Modeling Extreme Deformation and Fluid Flow with Abaqus

Abaqus 2018

3DEXPERIENCE®
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

About this Course
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
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

- Multibody Simulation, Simpack
  System analysis to extract virtual load history of complete working cycle

- CAD Geometry, CATIA
  Fully parameterized 3D geometry; FEA model generation via associative interface

- 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

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

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

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

## Simpack
- 3D Multibody Dynamics Simulation
- Mechanical or Mechatronic Systems
- Detailed Transient Simulation (Offline and Realtime)

## Realistic Human Simulation
- High Speed Crash & Impact Noise & Vibration

## Material Calibration
- Workflow Automation
- Design Exploration

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

## Safety Factors
- Creep-Fatigue Interaction
- Weld Fatigue

## Complete System Analyses
- (Quasi-)Static, Dynamics, NVH
- Flex Bodies, Advanced Contact
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<td>11/17</td>
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Lesson content:

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

- CEL Analysis Technique
- CEL Examples
- Detailed case study: Tire Hydroplaning/Aquaplaning
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
Lesson 4: Abaqus/CAE Volume Fraction Tool

Lesson content:

- Introduction
- Using the volume fraction tool
- Tips
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
Lesson 6: CEL for Fluid Applications

Lesson content:

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