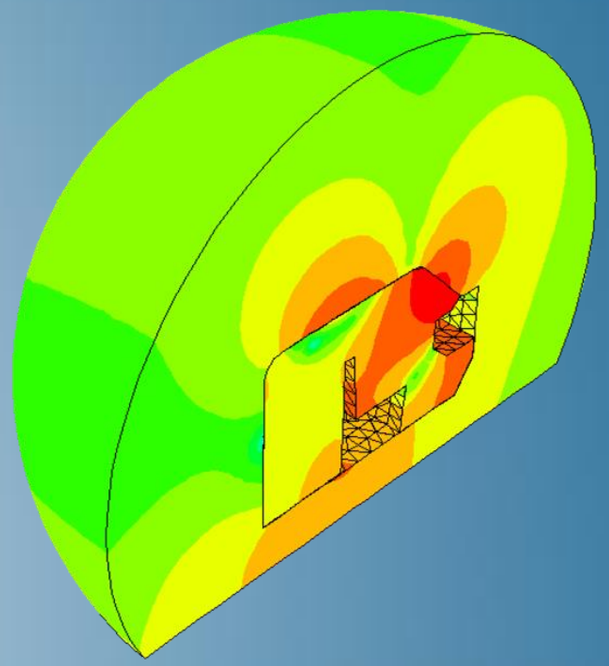
Structural-Acoustic Analysis with Abaqus

Abaqus 2018



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

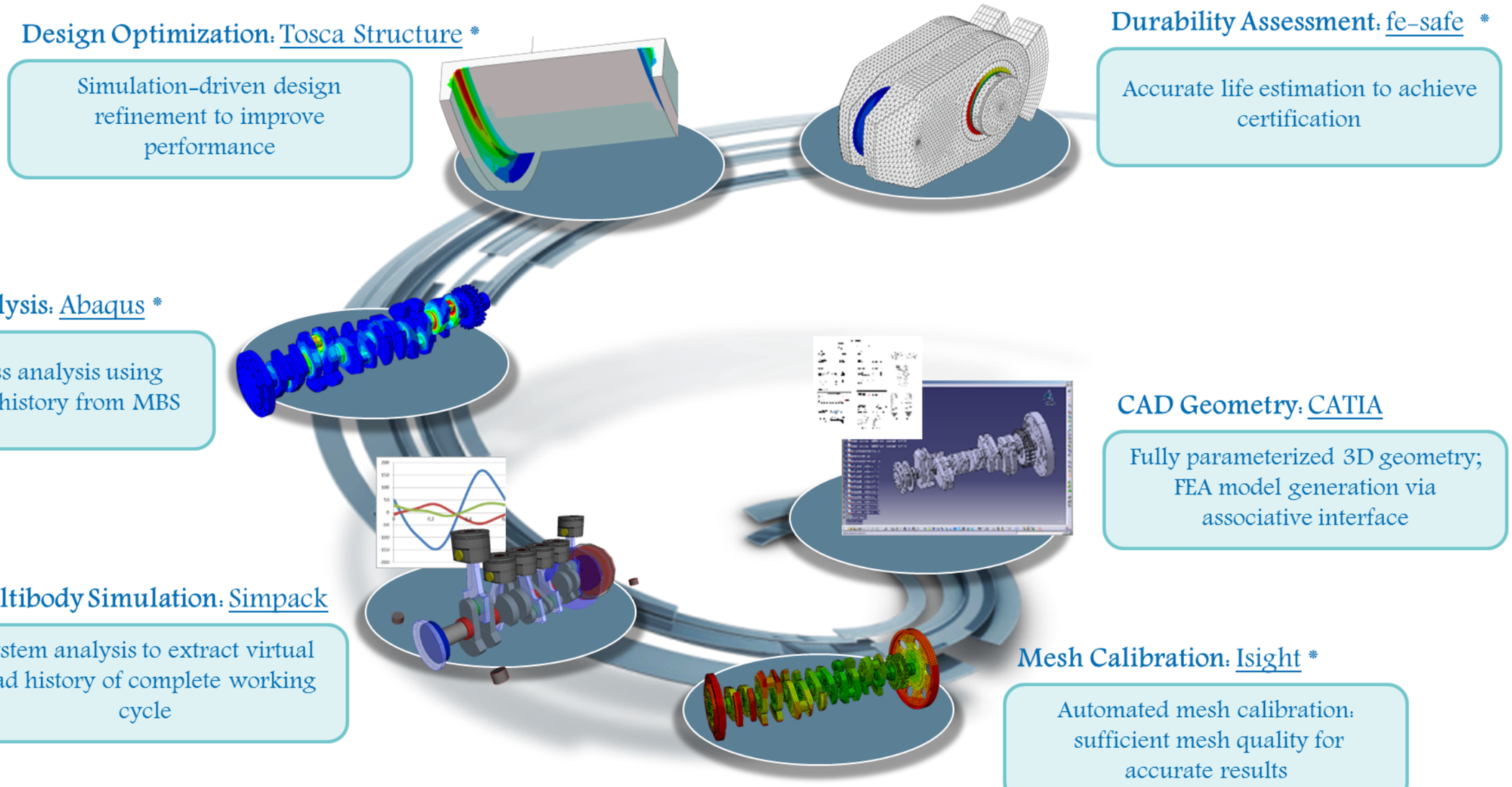
- Lecture 4 Coupled Structural-Acoustic Analysis
  - Workshop 3 Truck Cab Acoustic Analysis
- Lecture 5 Acoustic Scattering and Shock
  - Workshop 4 Underwater Shock Analysis
- Lecture 6 Additional Examples

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 *

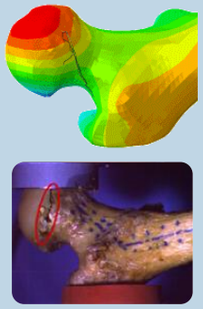
Automated mesh calibration: sufficient mesh quality for accurate results

* Included in extended licensing pool

SIMULIA's Power of the Portfolio

Abaqus

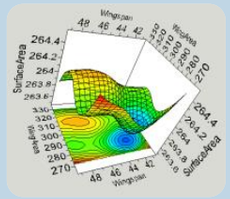
- Routine and Advanced Simulation
- Linear and Nonlinear, Static and Dynamic
- Thermal, Electrical, Acoustics
- Extended Physics through Co-simulation
- Model Preparation and Visualization



Realistic Human Simulation
High Speed Crash & Impact
Noise & Vibration

Isight

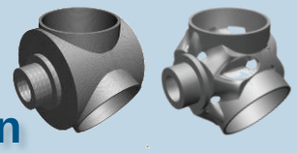
- Process Integration
- Design Optimization
- Parametric Optimization
- Six Sigma and Design of Experiments



Material Calibration
Workflow Automation
Design Exploration

Tosca

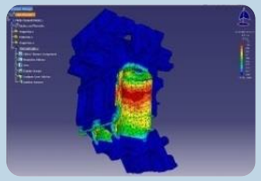
- Non-Parametric Optimization
- Structural and Fluid Flow Optimization
- Topology, Sizing, Shape, Bead Optimization



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

fe-safe

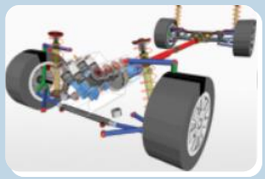
- Durability Simulation
- Low Cycle and High Cycle Fatigue
- Weld, High Temperature, Non-metallics



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

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!

SIMULIA

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.

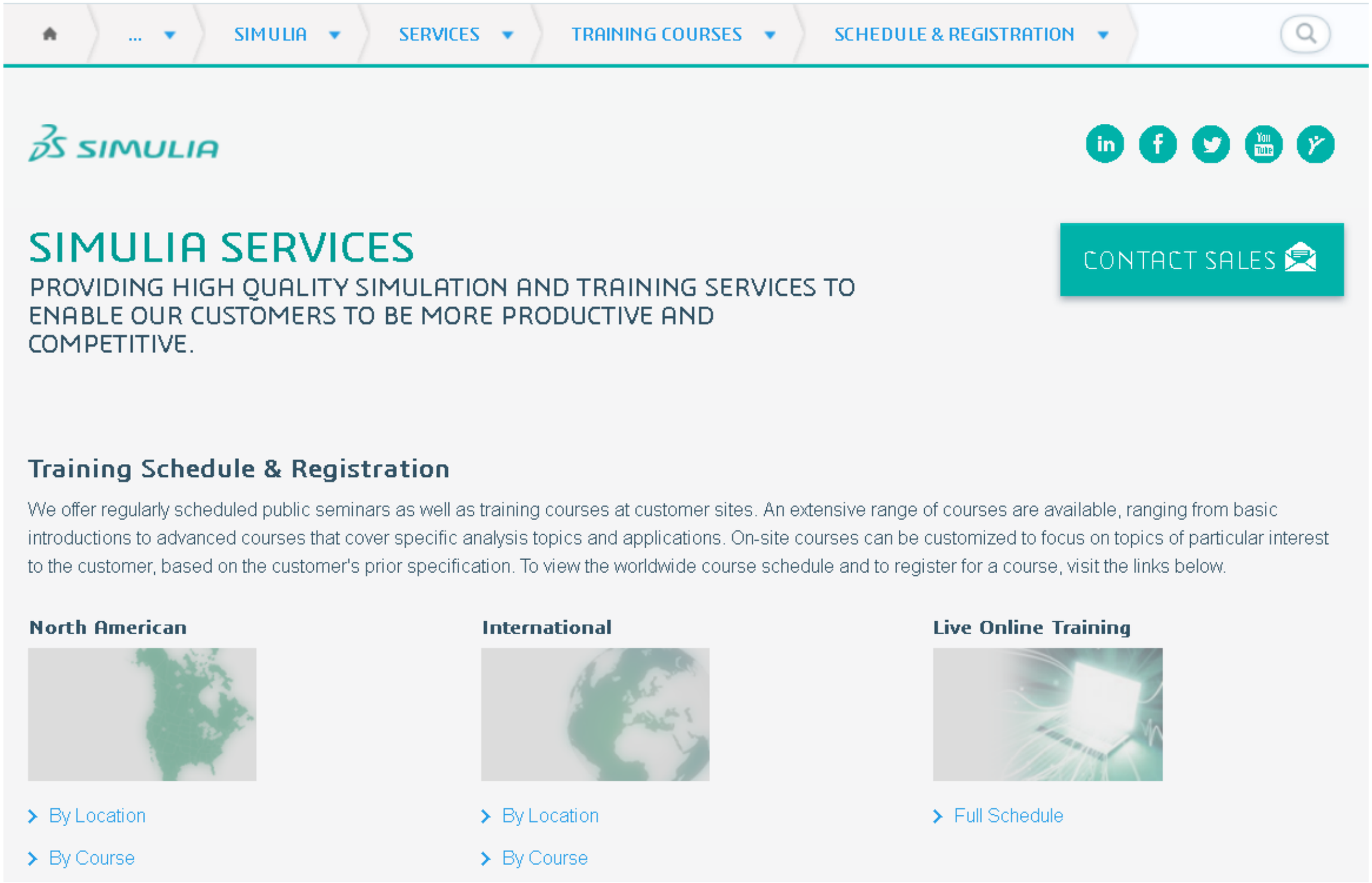
For more information and registration, visit **3ds.com/simulia-learning**.
Connect. Share. Spark Innovation.

DASSAULT SYSTEMES | The **3D**EXPERIENCE Company

©2013 Dassault Systèmes. All rights reserved.

SIMULIA Training

http://www.3ds.com/products-services/simulia/services/training-courses/



Legal Notices

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

Lecture 1	11/17	Updated for Abaqus 2018
Lecture 2	11/17	Updated for Abaqus 2018
Lecture 3	11/17	Updated for Abaqus 2018
Lecture 4	11/17	Updated for Abaqus 2018
Lecture 5	11/17	Updated for Abaqus 2018
Lecture 6	11/17	Updated for Abaqus 2018
Appendix 1	11/17	Updated for Abaqus 2018
Workshop 1	11/17	Updated for Abaqus 2018
Workshop 2	11/17	Updated for Abaqus 2018
Workshop 3	11/17	Updated for Abaqus 2018
Workshop 4	11/17	Updated for Abaqus 2018

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

www.3ds.com | © Dassault Systèmes

Lesson 2: Acoustic Phenomena

Lesson content:

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

www.3ds.com | © Dassault Systèmes

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
- 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

www.3ds.com | © Dassault Systèmes

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

www.3ds.com | © Dassault Systèmes

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

www.3ds.com | © Dassault Systèmes

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

www.3ds.com | © Dassault Systèmes

Appendix 1: Acoustic Theory

Appendix content:

- Governing Equations
- Properties of an Acoustic Medium
- Loads

45 minutes

www.3ds.com | © Dassault Systèmes