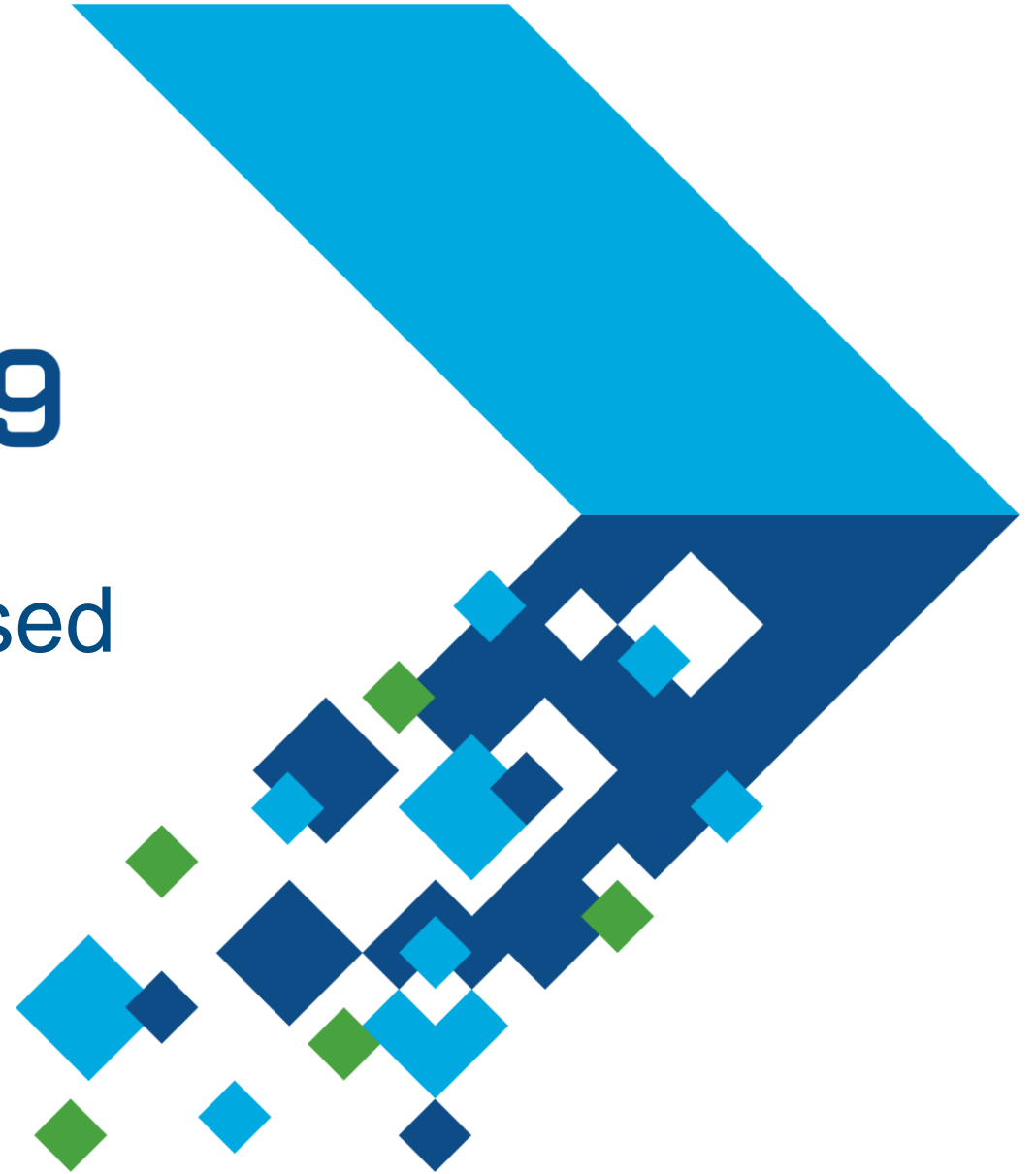


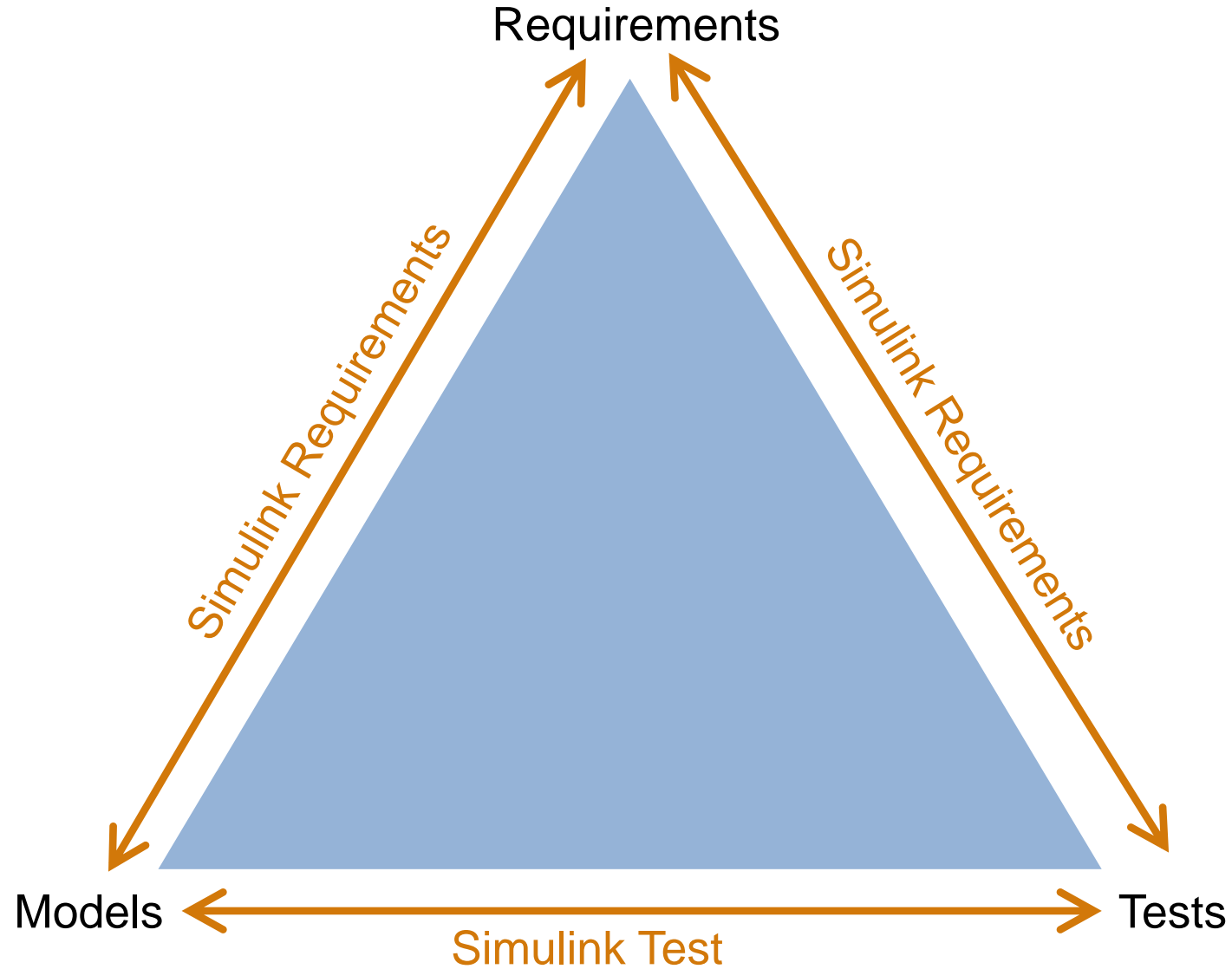
MATLAB EXPO 2019

Simplifying Requirements Based Verification with Model-Based Design

Fraser Macmillen



Requirements & Model-Based Design



Verification & Validation Products

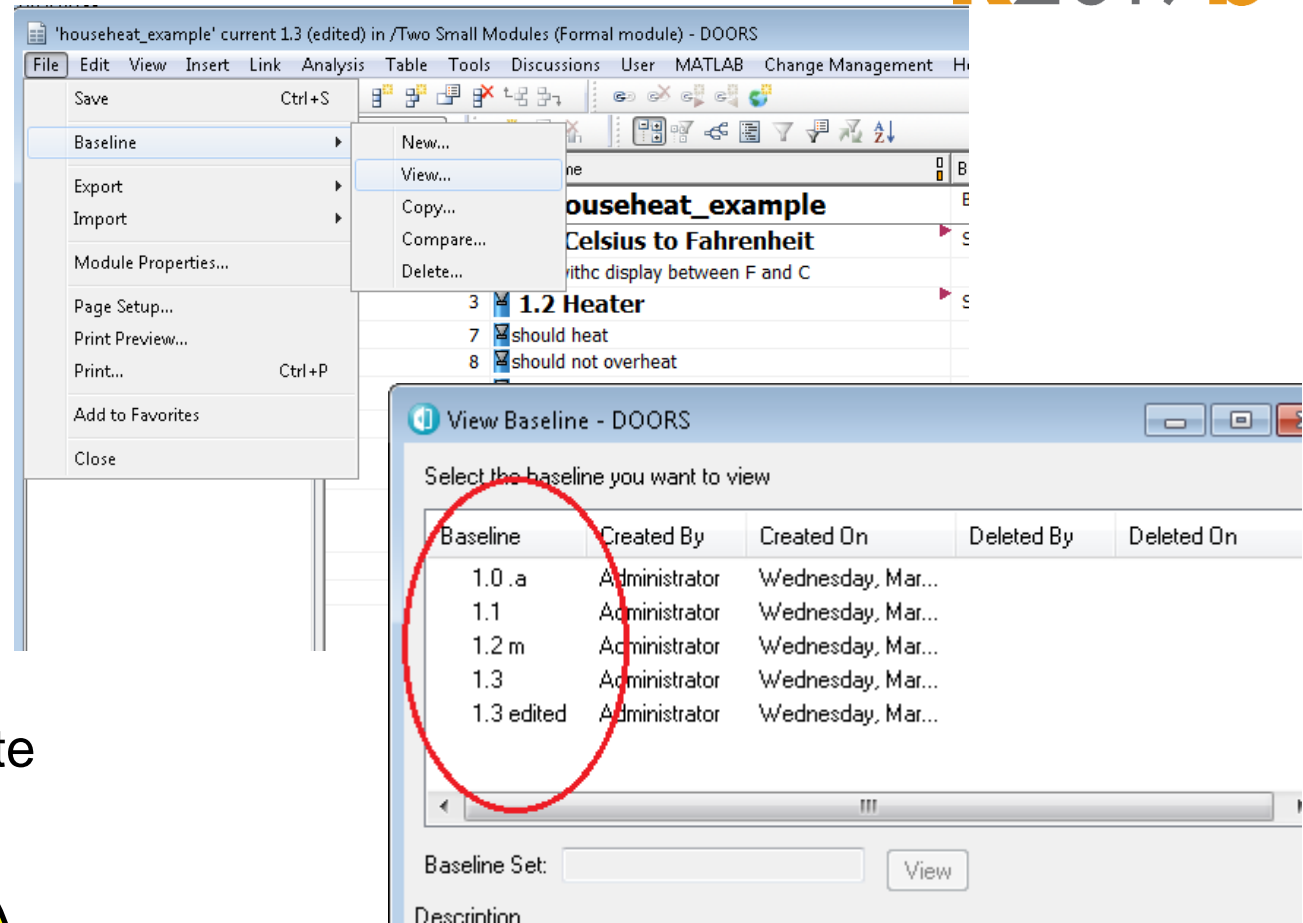
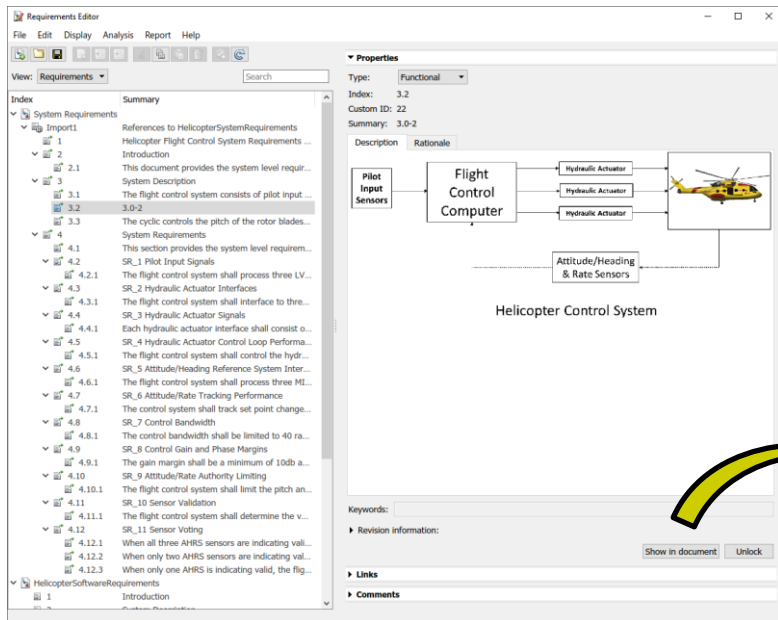
86 slides of new features in 2019...

R2019a **R2019b**

DOORS 9 Baseline Navigation

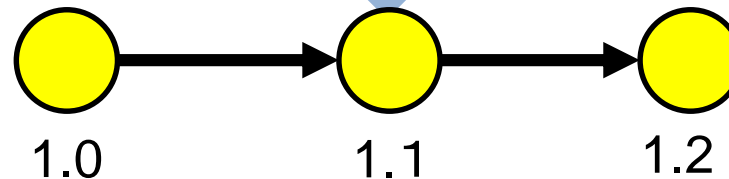
R2019b

Simulink Requirements is aware of baseline in DOORS 9



Navigate

Specified Baseline

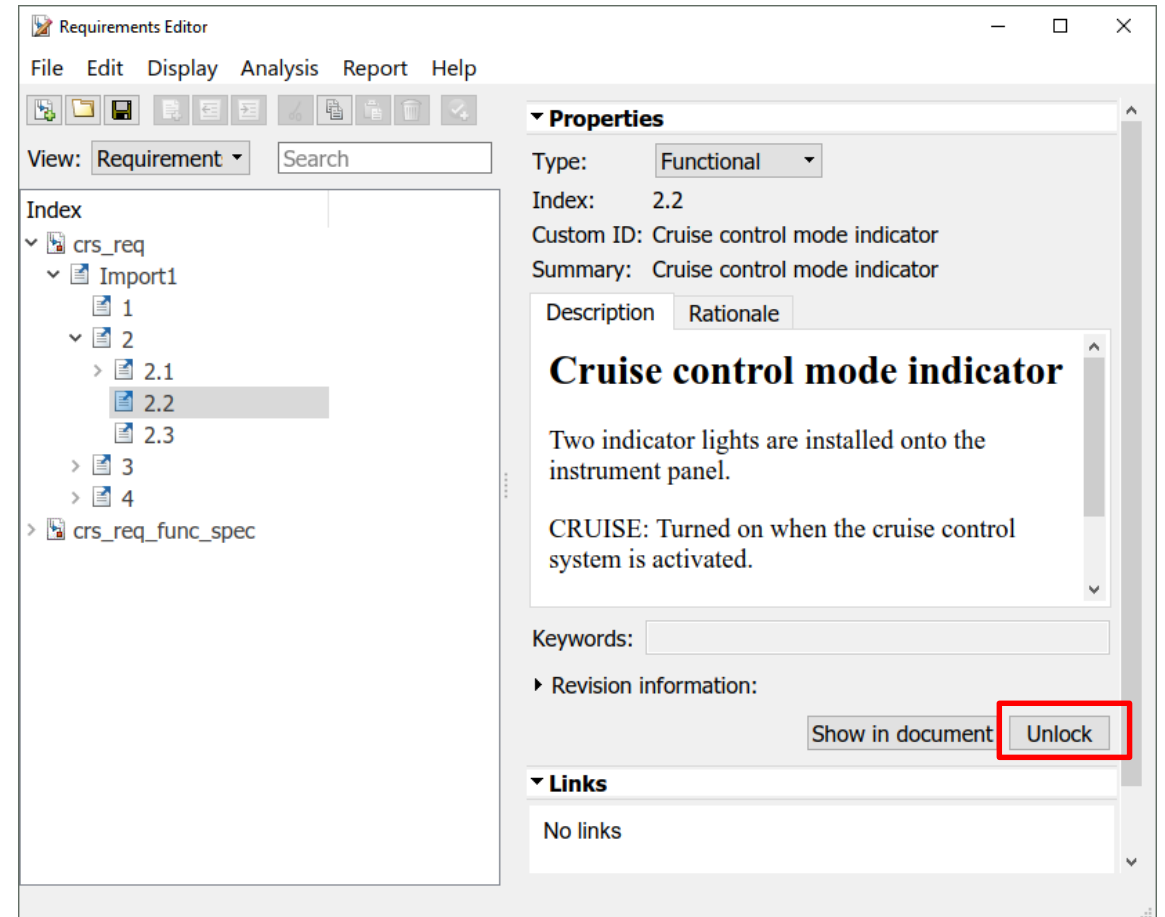


Unlock and Edit Referenced Requirements

Augment referenced requirements with additional details

- Add additional custom attributes without modifying imported content
 - Update restores data from external source and preserves additional content
- Export to ReqIF for roundtrip workflow of local edits with third party tool

See: [Roundtrip Workflows with ReqIF Files](#)



Test Specification Report

- Generate report in PDF, ZIP or DOCX format consisting of test specifications (models, inputs, baseline, assessments etc)
- Customization through templates for report formatting
- Custom sections to add extra content that are user specific

Table of Contents

- [1. ExampleTestFile.....](#) 2
- [1.1. Example TestSuite.....](#) 2
- [1.1.1. Example BaselineTest.....](#) 2
- [1.1.2. Example EquivalenceTest.....](#) 2
- [1.1.3. Example SimulationTest.....](#) 2

Baseline Criteria

Signal Name	Abs Tol	Rel Tol	Leading Tol	Lagging Tol
baseCap.mat	12	0.25	0	3
• Input Conversion Subsystem:2	12	0.25	0	3
• vehiclespeed	12	0.25	0	3

Create a Test Specification Report

Title Page Information

Title:

Author:

Include in Report

<input checked="" type="checkbox"/> Test Details	<input checked="" type="checkbox"/> Iterations
<input checked="" type="checkbox"/> Logged Signals	<input checked="" type="checkbox"/> External Inputs
<input checked="" type="checkbox"/> Callback Scripts	<input checked="" type="checkbox"/> Parameter Overrides
<input checked="" type="checkbox"/> Coverage Settings	<input checked="" type="checkbox"/> Logical and Temporal Assessments
<input checked="" type="checkbox"/> System Under Test	<input checked="" type="checkbox"/> Baseline Criteria
<input checked="" type="checkbox"/> Custom Criteria	<input checked="" type="checkbox"/> Equivalence Criteria
<input checked="" type="checkbox"/> Test File Options	<input checked="" type="checkbox"/> Configuration Settings

Output Options

File Format:

File Name:

Customization Templates

Test Suite Reporter

Test Case Reporter

But what are my requirements for this talk?

- 1. I shall expand awareness and capability in the use of our tools that support verification of requirements**
- 2. I shall not repeat content from previous EXPOs**
- 3. I shall deliver content appropriate to a masterclass**
- 4. I shall make it interesting!**

Simplifying Requirements Based Verification with Model-Based Design

Minimising

the less we have to deal with the simpler it is

Insight

insight leads to understanding and makes our work simpler

Automation

to speed up the process and avoid errors makes our work simpler

Simplifying Requirements Based Verification with Model-Based Design

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Minimising – being at the right level

Requirements at the right level

Verification at the right level

Tracing to the right level

Minimising – handling multiple levels

Example

Control system requirements specify the need for filtering of certain signals

The design uses a reusable custom filter to implement the requirement

There are lower level requirements for the filter behaviour itself

Let's start by creating some links to an instance of the custom filter in the design

PROJECT PROJECT SHORTCUTS DEPENDENCY ANALYSIS

P: PEC R: ReqtWkShop Intro W: WindTurbine Snippets D: DOORS C: Cleanup

New Shortcut Organize Groups

MANAGE DOCUMENTATION MODELS REQUIREMENTS TESTING REFERENCES

PitchActuatorController
System Architecture
WindTurbine

Open Project Requirements
Requirements Diagram
Verify Requirement Parameters

C I
Control System Unit Level Requirement Based Tests
testHarness_WindTurbineDemonstrate

RequirementGraphAnalysis
SimulinkTools
genericProjectTools

Views

Files

Dependency Analysis

References

Labels

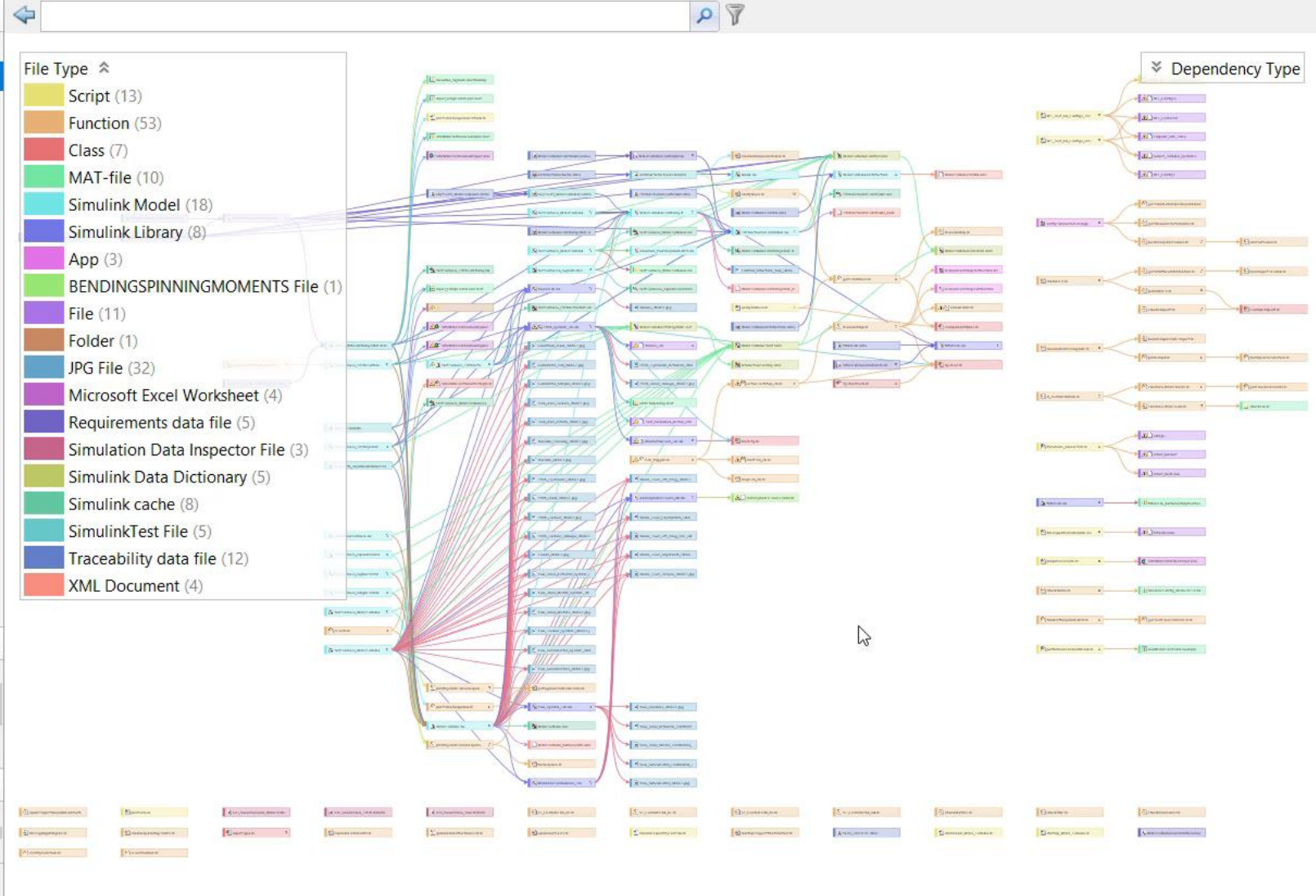
- AssignedTo (String)
- Classification
- Export (String)
- ModelComponent (String)

Git

Current branch: master

Branch status: Normal

Ahead of /origin/master



Impact View

WindTurbine

Root: C:\Users\...\WindTurbine

Analyzed: 20/09/2019 16:50

Products (20)

- MATLAB 9.7
- Simulink 10.0
- Control System Toolbox 10.7
- DSP System Toolbox 9.9
- Embedded Coder 7.3
- [Show All](#)

Problems (25)

- In unreferenced project (1)
- Missing file (15)
- Not in project (2)
- Outside project root (1)
- Requires Simulink Real-Time (5)
- Unsaved changes (1)

Minimising – handling multiple levels

When linking a requirement to a Simulink block...

- Can link from either end
- The Simulink block is always the source
- The requirement is always the destination
- The link is saved in the file associated with the source:
i.e. [modelFileName].slmx

Minimising – handling multiple levels

Linking Between Requirements At Different Levels

The prime purpose of traceability is to infer what is the origin/parent/source of an object.

i.e. a link is from child to parent, from source to destination

i.e. the source is the lower level requirement
the destination is the upper level requirement

The link is saved in the file associated with the source

So: click on source (lower-level requirement) first and create link from the parent requirement...



View: Requirements Search

Index	Summary	Implemented	Verified	Type	Verification	ParameterValue	ParameterUnit
> WindTurbineSystemRequirements							
> WindTurbineControllerRequirements							
> Import1	References to WindTurbineControllerReq...			Container			
> 1	Front Matter			Heading			
> 1.1	WindTurbine Controller Functional Requi...			Functional			
> 2	Controllers			Heading			
> 2.1	Signal Conditioning			Heading			
> 2.1.1	Wind speed filtering attenuation shall be...			Functional			
> 2.1.2	Wind speed filtering attenuation shall be...			Functional			
> 2.1.3	Wind direction filtering attenuation shall ...			Functional			
> 2.1.4	Wind direction filtering attenuation shall ...			Functional			
> 2.2	Supervisory Control			Heading			
> 2.3	Pitch Control System			Container			
> 2.4	Yaw Control System			Heading			
> 3	User Interface			Heading			
> 2	Justifications						
> 2.1							
> WindTurbineControllerDerivedReq...							
> FiltersLibRequirements							
> 1	Low-Pass Filter			Functional	Unset		
> 1.6	Reset Behaviour			Functional	Analysis - Simulation		
> 1.7	Time constant			Functional	Analysis - Simulation		
> 1.1	Discrete transform			Functional	Inspection		
> 1.2	Input			Functional	Inspection		
> 1.3	Output			Functional	Inspection		
> 1.4	Reset Input			Functional	Inspection		
> 1.5	Reset Value Input			Functional	Inspection		

▼ Properties

Type: Functional
 Index: 1
 Custom ID: #1
 Summary: Low-Pass Filter

Description Rationale

Arial 10 B I U

Keywords:

► Revision information:

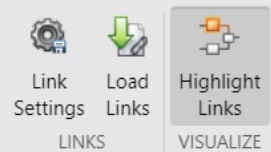
► Custom Attributes

▼ Links

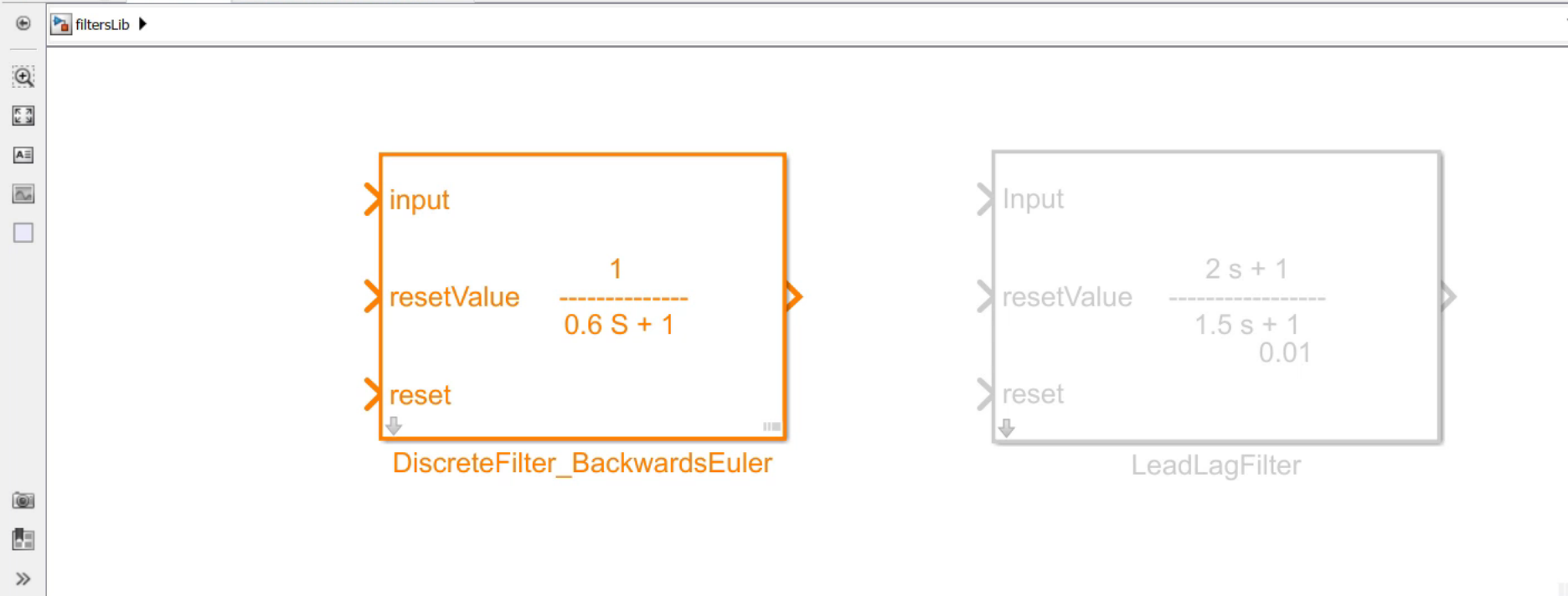
No links

► Comments

Minimising - Links



filtersLib x DiscreteFilter_BackwardsEuler x



Property Inspector

BlockDiagram

Properties Info Execution

Last saved by: fmacmill

Last saved on: Sun Sep 22 21:53:26 2019

► Description

► Model information

▼ Links

No links

Select a model element to set or view its parameters or properties.

Requirements - filtersLib

View: Requirements



Search

Index	ID	Summary
FiltersLibRequirements		
1	#1	Low-Pass Filter
1.1	#2	Discrete transform
1.2	#7	Input
1.3	#9	Output

Ready

200%

Minimising

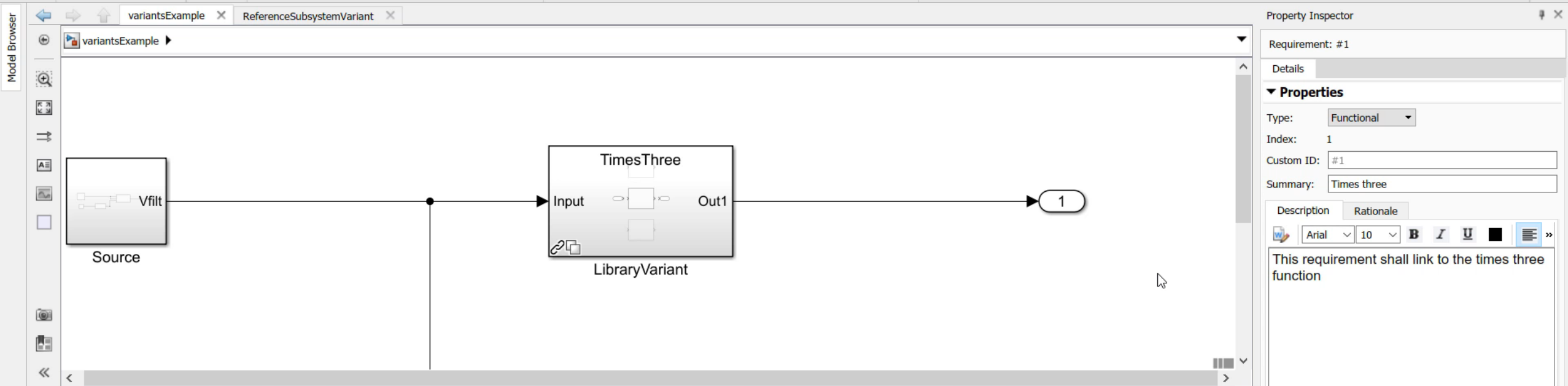
Using re-usable components can help

- minimise requirements
- minimise requirement links

Simulation environment tabs: SIMULATION, DEBUG, MODELING, FORMAT, APPS, REQUIREMENTS, REQUIREMENTS VIEWER, MULTIPLE.

Toolbars: Project, FILE, LIBRARY, PREPARE, SIMULATE, REVIEW RESULTS.

Simulation controls: Stop Time: 10.0, Normal, Step Back, Run, Step Forward, Stop, Data Inspector, Logic Analyzer.



Property Inspector

Requirement: #1

Details

Properties

Type: Functional

Index: 1

Custom ID: #1

Summary: Times three

Description Rationale

Arial 10 B I U

This requirement shall link to the times three function

Keywords:

Revision information:

Links

No links

Comments

Requirements - variantsExample

View: Requirements

Index	ID	Summary
variantExample		
1	#1	Times three

Simplifying Requirements Based Verification with Model-Based Design

Minimising

the less we have to deal with the simpler it is

Insight

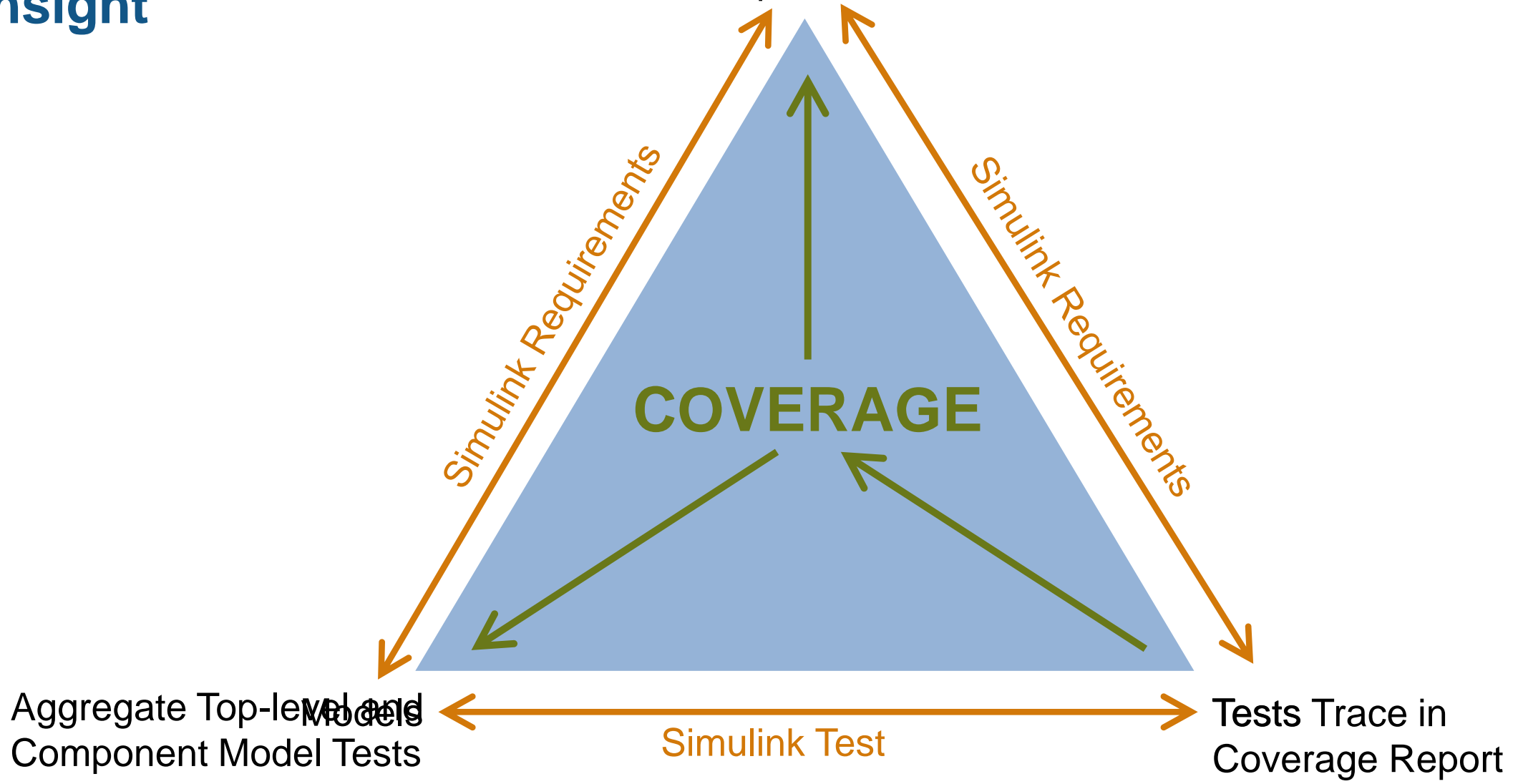
insight leads to understanding and makes our work simpler

Automation

to speed up the process and avoid errors makes our work simpler

Insight

Requirements Trace in Coverage Report



TESTS DATA INSPECTOR FORMAT

+ New 📁 Open 💾 Save ✂ Cut 🗑 Delete 📄 Copy 📄 Paste 📄 Test Spec Report ▶ Run ▶ Run with Stepper ⏹ Stop 🏗 Parallel 📄 Report 📊 Visualize 📄 Highlight in Model 📄 Import 📄 Export ⚙ Preferences ? Help

FILE EDIT RUN RESULTS ENVIRONMENT RESOURCES

Test Browser Results and Artifacts

Filter tests by name or tags, e.g. tags: test

- aggregateTests
 - TopLevelTests
 - Rotor speed dependency
 - Component Tests
 - FreqResponse
 - TimeResponse

PROPERTY	VALUE
Name	aggregateTests
Location	C:\Users\lmacmill\OneDrive - MathWorksID...
Enabled	<input checked="" type="checkbox"/>
Tags	Type comma or space separated tags. You ca

aggregateTests Start Page Rotor speed dependency FreqResponse Visualize TimeResponse

▶ TAGS
 ▶ DESCRIPTION
 ▶ REQUIREMENTS
 ▶ CALLBACKS ?
 ▼ COVERAGE SETTINGS* ?

▼ COVERAGE TO COLLECT

- Record coverage for system under test
- Record coverage for referenced models

Coverage filter filename: [Model Settings] 📁

COVERAGE METRICS

- Decision Condition
- MCDC Lookup Table
- Signal Range Signal Size
- Simulink Design Verifier Saturation on integer overflow
- Relational Boundary

▼ TEST FILE OPTIONS* ?

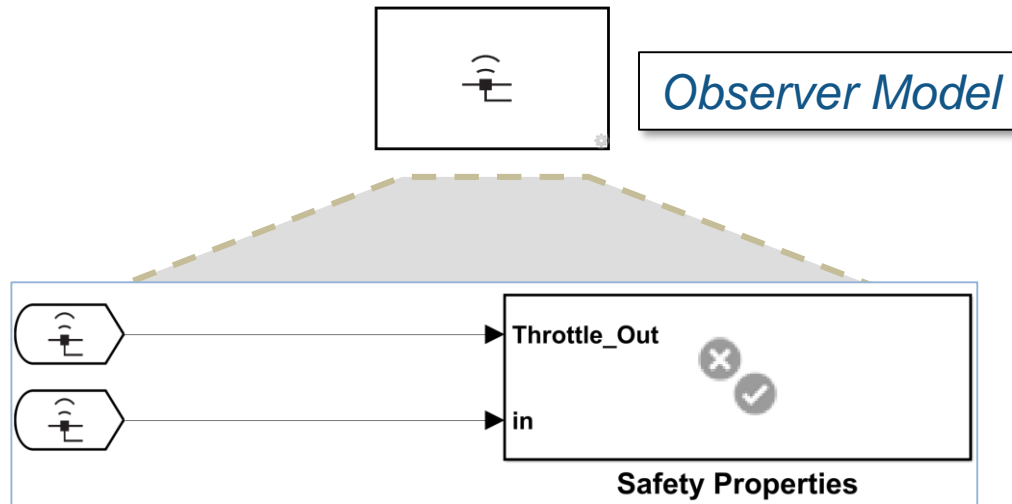
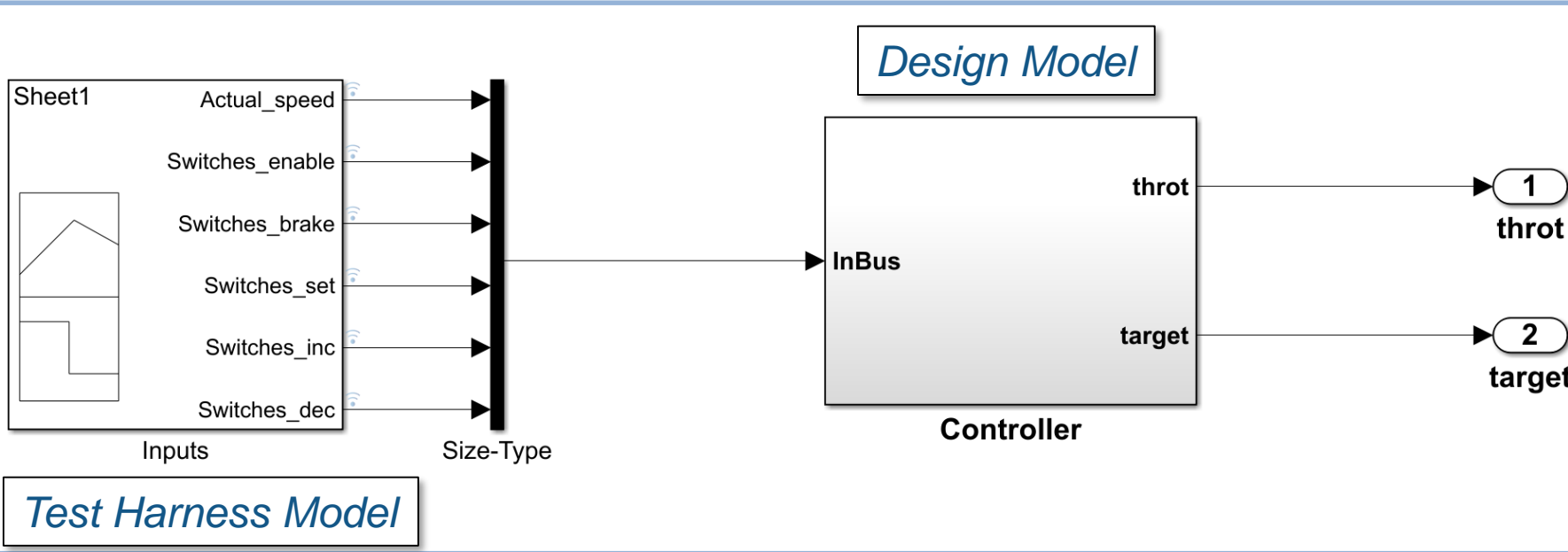
- Close all open figures at the end of execution
- Store MATLAB figures
- Generate report after execution

Insight - Observers

Observers: Separate verification logic from design

R2019a

- Access nested signals
- Without modifying interface



HOME PLOTS APPS PROJECT PROJECT SHORTCUTS

P: PEC R: ReqtWkShop Intro W: WindTurbine Snippets D: DOORS C: Cleanup verify Fraser

New Organize RealTimeTesting PitchActuatorController
Shortcut Groups Wind_Turbine_Requirements WindTurbine Open Requirement Tests C I
MANAGE DOCUMENTATION MODELS REQUIREMENTS TESTING REFERENCES

testHarness_WindTurbineDemonstrate SimulinkTools
genericProjectTools

C:\Users\fmacmill\OneDrive - MathWorks\Demos\General\WindTurbine\Testing

Current Folder Project - WindTurbine

Views: Files, Dependency Analysis, References

Labels: AssignedTo (String), Classification, Export (String), ModelComponent (String), Release (String, Single Valued), Verification (String, Single Valued)

Script: createUnitC, exportTestR, iterations_B, parseStruct, performanc, performanc, plotTimeRe, runAndExp, strictCovera

MAT-file: baseline_Sig, baseline_Sig, baseline_St, baselineR2C, BaselineVar, filtersLib_ha, input_Chirp, filtersLib_harnessStepAn

Git: Current branch: master, Branch status: Normal, Ahead of /origin/master

Name	Git	Status	Verificati...	Export	Release	Model...	Classification	Assigned...
simple_mod								
simple_mod								
simple_mod								
simple_mod								
simple_mod								
startupProje								

Workspace: Project - WindTurbine

Translate textual requirements into unambiguous Assessments

- Compose assessments using form based editor
- View assessments as English-like sentence
- Review and debug temporal assessment results
- Link to requirements

Temporal Assessment Editor

View and Debug Assessment Results



View: Requirements

Search

Index	Summary	Implemented	Verified	Type	ParameterValue	ParameterUnits	Keywords	Verification	SID
> WindTurbineSystemRe...		<input type="checkbox"/>	<input type="checkbox"/>						
> WindTurbineController...		<input type="checkbox"/>	<input type="checkbox"/>						
> Import1	References to WindTurbineControllerReq...	<input type="checkbox"/>	<input type="checkbox"/>	Container					1
> 1	Front Matter	<input type="checkbox"/>	<input type="checkbox"/>	Heading			No		2
> 1.1	WindTurbine Controller Functional Requi...	<input type="checkbox"/>	<input type="checkbox"/>	Functional			No		3
> 2	Controllers	<input type="checkbox"/>	<input type="checkbox"/>	Heading			No		4
> 2.1	Signal Conditioning	<input type="checkbox"/>	<input type="checkbox"/>	Heading			No		5
> 2.1.1	Wind speed filtering attenuation shall be...	<input type="checkbox"/>	<input type="checkbox"/>	Functional			No		6
> 2.1.2	Wind speed filtering attenuation shall be...	<input type="checkbox"/>	<input type="checkbox"/>	Functional			No		7
> 2.1.3	Wind direction filtering attenuation shall ...	<input type="checkbox"/>	<input type="checkbox"/>	Functional			No		8
> 2.1.4	Wind direction filtering attenuation shall ...	<input type="checkbox"/>	<input type="checkbox"/>	Functional			No		9
> 2.2	Supervisory Control	<input type="checkbox"/>	<input type="checkbox"/>	Heading			No		10
> 2.2.1	Normal Operation	<input type="checkbox"/>	<input type="checkbox"/>	Functional			No		11
> 2.2.2	In normal "auto" operation the turbine s...	<input type="checkbox"/>	<input type="checkbox"/>	Functional			No		242
> 2.2.3	The turbine shall enter the Standby mod...	<input type="checkbox"/>	<input type="checkbox"/>	Functional			No		243
> 2.2.4	The turbine shall enter Brake mode if A...	<input type="checkbox"/>	<input type="checkbox"/>	Functional			No		12
> 2.2.5	The turbine shall enter the Generating ...	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Functional			No		13
> 2.2.6	Abnormal Conditions	<input type="checkbox"/>	<input type="checkbox"/>	Functional			No		14
> 2.2.7	The turbine shall stop if wind speed exc...	<input type="checkbox"/>	<input type="checkbox"/>	Functional			SafetyRelated		15
> 2.3	Pitch Control System	<input type="checkbox"/>	<input type="checkbox"/>	Container			No		16
> 2.3.1	when in power generation mode the rot...	<input type="checkbox"/>	<input type="checkbox"/>	Functional			No	by system level simulation	17
> 2.3.2	Under inertial load only (zero aerodyna...	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Functional			No	by sub-system simulation	18
> 2.3.3	Under inertial load only (zero aerodyna...	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Functional			No	by sub-system simulation	19
> 2.3.4	Open-loop gain margin shall be greater t...	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Functional			No	by sub-system simulation	166
> 2.3.5	Open-loop phase margin shall be greate...	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Functional			No	by sub-system simulation	167
> 2.4	Yaw Control System	<input type="checkbox"/>	<input type="checkbox"/>	Heading			No		20
> 2.4.1	The yaw rate magnitude shall be less th...	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Functional			No	by system simulation	21
> 2.4.2	The commanded yaw torque per actuat...	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Functional			No	by system simulation	55
> 3	User Interface	<input type="checkbox"/>	<input type="checkbox"/>	Heading			No		22
> 3.1	Operator inputs to system	<input type="checkbox"/>	<input type="checkbox"/>	Functional			No		23
> 3.2	The operator panel shall provide a switc...	<input type="checkbox"/>	<input type="checkbox"/>	Functional			No		24
> 3.3	Information displayed to operator	<input type="checkbox"/>	<input type="checkbox"/>	Functional			No		25
> 2	Justifications	<input type="checkbox"/>	<input type="checkbox"/>						26
> WindTurbineController...		<input type="checkbox"/>	<input type="checkbox"/>						
> FiltersLibRequirements		<input type="checkbox"/>	<input type="checkbox"/>						

▼ Properties

Type: Functional
 Index: 2.2.5
 Custom ID: SRD-CONTROL-84
 Summary: The turbine shall enter the Generating mode [GeneratorTrip FALSE] ...

Description Rationale

The turbine shall enter the Generating mode [GeneratorTrip FALSE] if the generator speed is greater than 1200 rpm and less than 2200 rpm

Keywords: No

▶ Revision information: Show in document Unlock

▶ Custom Attributes

▼ Links

- Implemented by:
 - [\[GeneratorSpeed>... GeneratorSpeedCutIn\]](#)
 - [\[WindSpeed<... WindSpeedCutInLower... ||WindSpeed>... WindSpeedCutOut... ||GeneratorSpeed>...\]](#)
- Verified by:
 - [GeneratingMode ?](#)

< >

▼ Comments

Add Comment

No comments

Insight - What if verification is by analysis, not simulation?

PROJECT SHORTCUTS

MANAGE: New Shortcut, Organize Groups

DOCUMENTATION: RealTimeTesting, Wind_Turbine_Requirements

MODELS: PitchActuatorController, System Architecture, WindTurbineControlSystem, WindTurbine

REQUIREMENTS: Open Project Requirements, Verify Requirement Parameters

TESTING: C I, Control System Unit Level Requirement Based Tests, Open Requirement Tests

REFERENCES: Pitch Control System, testHarness_WindTurbineDemonstrate

Views

- Files
- Dependency Analysis
- References

Labels

- AssignedTo (String)
- Classification
- Export (String)
- ModelComponent (String)

Git

Current branch: master
Branch status: Normal
Ahead of /origin/master

All | Project (316) | **Modified (0)**

Name	Git	Status	Verification	Export	Release	ModelComponent	Classification	AssignedTo

Details

Simplifying Requirements Based Verification with Model-Based Design

Minimising

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Simplification – Automation

Examples:

- *Checking parameter values against requirements*
- *Continuous Integration*

« Documentation Home

« Functions

Category

Simulink Report Generator

Simulink Requirements

Requirements Definition 14

Requirements Traceability 8

Requirements-based Testing 1

Requirements Comparison and
Change Tracking 3Requirements Management
Interface 16

Simulink Test

Stateflow

Statistics and Machine Learning
Toolbox

System Composer

System Identification Toolbox

Text Analytics Toolbox

Simulink Requirements — Functions

Requirements Definition

slreq.ReqSet	Work with Requirements sets
slreq.Reference	Work with external requirement proxy objects
slreq.Requirement	Work with Requirement objects
slreq.clear	Clear requirements and links from memory
slreq.convertAnnotation	Convert annotations to requirement objects
slreq.editor	Open Requirements Editor
slreq.find	Find requirement, reference, and link set artifacts
slreq.import	Import requirements from external documents
slreq.load	Load requirements/link set
slreq.new	Create requirements set
slreq.open	Open requirements set
slreq.resetViewSettings	Reset saved view settings
slreq.importViewSettings	Import view settings
slreq.exportViewSettings	Export view settings

Requirements Traceability

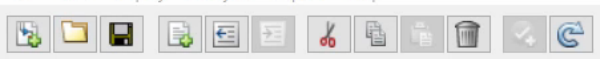
slreq.LinkSet	Work with link sets
slreq.Link	Work with link objects
slreq.clear	Clear requirements and links from memory
slreq.createLink	Create traceable links
slreq.find	Find requirement, reference, and link set artifacts
slreq.load	Load requirements/link set
slreq.cmConfigureVersion	Set version of linked requirements documents
slreq.cmGetVersion	Get configured version of linked requirements documents

Simplification – Automation

Programmatic Interface:

- *Find and interrogate requirements and links*
- *Use to create custom artefacts or utilities*

Example...



View: Requirements

Search

Index	Summary	Implemented	Verified	Type	ParameterValue	ParameterUnits	Keywords	Verification	SID
WindTurbineSystemRequirements		<input type="checkbox"/>	<input type="checkbox"/>						
1	General Information	<input type="checkbox"/>	<input type="checkbox"/>	Container					1
2	Operating Conditions	<input type="checkbox"/>	<input type="checkbox"/>	Container					7
2.1	Cut-in wind speed	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Functional	3.0	m/s	Parameter		23
2.2	Rated wind speed	<input type="checkbox"/>	<input type="checkbox"/>	Functional	12.5	m/s	Parameter		24
2.3	Cut-out wind speed	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Functional	25	m/s	Parameter		25
2.4	Maximum design speed	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Functional	59.5	m/s	Parameter		26
3	Mechanical Design	<input type="checkbox"/>	<input type="checkbox"/>	Container					3
4	Electrical Systems	<input type="checkbox"/>	<input type="checkbox"/>	Container					8
5	ControlSystems	<input type="checkbox"/>	<input type="checkbox"/>	Container					4
6	Monitors	<input type="checkbox"/>	<input type="checkbox"/>	Container	40.0		Parameter		5
WindTurbineControllerRequirements		<input type="checkbox"/>	<input type="checkbox"/>						
Import1	References to WindTurbineControllerReq...	<input type="checkbox"/>	<input type="checkbox"/>	Container					1
1	Front Matter	<input type="checkbox"/>	<input type="checkbox"/>	Heading			No		2
1.1	WindTurbine Controller Functional Requi...	<input type="checkbox"/>	<input type="checkbox"/>	Functional			No		3
2	Controllers	<input type="checkbox"/>	<input type="checkbox"/>	Heading			No		4
2.1	Signal Conditioning	<input type="checkbox"/>	<input type="checkbox"/>	Heading			No		5
2.1.1	Wind speed filtering attenuation shall be...	<input type="checkbox"/>	<input type="checkbox"/>	Functional			No		6
2.1.2	Wind speed filtering attenuation shall be...	<input type="checkbox"/>	<input type="checkbox"/>	Functional			No		7
2.1.3	Wind direction filtering attenuation shall ...	<input type="checkbox"/>	<input type="checkbox"/>	Functional			No		8
2.1.4	Wind direction filtering attenuation shall ...	<input type="checkbox"/>	<input type="checkbox"/>	Functional			No		9
2.2	Supervisory Control	<input type="checkbox"/>	<input type="checkbox"/>	Heading			No		10
2.2.1	Normal Operation	<input type="checkbox"/>	<input type="checkbox"/>	Functional			No		11
2.2.2	In normal "auto" operation the turbine s...	<input type="checkbox"/>	<input type="checkbox"/>	Functional			No		242
2.2.3	The turbine shall enter the Standby mod...	<input type="checkbox"/>	<input type="checkbox"/>	Functional			No		243
2.2.4	The turbine shall enter Brake mode if A...	<input type="checkbox"/>	<input type="checkbox"/>	Functional			No		12
2.2.5	The turbine shall enter the Generating ...	<input type="checkbox"/>	<input type="checkbox"/>	Functional			No		13
2.2.6	Abnormal Conditions	<input type="checkbox"/>	<input type="checkbox"/>	Functional			No		14
2.2.7	The turbine shall stop if wind speed exc...	<input type="checkbox"/>	<input type="checkbox"/>	Functional			SafetyRelated		15
2.3	Pitch Control System	<input type="checkbox"/>	<input type="checkbox"/>	Heading			No		16
2.3.1	when in power generation mode the rot...	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Functional			No	by system level simulation	17
2.3.2	Under inertial load only (zero aerodyna...	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Functional			No	by sub-system simulation	18
2.3.3	Under inertial load only (zero aerodyna...	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Functional			No	by sub-system simulation	19
2.3.4	Open-loop gain margin shall be greater t...	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Functional			No	by sub-system simulation	166
2.3.5	Open-loop phase margin shall be greate...	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Functional			No	by sub-system simulation	167
2.4	Yaw Control System	<input type="checkbox"/>	<input type="checkbox"/>	Heading			No		20
2.4.1	The yaw rate magnitude shall be less th...	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Functional			No	by system simulation	21
2.4.2	The commanded yaw torque per actuat...	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Functional			No	by system simulation	55
3	User Interface	<input type="checkbox"/>	<input type="checkbox"/>	Heading			No		22
3.1	Operator inputs to system	<input type="checkbox"/>	<input type="checkbox"/>	Functional			No		23
3.2	The operator panel shall provide a switc...	<input type="checkbox"/>	<input type="checkbox"/>	Functional			No		24
3.3	Information displayed to operator	<input type="checkbox"/>	<input type="checkbox"/>	Functional			No		25

Properties

Type: Functional

Index: 2.1

Custom ID: #23

Summary: Cut-in wind speed

Description: The rotor cut-in wind speed shall be [windSpeedCutIn]

Keywords: Parameter

Revision information:

- SID: 23
- Revision: 31
- Created by: fmacmill
- Created on: 14-Aug-2019 10:53:06
- Modified by: fmacmill
- Modified on: 11-Sep-2019 10:42:51

Custom Attributes:

ParameterUnits: m/s

ParameterValue: 3.0

Links:

Implemented by:

- [WindSpeed>... WindSpeedCutInLower... &&WindSpeed<... WindSpeedCutOut]
- Design.WindSpeedCutInLower

Related to:

- SRD-CONTROL-32 The turbine shall enter Brake mode if ANY of the following condi...

Simplification – Automation - Continuous Integration (CI)

Continuous Integration (CI) originated as a software development process in which developers integrate their code into a shared repository on a regular basis.

Each commit into a repository is verified by an automated build and test.

These tests may be a pre-cursor to pushing the changes to a main branch

Continuous Integration can be applied to Mode-Based Design workflows

Simplification – Automation – Continuous Integration (CI)

How quickly can one set up a continuous integration project to run Simulink Tests against requirements?

How many lines of MATLAB code are required?

- New Item
- People
- Build History
- Edit View
- Delete View
- Manage Jenkins
- Credentials
- New View

S	W	Name ↓	Last Success	Last Failure	Last Duration
		Bloodhound	1 yr 6 mo - #28	N/A	1 min 48 sec
		ETC	3 mo 24 days - #43	N/A	1 min 11 sec
		WindTurbine	20 hr - #93	N/A	1 min 38 sec
		WindTurbineCustom	18 hr - #12	N/A	2 min 14 sec

Icon: [S](#) [M](#) [L](#)

[Legend](#) [RSS for all](#) [RSS for failures](#) [RSS for just latest builds](#)

Build Queue

No builds in the queue.

Build Executor Status

1 Idle
2 Idle

Simplification – Automation - Continuous Integration (CI)

How quickly can one set up a continuous integration project to run Simulink Tests against requirements?

< 5 minutes!

How many lines of MATLAB code are required?

- None!

General Source Code Management Build Triggers **Build Environment** Build Post-build Actions

- Use secret text(s) or file(s) ?
- Abort the build if it's stuck
- Add timestamps to the Console Output
- With Ant ?

Build

Run MATLAB Tests [X]

MATLAB root:

Test mode: ?

Generate Test Artifacts

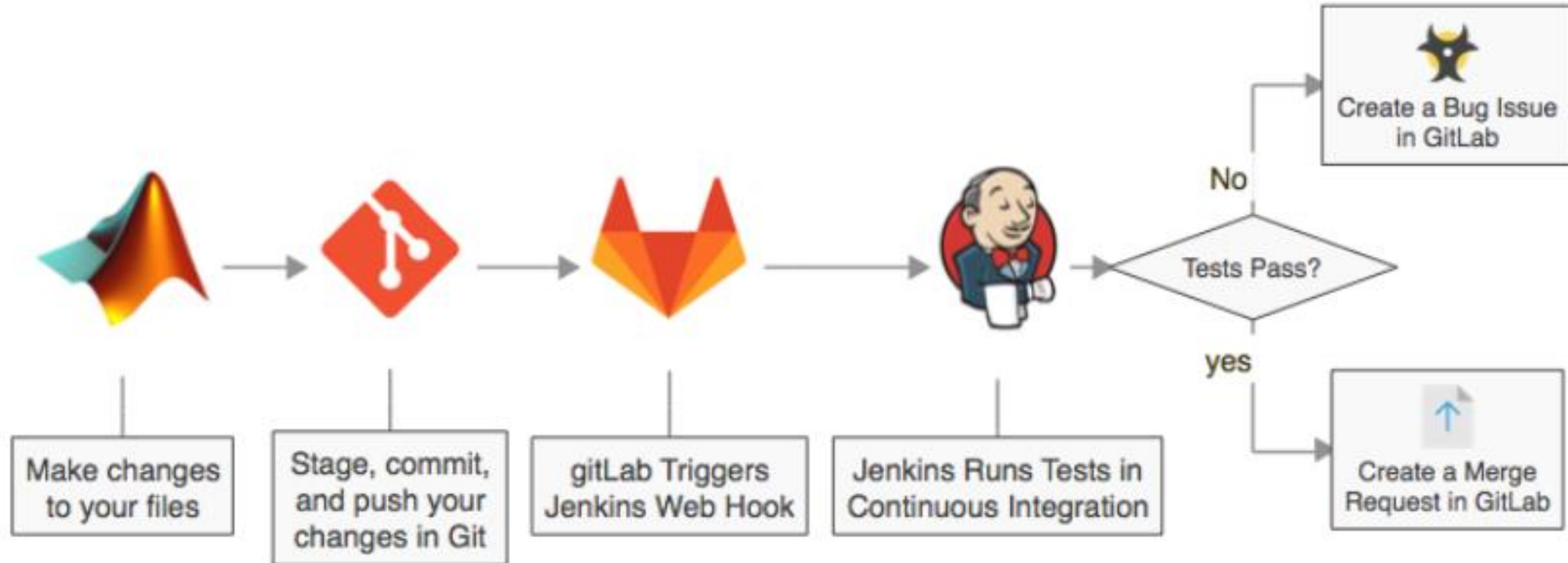
- TAP test results ?
- JUnit-style test results ?
- Cobertura code coverage ?

Add build step ▾

Post-build Actions

[X] ?

Simplification – Automation - Continuous Integration (CI)



<https://blogs.mathworks.com/developer/2018/08/23/gitlab-jenkins-workflow/>

Simplifying Requirements Based Verification with Model-Based Design

Best practices can minimise the work required

Model-Based verification tools continue to develop to provide insight

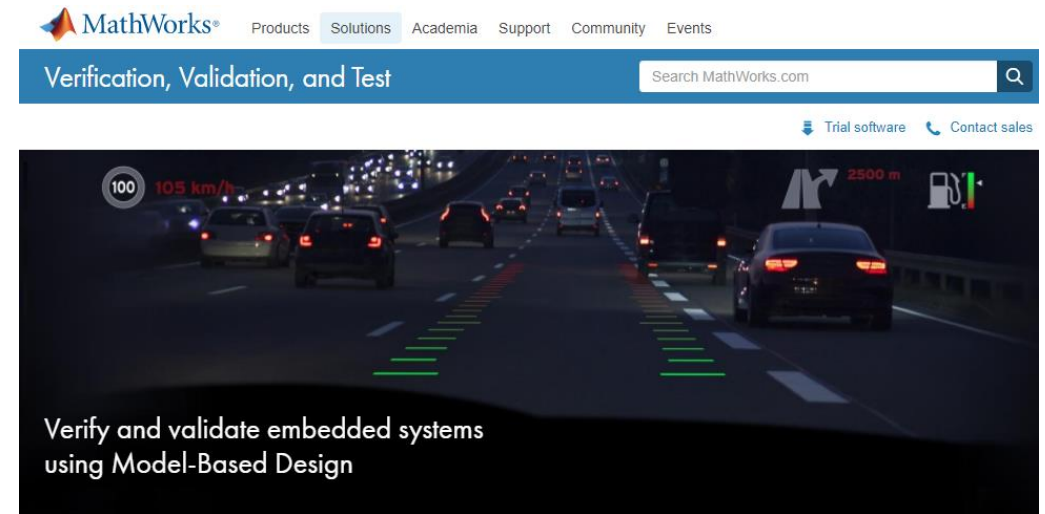
- more tool integration*
- more ways of accessing information you need intuitively & unobtrusively*
- more control over granularity*

Automation can be quick to set up, and offers significant benefits

Learn More

Key products covered in this presentation:

- [Simulink Requirements](#)
- [Simulink Test](#)
- [Simulink Coverage](#)
- [System Composer](#)



Learn more at Verification, Validation and Test Solution Page:

mathworks.com/solutions/verification-validation.html

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MATLAB EXPO 2019