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

- Understand all necessary elements for railway modeling
- Set up railway vehicles according to common concepts
- Set up, run and analyze typical applications for railway models

Targeted Audience
- Simulation analysts and design engineers in the railway industry
- Multibody simulation experts with no previous experience of railway simulation in Simpack

Prerequisites
- Before undertaking this course, you should have completed the Introduction to Simpack training course
- Some familiarity with fundamental railway theory
Day 1

- Lesson 1  Basic Elements
  - Workshop 1  Single Wheelset
- Lesson 2  Plots and Outputs
- Lesson 3  Track Settings
  - Workshop 2  Track Definition
- Lesson 4  Suspension Modeling
  - Workshop 3  Full Vehicle
- Lesson 5  Finalize Model Setup
  - Workshop 4  Preloads and Solver
Day 2

Lesson 6  Quasilinearization
  Workshop 5  Calculate Eigenvalues

Lesson 7  Critical Speed
  Workshop 6  Root Loci (Linear Critical Speed)
  Workshop 7  Nonlinear Critical Speed

Lesson 8  Typical Applications
  Workshop 8  Derailment
  Workshop 9  Comfort Analysis
  Workshop 10  Roll Coefficient

Lesson 9  Additional Rail Topics  (optional)
  Workshop 11  Independent Wheels  (optional)
  Workshop 12  Roller Rig  (optional)
  Workshop 13  Elastic Track Foundation  (optional)
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

- FEA Stress Analysis, Abaqus *
  Detailed stress analysis using extracted load history from MBS

- Multibody Simulation, Simpack
  System analysis to extract virtual load history of complete working cycle

- Durability Assessment, fe-safe *
  Accurate life estimation to achieve certification

- CAD Geometry, CATIA
  Fully parameterized 3D geometry; FEA model generation via associative interface

- 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

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

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

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

#### Simpack
- 3D Multibody Dynamics Simulation
- Mechanical or Mechatronic Systems
- Detailed Transient Simulation (Offline and Realtime)

#### Additional Features
- 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
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 SERVICES
PROVIDING HIGH QUALITY SIMULATION AND TRAINING SERVICES TO ENABLE OUR CUSTOMERS TO BE MORE PRODUCTIVE AND COMPETITIVE.

Training Schedule & Registration
We offer regularly scheduled public seminars as well as training courses at customer sites. An extensive range of courses are available, ranging from basic introductions to advanced courses that cover specific analysis topics and applications. On-site courses can be customized to focus on topics of particular interest to the customer, based on the customer's prior specification. To view the worldwide course schedule and to register for a course, visit the links below.

North American
- By Location
- By Course

International
- By Location
- By Course

Live Online Training
- Full Schedule
The software described in this documentation is available only under license from Dassault Systèmes or its subsidiaries and may be used or reproduced only in accordance with the terms of such license.

This documentation and the software described in this documentation are subject to change without prior notice.

Dassault Systèmes and its subsidiaries shall not be responsible for the consequences of any errors or omissions that may appear in this documentation.

No part of this documentation may be reproduced or distributed in any form without prior written permission of Dassault Systèmes or its subsidiaries.

© Dassault Systèmes, 2019

Printed in the United States of America.

Abaqus, the 3DS logo, and SIMULIA are trademarks or registered trademarks of Dassault Systèmes or its subsidiaries in the US and/or other countries.

Other company, product, and service names may be trademarks or service marks of their respective owners. For additional information concerning trademarks, copyrights, and licenses, see the Legal Notices in the SIMULIA User Assistance.
# Revision Status

| Lesson 1 | 11/19 | Updated for Simpack 2020x |
| Lesson 2 | 11/19 | Updated for Simpack 2020x |
| Lesson 3 | 11/19 | Updated for Simpack 2020x |
| Lesson 4 | 11/19 | Updated for Simpack 2020x |
| Lesson 5 | 11/19 | Updated for Simpack 2020x |
| Lesson 6 | 11/19 | Updated for Simpack 2020x |
| Lesson 7 | 11/19 | Updated for Simpack 2020x |
| Lesson 8 | 11/19 | Updated for Simpack 2020x |
| Lesson 9 | 11/19 | Updated for Simpack 2020x |
| Workshop 1 | 11/19 | Updated for Simpack 2020x |
| Workshop 2 | 11/19 | Updated for Simpack 2020x |
| Workshop 3 | 11/19 | Updated for Simpack 2020x |
| Workshop 4 | 11/19 | Updated for Simpack 2020x |
| Workshop 5 | 11/19 | Updated for Simpack 2020x |
| Workshop 6 | 11/19 | Updated for Simpack 2020x |
| Workshop 7 | 11/19 | Updated for Simpack 2020x |
| Workshop 8 | 11/19 | Updated for Simpack 2020x |
| Workshop 9 | 11/19 | Updated for Simpack 2020x |
| Workshop 10 | 11/19 | Updated for Simpack 2020x |
| Workshop 11 | 11/19 | Updated for Simpack 2020x |
| Workshop 12 | 11/19 | Updated for Simpack 2020x |
| Workshop 13 | 11/19 | Updated for Simpack 2020x |
Lesson 1: Basic Elements

Lesson content:

- Simpack Rail
- Track Joints
- Specific Modeling Elements
- Model Setup Strategy
- Rail-Wheel Pairs
- Rail Element
- Geometry Data
- Profile Position and Projection
- Possible Configurations for Wheel Setup
- Possible Configurations for Rail Setup
- Contact Search
- Normal Contact Evaluation
- Creepage
- Tangential Forces
- Wheelset
- Basic Rail Elements Overview
- Typical Rail Vehicle Model
- Data Handling
- Workshop 1: Single Wheelset
Workshop 1: Single Wheelset

Aim:

1. Understand how a Wheelset is set up
2. Become familiar with the Railway Specific Elements
3. Learn how Rail-Wheel Pairs are used
4. Create a Wheelset Element

60 minutes
Lesson 2: Plots and Outputs

Lesson content:

- General
- Rail-Wheel Pair Plots
- Rail Plots
- Wheelset Plots
- Result Elements

30 minutes
Lesson content:

- Track Types
- Superelevation
- General Track Settings
- Cartographic Track
- Measured Track
- Plots
- Follow Track Joint Marker
- Active Track
- Workshop 2: Track Definition
Workshop 2: Track Definition

Aim:

1. Become familiar with the set-up of a Cartographic Track

2. Understand the different settings for the **Follow Track Joint** Marker
Lesson content:

- Overview
- Rubber Spring
- Shear Spring
- Coil Spring
- Damper
- Graphical Representation of Force Elements
- Workshop 3: Full Vehicle

30 minutes
Workshop 3: Full Vehicle

Aim:

1. Build up a Bogie (Truck) model in Simpack
2. Build up a full train model in Simpack
3. Understand and use common rail modeling elements
Lesson 5: Finalize Model Setup

Lesson content:

- Model Check – Graphical
- Model Check – Test Call
- Vehicle Globals
- Static Equilibrium and Preload
- Preload
- Solver Settings
- Workshop 4: Preloads and Solver
Aim:

1. Understand how to check model plausibility
   a. Graphical
   b. Test Call

2. Understand the Vehicle Globals

3. Understand how to bring a rail vehicle model into equilibrium

Workshop 4: Preloads and Solver

45 minutes
Lesson content:

- Principle of a Guided Wheelset
- Quasilinearization
- Linearization Process
- Workshop 5: Calculate Eigenvalues

30 minutes
Workshop 5: Calculate Eigenvalues

Aim:

1. Learn how to use the Online Eigenvalues calculator
2. Learn how to adjust the linear arc profiles
Lesson content:

- DoE
- Critical Speed
- Track Excitations
- Model Setup
- Stop Integration Force Element
- Workshop 6: Root Loci (Linear Critical Speed)
- Workshop 7: Nonlinear Critical Speed

45 minutes
Workshop 6: Root Loci (Linear Critical Speed)

Aim:

1. Understand how to perform a Root Loci calculation using:
   a. the Simpack DoE and/or
   b. a Simpack Post Script
Aim:

1. Understand how to perform a simple nonlinear critical speed analysis in Simpack
Lesson content:

- Derailment
- Mover Bodies
- Workshop 8: Derailment
- Comfort
- Workshop 9: Comfort Analysis
- Roll coefficient
- Workshop 10: Roll Coefficient

30 minutes
Aim:

1. Understand how to perform a Derailment analysis in Simpack
Aim:

1. Understand how to perform a simple Comfort Analysis in Simpack
Aim:

1. Understand how to determine the Roll Coefficient using Simpack
Lesson 9: Additional Rail Topics

Lesson content:

- Generating Wheel/Rail Profiles
- Variable Rail Profiles
- Independent Wheels
- Roller Rigs
- Elastic Foundation
- Rail–Wheel Wear
- Workshop 11: Independent Wheels
- Workshop 12: Roller Rig
- Workshop 13: Elastic Track Foundation

This lesson and workshops 11-13 are optional
Workshop 11: Independent Wheels

Aim:

1. Understand the influence of Rail-Wheel Pairs in Simpack
2. Learn how to setup independent Wheels in a Wheelset
Aim:

1. Learn how to define a basic roller rig in Simpack
2. Convert a Rail-mounted wheelset to roller-mounted
3. Create a roller Body and its Primitives
4. Define Rail-Wheel Pairs for a roller rig

Workshop 12: Roller Rig

20 minutes
Aim:

1. Learn how to set up an Elastic Track Foundation in Simpack