Automating Plant Model Parameterization and Control Optimization

MathWorks Automotive Conference 2016

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Application Engineering
Problem - Design Electric Car

- System level architecture
- Control design and tuning
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- System level architecture
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Approach

- Modeling and Simulation with Simulink
- The power of MATLAB
  - Parameter estimation
  - Performance optimization
Agenda

- Simple Drivetrain
  - Causal and Acausal modeling
  - Control Design
  - Response Optimization

- Buck Converter
  - Parameter Estimation
Simulink

- Model and simulate dynamic systems
- Signal-based, or causal, modeling
- Need equations
Dynamic System

\[ m\ddot{x} = F - b\dot{x}^2 \]
Simscape

- Model and simulate dynamic systems
- Network-based, or *acausal*, modeling
- Intuitive, reusable, less math
- Simscape Language
Response Optimization

\[ |\text{sim} - \text{req}|^2 \]

\[ \text{model} (a,b,c,d) = \text{requirement} \]
Response Optimization

- Optimization + Simulation
- Fully non-linear plant
- Applicable to any parameter
  - Controller
  - Plant
- Parallelizable
Parameter Estimation

\[ \text{model } (a,b,c,d) \rightarrow \text{out} \]

\[ \text{in} \rightarrow \text{experiment} \rightarrow \text{out} \]

\[ |\text{sim} - \text{exp}|^2 \]

\[ \text{iteration} \]
Summary

- Simulink and Simscape
  - Signal- and network-based multi-domain modeling

- The Power of MATLAB
  - Response Optimization
  - Parameter Estimation
Please come by our booth!
Thank You
Simulink

\[ m \ddot{x} = F - b \dot{x}^2 \]