CSU Course Syllabus: Spring 2024

ECE612 - Robust Control Systems

TR 2:00pm-3:15pm, Eddy 106

Instructor: Dr. Peter M. Young, Engr B114, Ext. 1-5406,
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Office Hours: TR 3:30pm-4:30pm, Engr B114

Book: *Multivariable Feedback Control*
Skogestad and Postlethwaite

Prerequisites: ECE411

Grading and Exams:

Midterm Exam	30%
Final Exam	40%
Computer Projects	20%
Homework Assignments	10%

Course Schedule: Homework problems will usually be assigned every other week (due two weeks later). In addition there will be a number of special computer projects. You are expected to work on all these problems yourself, but *reasonable* collaboration is allowed.

No collaboration is allowed for the Midterm and Final Exams. Both exams will be take-home, open-book and open-notes.

Course Objective: Introduction to modern robust control theory techniques for large-scale uncertain multivariable systems: stability and performance; computer-aided tools for both system analysis and controller design.

ECE612 Course Outline

This course will be lecture-based, with both homework assignments and exams. In addition a number of computer projects will be assigned. The following topics will be covered:

Introduction and Background

Introduction to concepts of model uncertainty, including both parametric and dynamic uncertainty. Fundamental concept of robustness and the relationship between physical systems and mathematical models. Mathematical background including norms for vectors, matrices, signals, and systems. The singular value decomposition (SVD) and its application to perturbation analysis.

Robustness Problems

Linear fractional transformations and canonical forms. Performance measured via (induced) norms. Robust stability and performance problems. Solution of SISO robustness problems.

Computer-Aided Analysis Techniques

Introduction to the structured singular value for robustness analysis of MIMO systems. Conversion of robustness problems to canonical M-Δ form. The small gain theorem and approximate computation of μ via efficient upper and lower bounds. Computer-aided tools for μ-analysis based on the Matlab Robust Control Toolbox.

Synthesis and Controller Design

Optimal controller design including $\mathcal{H}_2$ and $\mathcal{H}_\infty$ optimal control. Scaled $\mathcal{H}_\infty$-optimal control problems and μ-synthesis. Computer-aided tools to implement $D-K$ iteration for advanced controller design. Design case studies.