SEMINAR NOTICE

Preston M. Green Department of Electrical and Systems Engineering

ENSEMBLE CONTROL OF DETERMINISTIC AND STOCHASTIC LINEAR SYSTEMS

PhD Preliminary Research Examination

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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.

Deterministic ensemble control systems have been investigated in our previous work, where the necessary and sufficient controllability conditions were established. We extend this 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 control 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.

Although controllability for deterministic linear ensemble systems has been characterized, explicit controllability conditions have not been developed. We study a class of time-invariant linear ensemble systems and derive controllability conditions in terms of the rank of the system matrices. This is achieved by mapping the controllability analysis to a problem of polynomial approximation. With a generalization of this procedure, we plan to establish explicit controllability conditions for the general time-invariant linear ensemble systems.

DATE: Wednesday, May 15, 2013
TIME: 1:00 p.m.
PLACE: Green Hall, Room 0120

Thesis advisor:
Dr. Jr-Shin Li

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

Washington University in St. Louis
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