MATLAB EXPO 2019

Systems Engineering
Requirements to Architecture to Simulation
Key Takeaways

- Digital thread providing traceability between requirements, architecture, and design

REQ 3.1 ENABLING CRUISE CONTROL
Cruise control is enabled when

ENABLE SWITCH DETECTION
If the Enable switch is pressed

Implemented
By

Derives

Implemented
By

reqMode.Cruise
Key Takeaways

- Digital thread providing traceability between requirements, architecture, and design
- Connected environment for designing and analyzing architectures and designs
Key Takeaways

- Digital thread providing traceability between requirements, architecture, and design

- Connected environment for designing and analyzing architectures and designs

- Integrated platform for analyzing all parts of your architecture in one multi-domain environment
Early in the Process
Concepts/Descriptions

Later in the Process
Models

What does that mean?
What is the Gap?

**Early in the Process**
Concepts/Descriptions

**Later in the Process**
Models

Digital Thread
Connected Environment
Analysis & Simulation Platform
What goes into the bridge?

- Be Intuitive
- Facilitate Analysis
- Tackle Complexity
- Enable Implementation

Digital Thread for Traceability

1. Functional Requirements
   1.1. Normal Mode of Operation
       During the normal mode of operation, the Fault Tolerant Fuel Control System shall determine the fuel rate which is injected at the valves.
       1.1.1. Stoichiometric mixture ratio
           During normal model of operation, the System shall maintain the stoichiometric mixture target ratio of 14.6.
       1.1.2. Oxygen Sensor (EGO)
MathWorks Solution: System Composer R2019a and

- Be Intuitive
- Facilitate Analysis
- Tackle Complexity
- Enable Implementation

Requirements Coverage Reporting and Impact Analysis

Simulink Requirements
Now let’s see it in action
**Property Inspector**

**Requirement:** #35

**Details**

**Properties**

- **Type:** Functional
- **Index:** 1.4.2
- **Custom ID:** #35

**Summary:** Propulsion Power

**Description:**

- Engine: Nine-cylinder, air-cooled, radial aircraft engine
- Fuel type: 80/87 grade aviation gasoline
- Dry weight / lb (1.03 kW/kg): 290 kg
- Power output:
  - 400 hp (298 kW) at 2,200 RPM
  - 5,000 ft (1,500 m)
<table>
<thead>
<tr>
<th>Instance</th>
<th>Mass</th>
<th>Power</th>
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<tr>
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<td>175614300</td>
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<tr>
<td>BVLOS Navigation</td>
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<td>0</td>
</tr>
<tr>
<td>Ground Station</td>
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<td>0</td>
</tr>
<tr>
<td>Communication Box</td>
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<td>0</td>
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<tr>
<td>Ground Station GPS Interface</td>
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<td>USB Serial Converter</td>
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<td>GPS receiver</td>
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<td>Guidance and Navigation Computer</td>
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<td>Radio RX PPM/PWM</td>
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<tr>
<td>Power Source</td>
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<td>Environment</td>
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<tr>
<td>Propulsion Power Subsystem (Electric)</td>
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</table>

NodeInstance: Propulsion Power Subsystem (Electric)

- Property: Mass Units: kg, Value: 100
- Property: Power Units: mW, Value: 175,000,000
Simulink Requirements
Digital Thread from Requirements to Architecture and Design

Author requirements or view from external source

Link requirements, architectures, design, code and test

Identify gaps in architecture or design

Identify impact of requirement changes
System Composer
Intuitively design system and software architectures

Description
==
Architecture
System Composer
Perform trade studies based on data driven analysis to optimize architectures

Add custom data
Create analysis model
Calculate mass roll-up data
System Composer
Tackle Architecture complexity with spotlight views
System Composer
System and software architectures connected to implementations in Simulink

Link Simulink models to architecture components

Generate Simulink models from architecture components

Autogenerated by System Composer on Jan 25, 2019 2:00 pm EST
Simulink: A Multi-Language Simulation Environment

Dynamic Systems

State Machines

Discrete-Event Systems

Physical Modeling

Object-Oriented
Simulink: Connecting with External Models

- Connect your simulation models or code with Simulink, no matter where they originate:
  - Industry proven S-function API
  - Emerging FMI interface
  - Call your C code directly
Learn More

- Simulink Requirement Webpage
- System Composer Webpage
- System Modeling and Simulation Webpage
- Trial