Connector Elements and Mechanism Analysis with Abaqus

Abaqus 2019

3DEXPERIENCE®

About this Course

Course objectives

The topics include:

- Comparison of connectors and MPCs
- Basic connector components
- Assembled kinematic connections
- Local relative displacements and rotations
- Defining stops and locks
- Defining connector friction
- Connector failure
- Actuating components of relative motion
- Sensors and actuators
- Output and postprocessing

Targeted audience

Simulation Analysts

Prerequisites

This course is recommended for engineers with experience using Abaqus

2 days

Day 1

- Lecture 1 Mechanisms and Multibodies in Abaqus
- Lecture 2 Connection Elements and Library (Part 1)
  - Workshop 1 Hinge Connection
- Lecture 3 Connection Elements and Library (Part 2)
  - Workshop 2a Analysis of a UJOINT
  - Workshop 2b Four-Stroke Engine (Part 1)
- Lecture 4 Connector Builder
  - Workshop 3a Modeling Pliers
  - Workshop 3b Four-Stroke Engine (Part 2)
- Lecture 5 Overconstraints and Connectors
  - Workshop 4 Overconstraints: Hinge Model

Day 2

- Lecture 6 Connector Behavior (Part 1)
  - Workshop 5a Connector Attributes – Hinge Model
  - Workshop 5b Connector Attributes – Four-Stroke Engine Model
- Lecture 7 Connector Behavior (Part 2)
  - Workshop 6a Analysis of a Spot Weld
  - Workshop 6b Connector Friction
- Lecture 8 Rotational Connector Elements in Mechanism Analysis
  - Workshop 7 Rotational Connector Elements
- Lecture 9 Connector Actuation and Output
  - Workshop 8 Analysis of a Simple Four-Stroke Engine

Additional Material

- Appendix 1 Some Advanced Connection Types
- Appendix 2 Connector Uniaxial Behavior

SIMULIA

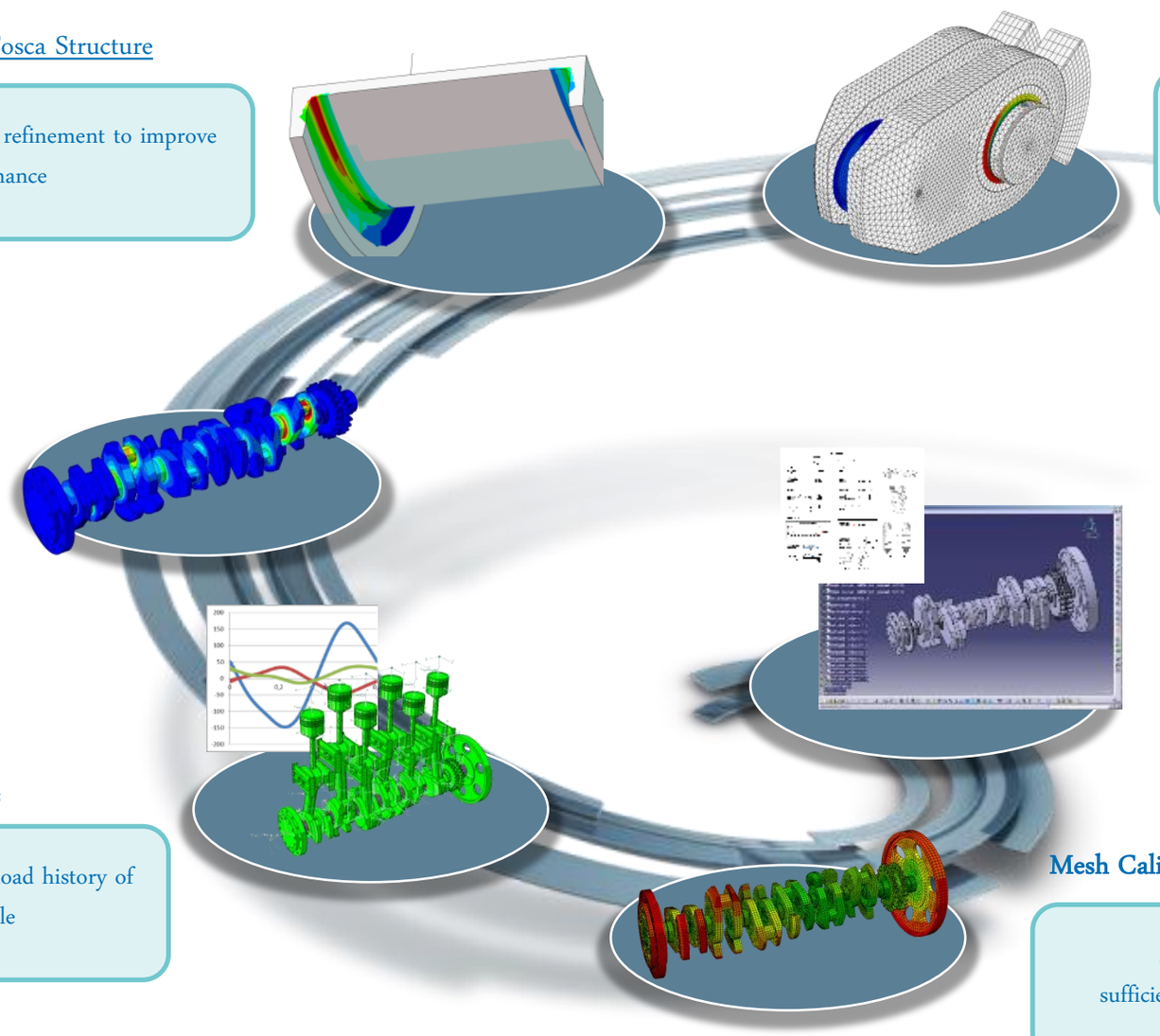
- SIMULIA is the Dassault Systèmes brand for Realistic Simulation solutions
- Portfolio of established, best-in-class products
  - Abaqus, Isight, Tosca, fe-safe, Simpack
  - Most use a common extended licensing pool

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

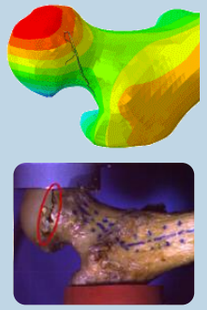
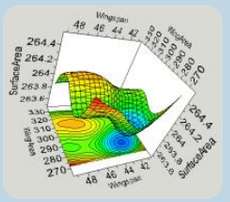
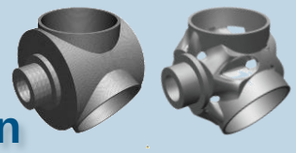
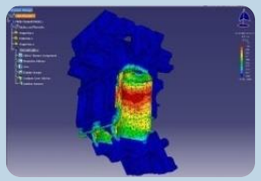
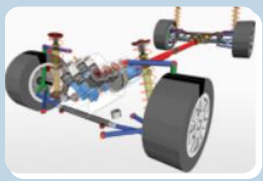
Multibody Simulation: Simpack

System analysis to extract virtual load history of complete working cycle

Mesh Calibration: Isight

Automated mesh calibration:
sufficient mesh quality for accurate results

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	• Multibody Dynamics Simulation • Mechanical or Mechatronic Systems		Flexible Bodies Single Component Design Complete System Analyses

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to log in or join!

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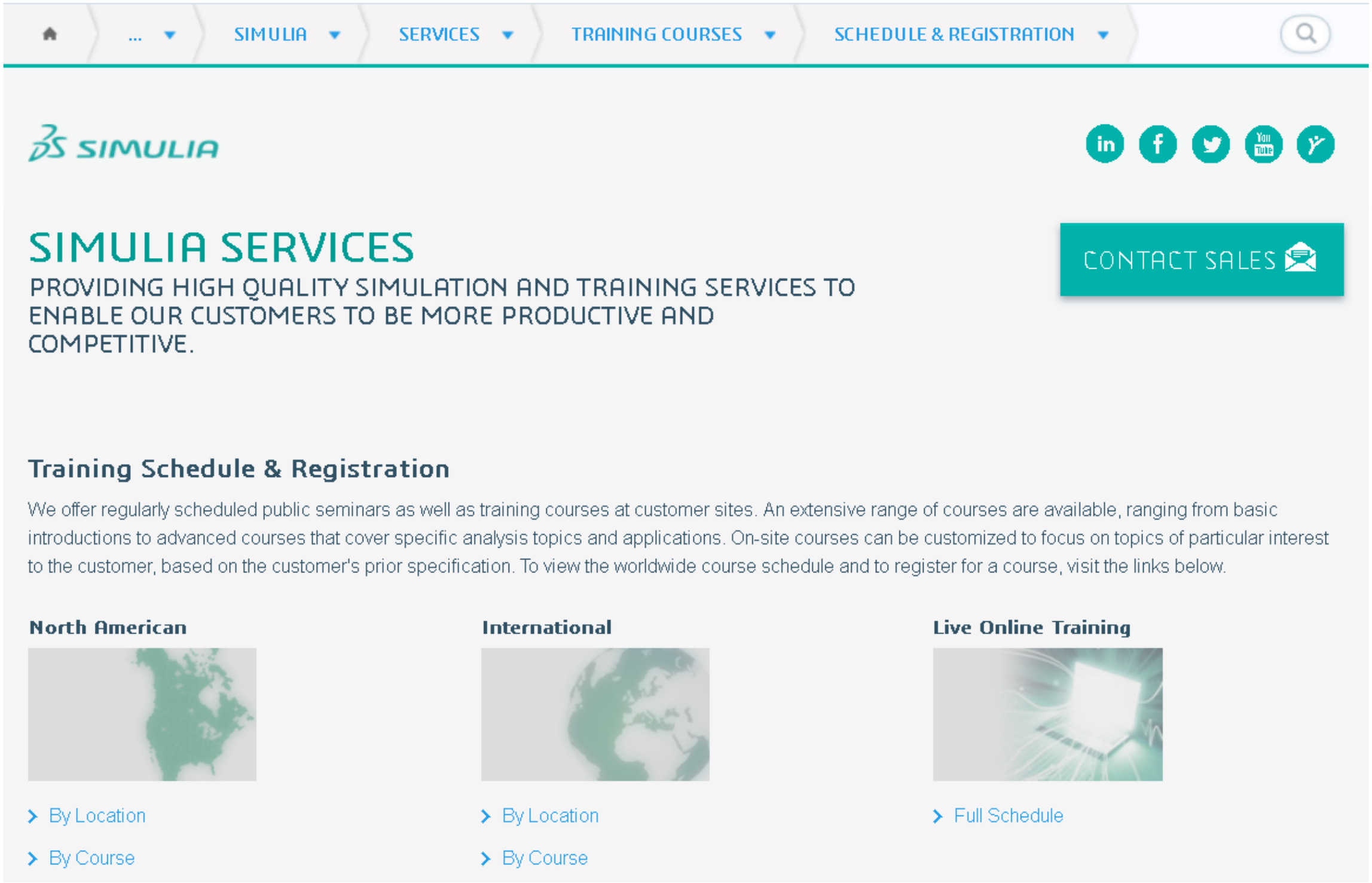

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Revision Status

Lecture 1	12/18	Updated for Abaqus 2019
Lecture 2	12/18	Updated for Abaqus 2019
Lecture 3	12/18	Updated for Abaqus 2019
Lecture 4	12/18	Updated for Abaqus 2019
Lecture 5	12/18	Updated for Abaqus 2019
Lecture 6	12/18	Updated for Abaqus 2019
Lecture 7	12/18	Updated for Abaqus 2019
Lecture 8	12/18	Updated for Abaqus 2019
Lecture 9	12/18	Updated for Abaqus 2019
Appendix 1	12/18	Updated for Abaqus 2019
Appendix 2	12/18	Updated for Abaqus 2019

Workshop 1	12/18	Updated for Abaqus 2019
Workshop 2a	12/18	Updated for Abaqus 2019
Workshop 2b	12/18	Updated for Abaqus 2019
Workshop 3a	12/18	Updated for Abaqus 2019
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Workshop 6b	12/18	Updated for Abaqus 2019
Workshop 7	12/18	Updated for Abaqus 2019
Workshop 8	12/18	Updated for Abaqus 2019

Lesson 1: Mechanisms and Multibodies in Abaqus

Lesson content:

- Introduction
- Interaction Options in Abaqus
- Connector Element Basics
- Connector Applications and Capabilities
- Connectors vs. Multi-point Constraints
- Flexible and Rigid components in a Model
- Procedures

1 hour

Lesson 2: Connection Elements and Library (Part 1)

Lesson content:

- Introduction
- Defining Connector Elements
- Understanding Connector Sections
- Understanding Connection Types
- Understanding Connector Local Directions
- Connector Element Output
- Effects of Node Ordering and Rotation on Results
- Workshop Preliminaries
- Workshop 1: Hinge Connection (IA)
- Workshop 1: Hinge Connection (KW)

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

1.5 hours

Lesson 3: Connection Elements and Library (Part 2)

Lesson content:

- Rotational Degrees of Freedom at Nodes
- Surface-Based Coupling Constraints
- Mesh-Independent Fasteners
- Components of Relative Motion
- Connector Local Kinematics
- Summary of Orientations and Local Directions
- Workshop 2a: Analysis of a UJOINT (IA)
- Workshop 2a: Analysis of a UJOINT (KW)
- Workshop 2b: Four-Stroke Engine (Part 1) (IA)
- Workshop 2b: Four-Stroke Engine (Part 1) (KW)

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

2 hours

Lesson 4: Connector Builder

Lesson content:

- Introduction
- Connector Builder
- Coincident Point Builder
- Workshop 3a: Modeling Pliers (IA)
- Workshop 3a: Modeling Pliers (KW)
- Workshop 3b: Four-Stroke Engine (Part 2) (IA)
- Workshop 3b: Four-Stroke Engine (Part 2) (KW)

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

1.5 hours

Lesson 5: Overconstraints and Connectors

Lesson content:

- General Remarks
- Overconstraints Detected during Model Processing
- Overconstraints Detected during Analysis Execution
- Controlling the Overconstraint Checks
- Example: Multibody System
- Workshop 4: Overconstraints: Hinge Model (IA)
- Workshop 4: Overconstraints: Hinge Model (KW)

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

1.5 hours

Lesson 6: Connector Behavior (Part 1)

Lesson content:

- Introduction
- Defining Connector Behavior
- Connector Elasticity
- Reference Configuration for Constitutive Behavior
- Connector Damping
- Connector Stops
- Connector Locks
- Connector Failure
- Workshop 5a: Connector Attributes – Hinge Model (IA)
- Workshop 5a: Connector Attributes – Hinge Model (KW)
- Workshop 5b: Connector Attributes – Four-Stroke Engine Model (IA)
- Workshop 5b: Connector Attributes – Four-Stroke Engine Model (KW)

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

2 hours

Lesson 7: Connector Behavior (Part 2)

Lesson content:

- Connectors in Series/Parallel
- Connector Functions
- Connector Friction
- Connector Plasticity
- Connector Damage
- Connector Failure
- Workshop 6a: Analysis of a Spot Weld (IA)
- Workshop 6a: Analysis of a Spot Weld (KW)
- Workshop 6b: Connector Friction (IA)
- Workshop 6b: Connector Friction (KW)

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

2.5 hours

Lesson 8: Rotational Connectors

Lesson content:

- Cardan
- Euler
- Flexion-Torsion
- Projection Flexion-Torsion
- Rotation
- Workshop 7: Rotational Connector Elements (IA)
- Workshop 7: Rotational Connector Elements (KW)

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

1 hour

Lesson 9: Connector Actuation

Lesson content:

- Introduction
- Fixed Relative Motion
- Displacement-Controlled Actuation
- Force-Controlled Actuation
- Sensors and Actuators
- Workshop 8: Analysis of a Simple Four-Stroke Engine (IA)
- Workshop 8: Analysis of a Simple Four-Stroke Engine (KW)

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

2 hours

Appendix 1: Some Advanced Connection Types

Appendix content:

- Overview
- SLIPRING
- FLOW-CONVERTER/RETRACTOR
- Example
- Limitations

20 minutes

Appendix 2: Connector Uniaxial Behavior

Appendix content:

- Connector Uniaxial Behavior

20 minutes