

ECE 792-065

Underactuated Robotics

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Objective or Description:

This course studies how to overcome issues with today's robots, robots that move far too conservatively, and accomplish only a fraction of the tasks and achieve a fraction of the performance that they are mechanically capable of. In many instances, today's robots are fundamentally limited by control technology, i.e., control systems that attempt to maintain full control authority at all times. As such, both industrial robots and mobile robots alike rely on classical PID controller design.

The study of underactuated robotics focuses on building control systems which use the natural dynamics of the machines. Humans and animals move much more aggressively by routinely executing motions which involve a loss of instantaneous control authority. Controlling nonlinear systems without complete control authority requires methods that can reason about and exploit the natural dynamics of our machines in an attempt to achieve extraordinary performance in terms of speed, efficiency, or robustness.

This course introduces nonlinear dynamics and control of underactuated electro-mechanical systems controlled by computer, with an emphasis on computational methods. Topics include the nonlinear dynamics of robotic manipulators, applied optimal and robust control and motion planning. Discussions include examples from biology and applications to legged locomotion, compliant manipulation, underwater robots, and flying machines.

Prerequisites: ECE 516, ECE535, ECE 555, ECE 556, BME 590 (or by lecturer agreement)

Cross-listing in other departments: BME 790-xxx