MATLAB EXPO 2019

Systems Engineering
Requirements to Architecture to Simulation

Gaurav Dubey, MathWorks
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

Dynamic Systems  State Machines  Discrete-Event  Physical Modeling
What does that mean?

**Early in the Process**

Concepts/Descriptions

**Later in the Process**

Models
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

Concepts/Descriptions  
Digital Thread for Traceability  
Models

### 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
Propulsion Power Subsystem

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

Actuator Power Subsystem
Propulsion Power Subsystem

Requirements - UAS_reference_architecture

Index Summary Implemented
1.4 Construction
1.4.1 Modularity
1.4.2 Propulsion Power
1.5 Flying Qualities
2 Ground Station Capabilities

#35: Propulsion Power

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 up to 5,000 ft (1,500 m)

Keywords:
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

Generate Simulink models from architecture components

Link Simulink models to architecture components

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

Dynamic Systems

State Machines

Discrete-Event Systems

Physical Modeling

Object-Oriented
Learn More

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