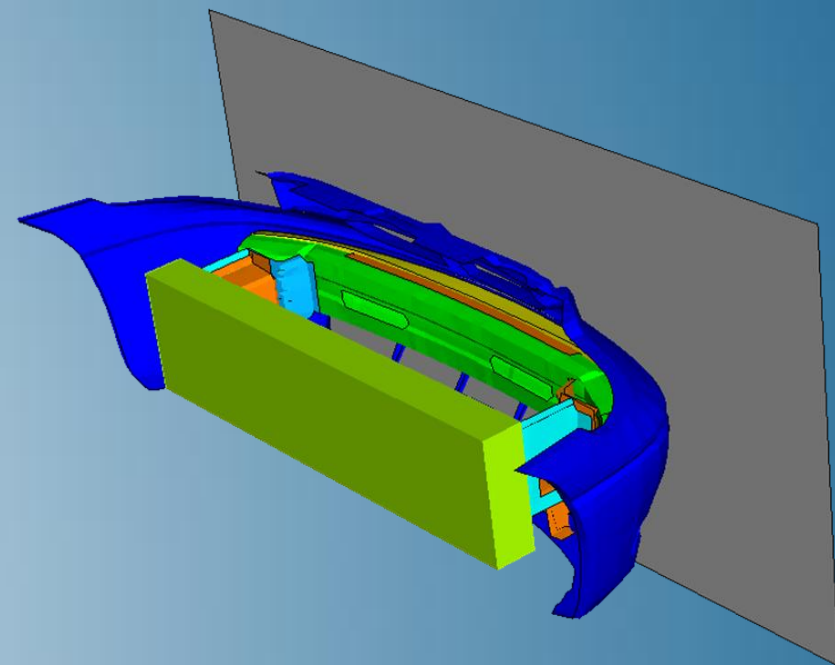


Abaqus/Explicit: Advanced Topics

Abaqus 2018



3DEXPERIENCE®



About this Course

Course objectives

Upon completion of this course you will be able to:

- ▶ Use the explicit dynamics method effectively, including the application of general contact, mass scaling, and adaptive remeshing
- ▶ Use Abaqus/Explicit and Abaqus/Standard together to solve difficult problems, including results transfer and co-simulation
- ▶ Model high-strain-rate deformation and failure
- ▶ Filter output

Targeted audience

Simulation Analysts

Prerequisites

This course is recommended for engineers with experience using Abaqus



3 days

Day 1

- ▶ Lecture 1 Overview of Abaqus/Explicit
 - Workshop 1 Conditional Stability of Abaqus/Explicit
- ▶ Lecture 2 Elements
- ▶ Lecture 3 Contact Modeling
 - Workshop 2 Impact of a Dodge Caravan Bumper Against a Rigid Barrier

Day 2

- ▶ Lecture 4 Quasi-Static Analyses
 - Workshop 3 Quasi-static Analysis of a Rubber Bushing
- ▶ Lecture 5 Constraints and Connections
- ▶ Lecture 6 Impact and Postbuckling Analyses
 - Workshop 4 Crushing of a Tube

Day 3

- ▶ Lecture 7 Material Damage and Failure
- ▶ Lecture 8 Importing and Transferring Results
 - Workshop 5 Bird Strike Simulation
- ▶ Lecture 9 Managing Large Models
- ▶ Lecture 10 Output Filtering

Additional Material

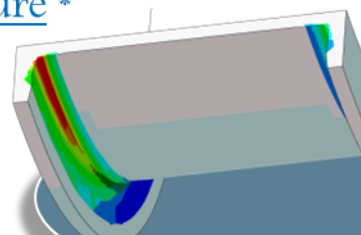
- ▶ Appendix 1 Explicit Dynamics Algorithm
- ▶ Appendix 2 Features of General Contact & Contact Pairs
- ▶ Appendix 3 Abaqus/Standard to Abaqus/Explicit Co-simulation
 - Workshop 6 Beam Impact Co-simulation

SIMULIA

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

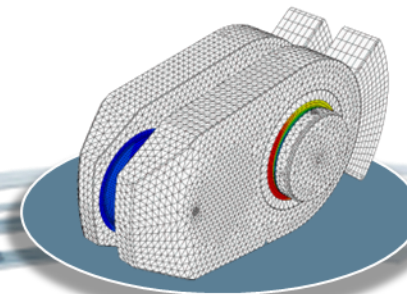
Design Optimization: Tosca Structure *

Simulation-driven design refinement to improve performance



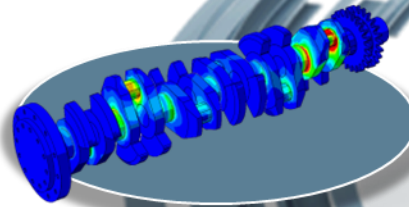
Durability Assessment: fe-safe *

Accurate life estimation to achieve certification



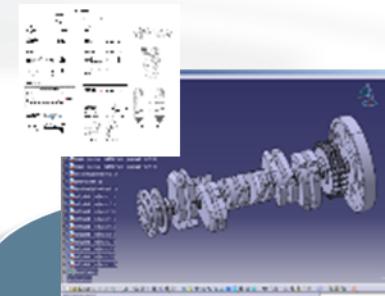
FEA Stress Analysis: Abaqus *

Detailed stress analysis using extracted load history from MBS



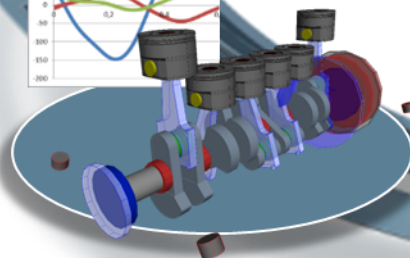
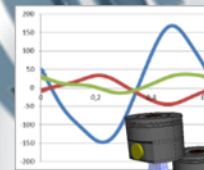
CAD Geometry: CATIA

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



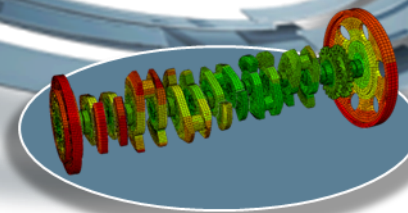
Multibody Simulation: Simpack

System analysis to extract virtual load history of complete working cycle



Mesh Calibration: Isight *

Automated mesh calibration; sufficient mesh quality for accurate results

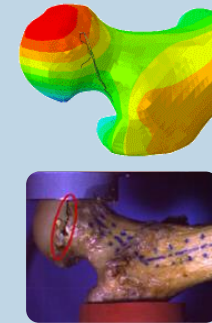


* Included in extended licensing pool

SIMULIA's Power of the Portfolio

Abaqus

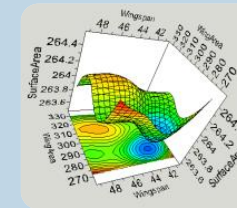
- Routine and Advanced Simulation
- Linear and Nonlinear, Static and Dynamic
- Thermal, Electrical, Acoustics
- Extended Physics through Co-simulation
- Model Preparation and Visualization



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

Isight

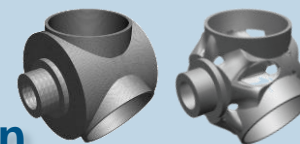
- Process Integration
- Design Optimization
- Parametric Optimization
- Six Sigma and Design of Experiments



**Material Calibration
Workflow Automation
Design Exploration**

Tosca

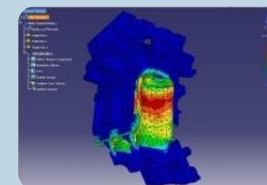
- Non-Parametric Optimization
- Structural and Fluid Flow Optimization
- Topology, Sizing, Shape, Bead Optimization



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

fe-safe

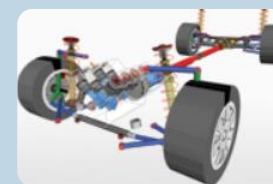
- Durability Simulation
- Low Cycle and High Cycle Fatigue
- Weld, High Temperature, Non-metallics



**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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- > By Course

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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
Workshop 6	11/17	Updated for Abaqus 2018

Lesson 1: Overview of Abaqus/Explicit

Lesson content:

- ▶ What is Explicit Dynamics?
- ▶ Abaqus/Explicit vs. Abaqus/Standard
- ▶ Some Challenging Problems
- ▶ Defining an Abaqus/Explicit Procedure
- ▶ Stable Time Increment
- ▶ Bulk Viscosity Damping
- ▶ Energy Balance
- ▶ Monitoring Diagnostic Messages
- ▶ Output
- ▶ Workshop Preliminaries
- ▶ Workshop 1: Conditional Stability of Abaqus/Explicit (IA)
- ▶ Workshop 1: Conditional Stability of Abaqus/Explicit (KW)



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



2 hours

Lesson 2: Elements

Lesson content:

- ▶ Introduction
- ▶ Solids Elements
- ▶ Shell and Membrane Elements
- ▶ Beam and Truss Elements
- ▶ Special-Purpose Elements and Techniques
- ▶ Element Distortion Control
- ▶ Hourglassing, Locking, and Other Issues
- ▶ Second-order Accuracy



1.5 hours

Lesson 3: Contact Modeling

Lesson content:

- ▶ Introduction to Contact in Abaqus/Explicit
- ▶ Basic Features of General Contact
- ▶ General Contact Surfaces
- ▶ General Contact Domain
- ▶ General Contact Interface Properties
- ▶ General Contact Constraint Enforcement
- ▶ General Contact Surface Thickness
- ▶ Edge Contact
- ▶ Initial General Contact State
- ▶ General Contact Output
- ▶ Limitations of General Contact
- ▶ Workshop 2: Impact of a Dodge Caravan Bumper Against a Rigid Barrier (IA)
- ▶ Workshop 2: Impact of a Dodge Caravan Bumper Against a Rigid Barrier (KW)



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



2.5 hours

Lesson 4: 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 3: Quasi-static Analysis of a Rubber Bushing (IA)
- ▶ Workshop 3: Quasi-static Analysis of a Rubber Bushing (KW)



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



1.5 hours

Lesson 5: Constraints and Connections

Lesson content:

- ▶ Introduction
- ▶ Rigid Bodies
- ▶ Surface-Based Coupling Constraints
- ▶ Connector Elements
- ▶ Surface-Based Ties
- ▶ Offset Tied Interfaces
- ▶ Mesh-Independent Fasteners
- ▶ Cohesive Connections
- ▶ Virtual Crack Closure Technique
- ▶ Tips



2.5 hours

Lesson 6: Impact and Postbuckling Analyses

Lesson content:

- ▶ Impact Analysis
- ▶ Geometric Imperfections for Postbuckling Analyses
- ▶ Workshop 4: Crushing of a Tube (IA)
- ▶ Workshop 4: Crushing of a Tube (KW)



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



2 hours

Lesson 7: Material Damage and Failure

Lesson content:

- ▶ Progressive Damage and Failure
- ▶ Damage Initiation
- ▶ Damage Evolution
- ▶ Element Removal
- ▶ Damage in Fasteners



1.5 hours

Lesson 8: Importing and Transferring Results

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
- ▶ Workshop 5: Bird Strike Simulation (IA)
- ▶ Workshop 5: Bird Strike Simulation (KW)



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



2 hours

Lesson 9: Managing Large Models

Lesson content:

- ▶ Introduction
- ▶ Simplifying the Model
- ▶ Parallel Execution
- ▶ Techniques for Reducing CPU Time
- ▶ Submodeling
- ▶ Restart
- ▶ Parts and Assemblies
- ▶ Tips



1.5 hours

Lesson 10: Output Filtering

Lesson content:

- ▶ Introduction
- ▶ What is aliasing?
- ▶ Preventing aliasing
- ▶ Abaqus/Viewer postprocessing filters
- ▶ Filter options
- ▶ Filter distortions
- ▶ References



1.5 hours

Appendix 1: Explicit Dynamics Algorithm

Appendix content:

- ▶ Explicit Dynamics Algorithm



30 minutes

Appendix 2: Contact Pairs

Appendix content:

▶ Contact Pairs



1 hour

Appendix 3: Co-simulation

Appendix content:

- ▶ Introduction
- ▶ Examples
- ▶ Co-simulation modeling
 - General concepts
 - Keyword interface
 - Interactive interface
- ▶ Postprocessing
- ▶ Substructuring
- ▶ Technology notes
- ▶ Workshop 6: Beam Impact Co-simulation (IA)
- ▶ Workshop 6: Beam Impact Co-simulation (KW)



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



3 hours