Structural-Acoustic Analysis with Abaqus

2017
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.
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 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

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

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

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

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

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

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

<table>
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<th>Tool</th>
<th>Features</th>
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| **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!

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Connect with peers to share knowledge and get technical insights

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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
- 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
- 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.
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.
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
Appendix 1: Acoustic Theory

Appendix content:

- Governing Equations
- Properties of an Acoustic Medium
- Loads