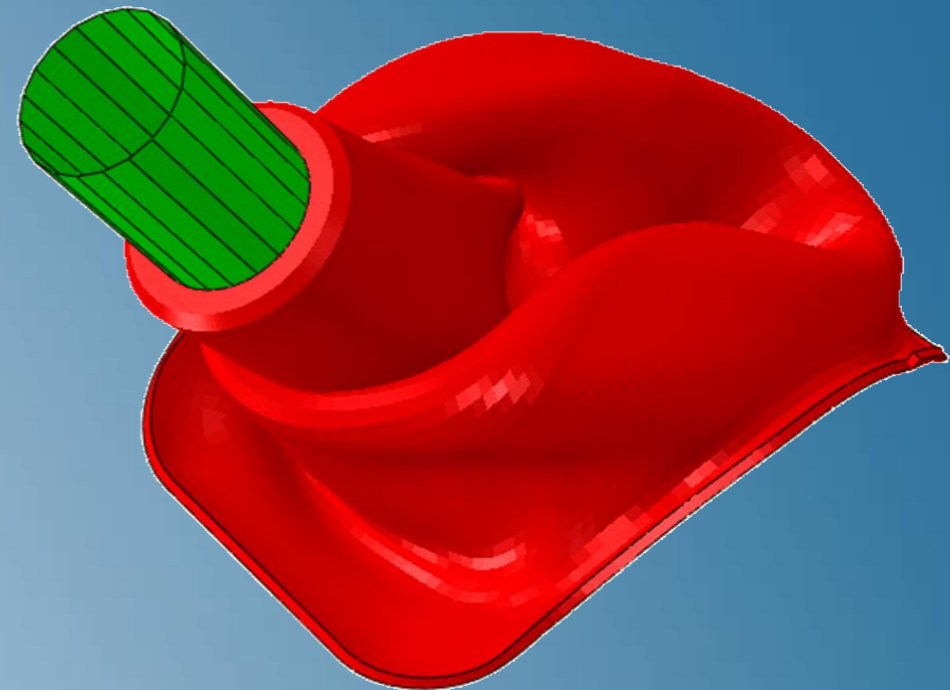


Modeling Rubber and Viscoelasticity with Abaqus

Abaqus 2021



3DEXPERIENCE[®]

About this Course

Course objectives

Upon completion of this course you will be able to:

- ▶ Use experimental test data to calculate material constants
- ▶ Check the stability of the Abaqus material model at extreme strains
- ▶ Obtain the best possible material constants from the available test data
- ▶ Select elements for modeling rubber and foams
- ▶ Design an appropriate finite element mesh
- ▶ Model viscoelastic behavior in both the time and frequency domain
- ▶ Use a user subroutine to define the hyperelastic behavior

Targeted audience

Simulation Analysts

Prerequisites

This course is recommended for engineers with experience using Abaqus



2 days

Day 1

- ▶ Lesson 1 Rubber Physics
- ▶ Lesson 2 Introduction to Hyperelasticity Models
- ▶ Lesson 3 Mechanical Testing
 - Workshop 1 Axial Deflection of a Rubber Bushing
- ▶ Lesson 4 Defining Rubber Elasticity Models in Abaqus
- ▶ Lesson 5 Modeling Issues and Tips
 - Workshop 2 Bead Seal Compression

Day 2

- ▶ Lesson 6 Viscoelastic Material Behavior
- ▶ Lesson 7 Time-Domain Viscoelasticity
 - Workshop 3 Bead Seal Relaxation
- ▶ Lesson 8 Frequency-Domain Viscoelasticity
 - Workshop 4 Bead Seal Vibration
- ▶ Lesson 9 Permanent Set in Solid Elastomers
- ▶ Lesson 10 Anisotropic Hyperelasticity

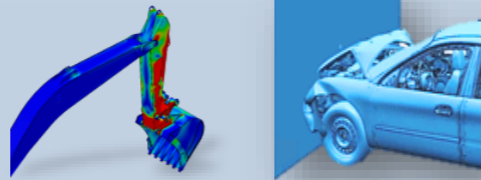
Additional Material

- ▶ Appendix 1 Finite Deformations
- ▶ Appendix 2 Rubber Elasticity Models: Mathematical Forms
- ▶ Appendix 3 Linear Viscoelasticity Theory
- ▶ Appendix 4 Harmonic Viscoelasticity Theory
- ▶ Appendix 5 Suggested Reading

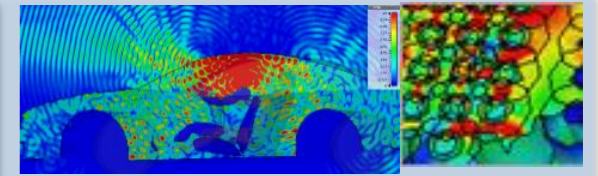
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- ▶ Advanced simulation portfolio covering simulation disciplines such as structural mechanics, computational fluid dynamics and electromagnetic field simulation, for a true multiphysics simulation approach.

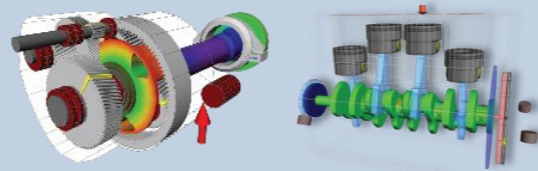
Structures



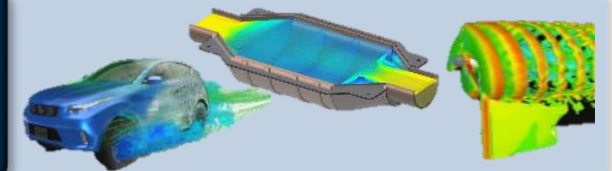
Electromagnetics



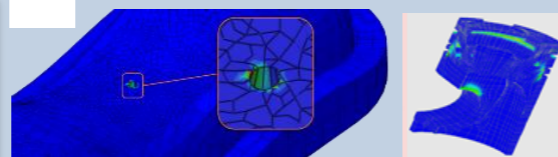
Multibody



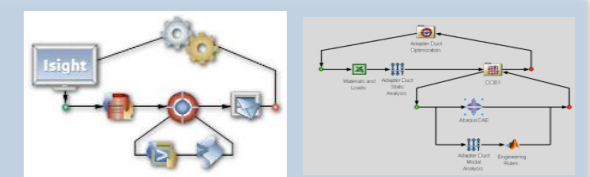
Fluids



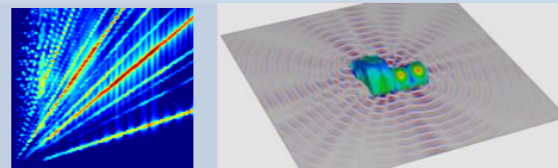
Durability



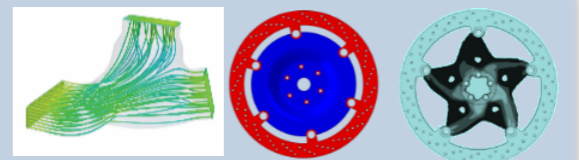
Automation



Vibro-acoustics



Optimization



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Revision Status

Lesson 1	11/20	Updated for Abaqus 2021
Lesson 2	11/20	Updated for Abaqus 2021
Lesson 3	11/20	Updated for Abaqus 2021
Lesson 4	11/20	Updated for Abaqus 2021
Lesson 5	11/20	Updated for Abaqus 2021
Lesson 6	11/20	Updated for Abaqus 2021
Lesson 7	11/20	Updated for Abaqus 2021
Lesson 8	11/20	Updated for Abaqus 2021
Lesson 9	11/20	Updated for Abaqus 2021
Lesson 10	11/20	Updated for Abaqus 2021
Appendix 1	11/20	Updated for Abaqus 2021
Appendix 2	11/20	Updated for Abaqus 2021
Appendix 3	11/20	Updated for Abaqus 2021
Appendix 4	11/20	Updated for Abaqus 2021
Appendix 5	11/20	Updated for Abaqus 2021
Workshop 1	11/20	Updated for Abaqus 2021
Workshop 2	11/20	Updated for Abaqus 2021
Workshop 3	11/20	Updated for Abaqus 2021
Workshop 4	11/20	Updated for Abaqus 2021

Lesson 1: Rubber Physics

Lesson content:

- ▶ Motivation
- ▶ Solid Rubber
 - Molecular structure
 - Material processing
 - Glass transition temperature
 - Nearly incompressible behavior
 - Typical stress–strain response
 - Hysteresis and damping
 - Damage
 - Anisotropy
- ▶ Thermoplastic Elastomers
 - Physical description
 - Advantages and disadvantages
- ▶ Rubber Foam
 - Physical description
 - Cellular structure
 - Typical stress–strain response
 - Poisson’s effect
- ▶ The Nonlinear Elastic Assumption



30 minutes

Lesson 2: Introduction to Hyperelasticity Models

Lesson content:

- ▶ Introduction
- ▶ Models for Nearly Incompressible Hyperelasticity
- ▶ Model for Foam Rubber Hyperelasticity



30 minutes

Lesson 3: Mechanical Testing

Lesson content:

- ▶ Modes of Deformation
 - Uniaxial tension
 - Planar tension
 - Uniaxial compression
 - Equibiaxial tension
 - Confined compression
- ▶ Loading History
 - Testing at temperature
- ▶ Test Specimens
- ▶ Test Data Guidelines
- ▶ Testing for Time-Dependent Properties
- ▶ Workshop Preliminaries
- ▶ Workshop 1: Axial Deflection of a Rubber Bushing (IA)
- ▶ Workshop 1: Axial Deflection of a Rubber Bushing (KW)



2 hours



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

