Workshop on Modelica® for Education

Technische Universität Berlin
Chair of Electronic Measurement and Diagnostic Technology
April 2, 2009
Goals: Find a way to improve the education on Modelica at universities and to exchange corresponding ideas and applications.
Agenda

09:00 - 09:30 Welcome reception with small snacks, coffee, tea

09:30 - 10:00 Prof. Gühmann, Dietmar Winkler: Opening and Modelica® at the Chair of Electronic Measurement and Diagnostic Technology

10:00 - 10:45 Prof. Martin Otter: Teaching Modelica® for electrical and mechanical engineers at Technische Universität München, Germany

10:45 - 11:00 🍵

11:00 - 11:45 Johan Åkesson, Hilding Elmqvist: Integrated Modeling, Control Synthesis and Code Generation with Modelica® and Dymola

11:45 - 12:30 Prof. Bernhard Bachmann: Teaching Modelica® for mathematicians and engineers at University of Applied Sciences, Bielefeld, Germany.

12:30 - 13:30 🍽️
13:30 - 14:15  Michael Tiller:  
**Physical Modeling and Product Development**

14:15 - 15:00  Prof. Bernhard Bachmann:  
**Using an Electronic Book to teach Modelica for PhD and Engineering students at Linköping University, Sweden.**

15:00 - 15:15  

15:15 - 16:00  Wilhelm Tegethoff:  
**Teaching Modelica for Engineers at Technische Universität Braunschweig, Germany**

16:00 - 17:00  Closing Discussion
Overview

- Bachelor and Master Education at MDT
- Modelica® Education - Basics
- Modelica® Education – Advanced/Deepening Knowledge
- Modelling and Simulation in Research Projects/PhD Projects
- Ideas for Improvement
Modelica® at MDT
Bachelor and Master Education at MDT

- Bachelor Electrical Engineering and Computer Engineering
  - Fundamentals in Electronic Measurement Techniques
  - Measurement data processing

- Master Electrical Engineering and Computer Engineering
  - Modelling and Real-Time Simulation of Technical Systems
  - Pattern Recognition and Technical Diagnosis

- Master Automotive Systems and EE/TI
  - Fundamentals in Automotive Electronics
  - Model-based Software Development for Automotive Applications

Modelling and Simulation Relevance/Competence:
- high:
- low:
Qualification objective: Modelling and simulation of the longitudinal vehicle dynamics

- IC engine model → methods: object oriented modelling, data based modelling, signal flow oriented modelling
- Modelling of the electric motors, vehicle power supply → method: object oriented modeling
- Modeling of the gearbox and clutch → method: object oriented modelling
- Modelling of the controls and data bus (CAN) → methods: state charts, signal flow oriented modelling,
Lecture „Modelling and real-time simulation“

Object-oriented modelling

- Signal-flow vs. Object-oriented
- Modelica: Overview, tools, addresses, literature
- Modelica: Introduction
- Solving of DAE
- Modelica fundamentals:
  - Basic elements
  - Interfaces and components
  - Blocks
Students Projects: Learning by Doing! (4/6 Credit Points)

- Modelling of electric components (freeFOClib)
  - Battery modelling
  - Controller for Hybrid Electric Vehicles
  - Machine modelling
- Gear-box modelling
  - Mechanics and controller logic
- Modelling of automotive sensors
- Modelling of internal combustion engine
- Real-time simulation of electric motors (simplified models)
- SiL modelling with Silver (Qtronic) co-simulation
- ...

Project „Test-bench of the future“
- Modelling of a vehicle-drivetrain in Modelica® in real-time.
Project development of a "free Field-Oriented Control library" (freeFOClib)
- Electric drives (with fault triggers)
- Drive controllers
- Inverters
- Batteries
Project „Modelling, simulation, and automated analysis of shifting processes of a double clutch transmission“
- Vehicle model with transmission and appropriate controller
- Simulation of shifting processes of different quality
Modelica® at MDT
Ideas for Improvement

- Data Based Methods for Modeling Physical Systems
  - Combination of physical-based models with data-based models
  - Identification algorithms
  - Artificial neural networks etc.

- Methods for „Software“ Modelling
  - „Easy to use“ state charts
  - task concepts

- Literature
  - Good textbooks (within student budget) with Modelica examples in Web
  - Recommendation label for good textbooks: „Recommended by the Modelica® Association“

- Student and lecturers friendly licensing of software tools