ESI‘s SimulationX

Courses and Contents

Doc. Vers. 08/2019

Preface

Dear Sir or Madam,

with the continuous development of SimulationX we provide you with the necessary resources for a targeted and sustainable work in the field of system simulation. You will learn the efficient use of the software and its innovations in group and individual training courses at ESI or directly at your site.

The highly practical nature of our courses and the professional expertise of our tutors guarantee a quick and successful learning process. We look forward to passing on our knowledge and would be happy to discuss new solutions with you.

With best regards on behalf of the ESI team,

Antje Richter,

Your personal contact:

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Content

Content

Content of the courses

All training courses around SimulationX provide you with basic or advanced knowledge in handling the software. Based on practical examples, you learn how to build and simulate models as well as how to output and analyze results. In addition to that, you can create custom models with your own applications and get advice in discussions with our skilled team on ways of analyzing them.

Target audience

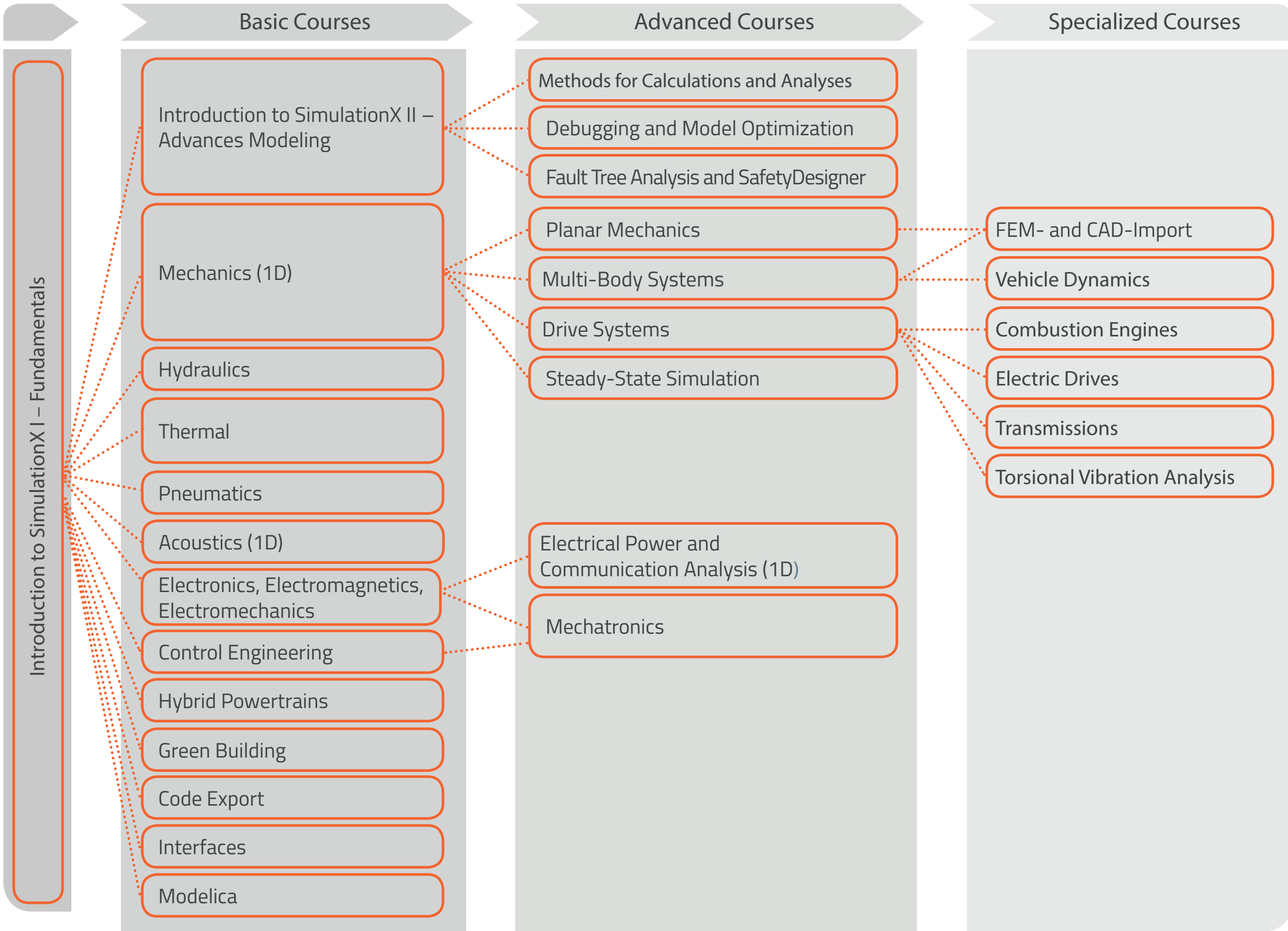
Our courses are designed for engineers, technicians and researchers who want to extend their knowledge about SimulationX for the work in the field of system simulation or who want to know more about the program's functionalities and potential applications.

Learning materials

For each course, you are provided with learning materials in class, both as hard copy and on a USB flash drive including the corresponding models.

Certificate

Upon completion, participants will receive an official course certificate. This certificate states the course topic or the advanced application that was dealt with in class.


Basic Courses
Advanced Courses
Specialized Courses
Introduction to SimulationX I – Fundamentals
Introduction to SimulationX II – Advances Modeling
Mechanics (1D)
Hydraulics
Thermal
Pneumatics
Acoustics (1D)
Electronics, Electromagnetics, Electromechanics
Control Engineering
Hybrid Powertrains
Green Building
Code Export
Interfaces
Modelica
Methods for Calculations and Analyses
Debugging and Model Optimization
Fault Tree Analysis and SafetyDesigner
Planar Mechanics
Multi-Body Systems
Drive Systems
Steady-State Simulation
Electrical Power and Communication Analysis (1D)
Mechatronics
FEM- and CAD-Import
Vehicle Dynamics
Combustion Engines
Electric Drives
Transmissions
Torsional Vibration Analysis

ESI ITI onsite

With our SimulationX training courses, we would also be pleased to come to your premises and conduct a training course specifically tailored to your applications in your company. That way, you can create your individual training courses for your employees without the need for them to travel incurring extra costs. Get in touch for a personal consultation on our program.

Registration and booking

Please submit your binding registration:

- online on www.simulationx.com/academy
- via E-Mail to academy.iti@esi-group.com

Course prerequisites

For each course, it is highly recommended to have completed the preceding course (see course overview). Basic knowledge in physics is advisable for all courses.

Cancellation policy

For cancellations that we receive no later than 10 working days before the course start date, we charge an administration fee of €50. Any later cancellation may incur a cancellation fee of 50% of the net price.

ESI reserves the right to cancel or postpone course dates. Participants get a full refund of all fees already paid, but cannot claim any compensation for additional costs or damage incurred. ESI gives notice immediately, but at least one week in advance, should courses be cancelled, and guarantees available slots in upcoming courses.

With the confirmation of registration you will receive further details of the training, such as time and place. By registering with us, you accept our conditions for participation.

Participation fee

Prices per course include learning materials plus USB flash drive, lunch if applicable and refreshments. Other expenses, such as accommodation or travel, are not covered.

Booking hotel rooms

We are more than happy to help you book a room should you require any assistance. Please call us on +49 351 26050-120.

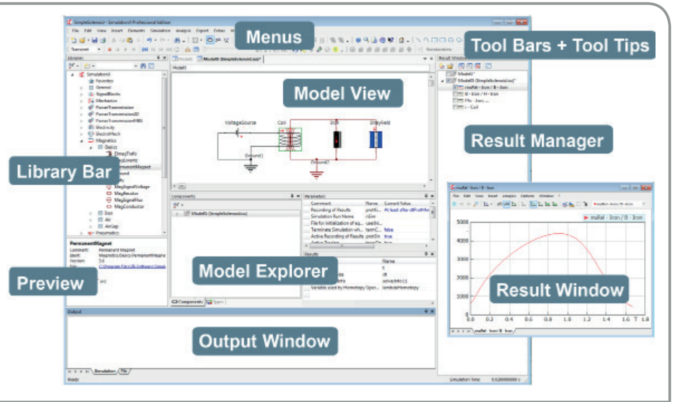
Privacy statement

By registering for a course, you accept that your data is saved and processed by us for administration purposes in accordance with the German Data Protection Act (Federal Data Protection Act).

Dates – prices – registration

You can find the latest information about course dates, participation fees, course offers and the registration form at

www.simulationx.com/academy



Goal

This course lays the foundation for the effective use of SimulationX. Gain comprehensive insight into the application's functionality and learn about its vast potential for modeling, simulating and optimizing complex, technical systems. Eventually, you will learn how to create your own models for custom applications.

Content

- Explanation of the graphical user interface
- Basics of network modeling, signal flow oriented modeling and multi domain models
- Overview of program functions, properties and use of libraries
- Parameterization (constant values, mathematical functions and dependencies, logical conditions, variables and references, graphs and characteristic curves, parameter properties)
- Hierarchical modeling (sub-structuring)
- Referencing: references to variables and parameters within a model
- Derivation of new model types
- Calculations (concept, transient simulation, calculation of consistent initial values, natural frequencies and mode shapes)
- Result visualization, evaluation and analysis
- Data exchange and interfaces

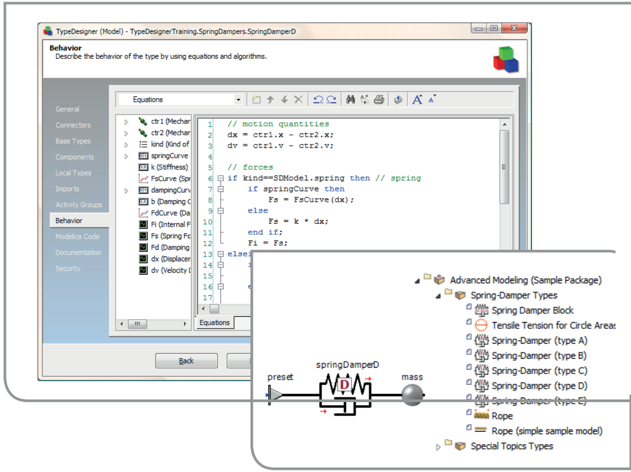
Scenarios

- One-mass oscillator
- Calculation of a cuboid's volume
- Combustion engine, sweep excitation

Duration: 1 Day

Goal

Learn more about modeling. Create custom functions, calculation blocks, model types as well as model libraries and packages. We show you the potentials of the Modelica based *TypeDesigner*, and you will learn through suitable examples how to create libraries without any knowledge of programming.



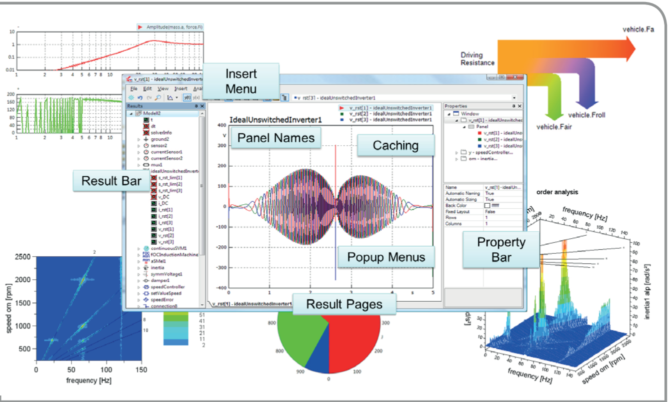
Content

- Type and library management
- Creating new libraries
- Creating new types
- Re-usable blocks and functions
- Creating clear property dialogs
- Branching of equation systems
- Use of characteristic curves and maps
- Implementation of loops and iteration methods
- Implementation of a database interface

Scenarios

- Various spring-damper models
- Function for tensile and compressive stress
- Rope model
- Pulse-width modulation (three variants)
- Euclidean algorithm
- Intersection of two curves with Newton’s method
- Organizing data sets

Duration: 1 Day



Goal

Make use of what you learned in the "Introduction to SimulationX – Fundamentals" and "Advanced Modeling" to take it one step further and become even more efficient in modeling, calculating and analyzing. This course also gives an overview of available interfaces for real-time simulations, process automation (scripting) and external software.

Content

1. Overview on model computation methods
2. Analysis tools for system analysis
    - Natural frequencies and mode shapes
    - Ordr analysis
    - IO-Analysis
    - FFT/FRF
3. Variants wizard/Task Manager

Scenarios

- Order analysis and frequency response analysis
- Simulation in the frequency domain
- Performance analysis of a powertrain model

Duration: 1 Day

Goal

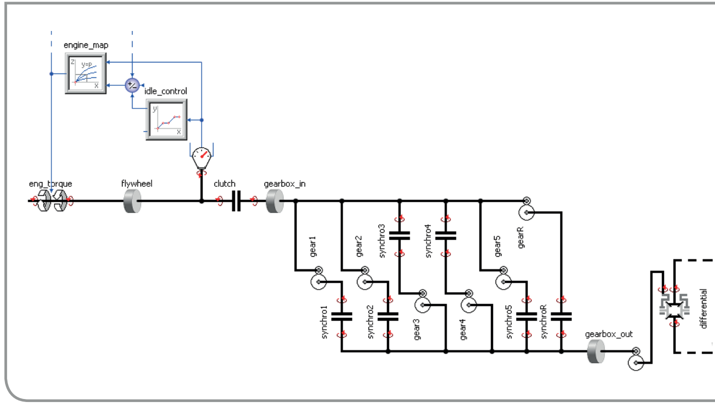
This course is about 1D mechanics and aims at learning how to create and analyze linear and non-linear oscillator chains quickly as well as complex systems for power transmissions and drivelines, various mechanisms and engine suspension.

Content

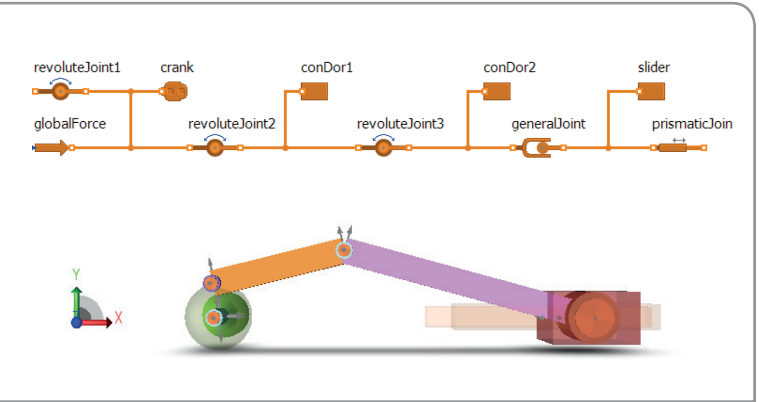
- Mechanics libraries and their fields of application
- Concept and structure of libraries
- Discretization and local definitions
- General modeling principles
- Properties and use of model elements
- Parameterization (presets) and variables
- Linear-elastic structures (modal substitute systems, ANSYS-import)
- Combination with other libraries
- Optimizing model performance
  - Illustration of relevant effects
  - Performance and dynamics analyses
  - Model reduction
  - Quick and efficient calculations
- Linear system analysis, result visualization, evaluation and analysis in the time and frequency domains

Scenarios

- Simple harmonic oscillator and slider-crank mechanism
- Simple planetary gear system
- Three coupled oscillators as an example for exciter functions
- Non-linear couplings (including hysteresis function)



Duration: 1 Day



Goal

This course on planar mechanics demonstrates through suitable examples how to quickly create and analyze linear and non-linear planar systems from the areas of driveline and power transmission, mechanisms, belt drives (belts and ropes) and many more.

Content

- Planar Mechanics libraries and their fields of application
- Concept and structure of the libraries
- Concept of connections
- General basics for modeling
- Discretization and local definitions
- Global and local orientation
- Properties and use of model elements
- Parameterization (presets) and variables
- Modeling planar mechanisms
- Representation of belt drives (belts and ropes)
- Combination with other libraries

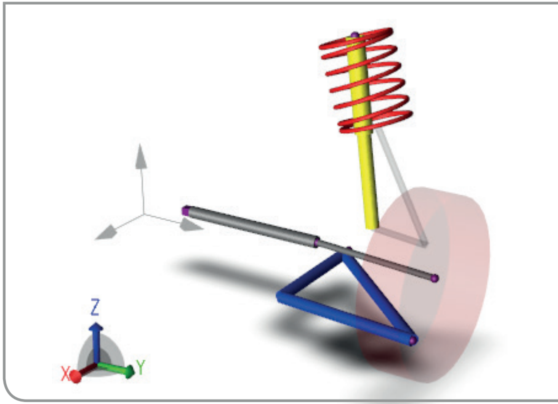
Scenarios

- Planar, asymmetrical mechanisms
- Rope drives (e.g. pulley block, crane drive), also with slip
- Translating behavior of a combined system consisting of a belt drive and a mechanism (e.g. a fitness machine with irregular wheels)
- Belt tension and lateral vibration

Duration: 1 Day

Goal

The examples shown in this course demonstrate how to model and analyze spatial mechanisms (e.g. wheel suspension) with open (e.g. excavator arm, robot) or closed chain linkages (e.g. crank-rocker) as well as open spatial motor mounts easily.



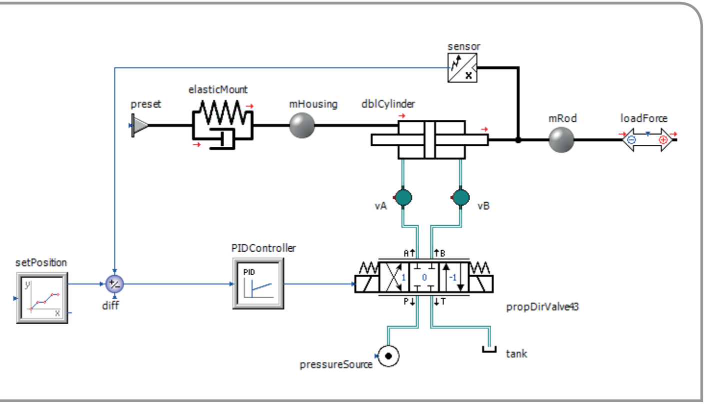
Content

- Concept, structure and fields of application of the MBS Mechanics library
- Open and closed kinematic linkages
- Discretization and local definitions
- Consideration of flexible bodies
- Properties and use of model elements
- Parameterization and variables
- Combination with other libraries
- Linear system analysis
- CAD interfaces, FEM import
- Representation, analysis and evaluation of results in the time domain
- Visualization and animation of results
- Overview of the mathematical basics

Scenarios

- Industrial robot
- 4-bar linkage
- McPherson strut (wheel suspension)
- Knee lever mechanism

Duration: 1 day



Goal

Suitable examples will demonstrate how to model valves, hydraulic drives, end cushioning of cylinders and proportional directional valves easily and quickly.

Content

- Modeling and simulating hydraulic components and systems
- Concept and structure of the hydraulic library
- Properties and use of model elements
- Description of fluid characteristics and hydraulic connections
- Types of calculations for pressure, temperature and gas proportions
- Extent of the fluid catalogues, FluidDesigner
- Hydraulic resistances
- Hydro-mechanical transformers, overlap with mechanics
- Parameterization and variables
- Overview of further fluid libraries, e.g. “Industrial Utilities” and „Heat Transfer“

Scenarios

- Hydraulic cylinder
- Hydraulic damper actuator
- Pilot operated proportional directional valve
- Bypass valve

Duration: 1 Day

Goal

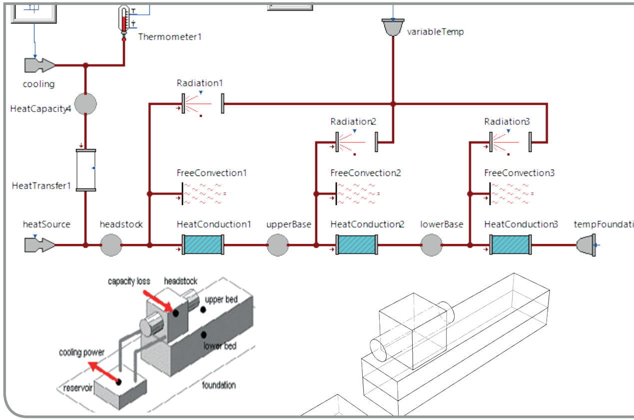
You will learn how to create, model and analyze heat exchangers, open systems and thermodynamic cycles.

Content

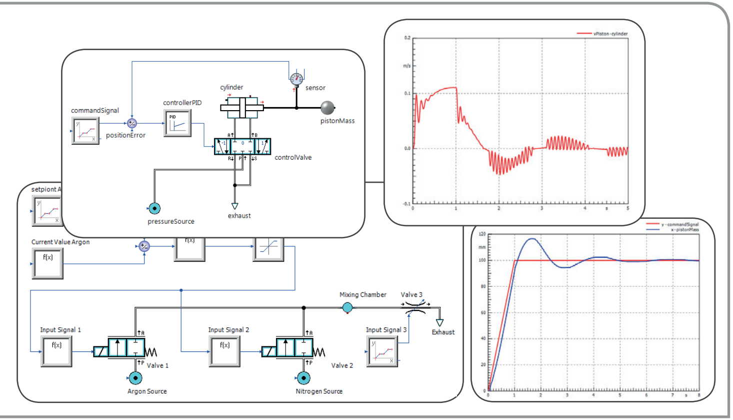
- Modeling thermal systems
- Concept and structure of the Thermal and Thermofluid libraries
- Description, properties and use of model elements
- Extent of the fluid catalogues in the Thermofluid library
- Basics and model functions
- Combination with other SimulationX libraries
- Overview of further fluid libraries, e.g. "Industrial Utilities" and „Heat Transfer"

Scenarios

- Basic thermal models for heat conduction, convection and radiation
- Fluid models with heat transfer and loss of pressure
- Cooling circuits
- Heat pump



Duration: 1 Day



Goal

This course exemplifies how to model pneumatic valves and drives, clutch actuating systems, pneumatic handling equipment as well as mixes of different gases.

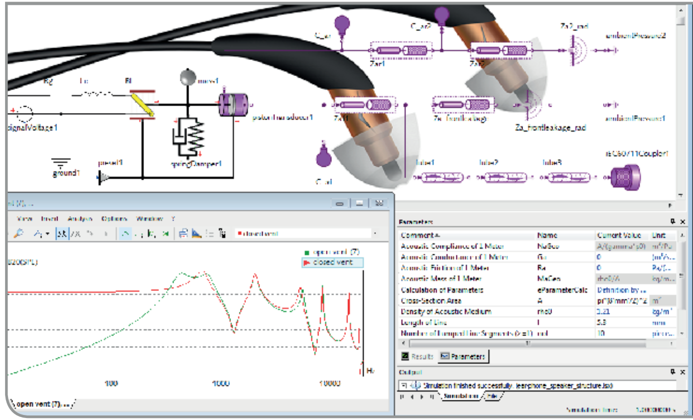
Content

- Modeling and simulating pneumatic components and systems
- Concept and structure of the Pneumatic library
- Properties and use of model elements
- Description of fluid characteristics and pneumatic connections
- Pneumatic resistances
- Extent of the fluid catalogues, FluidDesigner
- Valve models and cylinder drives
- Pneumatic-mechanical transformers, overlap with mechanics
- Gas mixes
- Overview of further fluid libraries, e.g. “Industrial Utilities” and „Heat Transfer“

Scenarios

- Pneumatic check valve
- Pneumatic cylinder
- Pneumatic damper actuator
- Compressed air treatment

Duration: 1 Day



Goal

Learn the basics of network modeling for acoustic applications with the SimulationX library “acoustics”. We show you typical scenarios with modeling and analysis methods for headphones and loudspeakers, for example.

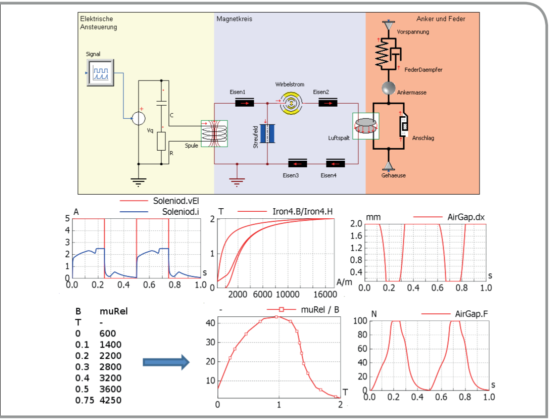
Content

- Fundamentals of acoustic systems
  - Basic phenomena, state variables
- Modeling acoustic systems
  - Partitioning/Discretization and network creation
  - Possible applications for the library
- Library content
  - Basic elements for acoustic phenomena
  - Modeling methods and scope
  - Interface elements
- Analysis and evaluation of acoustic signals
  - Basics and standards
  - Filters, couplers
  - Representation of sound pressure levels in dB
  - Transmission behavior

Scenarios

- Simple acoustic network examples
- Helmholtz resonator
- Loudspeaker, headphones

Duration: 1 Day



Goal

Gain a comprehensive insight into SimulationX' capabilities in the field of electronics, magnetics and electromechanics through various examples of motor models, amplifier circuits and electromagnetic drives.

Content

- Modeling electromechanical systems (concept, basics and structure of the libraries for electronics, electromechanics (electric motors, inverters, stepping motors) and magnetics)
- Properties and use of model elements from the Magnetics library
- Properties and use of model elements from the Electronics library (basic elements, ideal elements, semiconductors, sources, wires, sensors)
- Electrical and magnetic connections
- Interactions and interconnections of physical domains within the entire system – equilibrium calculation and simulation in the time domain

Scenarios

- Basic model of a closed magnetic circuit
- Open magnetic circuit with constant air gap
- Simple electromagnetic drive with variable air gap

Duration: ½ Day

Goal

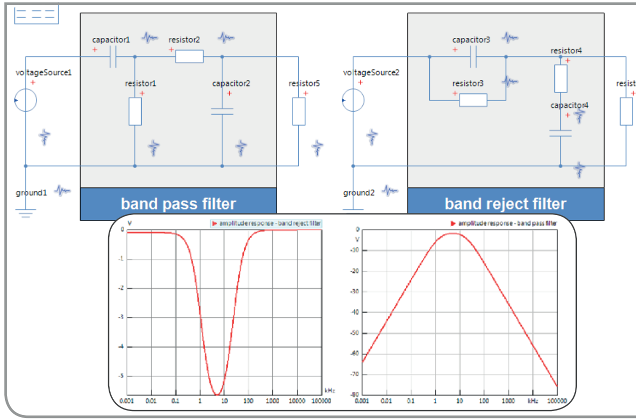
This course will show you the basic functionality of this library and how to use it for AC calculations in the time and frequency domain.

Content

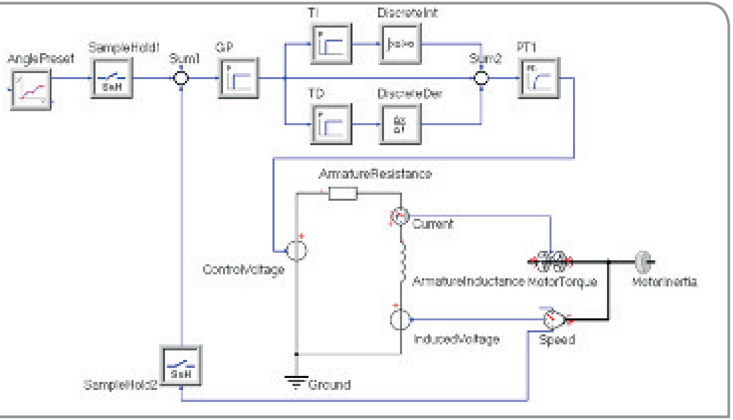
- Fundamentals of AC calculations
  - Complex numbers, indices
  - Terminology (frequency, amplitude, effective value, phase shift)
- Concept of the library
  - State variables within the connections (flux and potential)
  - Calculation methods (transient calculation, calculations in the frequency domain with transient solver)
- Library content
  - Basic elements and their representation in the frequency domain
  - Transformer
  - Line elements

Scenarios

- Examples for electrical energy transfer
- Analysis of filter circuits



Duration: 1 Day



Goal

The goal of this course is to learn how to design RPM and position controlled drives (PID controller) as well as how to model and analyze non-linear controllers.

Content

- Libraries and fields of application
- Concept and structure of the Signal Elements libraries
- Properties, use and special functions of model elements
- Parameterization (presets) and variables
- Combination with Mechanics, Electronics, Hydraulic and Thermal
- Structure and system analysis, use of analysis functions for the design of the control unit
- Continuous-time and discrete-time systems
- Applying design methods to the control unit
- Pole placement using Scilab or Matlab

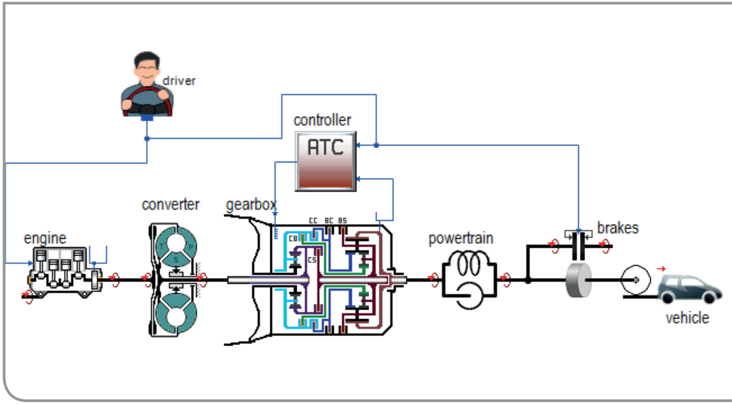
Scenarios

- Discrete-time control devices
- Servomotor
- Rotation and angle automation through pole placement
- Inverse pendulum

Duration: 1 Day

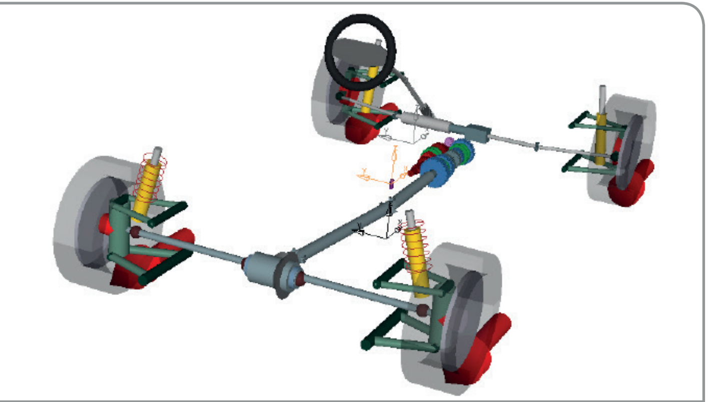
Goal

After completing the introduction and mechanics courses successfully, you will learn how to easily model powertrain components with varying depths of detail and how to optimize your entire model effectively. The seminar offers several specializations for you to choose from.



Content – Basics

- Transient simulation in the time domain
- Properties and use of libraries and model elements (e.g. engines, clutches, transmission elements, synchronizers)
- Parameterization, variables, dependencies and characteristic lines
- System discretization and modeling
- Options for calculations, analyses and post-processing
- Engine and transmission mounts
- Consideration of external loads and losses



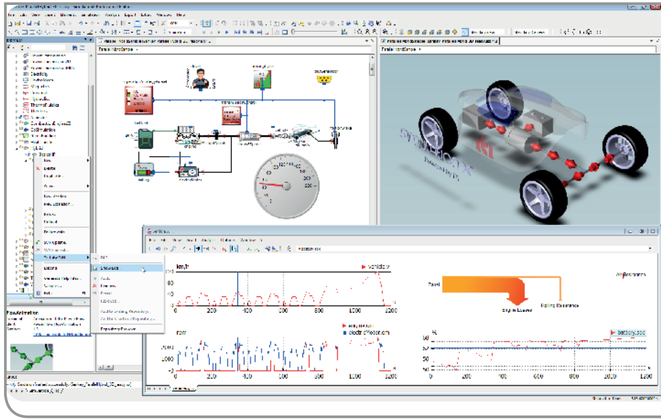
Available Specializations

- Combustion Engines
  - Handling and customization of the SimulationX Combustion Engine libraries
  - Modeling for specific depths of detail and parameterization
  - Particularities of steady-state and transient simulations
- Electric Drives
  - Electric machines and controllers
  - Signal oriented modeling
- Transmissions
  - Gearboxes in vehicles
  - Synchronizers
  - Planetary gears
  - Miscellaneous transmissions (torque converter, CVT)
  - Transmission actuation
- Torsional Vibration Analysis (TVA)
  - Ship propulsion and heavy machinery
  - Steady-state drive systems, e.g. in power plants
  - Transient simulation and simulation in the frequency domain
  - Package "Torsional Vibration Analysis"

Duration: 1–2 Days

Goal

The focus of this course lies on modeling, simulating and analyzing hybrid powertrain configurations as well as parameter studies and post-processing. It is based on the "Introduction to SimulationX".



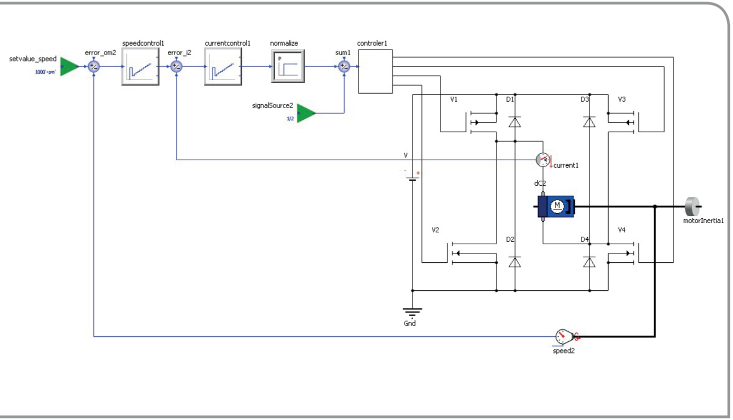
Content

- Concept and structure of models and libraries
- Selecting and combining physical vehicle components according to the desired level of detail
- Ways of controlling and initiating vehicle powertrains
- Use and extension of bus systems
- Operating strategies with state machines
- Parameterization of model components (user-specific driving cycles, characteristic maps, energy conversion efficiency)
- Analysis and result interpretation with respect to energy efficiency (power balance, energy flow diagram)

Scenarios

- Modeling of an entire vehicle powertrain
- Configuration and comparison of different vehicle topologies
- Visualization and extension of bus signals

Duration: 1 Day



Goal

This course's main focus lies on designing and analyzing controlled drives, test stands and devices, stepper motor drives as well as controlled synchronous and asynchronous motors. The introduction to SimulationX and the Mechanics course form the basis for this seminar.

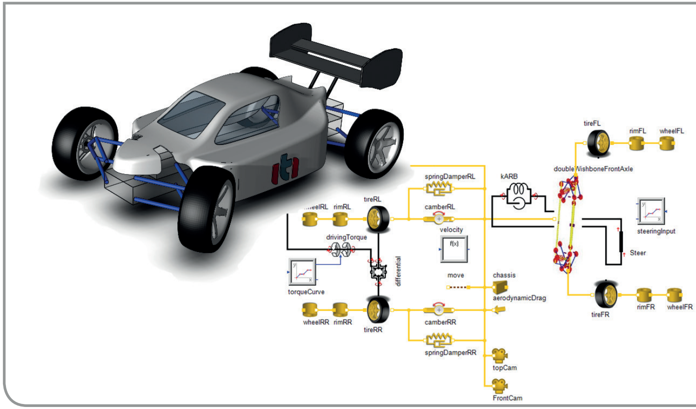
Content

- Applications and ways of modeling for optimizing electric drives in mechanical engineering
- Modeling electrical and mechanical drive components with different depths of detail
- Parameterization, variables, dependencies, characteristic lines
- Combination with various physical domains
- Expanding standard model elements through the TypeDesigner
- Natural frequency analysis and evaluation in the time and frequency domains

Scenarios

- RPM controlled DC motor
- Linear drive with DC motor
- Frequency controlled asynchronous motor

Duration: 1 Day



Goal

Based on a quarter vehicle model and several component models, such as the steering mechanism and the suspension, you will learn step by step how to create an entire passenger car model in motion.

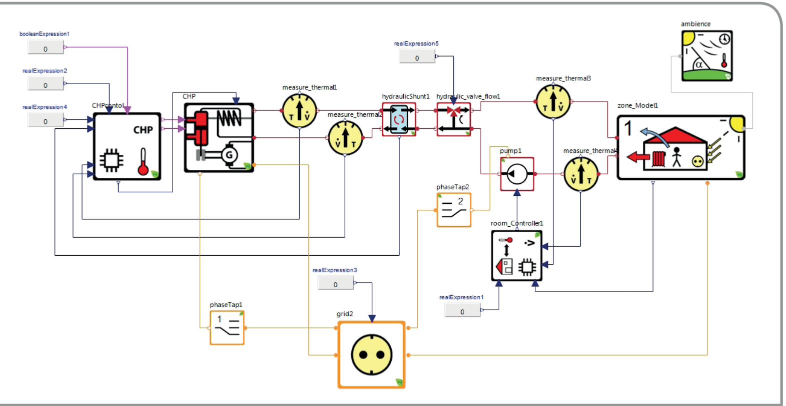
Content

- Applications and ways of modeling
- Structure and linking of component models
  - Modeling powertrains for the simulation of vehicle dynamics
  - Modeling chassis, power steering systems and controlled brakes
  - Use of various tire models, such as the Magic Formula, for simulating wheel-road contact
  - Approaches to modeling driving behavior and road conditions
- Visualization and animation of results
- Optimizing model performance
  - Illustration of relevant effects
  - Performance and dynamics analyses
  - Model reduction
- Adjusting shock absorbers and air suspension in the quarter vehicle model

Scenarios

- Rigid suspension with fixed steering shaft
- Flexible suspension with fixed steering shaft
- MBS model of a vehicle with rear wheel drive

Duration: 1 Day



Goal

In this course, you will learn how to use the Green Building package for modeling and simulating building systems including energy relevant sub-systems, such as electric vehicles.

Content

- Concept of the Green building package in SimulationX
- Introduction of available components
- Use of weather data
- “Bringing two worlds together” – simulating energy systems of buildings and vehicles
- Modeling a building’s energy system
- Comparing various concepts of energy systems

Scenarios

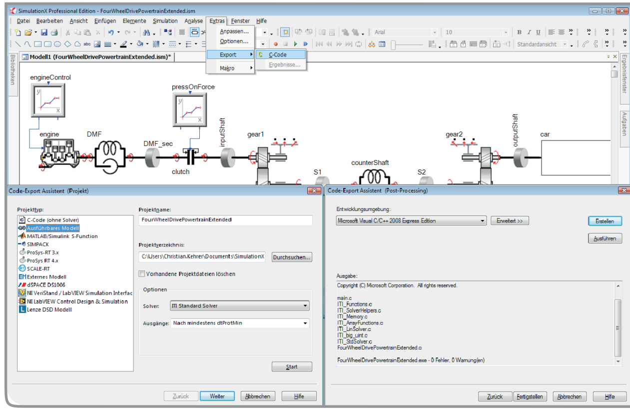
- Conventional building model
- Regenerative charging station
- Multi-zone model

This training course is provided by EA Systems Dresden.

Duration: 1 Day

Goal

This course gives you a comprehensive insight into SimulationX' versatile code export capabilities. Through suitable examples, you will learn how to embed SimulationX models in other environments, such as MiL, SiL, HiL or RCP.



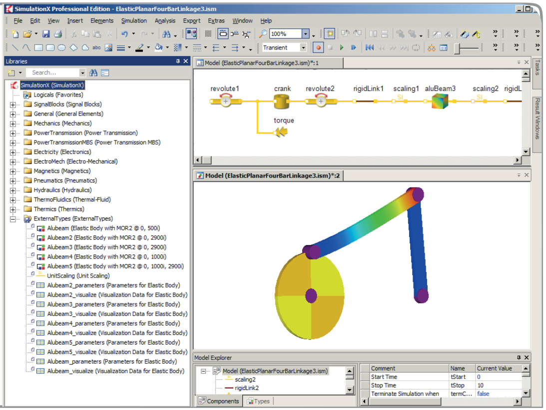
Content

- Overview of over 20 code export targets for CAx applications
- Code structure
- Capabilities of executable models
- Exporting models to Matlab/Simulink
- Comparing code export and co-simulation
- Exporting models to NI LabVIEW and VeriStand
- Particularities of real-time applications, e.g. hardware in the loop
- Functional Mockup Interface (FMI)
- Achieving and ensuring real-time capability
  - Illustration of relevant effects
  - Performance and dynamics analysis
  - Model reduction

Scenarios

- Calculation of variants with executable models
- Integration of an executable model into an external application
- Creation and use of an FMU (import, export)

Duration: ½ Day



Goal

We will show you how you can expand SimulationX MBS models by single CAD elements or entire CAD assemblies using the CAD import functionality. Suitable examples will illustrate the import of elastic structures from FE software programs.

Content

- Using the CAD interfaces for various CAD formats (stand-alone or software link)
  - Selecting CAD elements
  - Selecting joints
  - Specifying reference coordinate systems
  - Choosing layout for the diagram view
  - Update of CAD parameters
  - Saving import settings
- Using FEM imports
  - Calculating required input data in external FE software
  - Creating reduced-order sub-models for SimulationX
  - Integrating elastic bodies in multi-body systems

Scenarios

- CAD import of a crank slider
- Elastic mode of a conrod

Duration: 1 Day

Goal

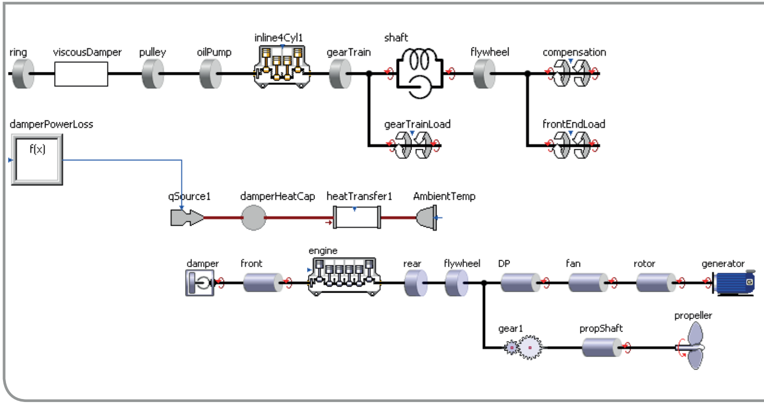
Learn how to quickly simulate and analyze excitation in machinery foundations, combustion engines with elastic crankshafts and cranks, powertrains as well as steady-state phenomena in other domains.

Content

- Steady-state calculations in the frequency domain
- Fields of application and workflow
- Calculation of powertrains' steady-state behavior
- Generating and interpreting steady-state result curves in the time and frequency domains
- Frequency dependent damper models
- Powertrains with combustion engines and non-linear components
- Systems with external, periodic excitation
- Calculation procedures, harmonic balance and curve tracking
- Solver settings and modifications for computation tasks

Scenarios

- Natural frequency analysis and steady-state calculation with combustion engine based powertrains
- Powertrains with elements from the TVA package
- Non-linear elements (clutches, thermal behavior)



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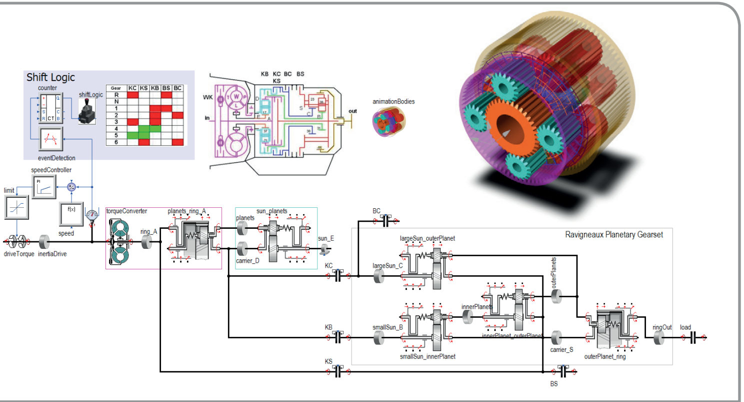


Goal

Several interfaces guarantee a seamless integration of SimulationX and its models into other CAD/CAE environments and process cycles. Learn which interface is most suitable for you and how to use it.

Content

- Importing and exporting data
- Database integration for parameterizing models
- Interaction with SimulationX over COM API:
  - Automation of recurring events
  - Parameter studies, calculation of variants
  - Automated integration into external tools
- External function/object interface for the integration of external algorithms
- CAD import
- Model exchange through code export and Functional Mockup Interface (FMI)
- Co-simulation with MATLAB®/Simulink®, MSC ADAMS and SIMPAC

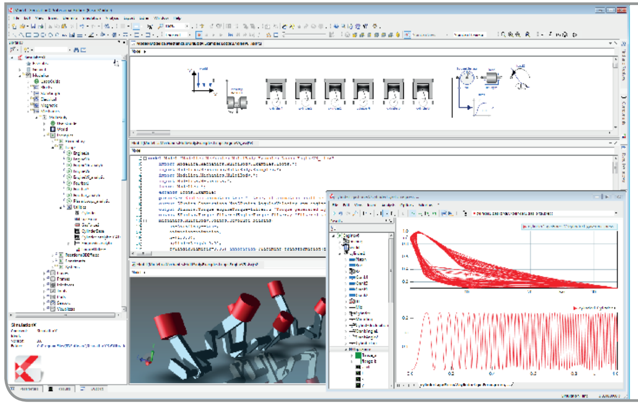
Scenarios

- Creating scripts for calculating variants and exporting results
- Integrating external C-code through the external function/object interface
- Model exchange through FMI for Model Exchange
- Examples for CAD import

Duration: 1 Day

Goal

This course introduces you to the object oriented model description language “Modelica”. You will learn the basics of modeling and simulation through appropriate examples of the Modelica libraries for physical domains.



Content

- Introduction and motivation: simulating and analyzing dynamic systems with Modelica
- Mathematical models of technical systems through Modelica (syntax)
- Concepts of modeling in Modelica, efficient implementation of models and libraries
- Libraries for physical domains in the Modelica standard library
- Additional expressions, graphical representation of models
- Mathematical aspects and robust modeling

Please note:

This course requires basic knowledge of Modelica. It is delivered by Kristin Majetta (Fraunhofer Institute for Integrated Circuits IIS, Design Automation Division EAS).

www.modelica.org

*Modelica is a registered trademark of the Modelica Association. For further information, please refer to www.modelica.org/documents.

Duration: 1 Day

```
Transient:
_der_gear1.connection2.phi=_der_connection1_.phi*(1/gear1.gear1.i_12);
gear1.connection2.phi=connection1_.phi*(1/gear1.gear1.i_12);
_zf_1:=500.*gear1.springDamper1.L+1000.*(connection3_.phi-gear1.connection2.phi);
_zf_2=if ZFSign(_zf_1)>0 then 500.*gear1.springDamper1.L+1000.*(gear1.connection2.phi-connection3_.phi);
gear1.springDamper1.Td=(if ZFSign(_zf_1)<=0 or ZFSign(_zf_2)<=0 then gear1.springDamper1.b*_der_gear1.connection2.phi-gear1.springDamper1.b*_der_conn
gear1.springDamper1.Ts=(if ZFSign(_zf_1)<=0 then(-0.5*gear1.springDamper1.L*gear1.springDamper1.k+gear1.connection2.phi*gear1.springDamper1.k)-connec
gear1.gear1.T1=-(gear1.springDamper1.Td*(1/gear1.gear1.i_12)+gear1.springDamper1.Ts*(1/gear1.gear1.i_12));
EQUATION<_der_connection3_.om>{_der_connection3_.om=(gear1.springDamper1.Td+gear1.springDamper1.Ts)/inertia2.J}
EQUATION<_der_connection1_.om>{_der_connection1_.om=gear1.gear1.T1/inertia1.J}


On Valid Step:
gear1.springDamper1.dphi=gear1.connection2.phi-connection3_.phi;
gear1.springDamper1.dom=_der_gear1.connection2.phi-_der_connection3_.phi;
inertia2.Ta=gear1.springDamper1.Td+gear1.springDamper1.Ts;
gear1.gear1.T2=gear1.springDamper1.Td+gear1.springDamper1.Ts;
gear1.springDamper1.eb.P=_der_gear1.connection2.phi*(gear1.springDamper1.Td+gear1.springDamper1.Ts)-(gear1.springDamper1.Td*_der_connection3_.phi+
gear1.springDamper1.Ti=gear1.springDamper1.Td+gear1.springDamper1.Ts;
gear1.springDamper1.Pp=gear1.springDamper1.Ts*_der_gear1.connection2.phi-gear1.springDamper1.Ts*_der_connection3_.phi;
gear1.springDamper1.Pl=gear1.springDamper1.Td*_der_gear1.connection2.phi-gear1.springDamper1.Td*_der_connection3_.phi;
inertia2.eb.P=_der_connection3_.phi*(gear1.springDamper1.Td+gear1.springDamper1.Ts);
inertia2.Pm=_der_connection3_.phi*(gear1.springDamper1.Td+gear1.springDamper1.Ts);
inertia1.eb.P=gear1.gear1.T1*_der_connection1_.phi;
inertia1.Pm=gear1.gear1.T1*_der_connection1_.phi;
_der_gear1.connection2.om=_der_connection1_.om*(1/gear1.gear1.i_12);
```

Goal

This course will broaden your knowledge about internal processes of SimulationX calculations and typical error scenarios. This knowledge then allows you to systematically pinpoint occurring errors and their origin within the model in order to eventually solve them on your own. The focus lies on understanding and mastering the Tracing feature in SimulationX as the key tool for troubleshooting.

Content

- Understanding and handling the Tracing functionality
- Understanding the BDF solver
- Simulation process (calculating initial values, time steps, event handling)
- Classification of typical error scenarios and error messages
- Tips for robust modeling
- Model optimization and reduction

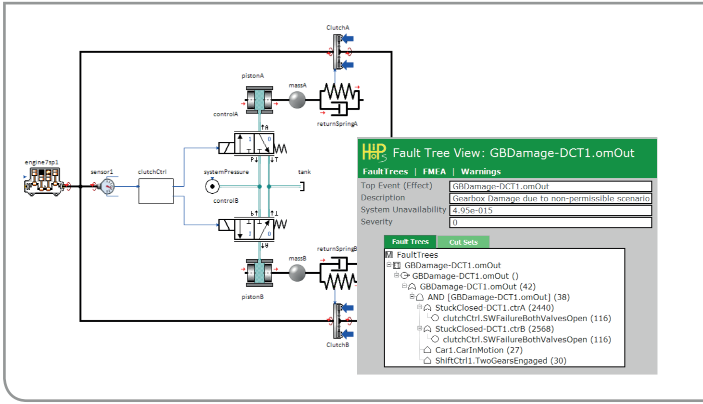
Scenarios

- Issues with singularities
- Issues with initial values in compounds
- Missing consistent initial values
- Non-converging solutions
- Cycles within event iterations

Duration: 1 Day

Goal

This course will introduce you to modeling and analyzing failure modes and reliability studies in SimulationX. You will learn the basics of failure analysis and get a better understanding of modeling and parameterizing failure modes in SimulationX with the integrated HiP-HOPS tool.



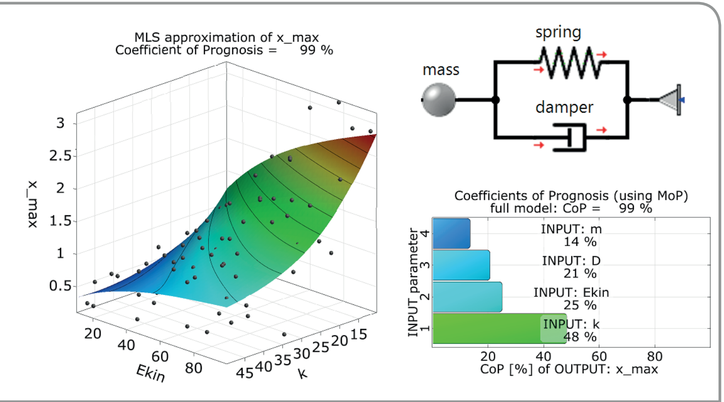
Content

- Basics of FTA (Fault Tree Analysis) and FMEA (Failure Mode and Effects Analysis)
- Modeling and parameterization in SimulationX for transient simulations and failure analysis
- Ways of describing failure modes
- Propagation of errors
- Failures with global effects (CCF – Common Case Failures)
- Output options and post-processing
- Combining failure analysis and multi-physics simulation

Scenarios

- Hydraulic cylinder drive
- Powertrain of a passenger car with dual clutch transmission
- Customer scenarios upon request

Duration: 1 Day



Goal

This course is an introduction to methods and application of sensitivity analysis and multi-disciplinary optimization. Using the software optiSLang, you will perform sensitivity analyses to understand the behavior of your SimulationX model (e.g. the effect of varying input parameters on the output variables). This additional information will then be used for efficient optimizations. Afterwards you will use these methods to match the results from the model to measured data (model calibration).

Content

- Explanation of the graphical user interface in optiSLang
- Process integration
- Application of sensitivity analysis
- Solutions to optimization problems
- Model parameter identification with measured data

Scenarios

- Calibrating a controlled system
- Designing a controller
- One-mass oscillator

This course is delivered by our partner Dynardo.

Duration: 1 Day

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