Introduction to Model-Based System Design

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Author Information

Marc Herniter
Rose-Hulman Institute of Technology

Zachariah Chambers
Rose-Hulman Institute of Technology

Course Details

Description

Introduction to Model-Based System Design: Model-in-the-Loop (MIL), Software-in-The-Loop Simulations (SIL), Hardware-in-the-Loop (HIL), Real-Time Simulations, Targeting, Verification and Validation, Design of Experiments, Model Refinement.

Objectives

After successfully completing this course the student should be able to:

- Build mathematical models for components in a system.
- Follow a process of continuous refinement and improvement to generate accurate models.
- Connect component models together to model a larger more complex system.
- Setup and run Model-in-the-Loop Simulations (MIL).
- Setup and run real-time simulations for a physical system.
- Setup and run Hardware-in-the-Loop Simulations (HIL).
- Apply basic control algorithms to a real physical system.
- Deploy a control algorithm on a real-time target.
- Apply verification and validation methods to a model of a physical systems.
- Use Design of Experiment methods to create models of physical systems.

Original Course Documents

Source file URL

Course Contents

    - Controller Model
    - SimDriveline Intro
- Simulink Simulations
    - Explore the system response using different control methods.
    - Tune the system
    - Explore system limitations
    - Understand and refine motor models.
- Real-time simulations with xPC
    - Plant and Controller Implement on Single Target
- Implement controller on MPC566 or MPC5554 target
    - Install hardware and software.
    - Use Freescale RAppID Toolbox or MathWorks 555 Toolbox
    - Wire up system to familiarize students with pin outs
    - Explore analog inputs, digital and PWM outputs
- Processor In The Loop Real-Time Simulations
    - Controller on Freescale Target
    - Plant on Real-Time Target
    - Display Performance on Virtual Gauge Display
    - Data Collection of Performance
- Test controller on real system
    - Observe system performance
    - Observe the effect of different control methods.
    - Tune the system
- Model Verification
    - Data Collection of Physical Model Response
    - Comparison of Physical Plant Response to Model Response
- Design of Experiments to Collect Experimental Data on Motor and Generator
    - Automatically Generate Test Schedule to Obtain Data
    - Run Experiments and Collect Data
    - Generate Models for Components
        - Table-Lookup
        - Curve Fits
- Model Refinement and Re-Verification
    - Update Models to Include Measured Data
    - Comparison of Updated Physical Plant to Model
- Further Exploration of Alternate Control Methods as Time Permits

Problem Sets

Resources

- Models, Drive Cycle Files, and Component Information
- MPS555x Demo Board Manual
- MPS555x Demo Board Schematic
- MPS555x Demo Board Silkscreen

Learn more about MathWorks academic resources:

- MATLAB Courseware
- Hardware Resources
- Classroom Resources
- MATLAB Examples
- Books
- Tutorials
- Webinars
- Technical Articles