THE OHIO STATE UNIVERSITY
COLLEGE OF ENGINEERING

Robust Control of Mechatronic Systems

MECHENG 8352

Credit Hours:
3.00 - 3.00

Course Levels:
Graduate (5000-8000 level)

Course Components:
Lecture

Course Description:
This course is focused on the application of the parameter space approach of robust control to mechatronic systems including ADAS and automated driving. The students will learn how to design multi-objective low order controllers in parameter space based on Hurwitz stability, D-stability, phase margin bounds, gain margin bounds and mixed sensitivity bounds.

Prerequisites and Co-requisites:
Prereq: Grad standing in MechEng or ECE, or permission of instructor.

Course Goals / Objectives:
- Learn how to design multi-objective low order controllers in parameter space based on Hurwitz stability, D-stability, phase margin bounds, gain margin bounds, mixed sensitivity bounds.
- Analyze the effect of non-minimum phase zeros and design input shaping / preview filters.
- Analyze and design robust SISO and MIMO disturbance observers for plants with uncertainty and unknown disturbances.
- Analyze and design communication disturbance observer for plants with unknown time delay.
- Analyze and design robust continuous-time and discrete-time repetitive controllers for control systems with periodic inputs.
- Use Matlab and Simulink to simulate, analyze and design control systems in parameter space

Course Topics:

- Introduction. Overview of syllabus: Information on the course, homework assignments and projects. Synopsis of all of the control techniques that will be covered in the course.
- Introduction to robust control. The parameter space method for robust control. Boundary crossing theorem. Real root boundary, complex root boundary and infinite root boundary computations.
- Hurwitz stability region determination in parameter space. D-stability region determination in parameter space. Physical significance of the D-region boundary.
- Method of mapping frequency domain bounds to parameter space. Mapping of mixed sensitivity bounds and phase margin bounds
- Review of conventional controller design (phase lead, phase lag, lag-lead, PID etc.). Conventional controller design in parameter space.
- Robust conventional controller design in parameter space.
- Characterization of nonminimum phase zeros and introduction to input shaping control.
- Input shaping control.
- Introduction to disturbance observer control. Robustness of disturbance observer control.
- Discrete time disturbance observer control. Communication disturbance observer.
- Designing robust disturbance observer control in parameter space. MIMO disturbance observer control.
- Introduction to repetitive control. Effect of time delays. The regeneration spectrum. Continuous time design.
- Discrete time repetitive control.
- Robust repetitive controller design in parameter space. MIMO repetitive control.

Designation:

Elective