EE 499-CONTROL SYSTEM DESIGN

Fall 2001

INSTRUCTOR:

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OFFICE HOURS:

Monday-Friday: 2 -4 p.m.

COURSE WEBSITE: http://www.engr.uky.edu/~ymzhang/EE499/EE499.html

GRADING:

HW/Projects	25 pts.
Final Examination	25 pts.
Design Project	50 pts.
Total ……	100 pts.

COURSE OUTLINE

Lecture

1. Control System Introduction
2. Identification
   2.1 Identification of Transfer Functions: Review of Transfer Function; Open-loop Step Response Experiment; From Step Response to Transfer Function; Step Response Experiment Design for Non-Linear Systems; Identification of Analog System Identification Project.
   2.2 Identification of Difference Equations: Review of Difference Equation; Parameters Estimation and Structure Identification Problems; Least Squares Method; Examples for Formation of Regression Equation; Experimental Design; Digital System Simulation and Identification Project.
   2.3 Model Conversion
3. Controller Design
   3.1 PID Controller Design: PID Control; Why PID Control? Circuit Realization of PID Controller; Digital Realization; PID Tuning Rules; PID Auto-Tuning; PID Design and Control System Simulation Project.
   3.2 Predictive Control of Impulse Discrete Systems: Long-Range Predictive Control; Interval Model Control; Simulation and Design Project.

4. Control System Implementation Issues
   4.1 Analog Control System: Controller Realization Using Operational Amplifiers; Feedback Control System Examples.
   4.2 Digital Control System: System Configuration; Digital Processor and Programming; A/D and D/A; Amplifiers/Filter for Feedback Signal and Control Signal; Initial Control Signal

Design Project: Thermal Processing Process Control

1. Problem Description: A thermal processing system has a plasma arc as the heating source to heat a copper plate which is being water–cooled. Four temperature sensors are embedded into the copper plate. The average of the readings from the four sensors is used as the feedback of the temperature. This project is to design and implement an analog control system and a digital control system which can adjust the current of the plasma arc to maintain the temperature at a given set-point and, if the set-point is changed, to change the temperature from a set-point to another following a given trajectory.
2. Available Resources: A plasma power supply whose current can be adjusted by using an analog signal; A water-cooled copper plate with four embedded temperature sensors; A digital signal processor with A/D and D/A.
3. Activities: Program the digital processor; Design amplifiers/filters for the feedback signal and control signal; Design and implement system identification experiments; Establish a transfer function model and a difference equation model for the process; Design and implement an analog PID control system and a digital predictive control system; Results analysis and discussion; Project report.

COURSE OUTCOMES

1. Abilities to obtain system dynamic models from practical systems through designing and implementing system identification experiments and processing experimental data.
2. Abilities to design and implement PID controller and predictive controllers.
3. Abilities to construct and test analog and digital feedback control systems.