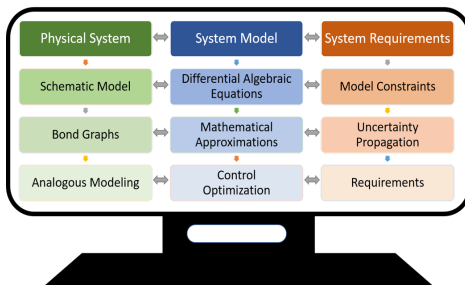


Graduate Courses in Systems Engineering

SE 5095 Special Topics in Model Based Design for Realtime Cyber Physical Systems



Course Description. This course is designed to connect key elements of model-based systems engineering for students interested in control system design and analysis applied to cyber-physical systems. Students will develop foundations in requirements engineering, physical system modeling, control structure design, and computational methods for control system performance analysis. Special

topics include an introduction to model predictive control and modeling of multi-rate control systems. This course makes extensive use of specific system examples to solidify concepts. Dynamic models of physical systems are implemented using the Modelica modeling language. The physical system examples cover thermo-fluid, electrical, and mechanical engineering domains.

Course Outcomes

- Author system concepts, descriptions, and requirements consistent with best practices in systems engineering
- Derive requirements for cyber-physical system (CPS) models used for control design
- Build acausal models of physical systems for rapid CPS prototyping
- Create numerically robust models of dynamic systems using the Modelica language
- Design and implement flexible and configurable model-based control functions, including model predictive control and state estimators
- Analyze robustness of control system stability and performance to variation in system parameters
- Incorporate real-time and discrete-time aspects into model-based CPS design process

Topics: Model-Based Design Principles, Acausal Modeling of Physical Systems, Building Reusable Models at Different Levels of Abstraction, Model Predictive Control and State Estimation, Analysis of Control System Robustness to Uncertainty, Modeling Discrete-Time, Multi-rate Control Systems