

ECE 726: ADVANCED FEEDBACK SYSTEMS

COURSE DESCRIPTION

This course will first cover conventional optimization techniques including linear programming, dynamic programming, and searching techniques including steepest decent. The basic optimization techniques will be applied mainly on dynamical systems control. Popular optimal control technique such as Kalman Filter and emerging control technique such as neural and fuzzy control will also be introduced. This course will heavily use numerical simulation package including MATLAB / SIMULINK to assist the understanding of the fundamental concepts and techniques discussed in class. The pre-requisite of this course is ECE 716: System Control Engineering or permission from the Instructor.

TEXT: Donald Kirk, *Optimal Control Theory - An Introduction*, Prentice Hall.

REFERENCES:

- A. David Luenberger, Linear and Nonlinear Programming, 2nd ed., Addison-Wesley.
- B. Sage & White, Optimal Systems Control, 2nd ed., Prentice Hall.
- C. Bryson & Ho, Applied Optimal Control, Hemisphere Publishing Corporation.

COURSE OUTLINE

- I. PROJECT PLANNING
- II. INTRODUCTION TO OPTIMAL CONTROL
- III. PARAMETER OPTIMIZATION
 - A. Stationary Points, Singular Points
 - B. The Penalty Function Method
 - C. Lagrange Multiplier
 - D. Overview of Optimization Techniques (Analytical and Numerical Methods)
 - 1. Steepest Decent Method
 - 2. Newton Raphson Method
 - 3. Linear Programming
- IV. DYNAMIC PROGRAMMING
 - 1. Principal of Optimality

V. THE PONTRYAGIN MINIMUM PRINCIPLE

- A. The Maximum Principle
 - 1. Hamiltonian
 - 2. Transversality Condition
- B. Classical Calculus of Variations

VI. OPTIMAL CONTROL

- A. Performance Measure
 - 1. Minimum Time Control
 - 2. Minimum Fuel Control
- B. Bang-Bang Control
- C. Terminal Control
- D. Optimal Decision Strategy

VII. PROJECT PRESENTATION