Modeling Contact with Abaqus/Standard

Abaqus 2020
Course objectives
Upon completion of this course you will be able to:

- Define general contact and contact pairs
- Define appropriate surfaces (rigid or deformable)
- Model frictional contact
- Model large sliding between deformable bodies
- Resolve overclosures in interference fit problems

Targeted audience
Simulation Analysts

Prerequisites
This course is recommended for engineers with experience using Abaqus/Standard
Day 1

Lesson 1  Introduction

Lesson 2  Contact Workflow

  Workshop 1  Compression of a Rubber Seal

Lesson 3  Surface-based Contact

  Workshop 2  Lap Joint Analysis

Lesson 4  Contact Logic and Diagnostics Tools

  Workshop 3  Bolted Flange Analysis
Day 2

- Lesson 5  Contact Properties
  - Workshop 4  Disk Forging Analysis
- Lesson 6  Interference Fits
  - Workshop 5  Interference Fit Analysis
  - Workshop 6  Syringe Analysis (optional)
- Lesson 7  Additional Features
  - Workshop 7  Pipe Reel Analysis
- Lesson 8  Modeling Tips
  - Workshop 8  Bolted Flange Analysis: Infinitesimal Sliding
  - Workshop 9  Snap Fit Analysis
  - Workshop 10  Analysis of a Radial Shaft Seal (optional)
Additional Material

- Appendix 1 Node-to-Surface Formulation
- Appendix 2 Contact Elements
- Appendix 3 Dynamic Contact using Implicit Integration
SIMULIA is the Dassault Systèmes brand for Realistic Simulation solutions

Portfolio of established, best-in-class products

- Abaqus, Isight, Tosca, fe-safe, Simpack

* Included in extended licensing pool
<table>
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<th>SIMULIA's Power of the Portfolio</th>
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<tr>
<td><strong>Abaqus</strong></td>
</tr>
<tr>
<td>- Routine and Advanced Simulation</td>
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<tr>
<td>- Linear and Nonlinear, Static and Dynamic</td>
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<tr>
<td>- Thermal, Electrical, Acoustics</td>
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<td>- Extended Physics through Co-simulation</td>
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<td>- Model Preparation and Visualization</td>
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<td><strong>Isight</strong></td>
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<tr>
<td>- Process Integration</td>
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<tr>
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<td>- Parametric Optimization</td>
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<td>- Six Sigma and Design of Experiments</td>
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<td><strong>Tosca</strong></td>
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<tr>
<td>- Non-Parametric Optimization</td>
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<td>- Topology, Sizing, Shape, Bead Optimization</td>
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<td><strong>fe-safe</strong></td>
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<tr>
<td>- Durability Simulation</td>
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<td>- Low Cycle and High Cycle Fatigue</td>
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<td>- Weld, High Temperature, Non-metallics</td>
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<td><strong>Simpack</strong></td>
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<td>- 3D Multibody Dynamics Simulation</td>
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<td>- Mechanical or Mechatronic Systems</td>
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<td>- Detailed Transient Simulation (Offline and Realtime)</td>
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**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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Lesson 1: Introduction

Lesson content:

- General Considerations
- Surface-based Contact
- Contact Examples
- Ingredients of a Contact Model
Lesson content:

- Defining General Contact
- Defining Contact Pairs
- Defining Surfaces
- Workshop Preliminaries
- Workshop 1: Compression of a Rubber Seal (IA)
- Workshop 1: Compression of a Rubber Seal (KW)

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

- Contact Formulations
- Contact Discretization
- Contact Enforcement Methods
- Relative Sliding Between Bodies
- Contact Output
- Summary
- Workshop 2: Lap Joint Analysis (IA)
- Workshop 2: Lap Joint Analysis (KW)

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

2 hours
Lesson 4: Contact Logic and Diagnostics Tools

Lesson content:

- Newton Method
- The Contact Algorithm
- Contact Diagnostics: Visual
- Contact Diagnostics: Text
- Workshop 3: Bolted Flange Analysis (IA)
- Workshop 3: Bolted Flange Analysis (KW)

Both interactive (IA) and keywords (KW) versions of the workshop are provided. Complete only one.
Lesson 5: Contact Properties

Lesson content:

- Pressure-Overclosure Models
- Friction Models
- Friction Enforcement
- Workshop 4: Disk Forging Analysis (IA)
- Workshop 4: Disk Forging Analysis (KW)

Both interactive (IA) and keywords (KW) versions of the workshop are provided. Complete only one.
Lesson 6: Interference Fits

Lesson content:

- Initial Overclosure
- Strain-free Adjustments
- Interference Fit Problems
- Interference Fit Techniques for General Contact
- Interference Fit Techniques for Contact Pairs
- Interference Fit Example
- Precise Specification of Clearances
- Geometric Smoothing for Curved Surfaces
- Workshop 5: Interference Fit Analysis (IA)
- Workshop 5: Interference Fit Analysis (KW)
- Workshop 6: Syringe Analysis (IA)
- Workshop 6: Syringe Analysis (KW)

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

3 hours
Lesson 7: Additional Features

Lesson content:
- Beam Contact
- Tie Constraints
- Rigid Bodies and Contact
- Analytical Rigid Surfaces
- Pre-Tensioning of Cross-Sections
- Pressure Penetration
- Contact in Linear Perturbation Procedures
- Initial Stresses for Contact
- Workshop 7: Pipe Reel Analysis (IA)
- Workshop 7: Pipe Reel Analysis (KW)

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

2 hours
Lesson 8: Modeling Tips

Lesson content:

- Initial Rigid Body Motion
- Overconstraint
- Contact with Quadratic Elements
- Unsymmetric Matrices in Finite-Sliding Problems
- Dynamic Instabilities
- Modeling Corners and Edges
- Workshop 8: Bolted Flange Analysis: Infinitesimal Sliding (IA)
- Workshop 8: Bolted Flange Analysis: Infinitesimal Sliding (KW)
- Workshop 9: Snap Fit Analysis (IA)
- Workshop 9: Snap Fit Analysis (KW)
- Workshop 10: Analysis of a Radial Shaft Seal (IA)
- Workshop 10: Analysis of a Radial Shaft Seal (KW)

Both interactive (IA) and keywords (KW) versions of the workshop are provided. Complete only one.
Appendix 1: Node-to-Surface Formulation

Appendix content:

- Discretization
- Finite Sliding: Surface Considerations
- Small Sliding Characteristics
- Small Sliding: Local Contact Plane
- Small Sliding: Surface Considerations
Appendix 2: Contact Elements

Appendix content:

- Surface-Based vs. Contact Element Approach
- Contact Elements
- Contact Element Output
- Contact Element Visualization

1 hour
Appendix 3: Dynamic Contact using Implicit Integration

Appendix content:

- Time Integration Issues
- Implicit Dynamics
- Damping
- Impact Problems