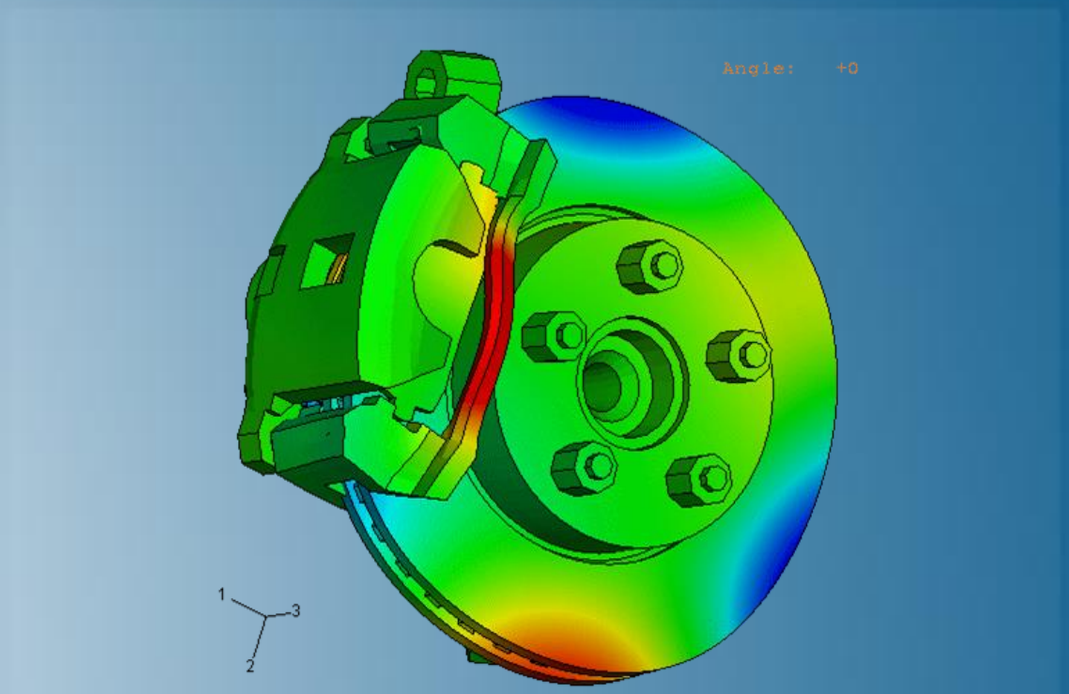
Automotive NVH with Abaqus

Abaqus 2018



3DEXPERIENCE®

About this Course

Course objectives

Upon completion of this course you will be able to:

- Perform natural frequency extractions
- Perform sound radiation analyses (acoustics)
- Include nonlinear preloading effects in your NVH simulations
- Perform Brake squeal analyses
- Create constraints and connections for Automotive NVH models
- Use substructuring techniques to run your NVH simulations more efficiently
- Perform advanced NVH postprocessing (via plug-ins)

Targeted audience

Simulation Analysts

Prerequisites

This course is recommended for engineers with experience using Abaqus

3 days

Day 1

- Lecture 1 Automotive NVH Overview
- Lecture 2 Modal Analysis
  - Workshop 1 Modal Analysis of a Control Arm
- Lecture 3 Steady-State Dynamics
  - Workshop 2 Steady State Dynamic Analysis of a Control Arm
- Lecture 4 Modal Transient Response

Day 2

- Lecture 5 Constraints and Interactions: Part 1
- Lecture 6 Constraints and Interactions: Part 2
  - Workshop 3 Constraints and Interactions for a Control Arm
- Lecture 7 Substructures
  - Workshop 4 Using Substructures to Model a Pick-up Truck
- Lecture 8 Base Motion Excitation
  - Workshop 5 Base Motion of a Pick-up Truck

Day 3

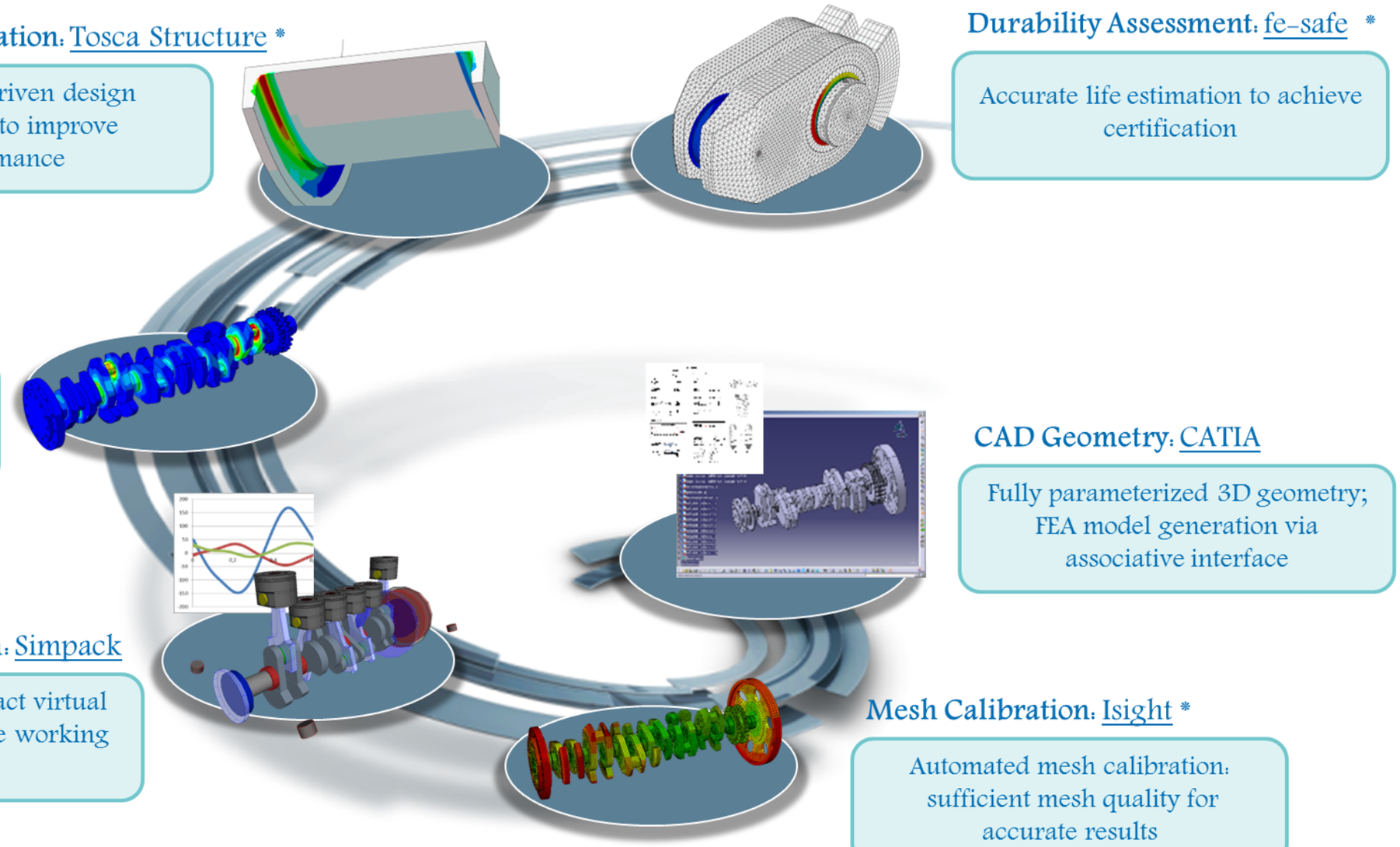
- Lecture 9 Coupled Structural-Acoustic Analysis
  - Workshop 6 Coupled Structural-Acoustic Analysis of a Truck
- Lecture 10 Brake Squeal Analysis
  - Workshop 7 Brake Squeal Analysis

Additional Material

- Appendix 1 Introduction to Modeling with Abaqus
- Appendix 2 Migrating from Nastran to Abaqus: Part 1
- Appendix 3 Migrating from Nastran to Abaqus: Part 2
  - Workshop 8 Nastran Translation: Control Arm Model
- Appendix 4 Abaqus-EXCITE Workflow

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 *

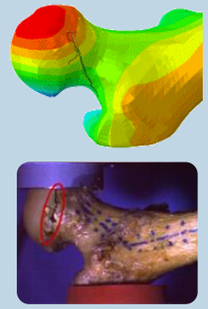
Automated mesh calibration: sufficient mesh quality for accurate results

* Included in extended licensing pool

SIMULIA's Power of the Portfolio

Abaqus

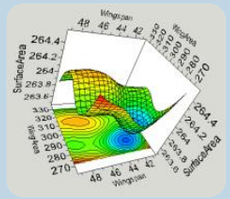
- Routine and Advanced Simulation
- Linear and Nonlinear, Static and Dynamic
- Thermal, Electrical, Acoustics
- Extended Physics through Co-simulation
- Model Preparation and Visualization



Realistic Human Simulation
High Speed Crash & Impact
Noise & Vibration

Isight

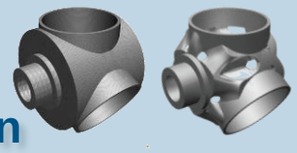
- Process Integration
- Design Optimization
- Parametric Optimization
- Six Sigma and Design of Experiments



Material Calibration
Workflow Automation
Design Exploration

Tosca

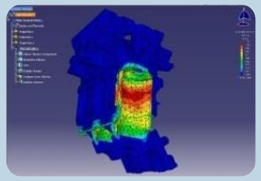
- Non-Parametric Optimization
- Structural and Fluid Flow Optimization
- Topology, Sizing, Shape, Bead Optimization



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

fe-safe

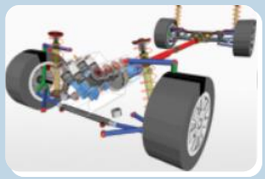
- Durability Simulation
- Low Cycle and High Cycle Fatigue
- Weld, High Temperature, Non-metallics



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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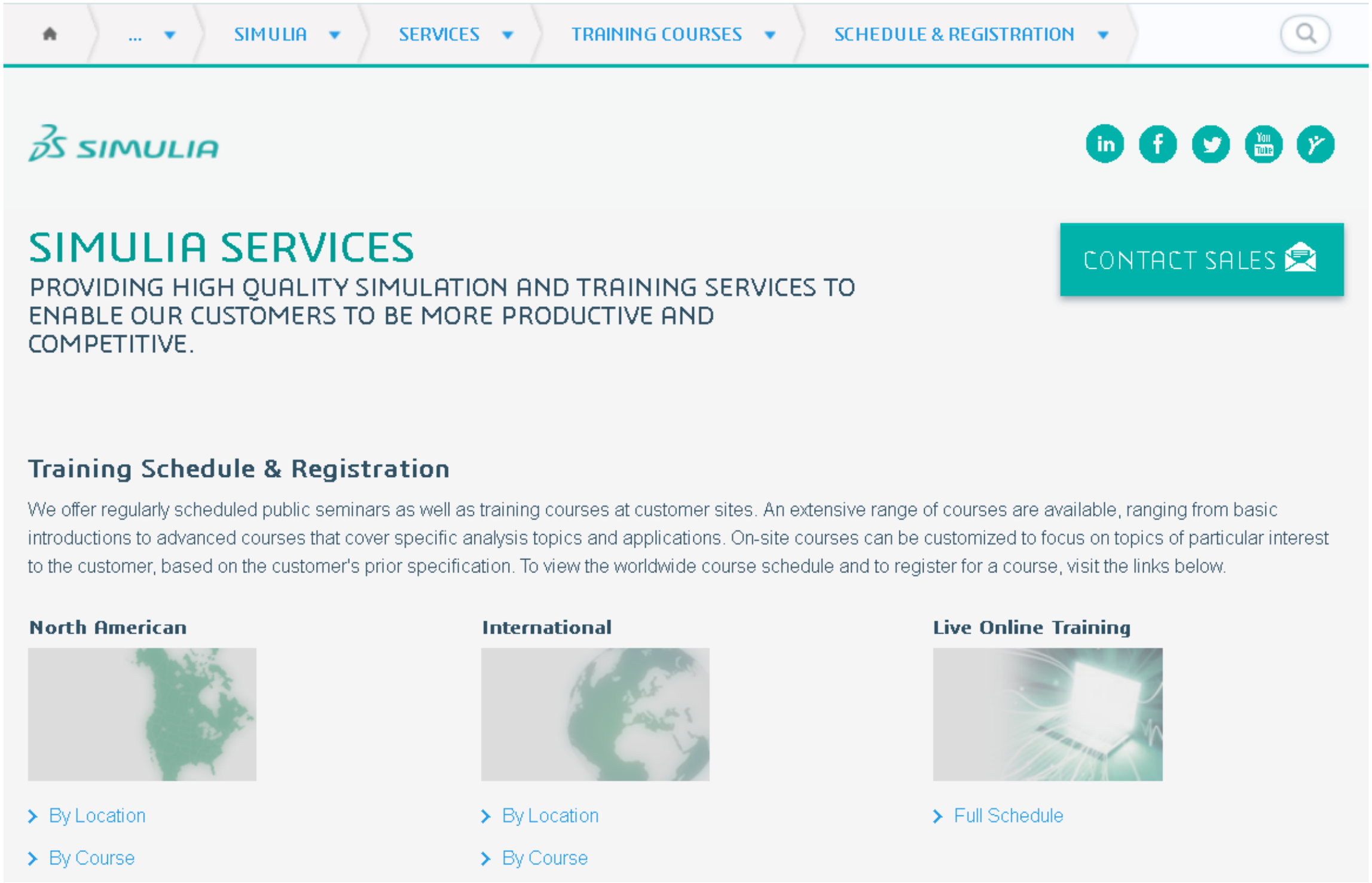

Legal Notices

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
Lecture 7	11/17	Updated for Abaqus 2018
Lecture 8	11/17	Updated for Abaqus 2018
Lecture 9	11/17	Updated for Abaqus 2018
Lecture 10	11/17	Updated for Abaqus 2018
Appendix 1	11/17	Updated for Abaqus 2018
Appendix 2	11/17	Updated for Abaqus 2018
Appendix 3	11/17	Updated for Abaqus 2018
Appendix 4	11/17	Updated for Abaqus 2018

Workshop 1	11/17	Updated for Abaqus 2018
Workshop 2	11/17	Updated for Abaqus 2018
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Workshop 6	11/17	Updated for Abaqus 2018
Workshop 7	11/17	Updated for Abaqus 2018
Workshop 8	11/17	Updated for Abaqus 2018

Lesson 1: Automotive NVH Overview

Lesson content:

- Introduction
- From Component to Full Vehicle NVH
- Example Analyses
- Abaqus NVH Functionality
- Summary

1 hour

Lesson 2: Modal Analysis

Lesson content:

- Problem Formulation
- Eigenvalue Solution Methods
- Example: Engine Block Frequency Extraction
- Frequency Output
- Frequencies of Preloaded Structures
- Residual Modes
- Workshop Preliminaries
- Workshop 1: Modal Analysis of a Control Arm (IA)
- Workshop 1: Modal Analysis of a Control Arm (KW)

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

2.5 hours

Lesson 3: Steady-State Dynamics

Lesson content:

- Introduction
- Damping
- Damping Controls
- Steady-State Dynamics Solution Procedures
- Excitation and Output
- Mobility
- Steady-State Dynamics Usage Example
- Examples
- Workshop 2: Steady State Dynamic Analysis of a Control Arm (IA)
- Workshop 2: Steady State Dynamic Analysis of a Control Arm (KW)

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

2.5 hours

Lesson 4: Modal Transient Response

Lesson content:

- Introduction
- Excitation
- Output
- Examples

45 minutes

Lesson 5: Constraints and Interactions: Part 1

Lesson content:

- Introduction
- Rigid Bodies
- Surface-Based Coupling Constraints
- Surface-Based Tie Constraints
- Contact Interactions
- Automatic Contact Pair Detection

1 hour

Lesson 6: Constraints and Interactions: Part 2

Lesson content:

- Multi-Point Constraints
- Connector Elements
- Mesh-Independent Fasteners
- Workshop 3: Constraints and Interactions for a Control Arm (IA)
- Workshop 3: Constraints and Interactions for a Control Arm (KW)

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

2.5 hours

Lesson 7: Substructures

Lesson content:

- Introduction
- Substructure Modeling
- Preloading Substructures
- Dynamic Substructuring
- Substructure Output
- Substructuring Example: Rolling Tires
- Workshop 4: Using Substructures to Model a Pick-up Truck (IA)
- Workshop 4: Using Substructures to Model a Pick-up Truck (KW)

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

2.5 hours

Lesson 8: Base Motion Excitation

Lesson content:

- Introduction
- Primary Base Motion
- Secondary Base Motion
- Usage
- Example
- Workshop 5: Base Motion of a Pick-up Truck (IA)
- Workshop 5: Base Motion of a Pick-up Truck (KW)

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

2 hours

Lesson 9: Coupled Structural-Acoustic Analysis

Lesson content:

- Introduction
- Coupled Structural-Acoustics Modeling
- Analysis Procedures
- Damping
- Element Size
- Acoustic Infinite Elements
- Impedance
- Output
- Acoustic Contribution Factors
- Estimate Acoustic Radiation
- Workshop 6: Coupled Structural-Acoustic Analysis of a Truck (IA)
- Workshop 6: Coupled Structural-Acoustic Analysis of a Truck (KW)

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

2.5 hours

Lesson 10: Brake Squeal Analysis

Lesson content:

- Introduction
- Complex Eigenvalue Extraction
- Verifying Brake Squeal Simulations
- Examples
- Transient Dynamics
- References
- Workshop 7: Brake Squeal Analysis (IA)
- Workshop 7: Brake Squeal Analysis (KW)

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

2.5 hours

Appendix 1: Introduction to Modeling with Abaqus

Appendix content:

- Abaqus Conventions
- Details of an Abaqus Input File
- Overview of Abaqus/CAE
- Starting Abaqus/CAE
- Orphan Mesh Import
- Example

1 hour

Appendix 2: Migrating from Nastran to Abaqus: Part 1

Appendix content:

- Introduction
- Nastran and Abaqus Input Comparison
- Translator from Nastran to Abaqus
- Solution Procedure Translation
- Validating a Translated Model

75 minutes

Appendix 3: Migrating from Nastran to Abaqus: Part 2

Appendix content:

- Modeling Differences Between Abaqus and Nastran
- Element Differences Between Abaqus and Nastran
- Interface Differences Between Abaqus and Nastran
- Translation Troubleshooting
- Workshop 8: Nastran Translation: Control Arm Model (IA)
- Workshop 8: Nastran Translation: Control Arm Model (KW)

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

2 hours

Appendix 4: Abaqus-EXCITE Workflow

Appendix content:

- Introduction
- Abaqus-EXCITE Workflow
- Abaqus-EXCITE-Abaqus Workflow

45 minutes