UCONN
SCHOOL OF ENGINEERING

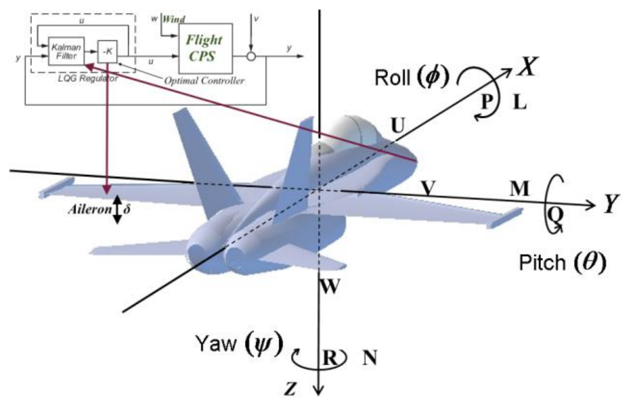
United Technologies Corporation
Institute for Advanced Systems Engineering
UNIVERSITY OF CONNECTICUT

Graduate Courses in Systems Engineering

SE 5202 Modern Control Systems

What's Exciting About this Course? Students learn to design and analyze nonlinear and robust controllers, which apply to a wide range of ubiquitous systems affected by nonlinearity and perturbations. Use of MATLAB for analysis and simulation.

Course Description This course is a modern take on control design and analysis and uses state-space and optimization-based approaches to deal with complex cyberphysical systems. The course builds on the necessary classical control systems analysis techniques in the frequency domain, but moves quickly to the more advanced time-domain optimization-based control and estimator design. The course includes both practical and theoretical aspects. The control design of cyberphysical systems is challenging as together with inadequate measurements and stringent performance criteria, they are often multivariable, nonlinear and uncertain in nature. The multivariable state-space based optimal control design and estimation techniques presented in this course teach students how to obtain maximum system performance with imprecise measurements. Students learn to design and analyze nonlinear and robust controllers, which apply to a wide range of ubiquitous systems affected by nonlinearity and perturbations. A full nonlinear model of a B747 aircraft is introduced as an advanced cyberphysical system and throughout the course practical controllers are developed for both the longitudinal and lateral flight dynamics that correspond to material covered. Students use Matlab-based controller code for the B747 aircraft example, amongst others, that they simulate to obtain hands-on training and in-depth understanding of modern control systems.



Course Outcomes

- Understand usefulness, appropriate applications, impediments and obstacles in control design.
- Characterize stability and uncertainty of systems and construct a robust controller.
- Apply modern state-space oriented methods from multivariable modeling to control.
- Determine the need of estimation and its association with the controller.
- Construct and integrate optimization-based estimators and controllers.
- Conduct basic model-in-the-loop based testing, verification, validation and tuning.

Topics: Root Locus Analysis, Frequency Response Methods, Control Design Using Bode Plots, Closed-loop System Analysis, State-space Models: Basic Properties, State-space Features: Observability and Controllability, Full-state Feedback Control, Open-loop and Closed-loop Estimators, Combined Estimators and Regulators, Linear Quadratic Regulator, Linear Quadratic Estimator and Gaussian, Multivariable and Digital Control Basics, Analysis of Nonlinear Systems.

Course Objectives and Links to Overall Program Goals. This course prepares engineers to design systems that satisfy stakeholder needs, while taking into account complex forms of interactions, and the demand for higher levels of quality and reliability through control.