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ECE 432-002: Control Systems

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Course number and name
ECE 432
Advanced Controls and Robotics

Credits, contact hours
3 credits
3 hours per week

Name(s) of instructor(s) or course coordinator(s)
Cong Wang

Instructional materials
> Chalk talk notes in the lectures
> Reference books:
Control System Design - An Introduction to State-Space Methods, Bernard Friedland
Control Systems Engineering, Norman Nise, 6th edition

Specific course information
> Catalog description:
Study of control systems with an emphasis on the modern control theories based on state space methods. Modeling and analysis of dynamic systems, feedback and feedforward control strategies, observers, and computer-based control systems. An introduction to optimal control, which is the foundation of advanced intelligent control methods such as model predictive control and reinforcement learning. The topics covered in the course are illustrated with applications in robotics.
> Prerequisite: ECE 431 – Introduction to Feedback Control Systems

Educational objectives for the course
The students will be able to
> Apply state space methods to model and analyze dynamic systems, design state feedback control laws using pole placement and quadratic optimization, and design state observers to facilitate state feedback control;
> Understand the applications of advanced control strategies such as zero-phase error tracking control, iterative learning control, and disturbance observers based on transfer functions;
> Explain the structure and control methods of classic servo-based robotic systems.

Brief list of topics covered
> Introduction to state space methods
> Modeling dynamics systems with state space models
> Stability
> Controllability and observability
> State feedback control using pole placement
> Observers
> Computerized control and discrete systems
> Introduction to optimal control
> Techniques beyond feedback control

> Introduction to robotics and servo systems
> Servo drivetrain, sensing, and power electronics
> Modeling servo systems
> Control of a single servo and multi-axis motion systems