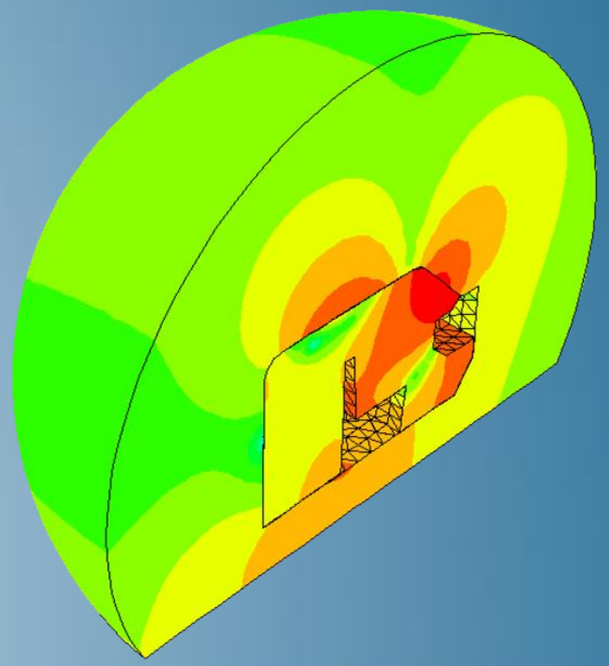
Structural-Acoustic Analysis with Abaqus

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

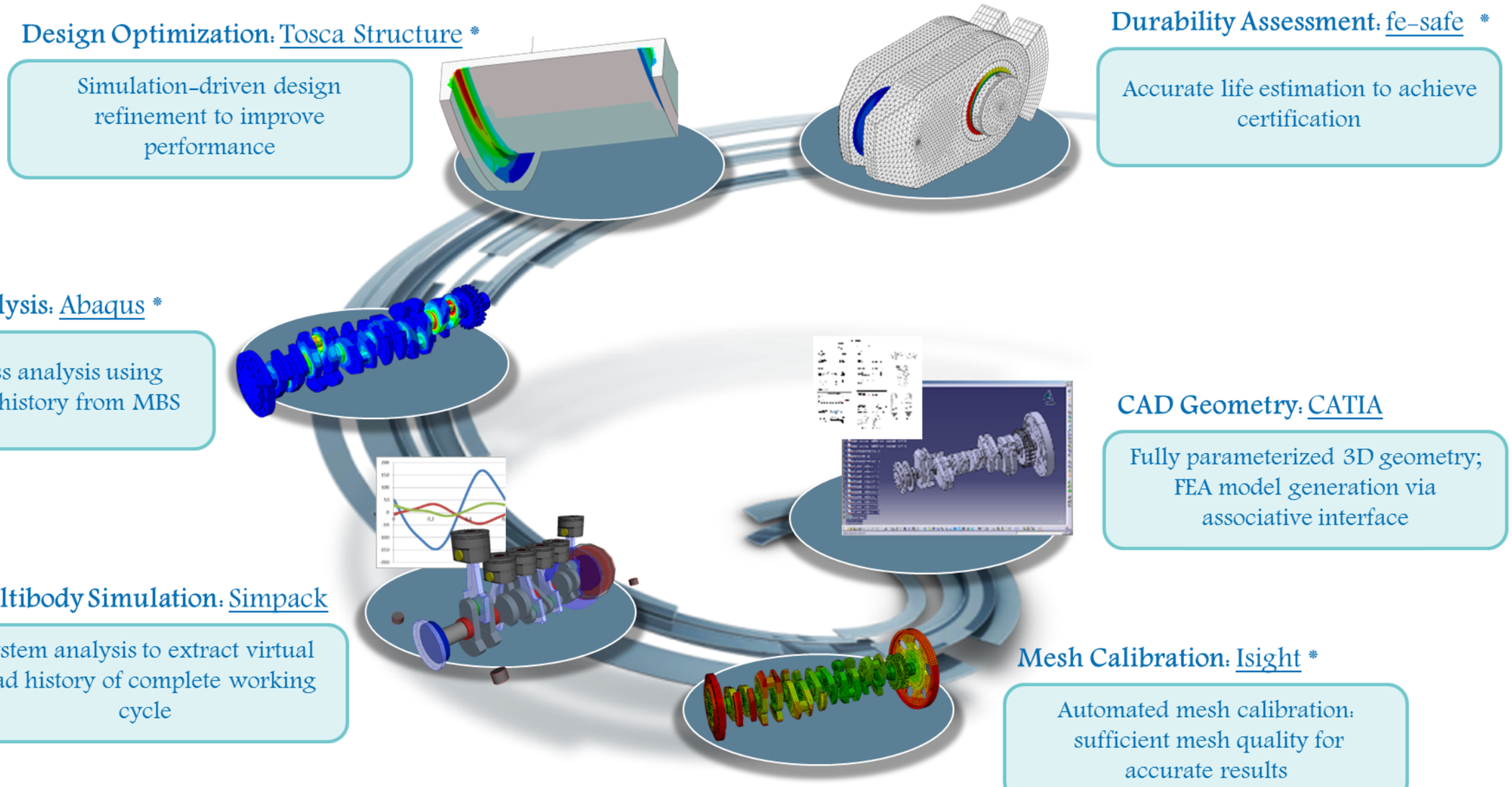
- Lecture 4 Coupled Structural-Acoustic Analysis
  - Workshop 3 Truck Cab Acoustic Analysis
- Lecture 5 Acoustic Scattering and Shock
  - Workshop 4 Underwater Shock Analysis
- Lecture 6 Additional Examples

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 *

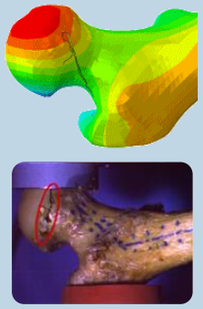
Automated mesh calibration: sufficient mesh quality for accurate results

* Included in extended licensing pool

SIMULIA's Power of the Portfolio

Abaqus

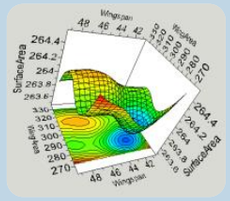
- Routine and Advanced Simulation
- Linear and Nonlinear, Static and Dynamic
- Thermal, Electrical, Acoustics
- Extended Physics through Co-simulation
- Model Preparation and Visualization



Realistic Human Simulation
High Speed Crash & Impact
Noise & Vibration

Isight

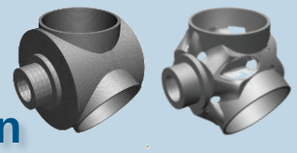
- Process Integration
- Design Optimization
- Parametric Optimization
- Six Sigma and Design of Experiments



Material Calibration
Workflow Automation
Design Exploration

Tosca

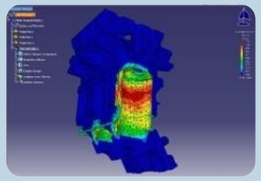
- Non-Parametric Optimization
- Structural and Fluid Flow Optimization
- Topology, Sizing, Shape, Bead Optimization



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

fe-safe

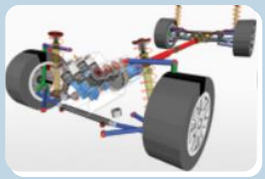
- Durability Simulation
- Low Cycle and High Cycle Fatigue
- Weld, High Temperature, Non-metallics



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 Contact

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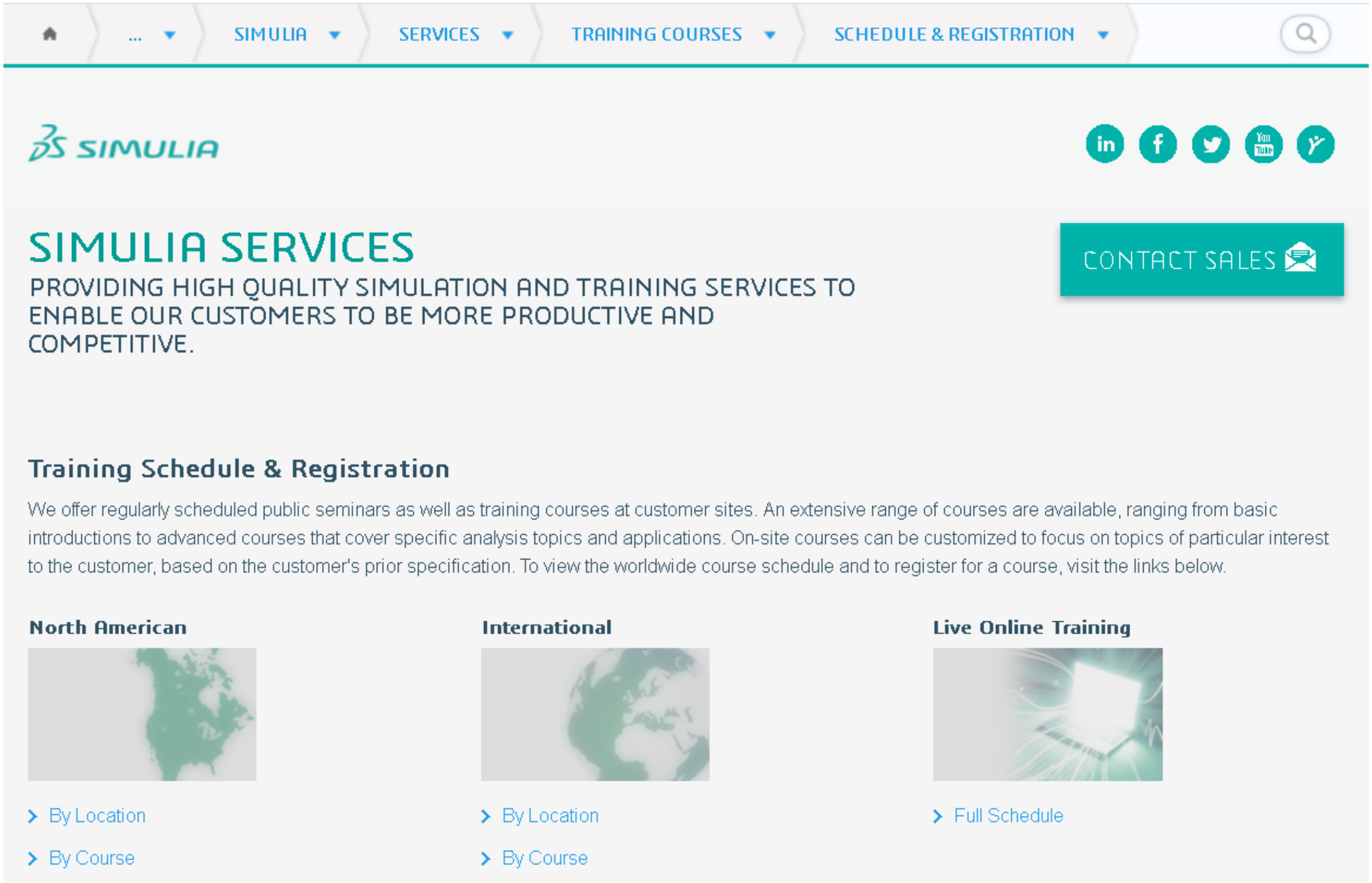

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Revision Status

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