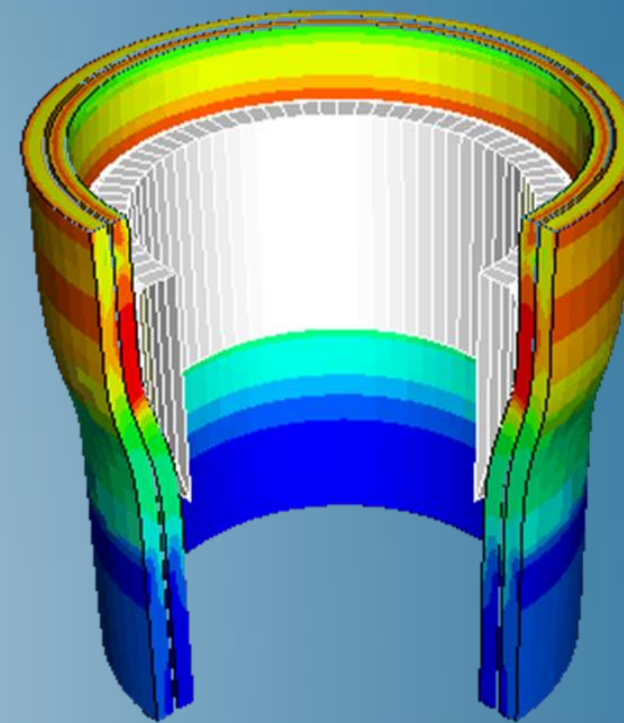


# Abaqus for Offshore Analysis

2017



3DEXPERIENCE



# About this Course

## Course objectives

The topics covered in this course include:

- ▶ Review nonlinear material behavior (metal plasticity and hyperelasticity)
- ▶ Capabilities of Abaqus element types in general
- ▶ Specific element discussions include drag chain, pipe, PSI and ITT elements
- ▶ Pipe-soil interaction, including lateral buckling of a pipe line on a seabed
- ▶ Abaqus/Aqua capabilities in Abaqus/Standard to model wave, buoyancy, current & wind loading
- ▶ Coupled Eulerian-Lagrangian (CEL) approach in Abaqus/Explicit

## Targeted audience

This course is recommended for engineers with experience using Abaqus who work in the Oil and Gas industry.

## Prerequisites

None



2 days

# Day 1

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- ▶ Lecture 1                      Overview of Abaqus
  
- ▶ Lecture 2                      Introduction to Offshore Applications with Abaqus
  - Demo 1                      A First Look at Abaqus/CAE
  - Workshop 1                Intersecting shell-pipe modeling with Abaqus/CAE
  
- ▶ Lecture 3                      What Makes a Problem Nonlinear
  
- ▶ Lecture 4                      Materials
  - Demo 2                      Rubber Material Evaluation
  
- ▶ Lecture 5                      Structural and Solid Elements in Abaqus
  - Workshop 2                Axisymmetric Pipe Expander Example
  
- ▶ Lecture 6                      Special Purpose Elements (Part 1)
  - Workshop 3                Pipeline Pull-in Analysis
  - Workshop 4                Buried Pipeline Analysis

## Day 2

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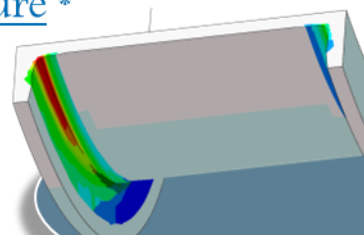
- ▶ Lecture 7                      Special Purpose Elements (Part 2)
  
- ▶ Lecture 8                      Seabed Pipe Interaction
  - Workshop 5              Lateral Buckling of a Sub-Sea Pipeline
  - Workshop 6              Threaded Connector Analysis
  
- ▶ Lecture 9                      Abaqus/Aqua Capabilities
  - Workshop 7              Abaqus/Aqua Example
  
- ▶ Lecture 10                    Coupled Eulerian-Lagrangian (CEL) Approach
  - Demo 3                    CEL interface in Abaqus/CAE
  - Workshop 8              Deformation of an Elastic Dam under Time-dependent Water Pressure
  
- ▶ Lecture 11                    Modeling Tips & Special Analysis Techniques

# SIMULIA

- ▶ SIMULIA is the Dassault Systèmes brand for Realistic Simulation solutions
- ▶ Portfolio of established, best-in-class products
  - Abaqus, Isight, Tosca, fe-safe, Simpack

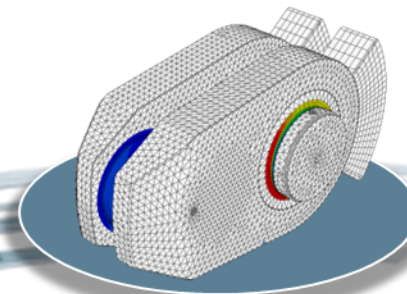
## Design Optimization: Tosca Structure \*

Simulation-driven design refinement to improve performance



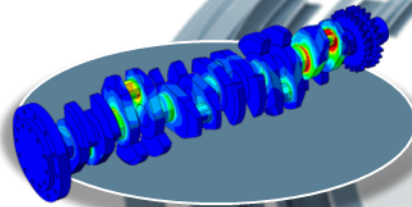
## Durability Assessment: fe-safe \*

Accurate life estimation to achieve certification



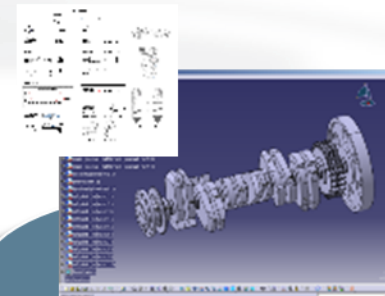
## FEA Stress Analysis: Abaqus \*

Detailed stress analysis using extracted load history from MBS



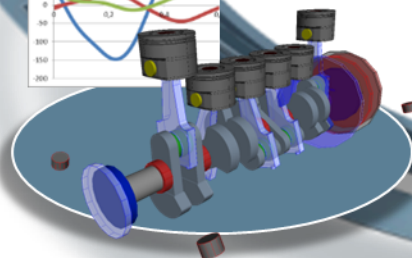
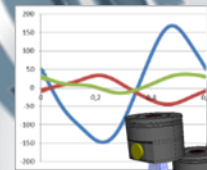
## CAD Geometry: CATIA

Fully parameterized 3D geometry; FEA model generation via associative interface



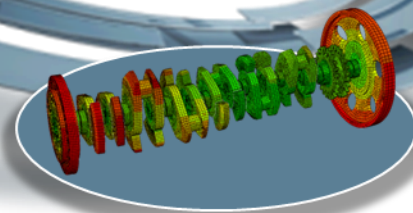
## Multibody Simulation: Simpack

System analysis to extract virtual load history of complete working cycle



## Mesh Calibration: Isight \*

Automated mesh calibration; sufficient mesh quality for accurate results



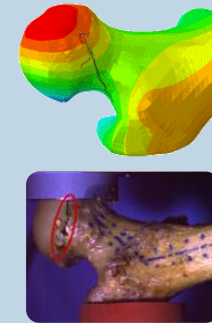
\* Included in extended licensing pool



# SIMULIA's Power of the Portfolio

## Abaqus

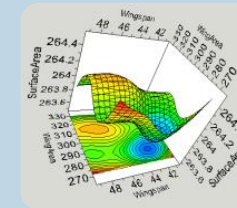
- Routine and Advanced Simulation
- Linear and Nonlinear, Static and Dynamic
- Thermal, Electrical, Acoustics
- Extended Physics through Co-simulation
- Model Preparation and Visualization



**Realistic Human Simulation  
High Speed Crash & Impact  
Noise & Vibration**

## Isight

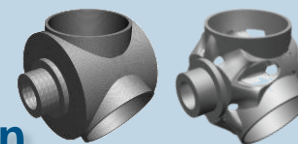
- Process Integration
- Design Optimization
- Parametric Optimization
- Six Sigma and Design of Experiments



**Material Calibration  
Workflow Automation  
Design Exploration**

## Tosca

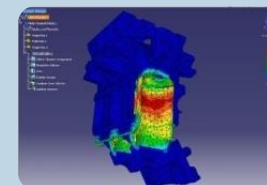
- Non-Parametric Optimization
- Structural and Fluid Flow Optimization
- Topology, Sizing, Shape, Bead Optimization



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

## fe-safe

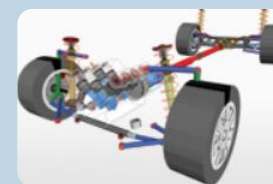
- Durability Simulation
- Low Cycle and High Cycle Fatigue
- Weld, High Temperature, Non-metallics



**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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- > By Course

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- > By Location
- > By Course

#### Live Online Training



- > Full Schedule



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# Revision Status

Lecture 1	11/16	Updated for Abaqus 2017
Lecture 2	11/16	Updated for Abaqus 2017
Lecture 3	11/16	Updated for Abaqus 2017
Lecture 4	11/16	Updated for Abaqus 2017
Lecture 5	11/16	Updated for Abaqus 2017
Lecture 6	11/16	Updated for Abaqus 2017
Lecture 7	11/16	Updated for Abaqus 2017
Lecture 8	11/16	Updated for Abaqus 2017
Lecture 9	11/16	Updated for Abaqus 2017
Lecture 10	11/16	Updated for Abaqus 2017
Lecture 11	11/16	Updated for Abaqus 2017

Demo 1	11/16	Updated for Abaqus 2017
Demo 2	11/16	Updated for Abaqus 2017
Demo 3	11/16	Updated for Abaqus 2017
Workshop 1	11/16	Updated for Abaqus 2017
Workshop 2	11/16	Updated for Abaqus 2017
Workshop 3	11/16	Updated for Abaqus 2017
Workshop 4	11/16	Updated for Abaqus 2017
Workshop 5	11/16	Updated for Abaqus 2017
Workshop 6	11/16	Updated for Abaqus 2017
Workshop 7	11/16	Updated for Abaqus 2017
Workshop 8	11/16	Updated for Abaqus 2017

# Lesson 1: Overview of Abaqus

## *Lesson content:*

- ▶ What is Abaqus FEA?
- ▶ Abaqus/CAE
- ▶ Abaqus/Standard and Abaqus/Explicit



15 minutes

# Lesson 2: Introduction

## *Lesson content:*

- ▶ Application Areas
- ▶ Statics
- ▶ Structural Processes
- ▶ Dynamics
- ▶ Lateral Buckling
- ▶ Pipe Laying
- ▶ Thermal
- ▶ Geotechnics
- ▶ Summary
- ▶ Workshop Preliminaries
- ▶ Demonstration 1: A First Look at Abaqus/CAE
- ▶ Workshop 1: Intersecting shell-pipe modeling with Abaqus/CAE



1.5 hours

# Lesson 3: Nonlinear FEA for Offshore Applications

## *Lesson content:*

- ▶ Nonlinearity in Structural Mechanics
- ▶ Including Nonlinear Effects in an Abaqus Simulation



15 minutes



# Lesson 4: Material Modeling in Abaqus

## *Lesson content:*

- ▶ Introduction
- ▶ Metal Behavior
  - ▣ Elasticity
  - ▣ Plasticity
- ▶ Rubber Behavior
  - ▣ Assumptions
  - ▣ Hyperelastic Material Models
  - ▣ Usage Tips
- ▶ Overview of Geotechnical Materials
- ▶ Demonstration 2: Rubber Material Evaluation



1 hour

# Lesson 5: Structural and Solid Elements in Abaqus

## *Lesson content:*

- ▶ Introduction
- ▶ Structural Elements in Abaqus
- ▶ Solid Elements in Abaqus
- ▶ Workshop 2: Axisymmetric Pipe Expander Example



1.5 hours

# Lesson 6: Special Purpose Elements (Part 1)

## *Lesson content:*

- ▶ Contact Elements
- ▶ Pipe-Soil Interaction Elements
- ▶ Drag Chain Elements
- ▶ Spud Can Elements
- ▶ Workshop 3: Pipeline Pull-in Analysis
- ▶ Workshop 4: Buried Pipeline Analysis



2 hours

# Lesson 7: Special Purpose Elements (Part 2)

## *Lesson content:*

- ▶ Pipe Elements
- ▶ Elbow Elements
- ▶ Axisymmetric Elements with Nonaxisymmetric Response
- ▶ Cylindrical Elements



30 minutes

# Lesson 8: Seabed-Pipe Interaction

## *Lesson content:*

- ▶ Seabed-Pipe Interaction
- ▶ Subroutine FRIC for Pipe-Soil Interaction
- ▶ Workshop 5: Lateral Buckling of a Sub-Sea Pipeline
- ▶ Workshop 6: Threaded Connector Analysis



1 .5 hours



# Lesson 9: Abaqus/Aqua

## *Lesson content:*

- ▶ Introduction
- ▶ Defining the Offshore Environment
- ▶ Defining Offshore Loads
- ▶ Workshop 7: Abaqus/Aqua Example



1.5 hours

# Lesson 10: Coupled Eulerian-Lagrangian (CEL) Approach

## *Lesson content:*

- ▶ Coupled Eulerian-Lagrangian (CEL) Approach
- ▶ Offshore Applications of CEL
- ▶ Demonstration 3: CEL interface in Abaqus/CAE
- ▶ Workshop 8: Deformation of an Elastic Dam under Time-dependent Water Pressure



1.5 hours

# Lesson 11: Modeling Tips & Special Analysis Techniques

## *Lesson content:*

- ▶ Random Waves
- ▶ Generating Seabed/Pipe-Wall Profiles
  - ▣ Abaqus/CAE - Lofting
- ▶ Scripting
- ▶ Modeling Suggestions: Pipe Laying
  - ▣ Contact modeling tips
- ▶ Modeling Suggestions: Surface Elements



1 hour