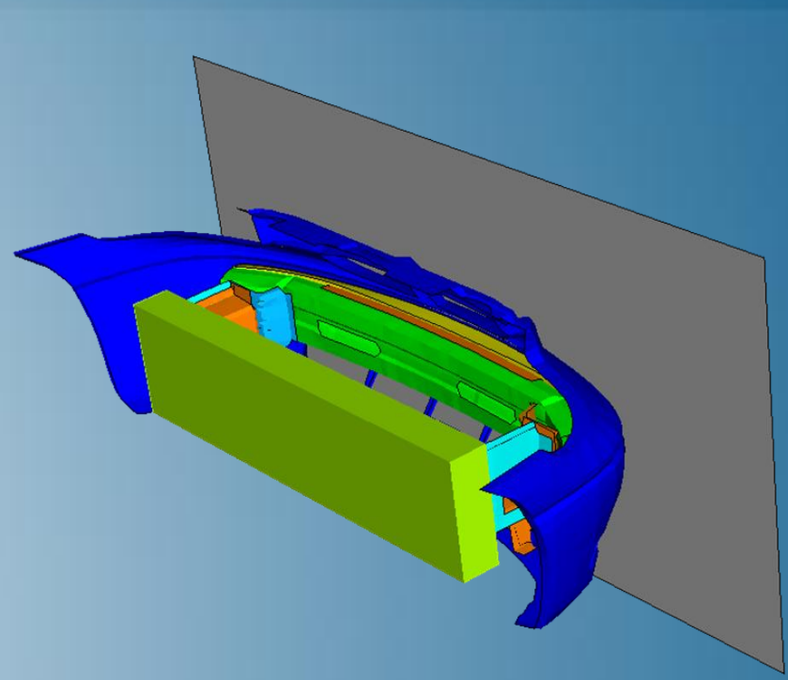
DASSAULT SYSTEMES

Abaqus/Explicit: Advanced Topics

Abaqus 2020



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

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

Day 2

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

Day 3

- Lesson 7 Material Damage and Failure
- Lesson 8 Importing and Transferring Results
  - Workshop 5 Bird Strike Simulation
- Lesson 9 Managing Large Models
- Lesson 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

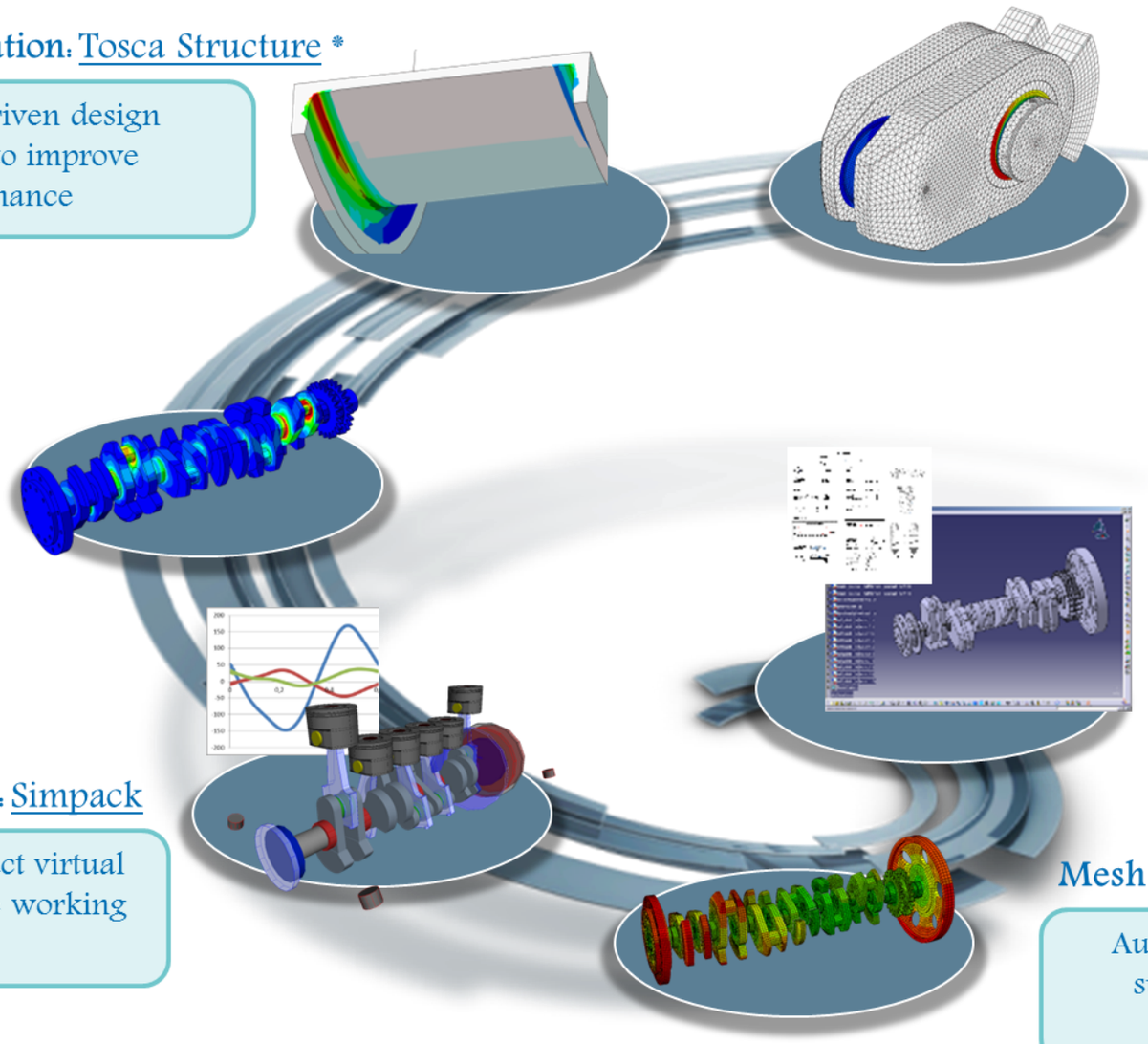
- SIMULIA is the Dassault Systèmes brand for Realistic Simulation solutions
- Portfolio of established, best-in-class products
  - Abaqus, Isight, Tosca, fe-safe, Simpack

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 *

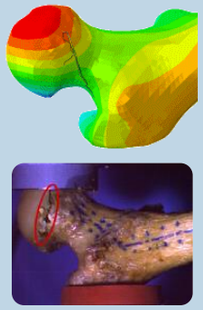
Automated mesh calibration: sufficient mesh quality for accurate results

* Included in extended licensing pool

SIMULIA's Power of the Portfolio

Abaqus

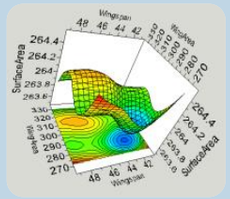
- Routine and Advanced Simulation
- Linear and Nonlinear, Static and Dynamic
- Thermal, Electrical, Acoustics
- Extended Physics through Co-simulation
- Model Preparation and Visualization



Realistic Human Simulation
High Speed Crash & Impact
Noise & Vibration

Isight

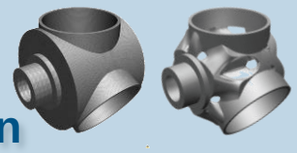
- Process Integration
- Design Optimization
- Parametric Optimization
- Six Sigma and Design of Experiments



Material Calibration
Workflow Automation
Design Exploration

Tosca

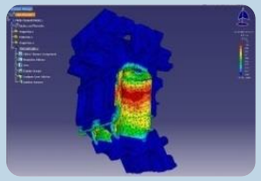
- Non-Parametric Optimization
- Structural and Fluid Flow Optimization
- Topology, Sizing, Shape, Bead Optimization



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

fe-safe

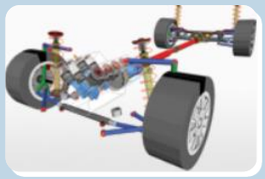
- Durability Simulation
- Low Cycle and High Cycle Fatigue
- Weld, High Temperature, Non-metallics



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

Join the Community!

How can you maximize the robust technology of the SIMULIA Portfolio ?

Connect with peers to share knowledge and get technical insights

Go to www.3ds.com/slc
to log in or join!

SIMULIA

Let the SIMULIA Learning Community be *Your* Portal to 21st Century Innovation

Discover new ways to explore how to leverage realistic simulation to drive product innovation. Join the thousands of Abaqus and Isight users who are already gaining valuable knowledge from the SIMULIA Learning Community.

For more information and registration, visit **3ds.com/simulia-learning**.
Connect. Share. Spark Innovation.

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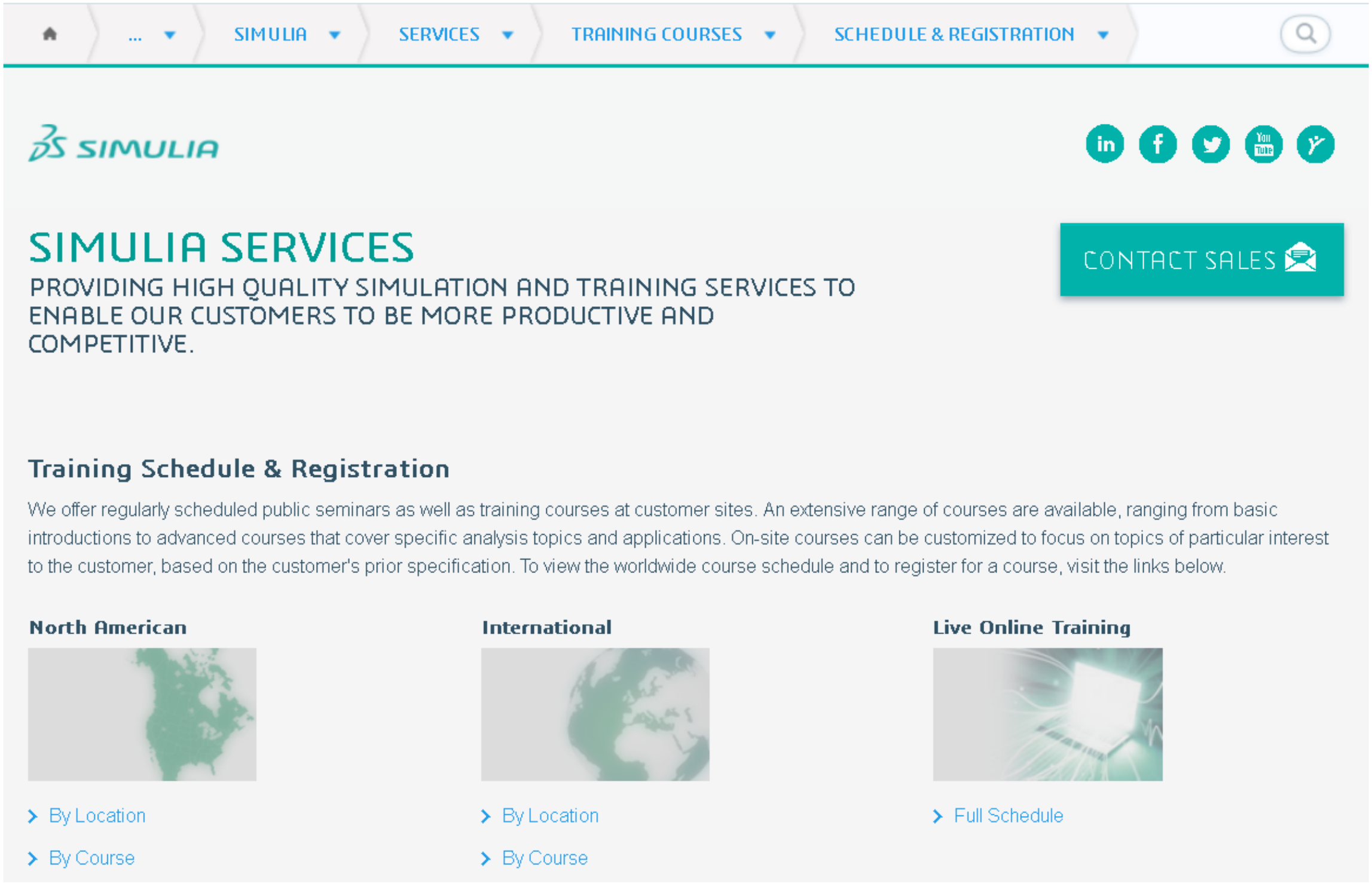
SIMULIA Training

http://www.3ds.com/products-services/simulia/services/training-courses/



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Revision Status

Lesson 1	11/19	Updated for Abaqus 2020
Lesson 2	11/19	Updated for Abaqus 2020
Lesson 3	11/19	Updated for Abaqus 2020
Lesson 4	11/19	Updated for Abaqus 2020
Lesson 5	11/19	Updated for Abaqus 2020
Lesson 6	11/19	Updated for Abaqus 2020
Lesson 7	11/19	Updated for Abaqus 2020
Lesson 8	11/19	Updated for Abaqus 2020
Lesson 9	11/19	Updated for Abaqus 2020
Lesson 10	11/19	Updated for Abaqus 2020

Appendix 1	11/19	Updated for Abaqus 2020
Appendix 2	11/19	Updated for Abaqus 2020
Appendix 3	11/19	Updated for Abaqus 2020
Workshop 1	11/19	Updated for Abaqus 2020
Workshop 2	11/19	Updated for Abaqus 2020
Workshop 3	11/19	Updated for Abaqus 2020
Workshop 4	11/19	Updated for Abaqus 2020
Workshop 5	11/19	Updated for Abaqus 2020
Workshop 6	11/19	Updated for Abaqus 2020

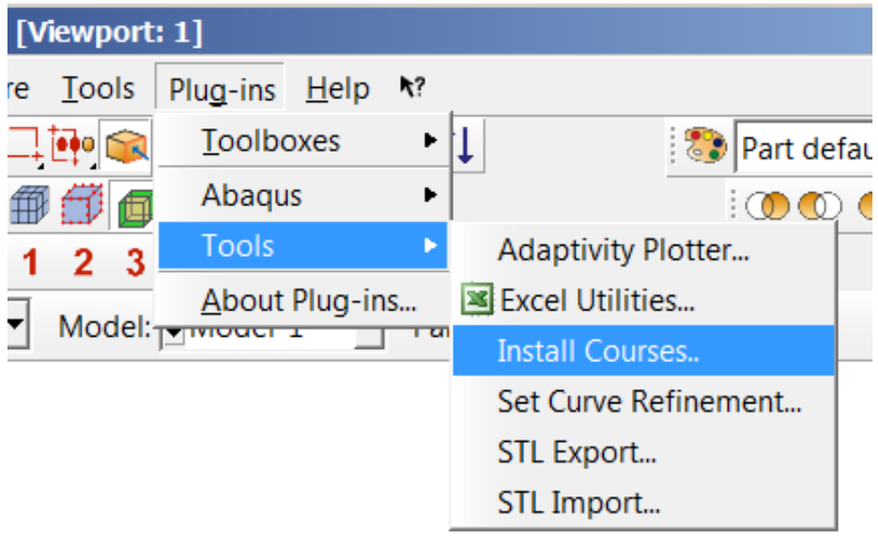
Environment Requirements for this course

This course does not contain any software installation files necessary to perform the exercises. In order to practice, you must have access to a software installation and environment that includes:

- Client application installed on your machine
  - Abaqus 2020

To install the files necessary to complete the workshop exercises, please do the following:

1. From the main menu bar of Abaqus/CAE, select **Plug-ins→Tools→Install Courses**.
2. In the **Install Courses** dialog box:
   - Specify the directory to which the files will be written.
   - Choose the course(s) for which the files will be extracted.
   - Click **OK**.



If you have any questions on how to access your environment, please contact your assigned Dassault Systèmes support team. You may also contact your education provider using the information on the **Contact us** page on the **Companion Learning Space** (**Help > Contact Us** menu.)

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

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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

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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

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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

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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

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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

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Lesson 7: Material Damage and Failure

Lesson content:

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

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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

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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

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Lesson 10: Output Filtering

Lesson content:

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

1.5 hours

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Appendix 1: Explicit Dynamics Algorithm

Appendix content:

- Explicit Dynamics Algorithm

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30 minutes

Appendix 2: Contact Pairs

Appendix content:

- Contact Pairs

1 hour

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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

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