

AE 6532: Aerospace Robust Control II

Catalog Description: AE 6532 Aerospace Robust control II. 3-0-3. Prerequisite: AE 6531

Advanced treatment of robustness issues. Controller analysis and design for linear and nonlinear systems with structured and non-structured uncertainty. Reduced-order control, stability multipliers, and mixed- μ .

Coordinator: Wassim Haddad, Associate Professor

Course Objective: To provide students with an advanced treatment of linear and nonlinear robust control as applied to aerospace systems.

Recommended Textbooks:

1. D.S. Bernstein and W.M. Haddad, *Multivariable Control-System Synthesis: The Fixed-Structure Approach*, preprint.
2. K. Zhou, J.C. Doyle, and K. Glover, *Robust and Optimal Control*, Prentice Hall, New Jersey, 1996.

Topics:

The Standard H_∞ Problem

- Riccati Equation Characterization for H_∞
- Disturbance Rejection as a Standard Problem
- Unstructured Uncertainty Models
- The H_∞ LQR Problem
- The H_∞ Dynamic Compensation Problem
- The Mixed-Norm H_2/H_∞ Problem
- Specialization to H_2 Dynamic Compensation
- Robust Controller Synthesis Using the Mixed-Norm H_2/H_∞ Standard Problem
- H_2/μ Synthesis

Fixed-Structure Controller Synthesis

- Reduced-Order Dynamic Compensation
- The Optimal Projection Equations
- Suboptimal Model Reduction via Balanced Realizations
- Optimal H_2 Model Reduction
- Mixed-norm H_2/H_∞ Extensions
- Decentralized Controller Architectures

Robust Analysis and Synthesis for Structured Real Parameter Uncertainty

- Robust Analysis
- Parameter Uncertainty Models
- Robust Stability and Robust Performance
- Fixed Quadratic Lyapunov Bounds for Robust Analysis and Synthesis
- Construction of Lyapunov Bounds: Linear Bound, Quadratic Bound
- The Robust LQR Problem
- The Robust Estimation Problem
- Robust Full-Order Dynamic Compensation
- Robust Mixed-Norm H_2/H_∞ Extensions
- Real Parameter Uncertainty and Parameter-Dependent Lyapunov Functions
- Popov Robustness and Controller Synthesis
- Connections to Absolute Stability Theory

The Real Structured Singular Value

- Mixed Complex/Real Uncertainty Models
- Nonlinear Uncertainty Models
- Connections to Absolute Stability Theory
- Multiple-Block Structured Uncertainty
- Real- μ Analysis
- Fixed-Structure H_2/μ Synthesis

Advanced Topics in Linear and Nonlinear Robust Control

Computers: Several assignments will require computations using MATLAB, Control System Toolbox, and the μ -Toolbox.