Co-simulation with Abaqus and Dymola

Abaqus 2018
Course objectives
Upon completion of this course you will be able to:

- Set up an Abaqus model for Abaqus-Dymola co-simulation
- Create a simple control system in Dymola
- Run a co-simulation

Targeted audience
Simulation Analysts

Prerequisites
None
Day 1

- Lecture 1: Abaqus-Dymola co-simulation
  - Workshop 1: Machining tool cooling system
- Lecture 2: Introduction to Dymola
  - Workshop 2: Dymola control system
- Lecture 3: Co-simulation features in Abaqus and execution
  - Workshop 3: Abaqus model for co-simulation
- Lecture 4: Interpretation of results
  - Workshop 4: Running jobs and interpreting results
SIMULIA is the Dassault Systèmes brand for Realistic Simulation solutions

- Portfolio of established, best-in-class products
  - Abaqus, Isight, Tosca, fe-safe, Simpack

- Design Optimization, Tosca Structure *
  - Simulation-driven design refinement to improve performance

- Durability Assessment, fe-safe *
  - Accurate life estimation to achieve certification

- FEA Stress Analysis, Abaqus *
  - Detailed stress analysis using extracted load history from MBS

- CAD Geometry, CATIA
  - Fully parameterized 3D geometry; FEA model generation via associative interface

- Multibody Simulation, Simpack
  - System analysis to extract virtual load history of complete working cycle

- Mesh Calibration, Isight *
  - Automated mesh calibration, sufficient mesh quality for accurate results

* Included in extended licensing pool
SIMULIA’s Power of the Portfolio

**Abaqus**
- Routine and Advanced Simulation
- Linear and Nonlinear, Static and Dynamic
- Thermal, Electrical, Acoustics
- Extended Physics through Co-simulation
- Model Preparation and Visualization

**Isight**
- Process Integration
- Design Optimization
- Parametric Optimization
- Six Sigma and Design of Experiments

**Tosca**
- Non-Parametric Optimization
- Structural and Fluid Flow Optimization
- Topology, Sizing, Shape, Bead Optimization

**fe-safe**
- Durability Simulation
- Low Cycle and High Cycle Fatigue
- Weld, High Temperature, Non-metallics

**Simpack**
- 3D Multibody Dynamics Simulation
- Mechanical or Mechatronic Systems
- Detailed Transient Simulation (Offline and Realtime)

**Realistic Human Simulation**
- High Speed Crash & Impact
- Noise & Vibration

**Material Calibration**
- Workflow Automation
- Design Exploration

**Conceptual/Detailed Design**
- Weight, Stiffness, Stress
- Pressure Loss Reduction

**Safety Factors**
- Creep-Fatigue Interaction
- Weld Fatigue

**Complete System Analyses**
- (Quasi-)Static, Dynamics, NVH
- Flex Bodies, Advanced Contact
Join the Community!

How can you maximize the robust technology of the SIMULIA Portfolio?
Connect with peers to share knowledge and get technical insights

Go to www.3ds.com/slc to log in or join!

Let the SIMULIA Learning Community be Your Portal to 21st Century Innovation

Discover new ways to explore how to leverage realistic simulation to drive product innovation. Join the thousands of Abaqus and Isight users who are already gaining valuable knowledge from the SIMULIA Learning Community.

For more information and registration, visit 3ds.com/simulia-learning. Connect. Share. Spark Innovation.

©2013 Dassault Systèmes. All rights reserved.
SIMULIA SERVICES

PROVIDING HIGH QUALITY SIMULATION AND TRAINING SERVICES TO ENABLE OUR CUSTOMERS TO BE MORE PRODUCTIVE AND COMPETITIVE.

Training Schedule & Registration

We offer regularly scheduled public seminars as well as training courses at customer sites. An extensive range of courses are available, ranging from basic introductions to advanced courses that cover specific analysis topics and applications. On-site courses can be customized to focus on topics of particular interest to the customer, based on the customer's prior specification. To view the worldwide course schedule and to register for a course, visit the links below.

North American

➤ By Location
➤ By Course

International

➤ By Location
➤ By Course

Live Online Training

➤ Full Schedule
The software described in this documentation is available only under license from Dassault Systèmes or its subsidiaries and may be used or reproduced only in accordance with the terms of such license.

This documentation and the software described in this documentation are subject to change without prior notice.

Dassault Systèmes and its subsidiaries shall not be responsible for the consequences of any errors or omissions that may appear in this documentation.

No part of this documentation may be reproduced or distributed in any form without prior written permission of Dassault Systèmes or its subsidiaries.

© Dassault Systèmes, 2017

Printed in the United States of America.

Abaqus, the 3DS logo, and SIMULIA are trademarks or registered trademarks of Dassault Systèmes or its subsidiaries in the US and/or other countries.

Other company, product, and service names may be trademarks or service marks of their respective owners. For additional information concerning trademarks, copyrights, and licenses, see the Legal Notices in the SIMULIA User Assistance.
## Revision Status

<table>
<thead>
<tr>
<th>Lecture 1</th>
<th>11/17</th>
<th>Updated for Abaqus 2018 / Dymola 2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture 2</td>
<td>11/17</td>
<td>Updated for Abaqus 2018 / Dymola 2018</td>
</tr>
<tr>
<td>Lecture 3</td>
<td>11/17</td>
<td>Updated for Abaqus 2018 / Dymola 2018</td>
</tr>
<tr>
<td>Lecture 4</td>
<td>11/17</td>
<td>Updated for Abaqus 2018 / Dymola 2018</td>
</tr>
<tr>
<td>Workshop 1</td>
<td>11/17</td>
<td>Updated for Abaqus 2018 / Dymola 2018</td>
</tr>
<tr>
<td>Workshop 2</td>
<td>11/17</td>
<td>Updated for Abaqus 2018 / Dymola 2018</td>
</tr>
<tr>
<td>Workshop 3</td>
<td>11/17</td>
<td>Updated for Abaqus 2018 / Dymola 2018</td>
</tr>
<tr>
<td>Workshop 4</td>
<td>11/17</td>
<td>Updated for Abaqus 2018 / Dymola 2018</td>
</tr>
</tbody>
</table>
Lesson 1: Abaqus-Dymola co-simulation

Lesson content:

- Logical modeling
- Abaqus-Dymola co-simulation
- Illustration – Backhoe digging automation
- Workflow for Abaqus-Dymola co-simulation
- Workshop Preliminaries

30 minutes
In this workshop, you will create a three-dimensional model of a lathe tool, simulate the heat produced by the friction, and control the flux of water cooling down the tool in order to maintain a target temperature at the tip.

Objectives

When you complete this workshop you will be able to:

i. Set up an Abaqus model for Abaqus-Dymola co-simulation.
ii. Create a simple control system in Dymola.
iii. Run a co-simulation.
Lesson content:
- Introduction to Dymola
- GUI Editor
- Modelica Language
- Requirements for Co-simulation
- What is FMI and FMU?
- Example – Cantilever Beam
- Summary
In this workshop, you will create a Dymola model of the control system of a robot with three degrees of freedom.

Objectives

When you complete this workshop you will be able to:

i. Create a Dymola model oriented for co-simulation.
Lesson content:

- Abaqus-Dymola co-simulation model preparation workflow
- Identifying the Abaqus analysis step for co-simulation
- Defining sensors and actuators
- SIMULIA co-simulation engine
- Configuration file
- Example – Cantilever Beam
- Summary
In this workshop, you will modify the robot model in order to prepare it to be controlled by Dymola.

Objectives

When you complete this workshop you will be able to:

i. Set up an Abaqus model for Abaqus-Dymola co-simulation.
Lesson 4: Interpretation of results

Lesson content:

- Running the co-simulation
- Example – Cantilever Beam
- Analyzing the results in Abaqus
- Analyzing the results in Dymola
In this workshop, you will set the parameters for the co-simulation, run the co-simulation jobs and examine the results in both Abaqus and Dymola.

Objectives

When you complete this workshop you will be able to:

i. Set up and run an Abaqus-Dymola co-simulation
ii. Evaluate the results in Abaqus
iii. Evaluate the results in Dymola

30 minutes