

MathWorks
**AUTOMOTIVE
CONFERENCE 2024**
Europe

How to Simulate and Test Heterogeneous AUTOSAR Software Compositions in Simulink

Martin Römpert, Continental Automotive



(he/him)



Agenda

- Continental Automotive Technologies GmbH
- Motivation
- Solution
 - Hand-written AUTOSAR SwComponent Simulation and Unit Testing
 - Heterogeneous AUTOSAR SwComposition Simulation and Integration Testing
- Process Advisor
- Conclusions and Outlook

Continental Automotive Technologies GmbH



Safety and Motion



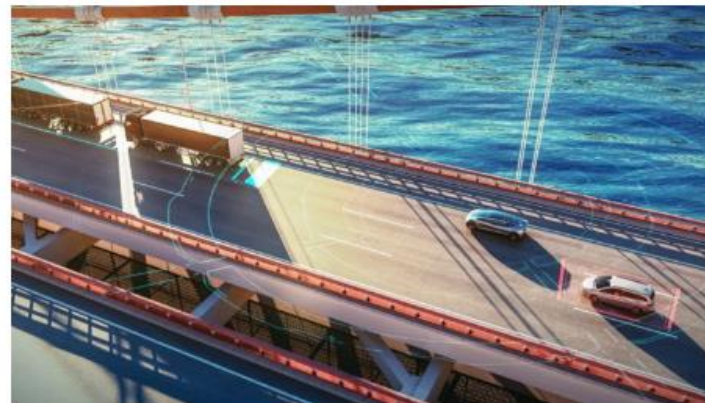
Architecture & Networking



User Experience



Smart Mobility



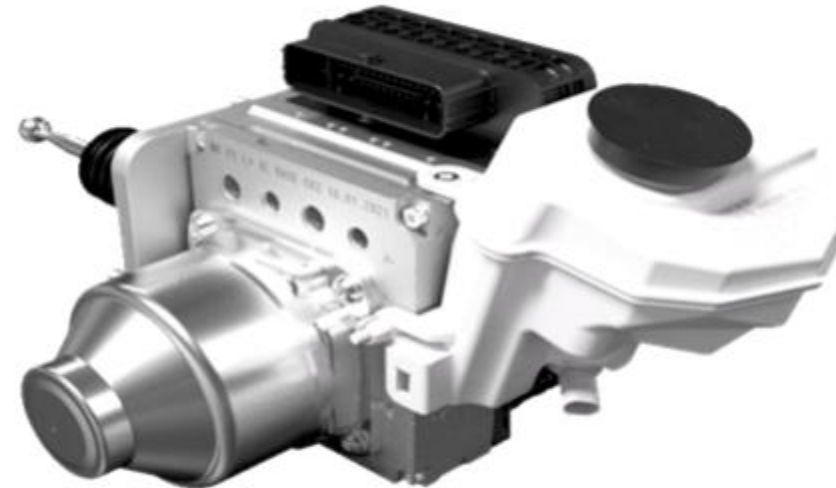
Autonomous Mobility

Continental Automotive Technologies GmbH

Safety and Motion

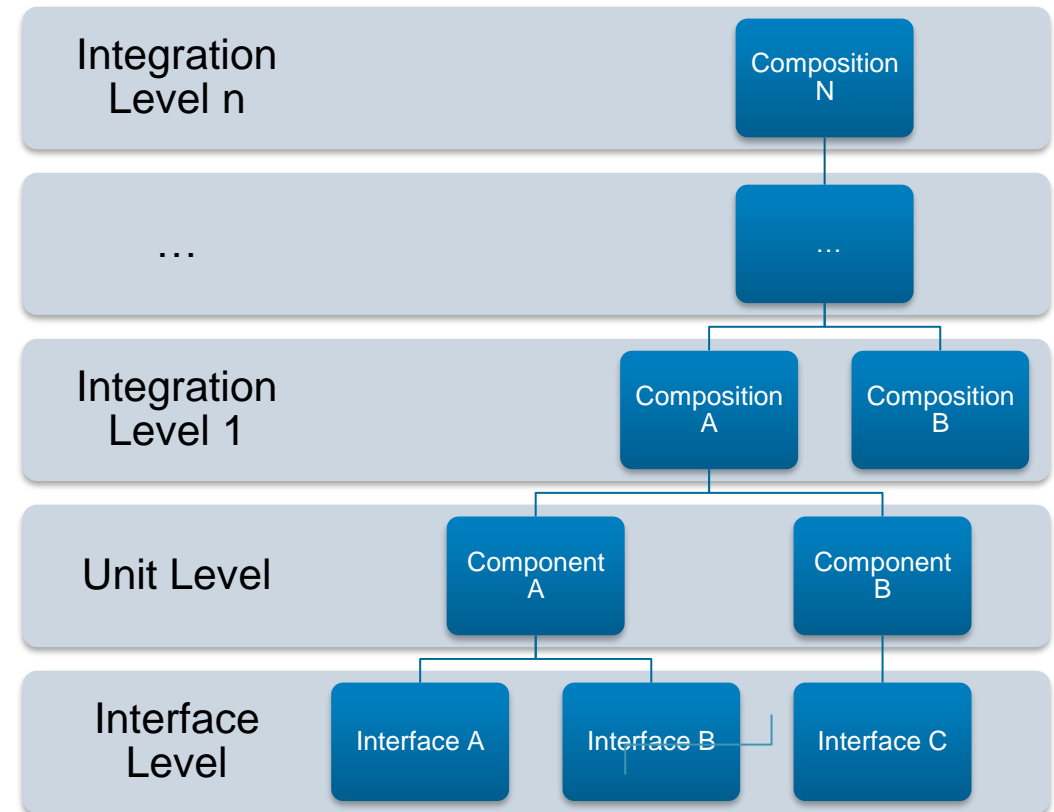
- Dynamics & Comfort
 - Electronic Air Suspension
 - Scalable Chassis Control Unit
- Passive and Integrated Safety
 - Airbag Control Units
- Brakes
 - Parking Brakes
 - Hydraulic
 - Electronic Brake Systems

MK 120
Hybrid



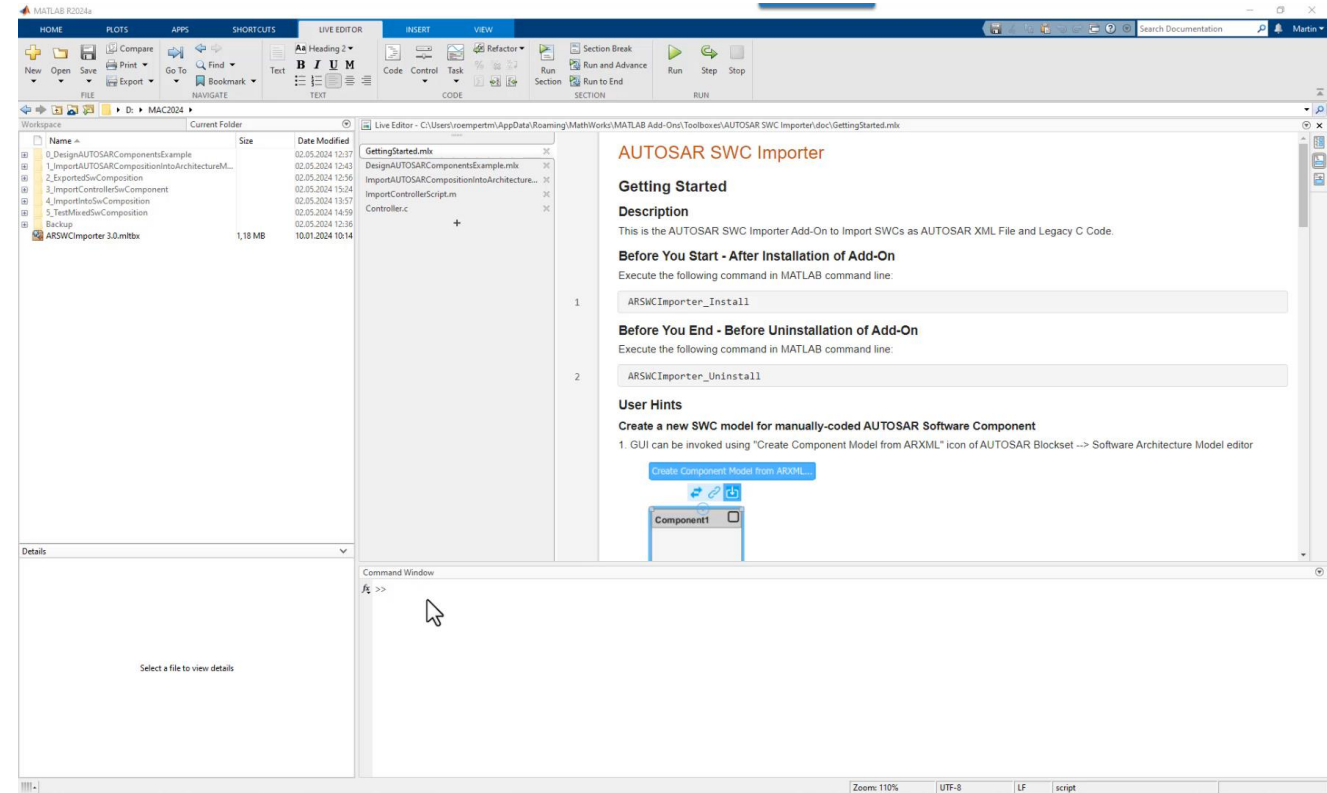
Motivation

- Modular Software
- 1000 ASW SwComponents
 - Model based design
 - Hand-written
- Challenges
 - Lack of resources to convert from hand-written code to model based design
- Goals
 - Use similar workflow for all SwComponents
 - Simulate and test hand-written SwComponents
 - Simulate and test heterogeneous SwCompositions
 - Common Toolchain for heterogeneous SwCompositions



Solution

- **AUTOSAR**
 - Hand-Written SwComponent
 - Import
 - Simulation
 - Test
 - Update
 - Heterogeneous SwComposition
 - Integration
 - Simulation
 - Test
 - Export

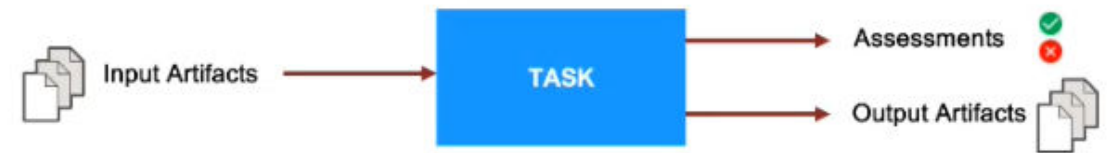


AUTOSAR

Process Advisor (CI / CD Automation for Simulink Check)

- Use Process Advisor for model based and hand-written SwComponents

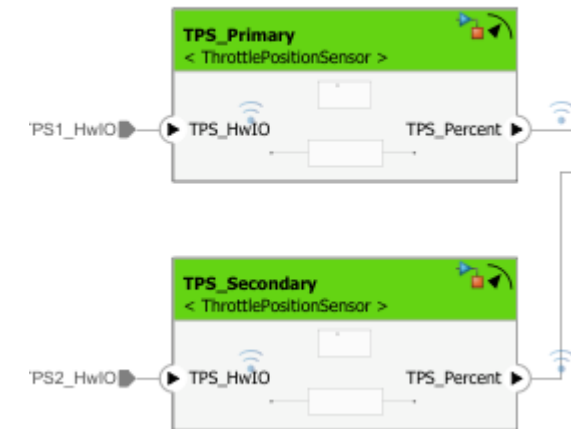
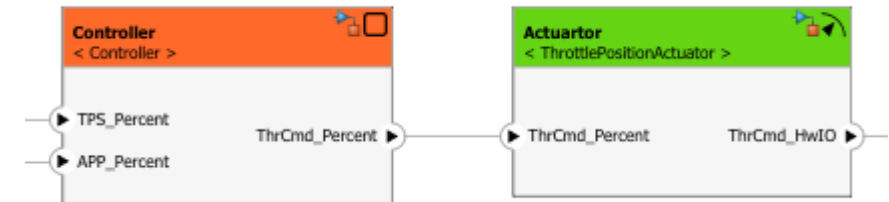
- Design Verifier
 - Test Case generation for full coverage
- (MiL) / SiL / PiL Tests
 - Coverage
 - Memory Profiling
 - Runtime Profiling
- Polyspace Bug Finder
- Polyspace Code Prover
- Conan2 Package Manager
 - Import
 - Creation
 - Upload



▼	✓ Run Tests - SiL		✓ 1
	▶ ✓ ComponentA		✓ 1
▼	✓ Run Tests - PiL		✓ 1
	▶ ✓ ComponentA		✓ 1
▼	✓ Analyze Top Model (Server)		✓ 1
	✓ ComponentA		✓ 1
▼	✓ Prove Top Model (Server)		✓ 1
	✓ ComponentA		✓ 1
▼	✓ Generate Conan Package for Code (Top)		✓ 1
	✓ ComponentA		✓ 1

Conclusions

- Simulate and Test Heterogeneous AUTOSAR Software Compositions
 - Interfaces
 - Client Server
 - Sender-Receiver
 - IRV
 - PIM / Shared Parameter
 - Multiple instances of SwComponents
 - Unit and integration test
 - Debug with Microsoft Visual Studio Code
 - System Composer as cosimulation environment
 - Simplified Process Advisor workflow
- Shift Left!



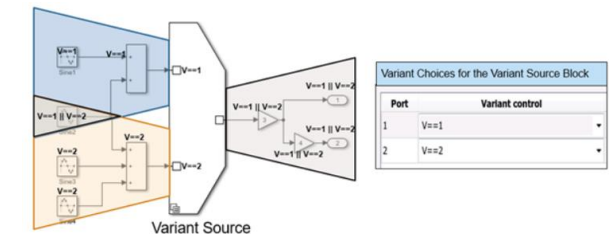
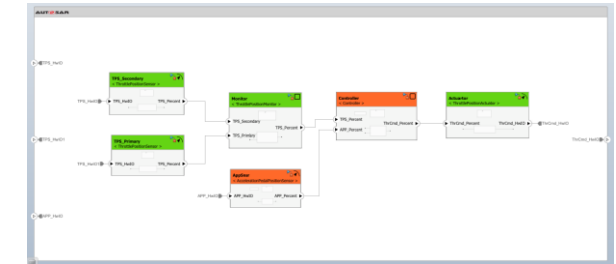
Outlook



Future Topics

- Import of heterogeneous SwCompositions
 - Including the source code of hand-written SwComponents
- AUTOSAR Variant Management
- Workflow alignment between MbD and hand-written SwComponents / SwCompositions
 - CI / CD
 - Data management
 - Artifacts management
 - Package management (Conan2)
 - Reports / Report Data Management

- Continue the successful Continental / MathWorks strategic partnership



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Thank you



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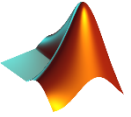


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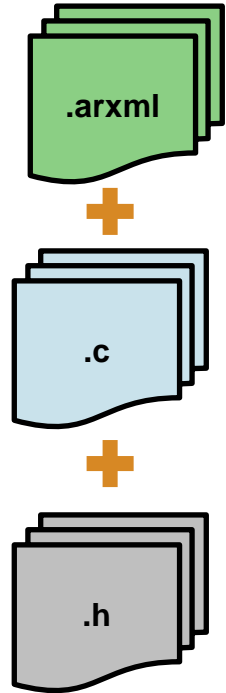
Backup



Import Hand-Written SwComponents



AUTOSAR Data Specification Format



Block Parameters: SWC Model

AUTOSAR SWC Model (mask) (link)

Parameters

ARXML file(s): arxml", "SrcFiles_arxml\LoDmc.arxml"

Software component name: /VehFctP/ADrVs/LoDmc/LoDmc

SWC Model name: LoDmc

Data dictionary: LoDmc.sidd

Source file(s): mc_out.c", "SrcFiles_c\lodmc_state.c"

Include directorie(s): SrcFiles_h

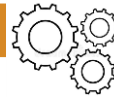
Custom define(s):

Model periodic runnables as: FunctionCallSubsystem

Use bus element ports

Simulation mode: Software-in-the-loop (SIL)

GUI, Wizard



Scripts

AUTOSAR Importer App

Select ARXML > Create Component

What to consider

Select the qualified name of the component and the modeling options for import.

About the selected option

Configure optional advanced modeling options for importing from ARXML.

Select component and modeling style

Component name: /VehFctP/ADrVs/LoDm...

Configure Modeling Options

Data Dictionary: LoDmc.sidd

Model periodic runnables as: FunctionCallSubsystem

Initialization Runnable: <Undefined>

Predefined Variant: <Undefined>

Add Custom Sources

Sources Files(s): "SrcFiles_c\lodmc_arbitration.c" "Srcf"

Include Directorie(s): SrcFiles_h

Custom Define(s): -D_inline__winline

