MATLAB EXPO 2018

Entwicklung mechatronischer Systeme in der Luft- und Raumfahrt

Eva Pelster
Key Points

- Create intuitive models that all teams can share

- Simulate system in one environment to
  - Perform tradeoff studies
  - Optimise system performance

- Test without prototypes
Agenda

- Example: Flight actuation system
  - Benefits of Model-Based Design

- Actuator design
  - Modeling the mechanical system
  - Determining actuator requirements
  - Testing Electrical and Hydraulic Designs

- Optimising System-Level Design

- HIL testing
Example: Aileron Actuation System

- System

- Simulation goals
  1. Determine requirements for actuation system
  2. Test actuator designs
  3. Optimise system performance
  4. Run simulation on real-time hardware for HIL tests
Traditional Design Process

REQUIREMENTS

Cannot validate design against requirements

DESIGN

Cannot test or optimize fully integrated design

Control

Mechanical

Electrical

IMPLEMENTATION

Can only find problems using hardware prototypes

Emb. Code

INTEGRATION AND TEST

Manual coding is slow, buggy, and hard to verify
Model-Based Design

- **Requirements**
  - Detect errors right away with continuous verification

- **System Level Design**
  - Optimize design in a single simulation environment

- **Implementation**
  - Lower costs using HIL tests
  - Save time by automatically generating embedded code

- **Test & Verification**
  - Cannot test or optimize fully integrated design
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Modeling the Mechanical System

Problem: Model the mechanical system within Simulink

Solution: Import the mechanical model from CAD into Simscape Multibody

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Determining Actuator Requirements

**Problem:** Determine the requirements for an aircraft aileron actuator

**Solution:** Use Simscape Multibody to model the aileron and Simscape to model an ideal actuator

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Problem: Test different actuator designs in the system

Solution: Use Simscape Fluids and Simscape Electronics to model the actuators, and variant subsystems to test them
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Optimising System Performance

Problem: Optimise the speed controller to meet system requirements

Solution: Tune controller parameters with Simulink Design Optimization

Model:

![Model Diagram]

- Speed Control
- Current Control
- Current
- Angle

Solution:

- $K_p = 0.62$
- $K_i = 0.29$
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Configuring an Electrical Actuator for HIL Testing

**Problem:** Configure solvers to minimize computations and convert to C code for real-time simulation

**Solution:** Use Simscape local solvers on stiff physical networks and Simulink Coder™ to generate C code

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