

**Short Course:
Nonlinear Programming Strategies for Process Optimization**

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This set of five two-hour lectures surveys advances in nonlinear programming (NLP) formulations and algorithms for challenging, large-scale applications of process optimization. These applications include topics in process modeling, design and control, and deal with both steady-state and dynamic systems. The lectures outline state-of-the-art NLP methods, application to optimal control problems, extensions to deal with switching conditions and a class of discrete decisions. These problem formulations are complemented with applications in process design, operations and control, and will be illustrated with a number of challenging large-scale case studies.

I. Nonlinear Programming: Concepts and Algorithms

9/23/09, 2:30-4:30, ENGR 2534

- Unconstrained methods
- Optimality conditions
- Classes of Nonlinear programming methods
- Large-scale Extensions

II. Overview of Dynamic Optimization

10/07/09, 2:30-4:30, ENGR 2534

- Introduction and Examples
- Sequential Methods for Dynamic Optimization
- Multiple Shooting and Unstable Systems
- Simultaneous Methods for Dynamic Optimization
- Case Studies

III. Advances and Challenges in Dynamic Optimization

10/22/09, 2:30-4:30, ENGR 3024

- Relation of Simultaneous to Variational Methods
- Path Constrained Problems
- Singular Problems
- Nonregular NLP Formulations

IV. Mathematical Programs with Equilibrium Constraints

10/28/09, 2:30-4:30, ENGR 2534

- Properties and Challenges of MPECs
- NLP Formulations and Solution Strategies
- Process Examples
- Dynamic MPECs and NLP Solution Strategies
- Case Studies

V. Topics in On-line Optimization

10/30/09, 2:30-4:30, TBA

- Introduction to Nonlinear Model Predictive Control and Moving Horizon Estimation
- Implementation and Computational Delay
- NLP Sensitivity
- NMPC Stability and Robustness
- NMPC and MHE Strategies