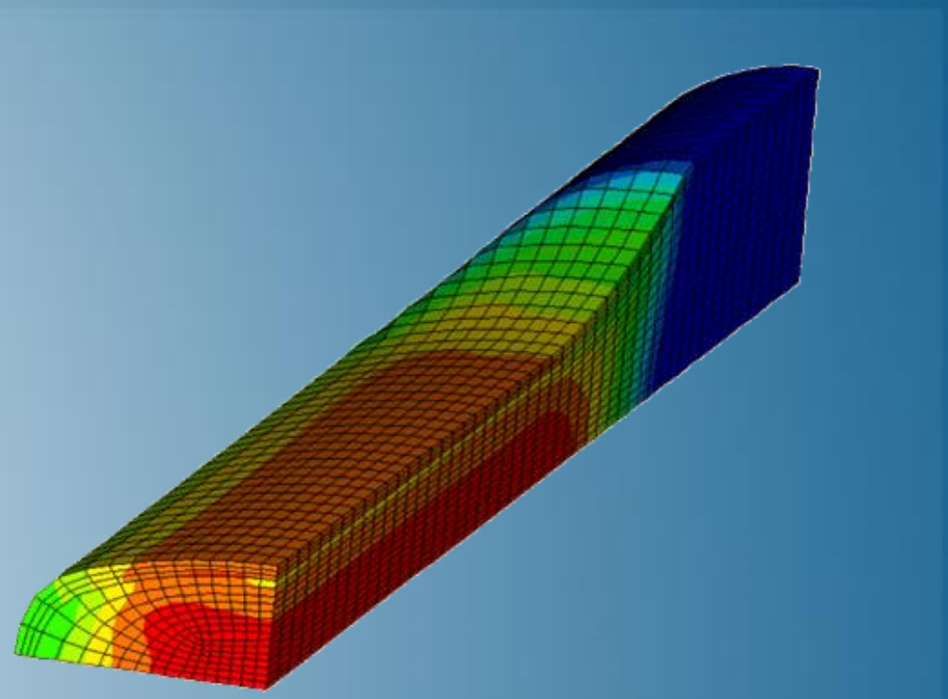
Metal Forming with Abaqus

Abaqus 2019



3DEXPERIENCE®

About this Course

Course objectives

In this course you will learn practical modeling skills and techniques for:

- Stamping
- Hydroforming
- Punch stretching
- Forging
- Rolling
- Drawing
- Superplastic forming

Targeted audience

This course is recommended for engineers with experience using Abaqus

Prerequisites

None

3 days

Day 1

- Lecture 1 Introduction
- Lecture 2 Solution Procedures in Abaqus
- Lecture 3 Contact
  - Workshop 1 Bulk Forming of a Cup
- Lecture 4 Elements
- Lecture 5 Materials

Day 2

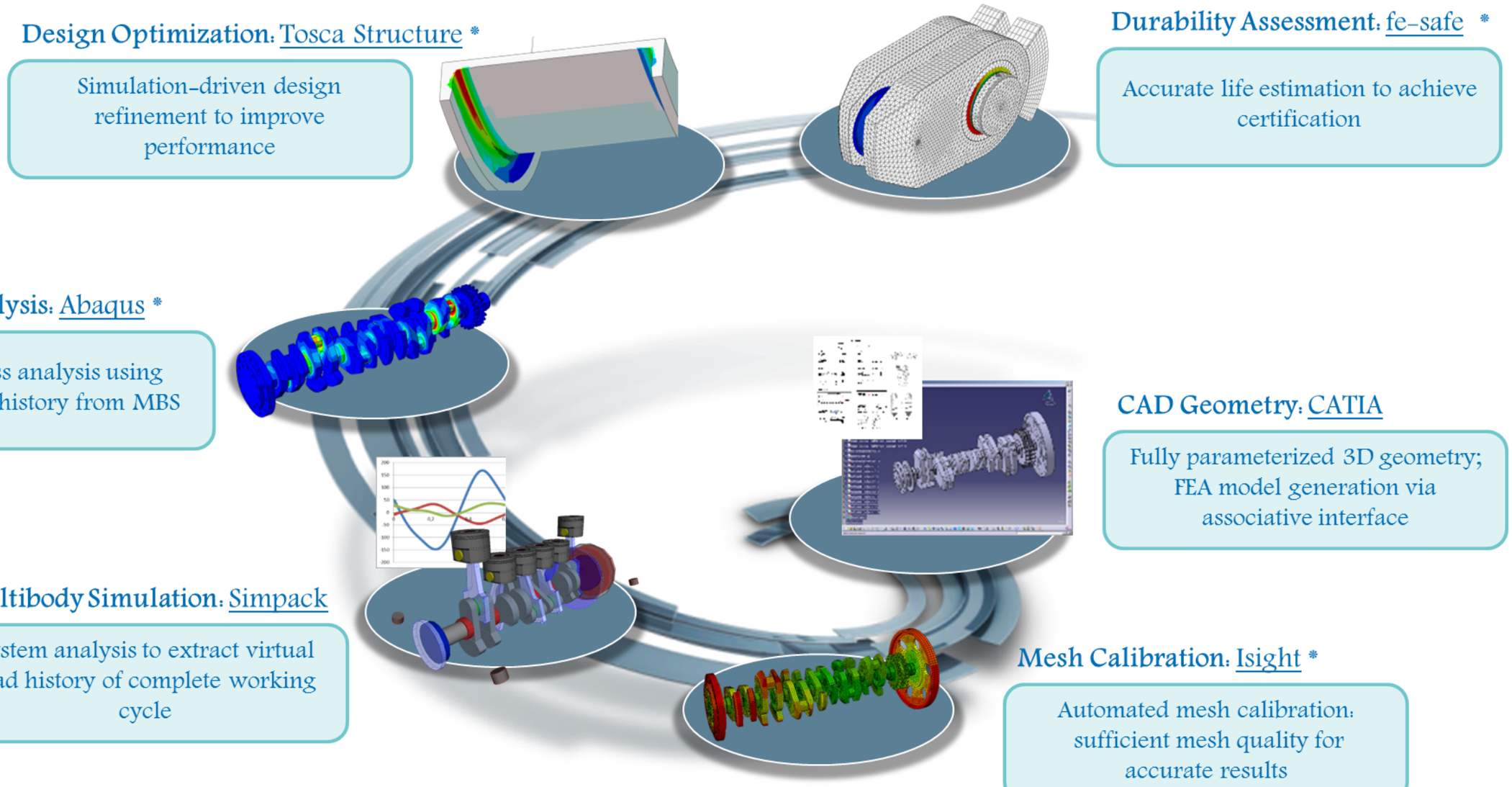
- Lecture 6 Adaptive Meshing
- Lecture 7 Modeling Quasi-Static Processes Using Abaqus/Explicit
  - Workshop 2 Rolling of a Thick Plate
- Lecture 8 Transferring Results between Abaqus Analyses
  - Workshop 3 Production of an Angle Bracket
- Lecture 9 Model Change
- Lecture 10 Thermal Effects

Day 3 (Selected topics as time permits)

- Lecture 11 Rolling Analysis
- Lecture 12 Multi-Pass Rolling
- Lecture 13 Drawbead Modeling
- Lecture 14 Hydroforming
- Lecture 15 Superelastic Forming Analysis with Abaqus

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 *

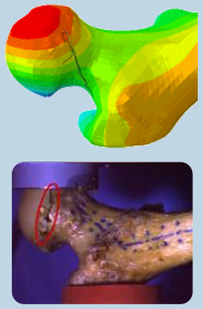
Automated mesh calibration: sufficient mesh quality for accurate results

* Included in extended licensing pool

SIMULIA's Power of the Portfolio

Abaqus

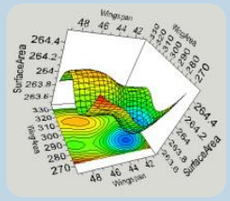
- Routine and Advanced Simulation
- Linear and Nonlinear, Static and Dynamic
- Thermal, Electrical, Acoustics
- Extended Physics through Co-simulation
- Model Preparation and Visualization



Realistic Human Simulation
High Speed Crash & Impact
Noise & Vibration

Isight

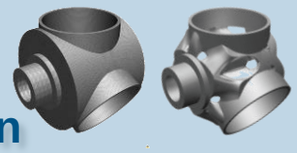
- Process Integration
- Design Optimization
- Parametric Optimization
- Six Sigma and Design of Experiments



Material Calibration
Workflow Automation
Design Exploration

Tosca

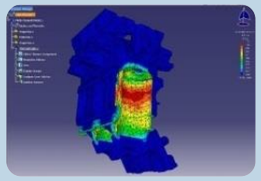
- Non-Parametric Optimization
- Structural and Fluid Flow Optimization
- Topology, Sizing, Shape, Bead Optimization



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

fe-safe

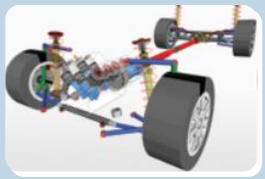
- Durability Simulation
- Low Cycle and High Cycle Fatigue
- Weld, High Temperature, Non-metallics



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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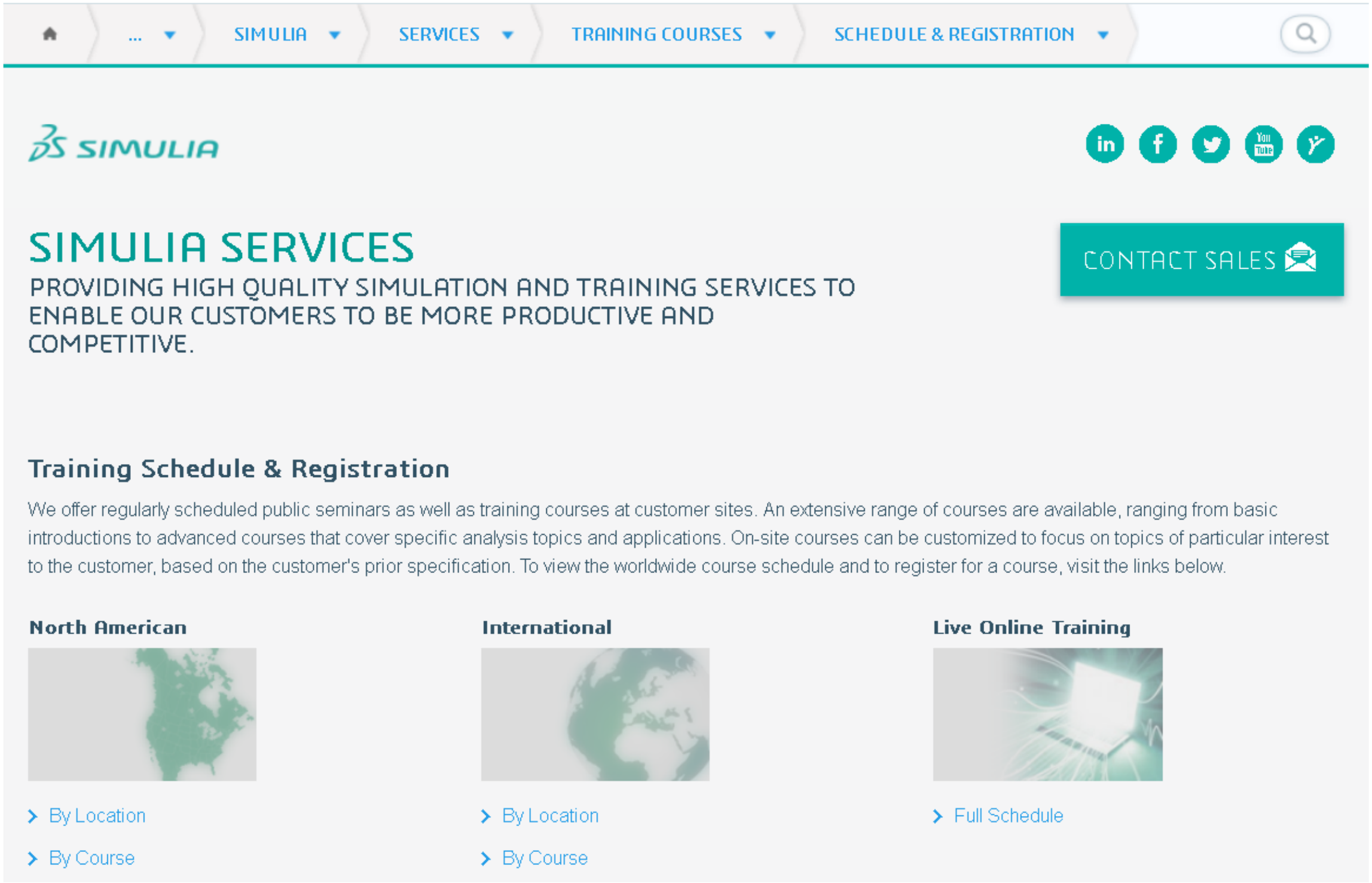

Legal Notices

Revision Status

Lecture 1	11/18	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
Lecture 7	11/18	Updated for Abaqus 2019
Lecture 8	11/18	Updated for Abaqus 2019
Lecture 9	11/18	Updated for Abaqus 2019
Lecture 10	11/18	Updated for Abaqus 2019
Lecture 11	11/18	Updated for Abaqus 2019
Lecture 12	11/18	Updated for Abaqus 2019
Lecture 13	11/18	Updated for Abaqus 2019
Lecture 14	11/18	Updated for Abaqus 2019
Lecture 15	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

Lesson 1: Introduction

Lesson content:

- Introduction
- Forming Processes
- Motivation Behind Metal Forming Simulation

45 minutes

Lesson 2: Solution Procedures with Abaqus

Lesson content:

- Introduction
- Equilibrium
- Implicit Solution of Static Equilibrium
- Explicit Solution of Dynamic Equilibrium
- Implicit and Explicit Procedures for Metal Forming

45 minutes

Lesson 3: Contact

Lesson content:

- Introduction to Modeling Contact
- Defining General Contact
- General Contact Output
- Limitations of General Contact
- Contact Pairs
- Contact Pair Output
- Contact Constraint Algorithm
- Friction
- Contact Modeling Tips
- Rigid Bodies in Abaqus
- Workshop Preliminaries
- Workshop 1: Bulk Forming of a Cup (IA)
- Workshop 1: Bulk Forming of a Cup (KW)

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

3 hours

Lesson 4: Elements

Lesson content:

- Introduction
- Continuum Elements
- Structural Elements
- Special-Purpose Elements
- Element Selection in Scoping Studies
- Hourglassing
- Secondary-order Accuracy

1.5 hours

Lesson 5: Materials

Lesson content:

- Introduction
- Elasticity
- Mises Plasticity
- Anisotropic (Hill's) Plasticity
- Gurson Model
- Rate Dependence
- Annealing
- Forming Limit Diagrams

1.5 hours

Lesson 6: Adaptive Meshing

Lesson content:

- Introduction to Adaptive Meshing
- Arbitrary Lagrangian-Eulerian (ALE) Method
- Lagrangian Adaptive Mesh Domains
- Eulerian Adaptive Mesh Domains for Steady-state Analyses
- Additional Features of Adaptive Meshing
- Adaptive Meshing Output and Diagnostics
- Summary

1.5 hours

Lesson 7: Quasi-Static Analyses

Lesson content:

- Introduction
- Quasi-Static Simulations Using Explicit Dynamics
- Loading Rates
- Energy Balance in Quasi-Static Analyses
- Mass Scaling
- Viscous Pressure
- Summary
- Workshop 2: Rolling of a Thick Plate (IA)
- Workshop 2: Rolling of a Thick Plate (KW)

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

2.5 hours

Lesson 8: Transferring Results between Abaqus Analyses

Lesson content:

- Introduction
- Import from Abaqus/Explicit to Abaqus/Standard
- Import from Abaqus/Standard to Abaqus/Explicit
- Import from Abaqus/Explicit to Abaqus/Explicit
- Additional Import Modeling Issues
- Limitations
- Demonstration
- Workshop 3: Production of an Angle Bracket (IA)
- Workshop 3: Production of an Angle Bracket (KW)

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

2 hours

Lesson 9: Model Change

Lesson content:

- Introduction
- Multistage Forming Processes
- Element Removal in Abaqus/Standard

30 minutes

Lesson 10: Thermal Effects

Lesson content:

- Introduction
- Fully Coupled Analysis
- Adiabatic Analysis
- Rigid Bodies in Thermal-Stress Analysis

45 minutes

Lesson 11: Rolling Analysis

Lesson content:

- Introduction
- Hot Rolling with Abaqus/Explicit
- Single Pass Simulation
- Steady-State Analysis
- Transient Analysis

45 minutes

Lesson 12: Multi-Pass Rolling Analysis

Lesson content:

- Multi-Pass Simulation

30 minutes

Lesson 13: Drawbead Modeling

Lesson content:

- Introduction
- Drawbead Restraint Forces
- Nonlinear Springs
- Point Masses with Node-Based Contact
- Example: Forming of a Fender

45 minutes

Lesson 14: Hydroforming

Lesson content:

- Introduction
- Hydroforming Processes
- Hydroforming Example

30 minutes

Lesson 15: Superplastic Forming Analysis with Abaqus

Lesson content:

- Introduction
- Superplastic Forming Modeling
- Superplastic Forming Example

30 minutes