MATLAB EXPO 2019

Systems Engineering
Requirements to Architecture to Simulation
### Key Takeaways

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

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**REQ 3.1 ENABLING CRUISE CONTROL**

Cruise control is enabled when

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**ENABLE SWITCH DETECTION**

If the Enable switch is pressed

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**Implemented By**

---

**Implemented By**

---

**Derives**

---

**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 mode 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

**Simulink**

Requirements Coverage Reporting and Impact Analysis

**Simulink Requirements**
Now let’s see it in action
Gas Engine: Nine-cylinder, air-cooled, radial aircraft engine
Fuel type: 80/87 grade aviation gasoline
Dry weight: 290 kg
Power output: 400 hp (298 kW) at
Propulsion Power Subsystem

< Engine_Power_Nm_s >

apControls

EnvBus

enginePower

Actuator Power Subsystem

< Actuators >

Subsystem Budget

#35: Propulsion Power

IMPLEMENTS
#35: Propulsion Power

**Propulsion Power Subsystem**

**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: 290 kg
- Power output: 400 hp (298 kW) at 2,200 RPM up to 5,000 ft (1,500 m)

**Implemented by:** Propulsion Power Subsystem
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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

MATLAB EXPO 2019
System Composer
Tackle Architecture complexity with spotlight views

Composition

Spotlight
System Composer
System and software architectures connected to implementations in Simulink

Link Simulink models to architecture components

Generate Simulink models from architecture components

ADD IMPLEMENTATION HERE

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

MATLAB EXPO 2018
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