NC STATE UNIVERSITY

# Upcoming Operations Research Ph.D. Final Oral Exam

## Dongkyoung Choe

### Digital Signal Design for Fault Detection in Linear Continuous Dynamical Systems (under direction of Dr. Stephen L. Campbell)

## Friday, March 16, 2007
## 2:00 p.m.
## HA146


**Abstract:**

A systematic approach to detect underlying undesirable states of a physical system is to compare its observed behaviors to several competing models and to identify the model that best describes the observation. This model selection process can be enhanced by applying a specially designed auxiliary input signal to the system.

This dissertation applies the auxiliary-signal-based model selection approach for recognizing faulty behaviors of systems whose dynamic behaviors can be described by linear differential equations. Using an existing analog-signal-based algorithm, the effect of the modeling error on this particular type of detection approach is examined and a geometrical explanation is provided. We also present a variation of the analog-signal-based algorithm which produces signals that are more practical for certain types of applications. In addition, an alternative auxiliary signal design algorithm is developed, producing digital signals that minimally disturb regular system operation and guarantee fault detection for a given amount of the gap between physical system and the corresponding model. The algorithm implements the analytical solution steps derived mostly by the optimal control problem solution technique while converting a nested optimization problem into an equivalent eigenvalue problem. The algorithm provides an option to optimize the duration of each digital piece to yield even more ``plant-friendly'' auxiliary detection signals at the cost of a moderate increase in computational time.