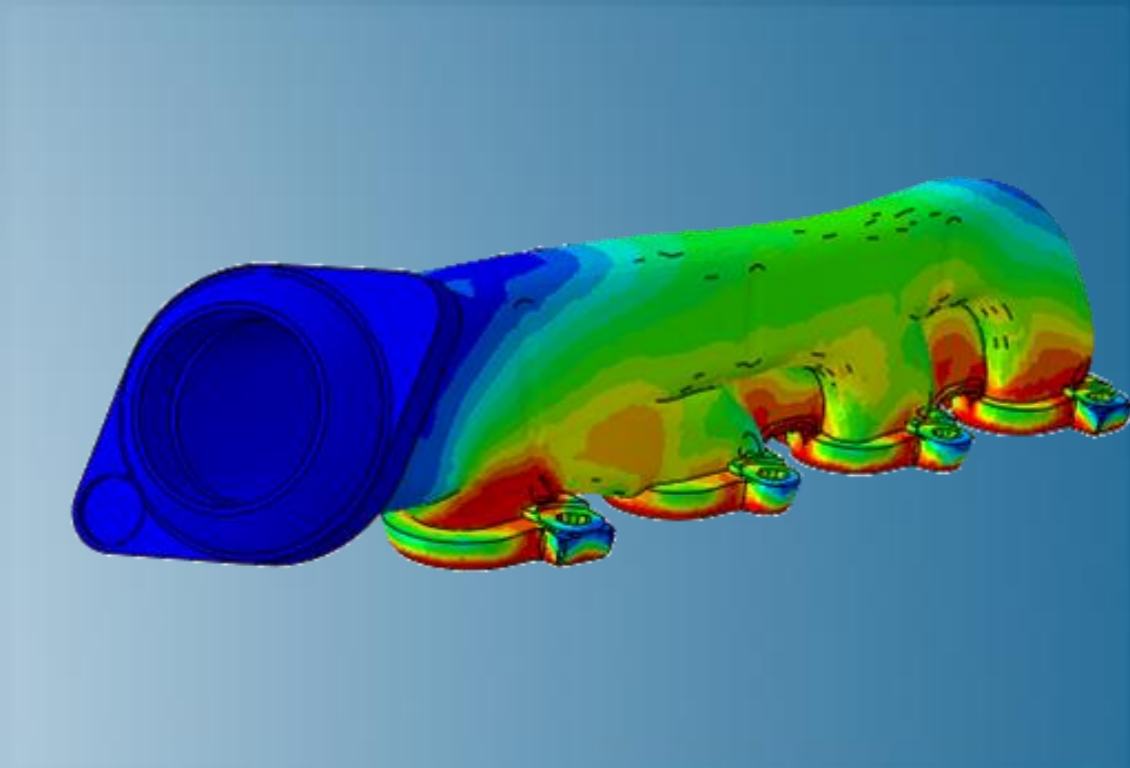


FSI Simulation with Abaqus and Third-party CFD Codes

Abaqus 2019



3DEXPERIENCE[®]



About this Course

Course objectives

Upon completion of this course you will be able to:

- ▶ Evaluate FSI applications
- ▶ Create compatible CSM and CFD models for FSI
- ▶ Run FSI problems
- ▶ Understand co-simulation strategies

Targeted audience

This seminar is recommended for both structural and CFD engineers with an interest in evaluating and analyzing real world FSI applications.

Prerequisites

None



1 day

Day 1

- ▶ Lecture 1 Introduction
- ▶ Lecture 2 Technical Details
- ▶ Lecture 3 Conducting an FSI Simulation using Abaqus and STAR-CCM+
 - Workshop 1 Antilock Braking System (Abaqus + STAR-CCM+)
- ▶ Lecture 4 Classifying FSI Applications
 - Workshop 2 Steady-State Flow in an Exhaust Manifold (Abaqus + STAR-CCM+)
- ▶ Lecture 5 Miscellaneous Topics

Additional Material

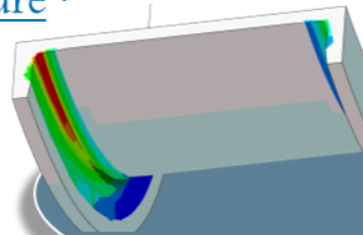
- ▶ Appendix 1 An Overview of CFD for Structural Analysts

SIMULIA

- ▶ SIMULIA is the Dassault Systèmes brand for Realistic Simulation solutions
- ▶ Portfolio of established, best-in-class products
 - Abaqus, Isight, Tosca, fe-safe, Simpack

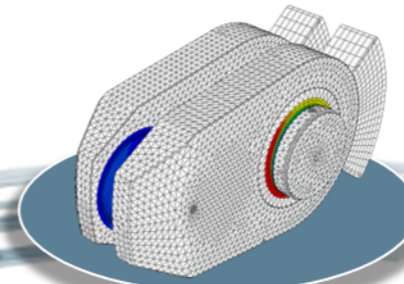
Design Optimization: Tosca Structure *

Simulation-driven design refinement to improve performance



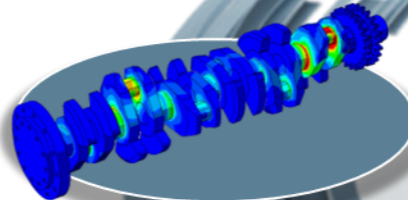
Durability Assessment: fe-safe *

Accurate life estimation to achieve certification



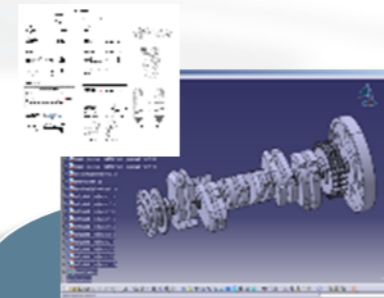
FEA Stress Analysis: Abaqus *

Detailed stress analysis using extracted load history from MBS



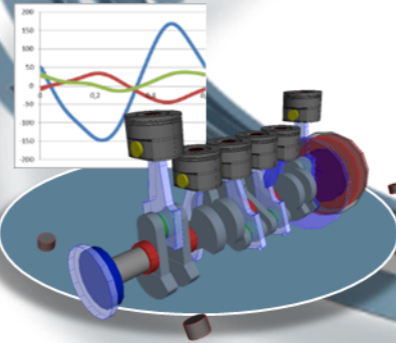
CAD Geometry: CATIA

Fully parameterized 3D geometry; FEA model generation via associative interface



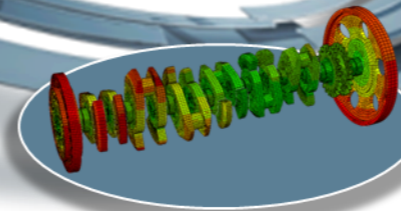
Multibody Simulation: Simpack

System analysis to extract virtual load history of complete working cycle



Mesh Calibration: Isight *

Automated mesh calibration; sufficient mesh quality for accurate results

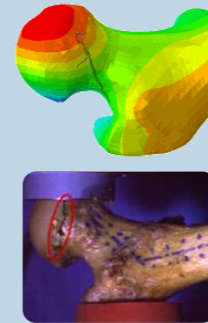


* Included in extended licensing pool

SIMULIA's Power of the Portfolio

Abaqus

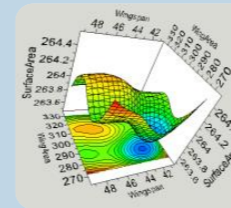
- Routine and Advanced Simulation
- Linear and Nonlinear, Static and Dynamic
- Thermal, Electrical, Acoustics
- Extended Physics through Co-simulation
- Model Preparation and Visualization



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

Isight

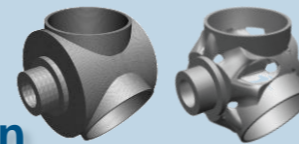
- Process Integration
- Design Optimization
- Parametric Optimization
- Six Sigma and Design of Experiments



**Material Calibration
Workflow Automation
Design Exploration**

Tosca

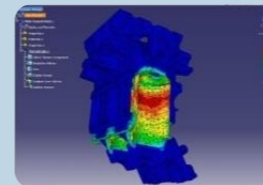
- Non-Parametric Optimization
- Structural and Fluid Flow Optimization
- Topology, Sizing, Shape, Bead Optimization



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

fe-safe

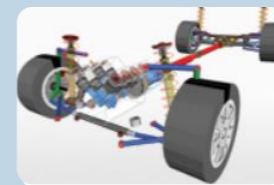
- Durability Simulation
- Low Cycle and High Cycle Fatigue
- Weld, High Temperature, Non-metallics



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

Simpack

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



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

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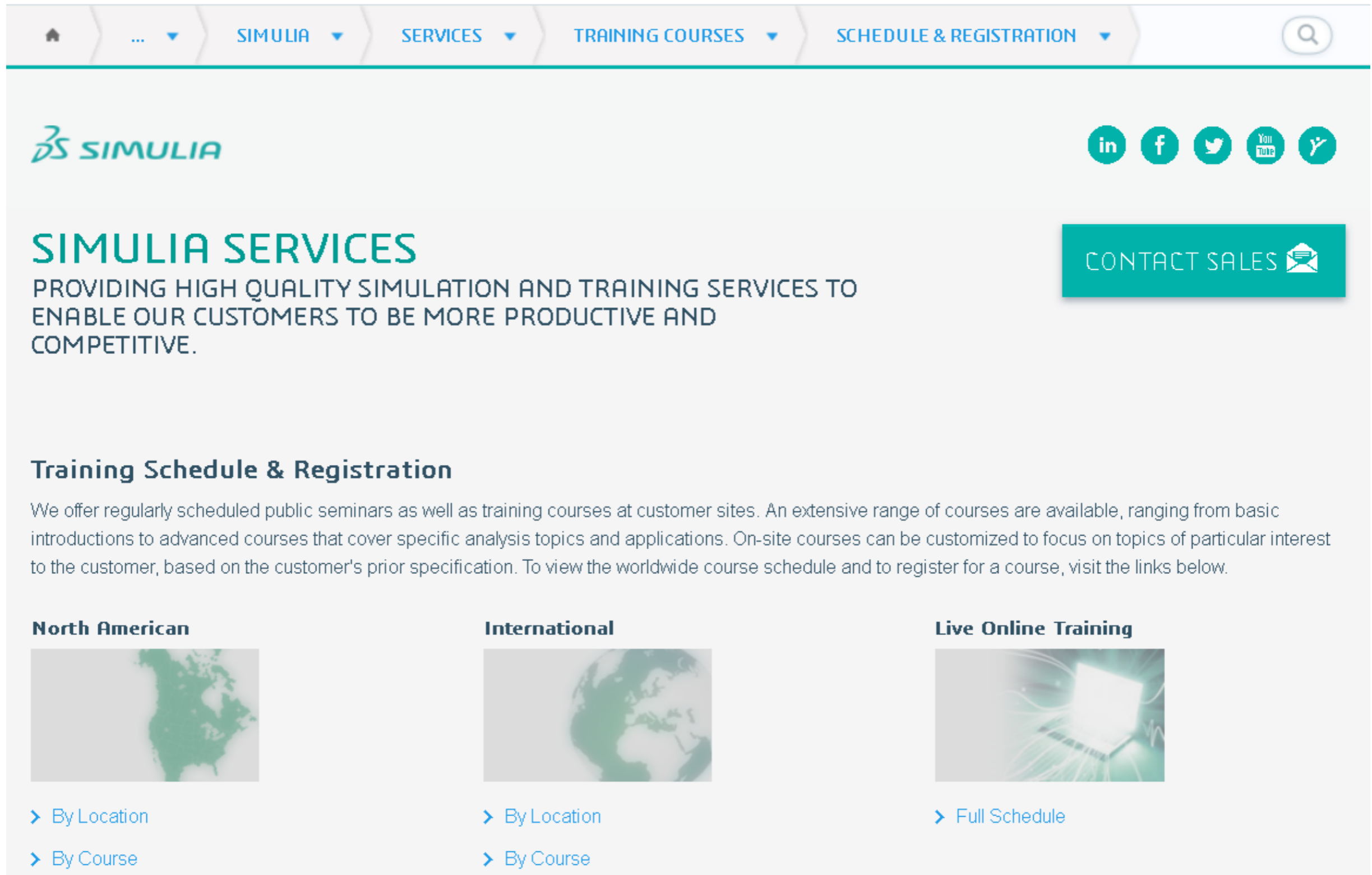
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COMPETITIVE.

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Revision Status

Lecture 1	5/19	Updated for Abaqus 2019
Lecture 2	5/19	Updated for Abaqus 2019
Lecture 3	5/19	Updated for Abaqus 2019
Lecture 4	5/19	Updated for Abaqus 2019
Lecture 5	5/19	Updated for Abaqus 2019
Appendix 1	5/19	Updated for Abaqus 2019
Workshop 1	5/19	Updated for Abaqus 2019
Workshop 2	5/19	Updated for Abaqus 2019

Lesson 1: Introduction

Lesson content:

- ▶ Multiphysics / Multiscale Simulation
- ▶ SIMULIA Multiphysics
- ▶ What is Co-Simulation?
- ▶ Co-Simulation Applications
- ▶ SIMULIA Co-Simulation
- ▶ CFD Co-Simulation with Abaqus
- ▶ Fluid-Structure Interaction
- ▶ FSI Applications
- ▶ FSI Examples
- ▶ Conjugate Heat Transfer between Solid and Fluids
- ▶ CHT Applications
- ▶ CHT Example
- ▶ FSI/CHT Co-Simulation Attributes



40 minutes

Lesson 2: Technical Details

Lesson content:

- ▶ What is Co-Simulation?
- ▶ Monolithic vs Segregated Solution
- ▶ Overcoming Numerical Challenges
- ▶ Definitions
- ▶ Technical Approach
- ▶ Determining the Coupling Step Size
- ▶ Common Coupling Strategies
- ▶ Updating the CFD Domain
- ▶ Software Architecture



40 minutes

Lesson 3: Conducting an FSI Simulation using Abaqus

Lesson content:

- ▶ Suggested Generic Workflow
- ▶ FSI Workflow using STAR-CCM+
- ▶ Workshop Preliminaries
- ▶ Workshop 1: Antilock Braking System (Abaqus + STAR-CCM+)



1.5 hours

Lesson 4: Classifying FSI Applications

Lesson content:

- ▶ Unidirectional Coupled Analysis
- ▶ Bidirectional Coupled Analysis
- ▶ File-Based Sequential Coupling
- ▶ Estimating Coupling Strength
- ▶ Workshop 2: Steady-State Flow in an Exhaust Manifold (Abaqus + STAR-CCM+)



2.5 hours

Lesson 5: Miscellaneous Topics

Lesson content:

- ▶ Co-Simulation Director
- ▶ The *CO-SIMULATION option
- ▶ Restart Analysis
- ▶ Convergence
- ▶ Workflow between CSS and Solvers
- ▶ Manually Starting the CSS Director Process



45 minutes

Appendix 1: An Overview of CFD for Structural Analysts

Appendix content:

- ▶ Introduction
- ▶ Governing Equations for Fluid Dynamics
- ▶ Computational Fluid Dynamics
- ▶ Fluid Properties
- ▶ CFD Modeling



45 minutes