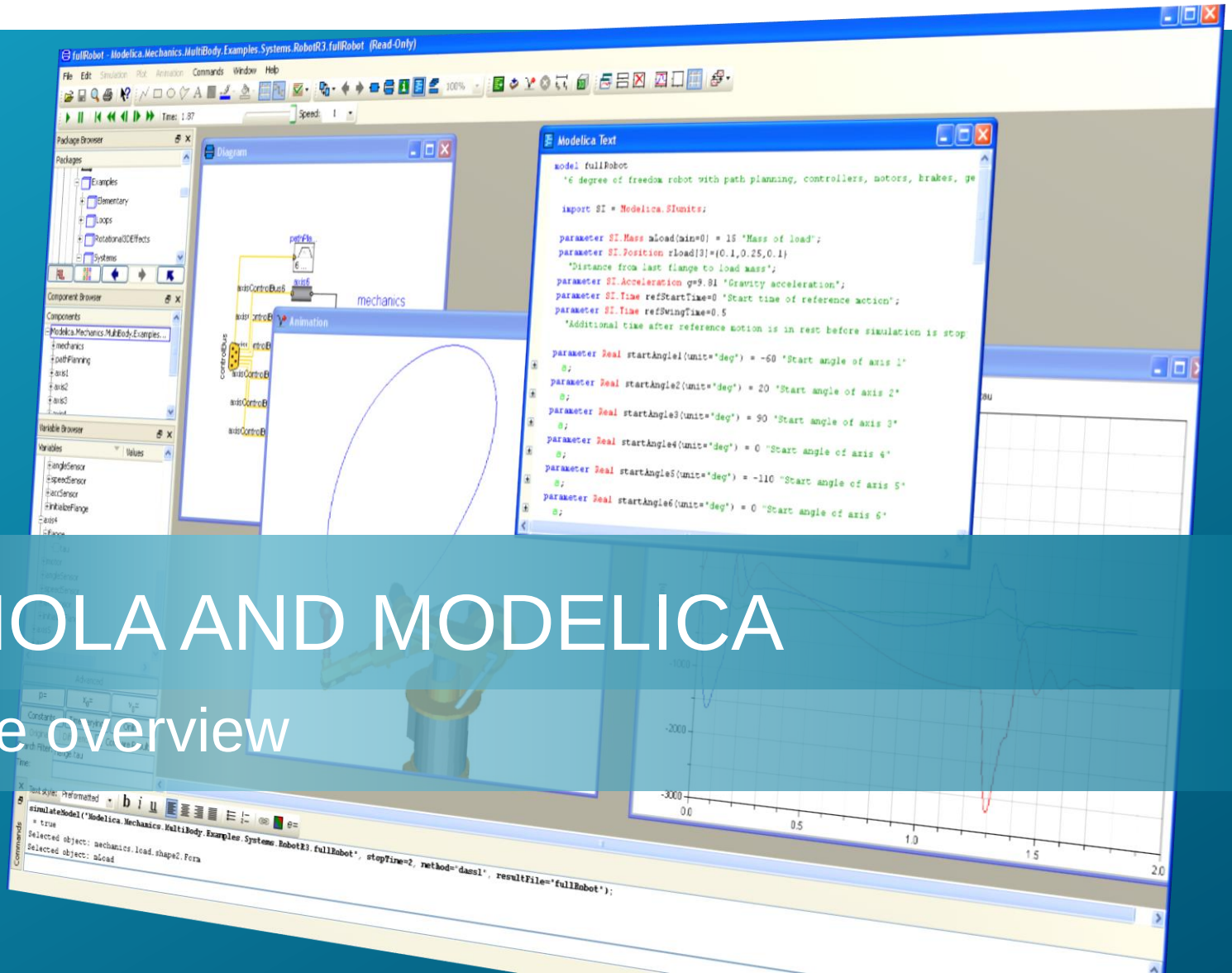
Modelon



DYMOLA AND MODELICA

Course overview

DAY 1

Dymola and Modelica I

- Introduction — Dymola, Modelica, Modelon
- Lecture 1 — Overview of Dymola and Physical modeling
  - Workshop 1 — Workflow of modeling physical systems in Dymola
- Lecture 2 — Simulation and post-processing with Dymola
  - Workshop 2 — Simulating and analyzing a physical system
- Lecture 3 — Configure system models
  - Workshop 3 — Creating a reconfigurable system

DAY 2

Dymola and Modelica I

- Lecture 4 — Modelica I – Writing Modelica models
  - Workshop 4a — Cauer low pass filter using Electric Library
  - Workshop 4b — A moving coil using Magnetic, Electric and Translational mechanics libraries
  - Workshop 4c — Temperature control using Heat transfer Library
- Lecture 5 — Understanding equation-based modeling
  - Workshop 5 — Defining boundary conditions
- Lecture 6 — Trouble shooting and common pitfalls
  - Workshop 6 — Common pitfalls

DAY 3

Dymola and Modelica II

- Lecture 7 — Modelica II – Advanced features
  - Workshop 7 — Implementing a solar collector
- Lecture 8 — Working with the Modelica Standard Library
  - Workshop 8a — Lamp logic using StateGraph II
  - Workshop 8b — Suspension linkage using MultiBody mechanics
- Lecture 9 — Hybrid modeling
  - Workshop 9a — Hybrid examples
  - Workshop 9b — Hammer impact model
  - Workshop 9c — Designing a thermostat valve

DAY 4

Dymola and Modelica II

- Lecture 10 — Efficient and reconfigurable modeling
  - Workshop 10 — Creating a system architecture based on templates and interfaces
- Lecture 11 — Model variants and data management
  - Workshop 11 — Creating a data architecture and adaptive parameter interfaces
- Lecture 12 — FMI technology
  - Workshop 12a — Import and Export FMUs in Dymola
  - Workshop 12b — FMI with Excel
  - Workshop 12c — FMI with Simulink

DAY 5

Dymola and Modelica II

- Lecture 13 — Workflow automation and scripting
  - Workshop 13 — Automated sensitivity analysis
- Lecture 14 — Dymola code with other tools
  - Workshop 14a — Source code and binary export
  - Workshop 14b — External functions and external objects
  - Workshop 14c — Simulink export
- Lecture 15 — Introduction to real-time
  - Workshop 15 — Configuring a model for real-time simulation

LECTURE 1

Overview of Dymola and physical modeling

Modelon

OVERVIEW

- Overview of Dymola
- Documentation
- Creating a new model
- Defining a model with several components
  - Connecting components, connectors
- Setting parameters, dialog boxes
- Interfacing:
  - Connector interface
  - Parameter interface
- Propagating parameters
- Organizing models in packages
- Using check in Dymola

LECTURE 2

Simulation and post-processing

Modelon

OVERVIEW

- What is an experiment?
- Setting up an experiment
- Working with results
- Analysis of results
- Exporting results
- Selecting solvers
- Initial conditions
- Understanding check, translate, simulate
- Understanding the translation and simulation logs

Modelon

LECTURE 3

Configure system models

Modelon

OVERVIEW

- Benefits with hierarchical models
- Structuring
- Configuring hierarchical models
  - Class vs component
  - Navigating
  - Setting and protecting parameters (encapsulation)
  - Changing components

Modelon

LECTURE 4

Modelica I - Writing Modelica models

Modelon

OVERVIEW

- Dymola text editor
- Variables
  - Modifying attributes of variables
  - Units and physical quantities, unit checking
- Equations and Algorithms
  - Equations
  - Initial equations
  - Accessing information in connectors
  - Algorithms
- Arrays and matrices
- Inheritance
- Modelica Standard Library
- Multidomain modeling

LECTURE 5

Understanding equation-based modelling

Modelon

OVERVIEW

- Equation-based components
  - Boundary conditions
  - Initialization
- Defining component boundaries
  - Potential and flow variables
  - Balanced models
  - Over-determined connectors
  - Input/output
  - Stream connectors
- Degrees of freedom in a system
  - State selection and index reduction
  - Identifying degrees of freedom in a system
- Other Modelica classes

LECTURE 6

Troubleshooting and common pitfalls

Modelon

OVERVIEW

- Development - Best practice
  - Specification
  - Implementation
  - Maintenance
- Troubleshooting
  - Translation problems
  - Simulation problems
- Debugging
  - Nonlinear solver diagnostics
  - Min/Max assertion
  - Logging options (Events, State variables)
  - Online debugging
  - Translation and Advanced Dymola flags
- Common problems

LECTURE 7

Modelica II – Advanced Features

Modelon

OVERVIEW

- Functions
  - Derivative, advanced derivative definitions
  - Inverse
  - Code generation annotations
- Enumerations
- Data records
- Component arrays
- Expandable connectors
  - Signal bus
- *Synchronous Language elements*

Modelon

LECTURE 8

Working with Modelica Standard Library

Modelon

OVERVIEW

- StateGraph
  - Fundamentals and Usage
  - Modelica.StateGraph vs. Modelica_StateGraph2
- Multibody Mechanics
  - Domain description and basic assumptions
  - Multi-body simulation in Dymola
- Fluid
  - Physical principles
  - Fundamentals and usage
- Media
  - Why and how is Media used?
  - Fundamentals

LECTURE 9

Hybrid modeling

Modelon

OVERVIEW

- What is a hybrid system?
- What is an event?
- Chattering
- Avoiding events
- Variable structures
  - Parameterized curves
  - State machines

Modelon

LECTURE 10

Efficient and reconfigurable modeling

Modelon

OVERVIEW

- Creating reconfigurable models
  - Templates and interfaces
  - Conditional components
  - Arrays of components
- Organizing models and data
  - Libraries
  - Data records

LECTURE 11

Model variants and data management

Modelon

OVERVIEW

- Modifiers in specific models
- Data records
- Data input blocks
- Replaceable functions
- Reading data from files
- Package constants
- Working with deeper hierarchies

Modelon

LECTURE 12

FMI Technology

Modelon

OVERVIEW

- Introduction and background
  - Why FMI?
- What is FMI?
  - The FMI standard
  - What is an FMU?
  - FMI Flavors
- Supported tools and testing
- FMI support in Dymola
  - Options
  - FMU import
  - FMU export
  - FMI workflow
- Using Dymola FMUs with other tools
  - Supported tools
  - Matlab/Simulink
  - Excel
  - Python

LECTURE 13

Workflow automation and scripting

Modelon

OVERVIEW

- Automated analysis
- Automatic script generation
- Scripts
- Scripting using functions
- Coupling commands to a model
- Example: Generating report data

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LECTURE 14

Using the Dymola code in other tools and environments

Modelon

OVERVIEW

- Binary export
  - Running dymosim.exe
    - Stand alone
    - Compiled with the DDE or OPC options
    - Compiled as DLL with API to C
  - Source code export
- Interface for Java and Python
- External functions in Dymola
- External objects in Dymola
- Dymola-Simulink Interface

LECTURE 15

Introduction to Real-time

Modelon

OVERVIEW

- Introduction
  - What is real-time simulation?
  - Why real-time?
  - Harder requirements
- Choosing solver
- Fast dynamics and instability
- Non-linear equation systems
  - Analytical Jacobians
- Profiling
  - Execution time analysis
  - Code profiling
  - Overruns
  - Translation log
- Inline integration
- Mixed mode integration
- Achieving real-time simulation

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