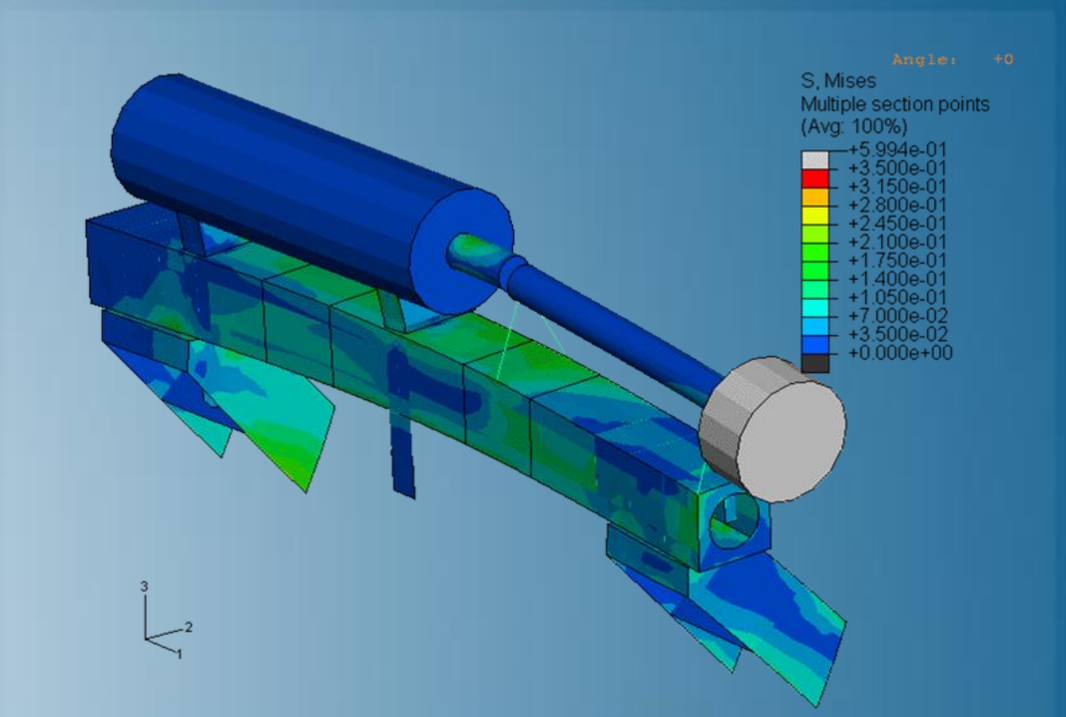
Linear Dynamics with Abaqus

Abaqus 2018



3DEXPERIENCE®

About this Course

Course objectives

Upon completion of this course you will be able to:

- Extract eigenmodes about a certain frequency
- Determine whether the number of extracted eigenmodes is sufficient to represent the structure's response adequately
- Perform transient, steady-state, response spectrum and random response analyses using the eigenmodes
- Use multiple base motions
- Apply damping in linear problems

Targeted audience

Simulation Analysts

Prerequisites

This course is recommended for engineers with experience using Abaqus

2 days

Day 1

- Lecture 1 — Introduction to Abaqus Linear Dynamics
- Lecture 2 — Extracting Real Eigenvalues
  - Workshop 1 — Eigenvalue Natural Frequency Extraction
- Lecture 3 — Modal Superposition
- Lecture 4 — Damping
- Lecture 5 — Base Motion Excitation
- Lecture 6 — Modal Transient Dynamics
  - Workshop 2 — Modal Dynamics

Day 2

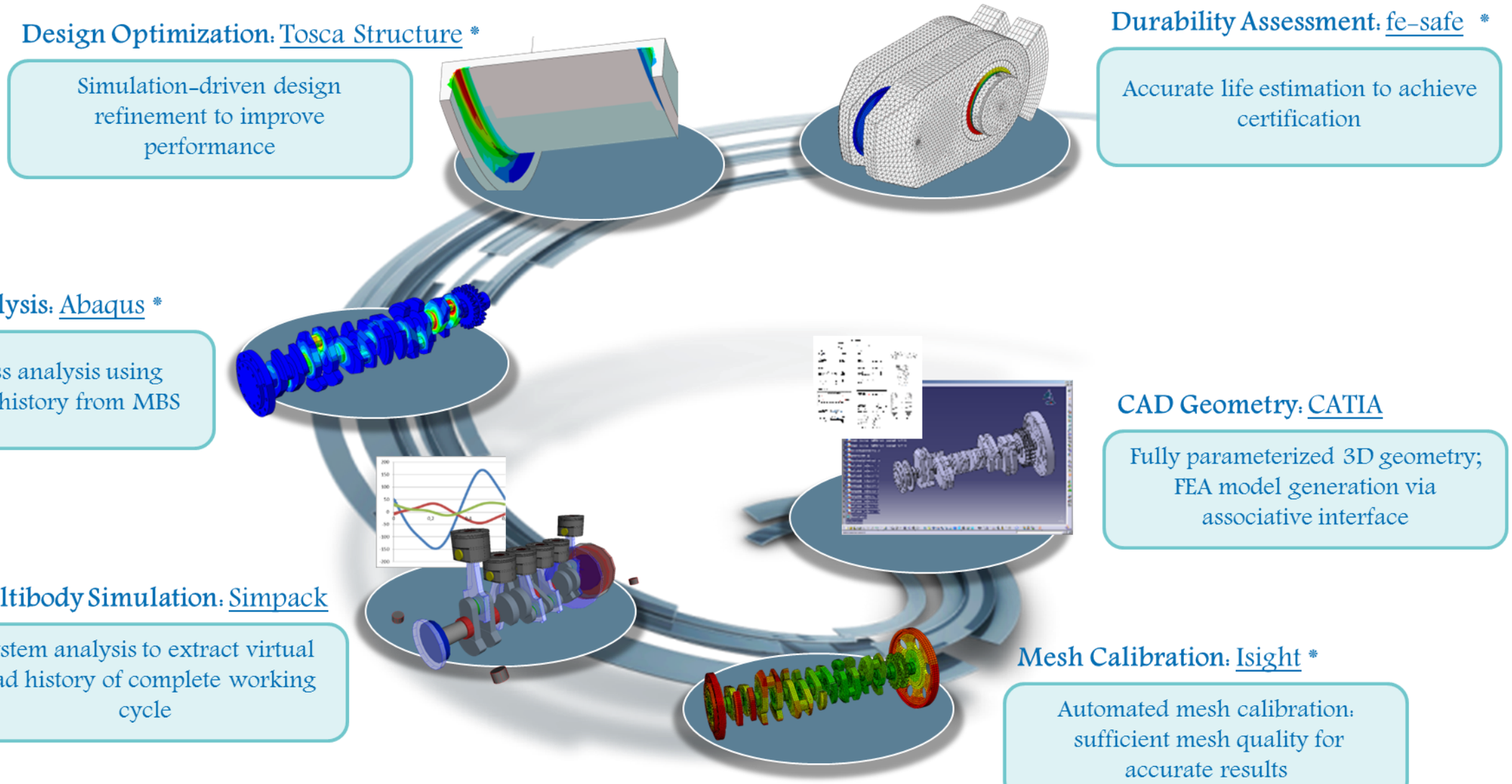
- Lecture 7 — Response Spectrum Analysis
  - Workshop 3 — Response Spectrum
- Lecture 8 — Steady-State Harmonic Response
  - Workshop 4 — Steady-State Dynamics
- Lecture 9 — Introduction to Random Response
  - Workshop 5 — Random Response Analysis
- Lecture 10 — Complex Eigenvalue Analysis

Additional Material

- Appendix 1 Introduction to Nonlinear Dynamics
- Appendix 2 Nonlinear Dynamics: Abaqus Usage
- Appendix 3 Nonlinear Dynamics Examples

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 *

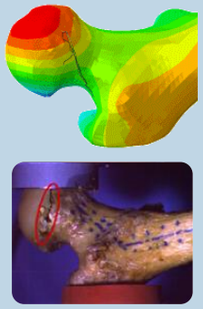
Automated mesh calibration: sufficient mesh quality for accurate results

* Included in extended licensing pool

SIMULIA's Power of the Portfolio

Abaqus

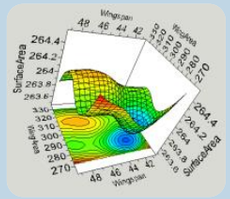
- Routine and Advanced Simulation
- Linear and Nonlinear, Static and Dynamic
- Thermal, Electrical, Acoustics
- Extended Physics through Co-simulation
- Model Preparation and Visualization



Realistic Human Simulation
High Speed Crash & Impact
Noise & Vibration

Isight

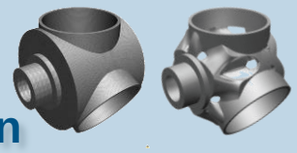
- Process Integration
- Design Optimization
- Parametric Optimization
- Six Sigma and Design of Experiments



Material Calibration
Workflow Automation
Design Exploration

Tosca

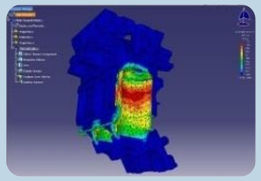
- Non-Parametric Optimization
- Structural and Fluid Flow Optimization
- Topology, Sizing, Shape, Bead Optimization



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

fe-safe

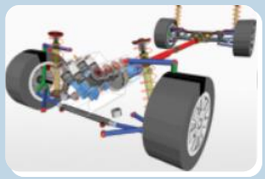
- Durability Simulation
- Low Cycle and High Cycle Fatigue
- Weld, High Temperature, Non-metallics



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

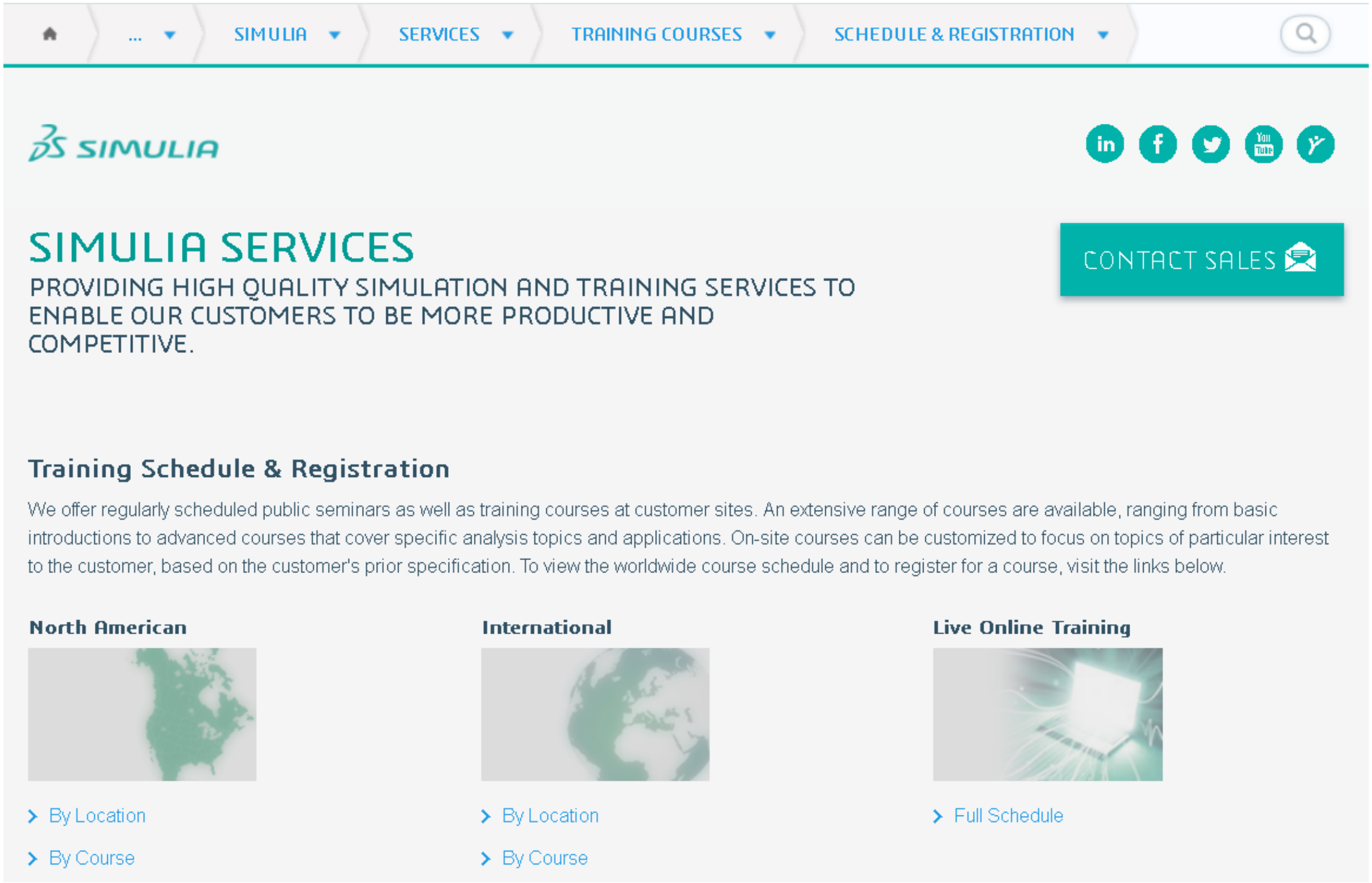
Discover new ways to explore how to leverage realistic simulation to drive product innovation. Join the thousands of Abaqus and Isight users who are already gaining valuable knowledge from the SIMULIA Learning Community.

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

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

SIMULIA Training

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



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
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
Workshop 5	11/17	Updated for Abaqus 2018

Lesson 1: Introduction to Abaqus Linear Dynamics

Lesson content:

- Dynamic Response
- When to Consider Dynamic Effects
- Linear Dynamics Procedures
- Linear Dynamics Software Architecture

1.5 hours

Lesson 2: Extracting Real Eigenvalues

Lesson content:

- Problem Formulation
- Eigenvalue Solution Methods
- Example: Engine Block Frequency Extraction
- Frequency Output
- Frequencies of Preloaded Structures
- Extracting Repeated Eigenfrequencies
- Residual Modes
- Workshop Model Description
- Workshop Preliminaries
- Workshop 1: Eigenvalue Natural Frequency Extraction (IA)
- Workshop 1: Eigenvalue Natural Frequency Extraction (KW)

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

3 hours

Lesson 3: Modal Superposition

Lesson content:

- Introduction
- Modal Superposition
- Example: Modal Reduction and Superposition
- Example: Cantilever Beam

0.5 hours

Lesson 4: Damping

Lesson content:

- Introduction
- Damping in Direct Solutions
- Damping in Modal Subspace Projection Solutions
- Damping in Modal Superposition Procedures
- Material Damping
- Element Damping
- Global Damping
- Modal Damping
- Damping Controls
- Summary

1.5 hours

Lesson 5: Base Motion Excitation

Lesson content:

- Introduction
- Primary Base Motion
- Secondary Base Motions
- Usage
- Example

45 minutes

Lesson 6: Modal Transient Dynamics

Lesson content:

- Introduction
- Excitation and Output
- Example
- Subspace Solutions for Transient Dynamics
- Workshop 2: Modal Dynamics (IA)
- Workshop 2: Modal Dynamics (KW)

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

2 hours

Lesson 7: Response Spectrum Analysis

Lesson content:

- Introduction
- The Response Spectrum
- Determining Peak Modal Response
- Modal Summation Methods
- Separation of Modal Responses into Periodic and Rigid Responses
- Combining Results from Multiple Spectrums
- Spectrum Definition
- Response Spectrum Usage
- Response Spectrum Example
- Workshop 3: Response Spectrum (IA)
- Workshop 3: Response Spectrum (KW)

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

2 hours

Lesson 8: Steady-State Harmonic Response

Lesson content:

- Introduction
- Steady-State Dynamics Solution Procedures
- Excitation and Output
- Steady-State Dynamics Usage
- Comparative Example
- Workshop 4: Steady-State Dynamics (IA)
- Workshop 4: Steady-State Dynamics (KW)

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

2 hours

Lesson 9: Introduction to Random Response

Lesson content:

- Overview
- Excitation and Output
- Random Response Usage
- Base Motion Example
- Steady-State Dynamics Alternative Approach
- Workshop 5: Random Response Analysis (IA)
- Workshop 5: Random Response Analysis (KW)

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

2 hours

Lesson 10: Complex Eigenvalue Analysis

Lesson content:

- Overview
- Implementation
- Brake Squeal Analysis

75 minutes

Appendix 1: Introduction to Nonlinear Dynamics

Appendix content:

- Introduction
- Equations for Dynamic Problems
- Time integration of the equations of motion
- Automatic time incrementation
- Dynamic Contact
- Comparing Abaqus/Standard and Abaqus/Explicit

45 minutes

Appendix 2: Nonlinear Dynamics: Abaqus Usage

Appendix content:

- Implicit Dynamics
- Explicit Dynamics
- Algorithmic Details
- Initial Conditions and Loads
- Stability and Accuracy of the Trapezoidal Rule
- Material Damping
- Half-Increment Residual Tolerance

75 minutes

Appendix 3: Nonlinear Dynamics Examples

Appendix content:

- Damped shallow arch
- Ball impact
- Tennis racket and ball
- Crimp forming
- Blade containment
- Inertia relief

1 hour