MODEL EXCHANGE & VIRTUAL INTEGRATION WITH MATLAB/SIMULINK

MATLAB EXPO – MAY 2022

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ABOUT COLLINS AEROSPACE

Collins Aerospace is a leader in technologically advanced, intelligent solutions that help redefine the aerospace and defense industry.

More than 78,000 people in more than 300 locations worldwide.
THE PERSPECTIVE OF AEROSPACE INDUSTRY

“ONCE-IN-A-CENTURY” AIR-VEHICLES CONCEPTS SHAKE-UP …

… WHILE FACING ALL THE TRADITIONAL CHALLENGES!

DIGITAL ENGINEERING IS A MUST TO ENABLE DEVELOPMENT OF NEXT GENERATION AIRCRAFT SYSTEMS
COMPLEX SYSTEMS & COMPLEX INTEGRATION

System complexity growing together with business organizations complexity
- Multi-fidelity
- Multi-domain
- Multi-criticality
- Multi-team / multi-companies
- Geographical Distribution

[Source: International Council on System Engineering (INCOSE) V-model (Walden et al., 2015)]

Early Integration to Enable Smooth Evolution of System Development

 Derived from Systems Engineering Vision 2035 Copyright © 2021 by INCOSE
https://www.incose.org/about-systems-engineering/se-vision-2035

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DIGITAL ENGINEERING TO DEAL WITH INCREASING COMPLEXITY

OEMs MBSE Initiatives

AIRBUS

BOEING


Shifts in Acquisition Towards Collaborative Processes

U.S. Department of Defense & Air Force Digital Campaign

Industry Standards for Interoperability

[Source: AF Digital Campaign Virtual Industry Exchange Day]

Aligned with OEMs, DOD & Engineering Community Strategy & Vision
FUNCTIONAL MOCK-UP INTERFACE STANDARD

MODELISAR Standard to exchange dynamic models and simulators (+10 years)

Contribute to an MBSE supply-chain for an agile and smooth integration of heterogeneous models (inter & intra companies)

Defines an open interface & a standard XML-based model descriptor that models (FMU) shall comply with

FMI is suitable for continuous-time & discrete-time models exchange and integration

MathWorks provides full support for FMI standard:
1) FMI Import to integrate 3rd parties FMUs in MATLAB/Simulink
2) FMI Export to generate an FMU out of a MATLAB/Simulink model leveraging Simulink Compiler
Modelling and Simulation Tools for Systems Integration on Aircraft

Methods & Tools to enhance Aerospace system development and integration reducing testing costs and paving the road to certification by simulation
CLEAN-SKY EUROPEAN USE-CASES

SIMULINK FMI IMPORT/EXPORT TO SUPPORT SYSTEM VALIDATION & VERIFICATION

- First-time-right tests for certification
- Eligibility of virtual tests for certification credits
- Dependability and quality assurance

WORKFLOW FOR SEAMLESS AND STANDARD BASED TOOLS INTEGRATION
CLEAN-SKY EUROPEAN USE-CASES
SIMULINK FMI IMPORT/EXPORT TO SUPPORT SYSTEM CLOSED-LOOP V&V

<table>
<thead>
<tr>
<th>INTEGRATION &amp; Tests</th>
<th>CMM-SW</th>
<th>CMM-HW</th>
<th>PEB</th>
<th>MOTOR &amp; EMA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sil</td>
<td>ControlDesk + Automation Desk</td>
<td>Host object code</td>
<td>N/A</td>
<td>Simulink model</td>
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<td>VPIl</td>
<td>Simulink</td>
<td>Target Object code</td>
<td>DESYRE model</td>
<td>Simulink model (refined w.r.t. Sil)</td>
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<td>Target Object code</td>
<td>Physical part</td>
<td>dSPACE model &amp; Simulink model</td>
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</tbody>
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CLEAN-SKY EUROPEAN USE-CASES

SIMULINK FMI IMPORT/EXPORT TO SUPPORT SYSTEM CLOSED-LOOP V&V

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FINDINGS & FORWARD LOOKING

CONTINUOUS ENGAGEMENT WITH MATHWORKS TEAM

- FMI Import/Export
- Ability to work with SLXP
- Simulink Design Optimization and Data Dictionaries limitations
- Improve documentation & speed

Adoption

Issues Reporting

Features Needs & Priorities

Fixes & Feature Release

- FMI 3.0 features prioritization
- Simulink Test enhancements for parametric envelop exploration test cases
- Requirements Formalization and Automatic Test Generation
CONCLUSIONS

• Digital Engineering and standard-based Virtual Integration solutions is the answer that the aerospace community is pushing to cope with the increasing complexity of next generation aerospace systems

• Collins Aerospace industrial use-cases have been presented to demonstrate how the support for interoperability standards in MATLAB/Simulink (e.g. FMI import/export) permits to realize efficient virtual integration workflow

• The strong interaction with MathWorks teams permitted to efficiently report and fix issues, and discuss and introduce new capabilities in MATLAB/Simulink to best serve the industry needs
THANK YOU