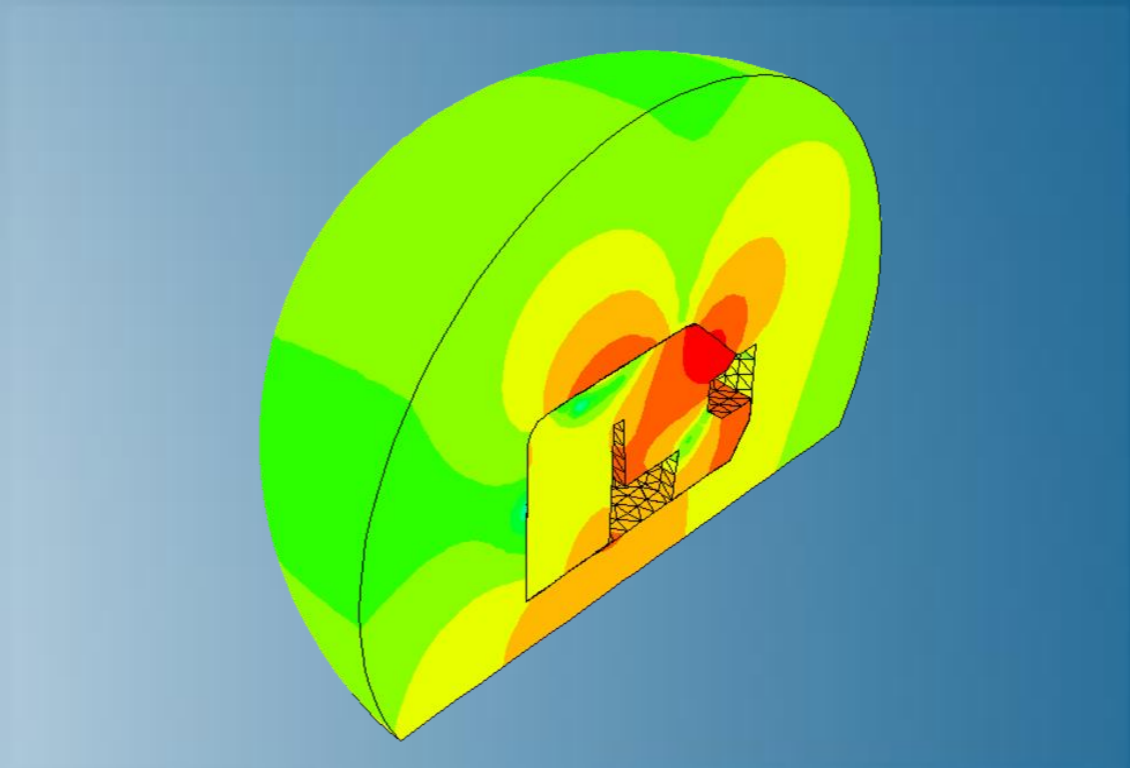


Structural-Acoustic Analysis with Abaqus

Abaqus 2019



3DEXPERIENCE[®]



About this Course

Course objectives

Upon completion of this course you will be able to:

- ▶ Pure acoustics analysis
- ▶ Coupled structural-acoustic analysis
- ▶ Scattering and shock analysis
- ▶ Mesh size and mesh density effects for different analysis procedures
- ▶ Acoustic analysis output and postprocessing

Targeted audience

Simulation Analysts

Prerequisites

This course is recommended for engineers with experience using Abaqus. Some understanding of acoustics is helpful but is not required.



2 days

Day 1

- ▶ Lecture 1 Introduction
- ▶ Lecture 2 Acoustic Phenomena
- ▶ Lecture 3 Modeling Acoustic Problems Using Abaqus
 - Workshop 1 Acoustic Evaluation of a Simple Air Duct Section
 - Workshop 2 Acoustic Evaluation of a Small Vented Room

Day 2

- ▶ Lecture 4 Coupled Structural-Acoustic Analysis
 - Workshop 3 Truck Cab Acoustic Analysis

- ▶ Lecture 5 Acoustic Scattering and Shock
 - Workshop 4 Underwater Shock Analysis

- ▶ Lecture 6 Additional Examples

Additional Material

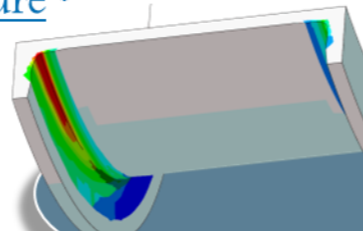
- ▶ Appendix 1 Acoustic Theory

SIMULIA

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

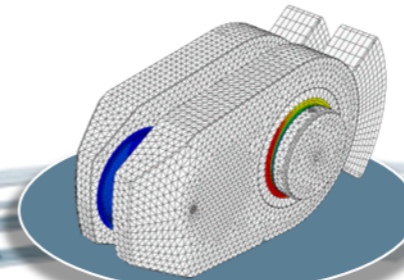
Design Optimization: Tosca Structure *

Simulation-driven design refinement to improve performance



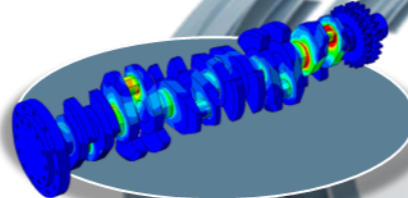
Durability Assessment: fe-safe *

Accurate life estimation to achieve certification



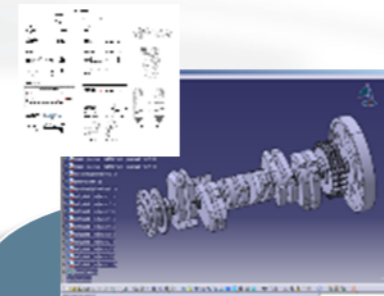
FEA Stress Analysis: Abaqus *

Detailed stress analysis using extracted load history from MBS



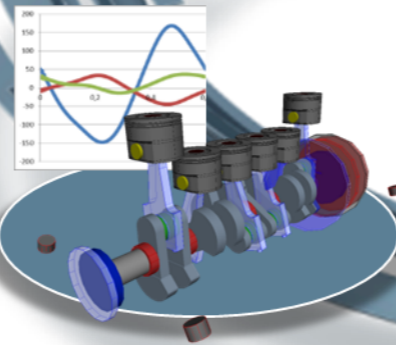
CAD Geometry: CATIA

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



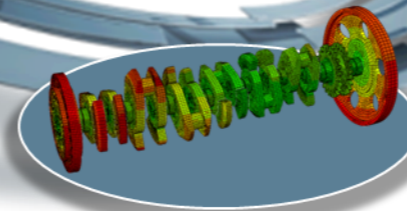
Multibody Simulation: Simpack

System analysis to extract virtual load history of complete working cycle



Mesh Calibration: Isight *

Automated mesh calibration; sufficient mesh quality for accurate results

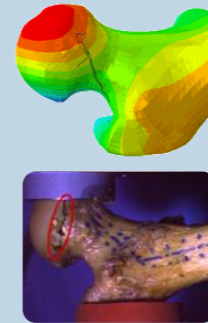


* Included in extended licensing pool

SIMULIA's Power of the Portfolio

Abaqus

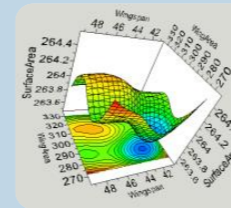
- Routine and Advanced Simulation
- Linear and Nonlinear, Static and Dynamic
- Thermal, Electrical, Acoustics
- Extended Physics through Co-simulation
- Model Preparation and Visualization



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

Isight

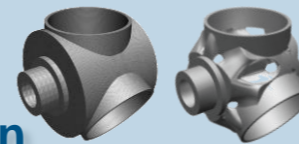
- Process Integration
- Design Optimization
- Parametric Optimization
- Six Sigma and Design of Experiments



**Material Calibration
Workflow Automation
Design Exploration**

Tosca

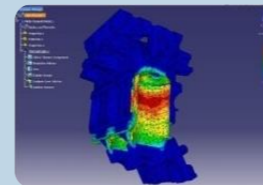
- Non-Parametric Optimization
- Structural and Fluid Flow Optimization
- Topology, Sizing, Shape, Bead Optimization



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

fe-safe

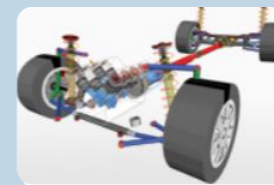
- Durability Simulation
- Low Cycle and High Cycle Fatigue
- Weld, High Temperature, Non-metallics



**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
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Revision Status

Lecture 1	11/18	Updated for Abaqus 2019
Lecture 2	11/18	Updated for Abaqus 2019
Lecture 3	11/18	Updated for Abaqus 2019
Lecture 4	11/18	Updated for Abaqus 2019
Lecture 5	11/18	Updated for Abaqus 2019
Lecture 6	11/18	Updated for Abaqus 2019
Appendix 1	11/18	Updated for Abaqus 2019
Workshop 1	11/18	Updated for Abaqus 2019
Workshop 2	11/18	Updated for Abaqus 2019
Workshop 3	11/18	Updated for Abaqus 2019
Workshop 4	11/18	Updated for Abaqus 2019

Lesson 1: Introduction

Lesson content:

- ▶ Acoustic Problem Types Possible with Abaqus
- ▶ General Capabilities
- ▶ Examples
 - Weighted dB in Abaqus/Viewer
 - Sound transmission through a rubber door seal
 - Acoustic radiation of a muffler
 - Ship shock simulation
 - Tire design for noise reduction



45 minutes

Lesson 2: Acoustic Phenomena

Lesson content:

- ▶ Phenomena
- ▶ Governing Equations and Assumptions
- ▶ Acoustics Modeling
- ▶ Acoustics Terminology
- ▶ Useful Data and Definitions
- ▶ References



45 minutes

Lesson 3: Modeling Acoustic Problems Using Abaqus

Lesson content:

- ▶ Acoustic Properties
- ▶ Acoustic Element Types
- ▶ Poroelastic Acoustic Biot Elements
- ▶ Loads
- ▶ Boundary Conditions
- ▶ Exterior Problems
- ▶ Exterior Problems using Impedance
- ▶ Exterior Problems using Infinite Elements
- ▶ Creating Acoustic Infinite Elements Using Abaqus/CAE
- ▶ Exterior Problems using Perfectly Matched Layers
- ▶ Acoustics with Mean Flow
- ▶ Analysis Procedures
- ▶ Damping
- ▶ Output
- ▶ Acoustic Contribution Factors
- ▶ Maximum Element Size
- ▶ External Meshed Domains
- ▶ Parallel Execution
- ▶ Workshop Preliminaries
- ▶ Workshop 1: Acoustic Evaluation of a Simple Air Duct Section (IA)
- ▶ Workshop 1: Acoustic Evaluation of a Simple Air Duct Section (KW)
- ▶ Workshop 2: Acoustic Evaluation of a Small Vented Room (IA)
- ▶ Workshop 2: Acoustic Evaluation of a Small Vented Room (KW)



Both interactive (IA) and keywords (KW) versions of the workshop are provided. Complete only one.



4.5 hours

Lesson 4: Coupled Structural-Acoustic Analysis

Lesson content:

- ▶ Introduction
- ▶ Near-Field and Far-Field Effects
- ▶ Fully Coupled Analysis
- ▶ Sequentially Coupled Analysis
- ▶ Acoustic-to-Structural Submodeling
- ▶ Coupled Acoustic-Structural Substructures
- ▶ Boundary Impedances
- ▶ Creating ASI elements on geometry
- ▶ Creating ASI elements on orphan meshes
- ▶ Workshop 3: Workshop 3: Truck Cab Acoustic Analysis (IA)
- ▶ Workshop 3: Workshop 3: Truck Cab Acoustic Analysis (KW)



Both interactive (IA) and keywords (KW) versions of the workshop are provided. Complete only one.



2.5 hours

Lesson 5: Acoustic Scattering and Shock

Lesson content:

- ▶ Acoustic Scattering and Shock with Abaqus
- ▶ Incident Wave Loading
- ▶ UNDEX Loading
- ▶ UNDEX Example Problem
- ▶ Air Blast Loading
- ▶ Workshop 4: Underwater Shock Analysis (IA)
- ▶ Workshop 4: Underwater Shock Analysis (KW)



Both interactive (IA) and keywords (KW) versions of the workshop are provided. Complete only one.



3 hours

Lesson 6: Additional Examples

Lesson content:

- ▶ Sloshing
- ▶ Acoustics in Fibrous Materials
- ▶ Simple Expansion Muffler with Mean Flow
- ▶ Harmonic Distortion
- ▶ Effect of Surface Treatments on Room Acoustics
- ▶ Nonlinear Structural Behavior
- ▶ Coupled Piezoelectric and Acoustic Analysis
- ▶ Acoustics of a Truck Cab: Fully Coupled Analysis
- ▶ Acoustics of a Truck Cab: Sequential Analysis
- ▶ Summary



75 minutes

Appendix 1: Acoustic Theory

Appendix content:

- ▶ Governing Equations
- ▶ Properties of an Acoustic Medium
- ▶ Loads



45 minutes