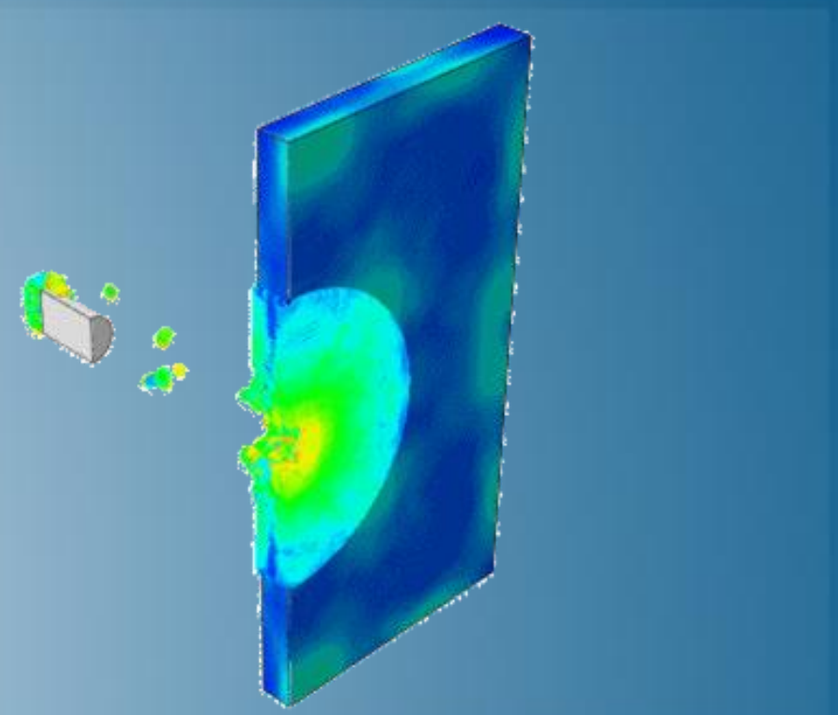
Modeling Extreme Deformation and Fluid Flow with Abaqus

Abaqus 2018



3DEXPERIENCE®

About this Course

Course objectives

Upon completion of this course you will be able to:

- Create Eulerian meshes and define the initial material location within an Eulerian mesh
- Specify initial conditions, boundary conditions and loads to materials in the Eulerian domain
- Use general contact to model Eulerian-Lagrangian interactions
- Create SPH meshes
- Automatically convert conventional continuum elements to SPH particles
- Define initial conditions, boundary conditions, and loads on SPH particles
- Define contact interactions between SPH particles an element-based or analytical surfaces
- Understand the differences between the CEL and SPH approaches

Targeted audience

Simulation Analysts

Prerequisites

This course is recommended for engineers with experience using Abaqus

2 days

Day 1

- Lecture 1 Introduction
- Lecture 2 Overview of CEL (Coupled Eulerian-Lagrangian) Analysis
- Lecture 3 Creating a CEL Model
  - Workshop 1 Deformation of an Elastic Dam under Time-dependent Water Pressure
- Lecture 4 Abaqus/CAE Volume Fraction Tool
- Lecture 5 CEL Modeling Techniques
  - Workshop 2 Bird Strike Impact on Double-walled Aircraft Fuselage

Day 2

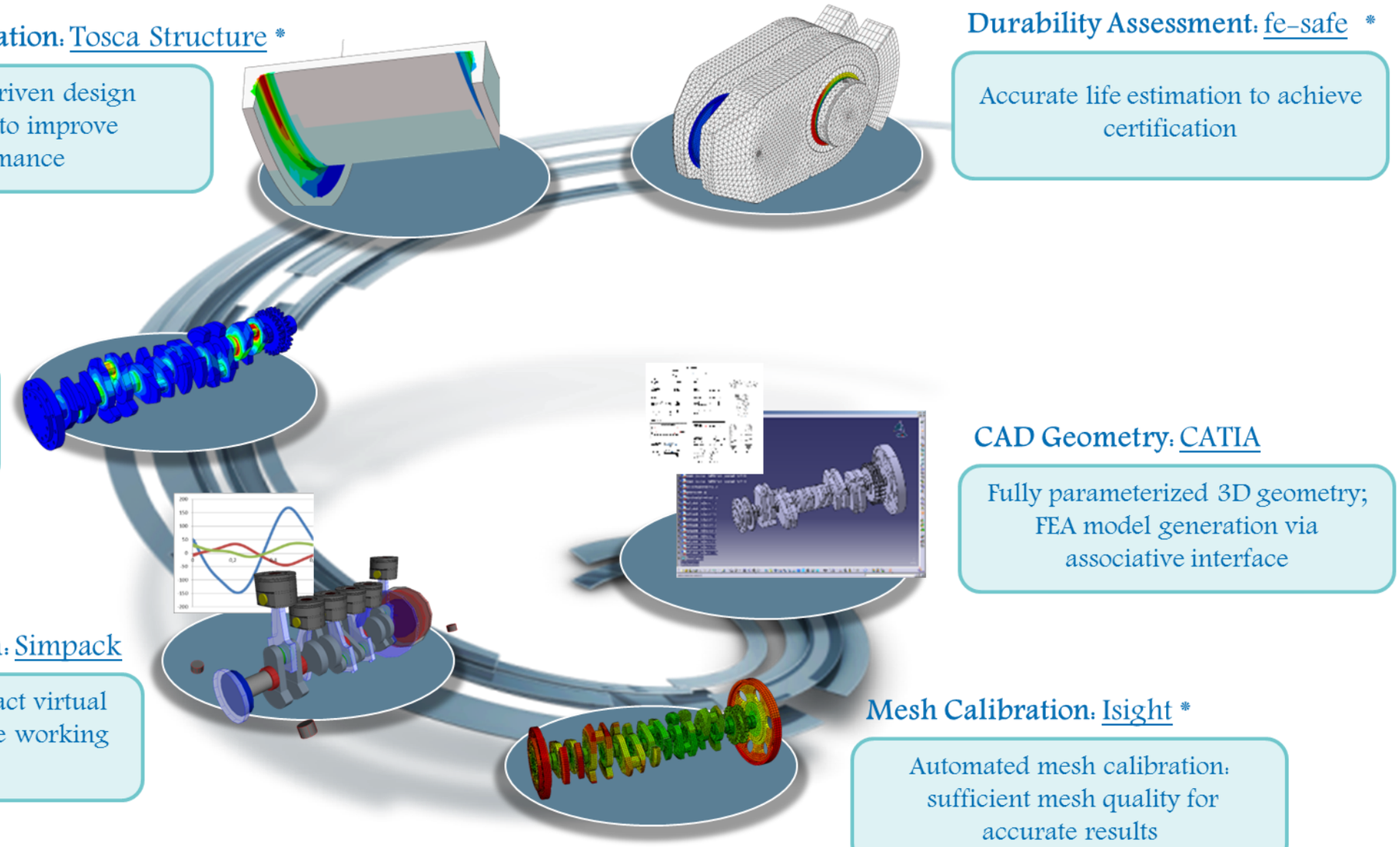
- Lecture 6 CEL for Fluid Applications
- Lecture 7 Overview of SPH (Smoothed Particle Hydrodynamics)
- Lecture 8 SPH Modeling Techniques
  - Workshop 3 Bird Strike on an Airplane Engine Blade
- Lecture 9 Comparison of CEL and SPH

Additional Material

- Appendix 1 SPH 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 *

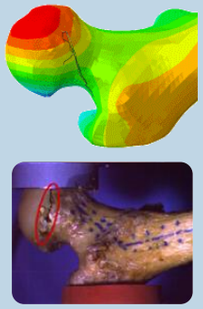
Automated mesh calibration: sufficient mesh quality for accurate results

* Included in extended licensing pool

SIMULIA's Power of the Portfolio

Abaqus

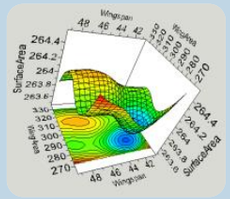
- Routine and Advanced Simulation
- Linear and Nonlinear, Static and Dynamic
- Thermal, Electrical, Acoustics
- Extended Physics through Co-simulation
- Model Preparation and Visualization



Realistic Human Simulation
High Speed Crash & Impact
Noise & Vibration

Isight

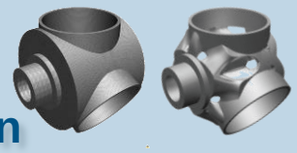
- Process Integration
- Design Optimization
- Parametric Optimization
- Six Sigma and Design of Experiments



Material Calibration
Workflow Automation
Design Exploration

Tosca

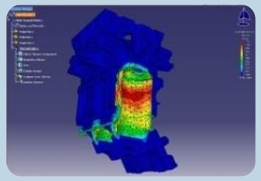
- Non-Parametric Optimization
- Structural and Fluid Flow Optimization
- Topology, Sizing, Shape, Bead Optimization



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

fe-safe

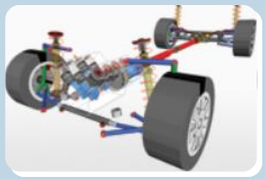
- Durability Simulation
- Low Cycle and High Cycle Fatigue
- Weld, High Temperature, Non-metallics



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

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to log in or join!

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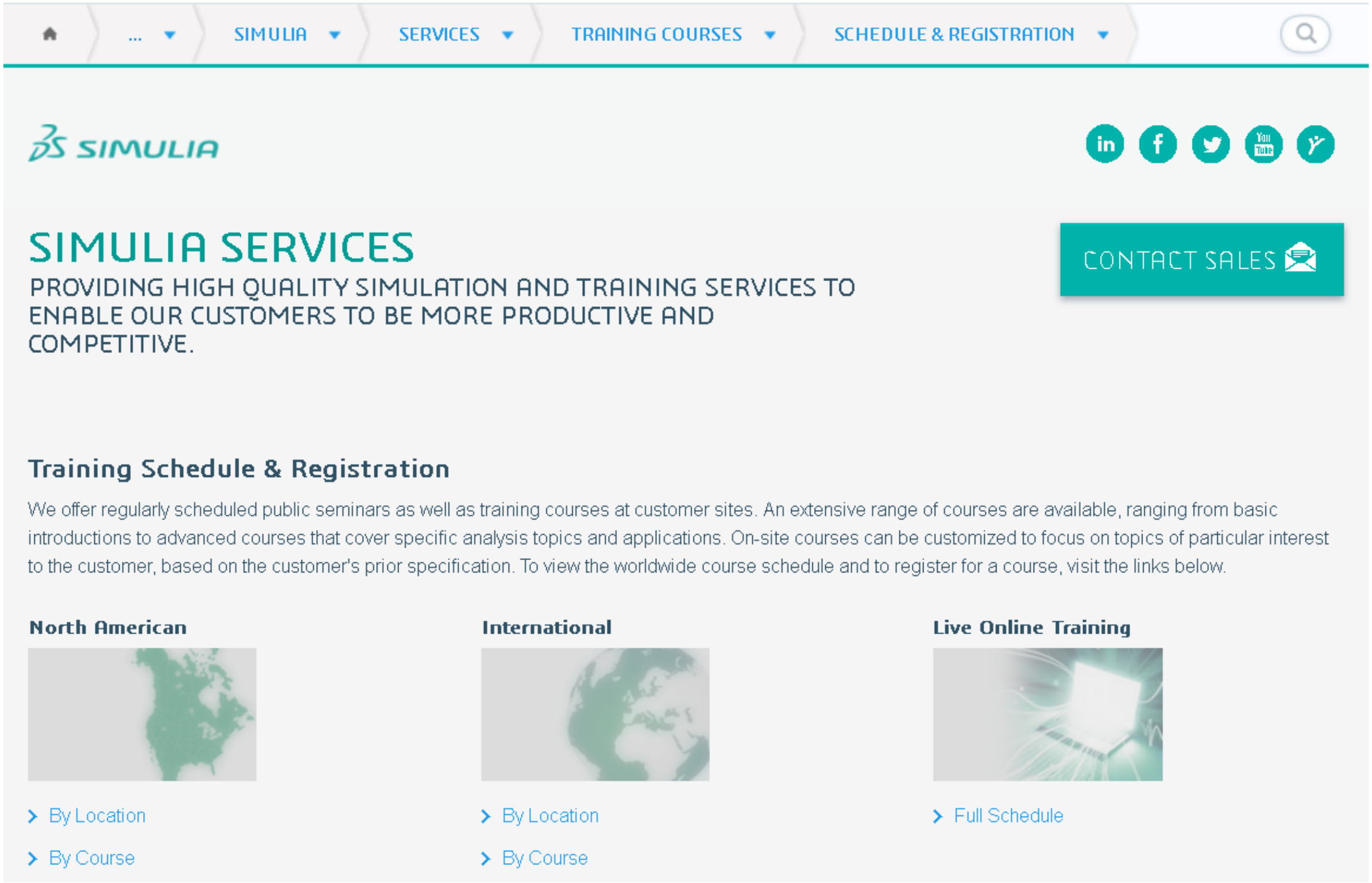

Legal Notices

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
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

Lesson 1: Introduction

Lesson content:

- Multiphysics / Multiscale Simulation
- SIMULIA Multiphysics
- Abaqus Multiphysics
- Coupled Eulerian-Lagrangian (CEL) approach
- Smoothed Particle Hydrodynamics (SPH) approach

1 hour

Lesson 2: Overview of CEL (Coupled Eulerian-Lagrangian) Analysis

Lesson content:

- CEL Analysis Technique
- CEL Examples
- Detailed case study: Tire Hydroplaning/Aquaplaning

45 minutes

Lesson 3: Creating a CEL Model

Lesson content:

- Case Study Introduction: Front-load washing machine
- Defining the Eulerian Domain
- Eulerian-Lagrangian Coupling
- Postprocessing—Basic tips
- Postprocessing—Additional suggestions
- Summary
- Workshop Preliminaries
- Workshop 1: Deformation of an Elastic Dam under Time-dependent Water Pressure

2 hours

Lesson 4: Abaqus/CAE Volume Fraction Tool

Lesson content:

- Introduction
- Using the volume fraction tool
- Tips

30 minutes

Lesson 5: Coupled Eulerian-Lagrangian Modeling Techniques

Lesson content:

- Element types and procedures
- Initial conditions, boundary conditions, and loads
- Eulerian mesh motion
- Contact
- Mesh density
- Adaptive mesh refinement
- Materials and material instances
- Output and postprocessing
- Tracer particles
- Comparison to Lagrangian analysis
- Limitations
- Workshop 2: Bird Strike Impact on Double-walled Aircraft Fuselage

2.5 hours

Lesson 6: CEL for Fluid Applications

Lesson content:

- EOS Materials
- CEL and Flow Problems
- Flow Benchmarks
- Hourglass Control
- Boundary Reflections
- Tips
- Troubleshooting Checklist

2 hours

Lesson 7: Overview of SPH (Smoothed Particle Hydrodynamics)

Lesson content:

- Introduction
- Examples
  - Water-wave impact
  - Priming a Pump
  - Bottle Drop
  - Garden Hose
  - Taylor Test
  - Projectile Impact on a Plate
  - Hail Impact
- SPH Basics
- SPH Interpolation

1 hour

Lesson 8: SPH Modeling Techniques

Lesson content:

- Overview
- Particle elements
- Model definition
- Optional controls
- Converting finite elements to SPH particles
- Inflow and outflow
- Limitations
- Workshop 3: Bird Strike on an Airplane Engine Blade

2 hours

Lesson 9: Comparison of CEL and SPH

Lesson content:

- Abbreviations
- Material considerations
- Contact considerations
- Geometry and mesh considerations
- Analysis type considerations
- Computational considerations
- Summary tables
  - Functionality-based comparison
  - Application-based comparison

45 minutes

Appendix 1: SPH Theory

Appendix content:

- Introduction
- Basic Properties of Kernels
- Particle Approximation
- SPH Interpolation
- Lucy's Weight Function
- Characteristic Properties of SPH
- SPH Applications
- References

45 minutes