become particularly challenging to control in a desired manner as a result, especially when feedback cannot be used to attenuate disturbances. We study optimal steering problems involving stochastic linear ensemble systems driven by Gaussian noise and Poisson counters. In particular, we seek to minimize the statistical objectives of mean square error (MSE) and the error in the mean of the terminal state of the ensemble with respect to the desired state.

DATE: **Friday October 3, 2014**
TIME: **10:10 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

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SCHOOL OF ENGINEERING & APPLIED SCIENCE