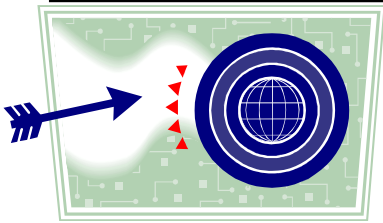# Workshop on Modelica® for Education

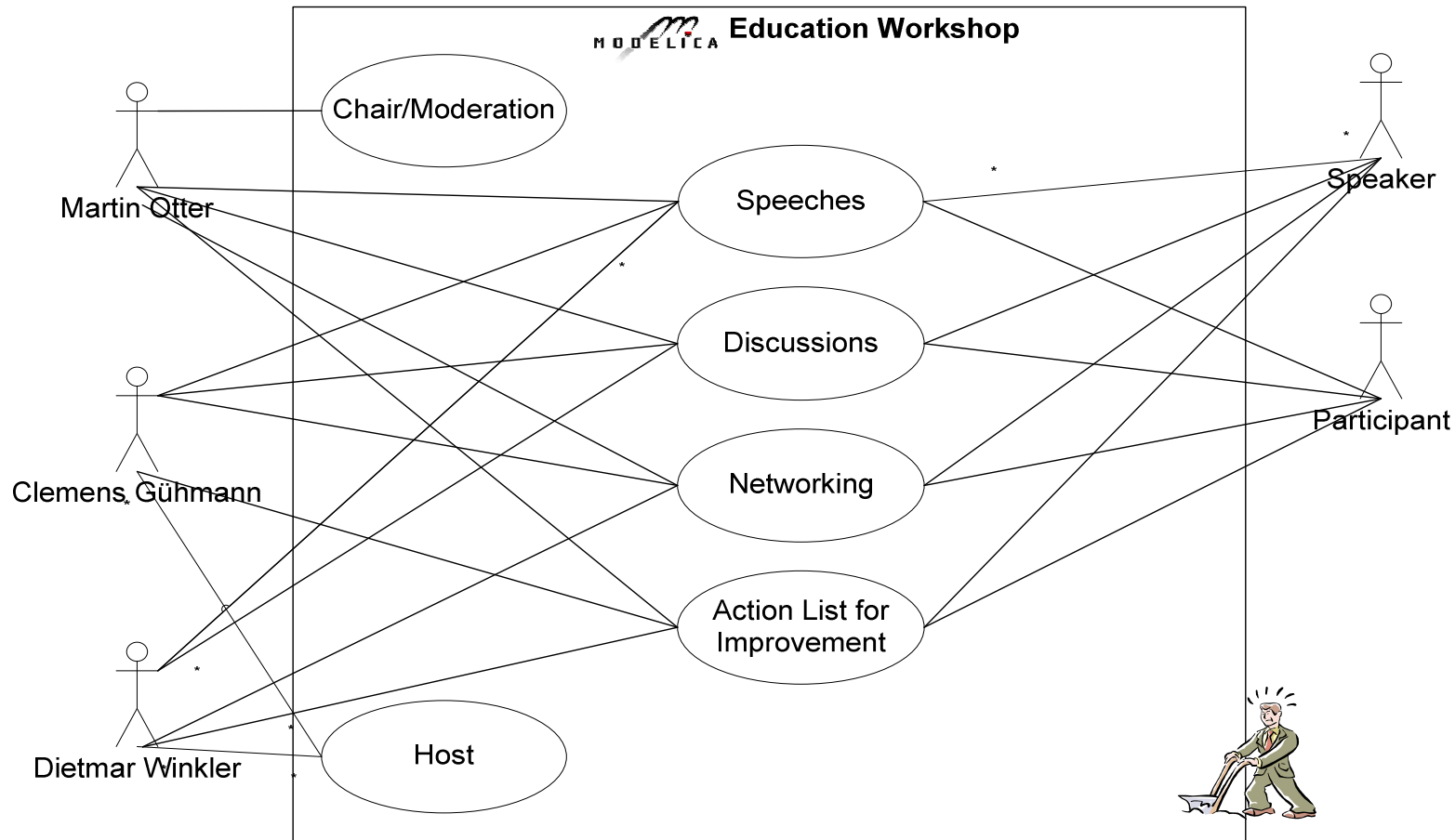**Technische Universität Berlin**
Chair of Electronic Measurement
and Diagnostic Technology
April 2, 2009

Opening and Organisation

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

Agenda

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

14:15 - 15:00 Prof. Bernhard Bachmann: *Using an Eletronic 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

Modelica® at the
Chair of Electronic Measurement and Diagnostic Technology

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
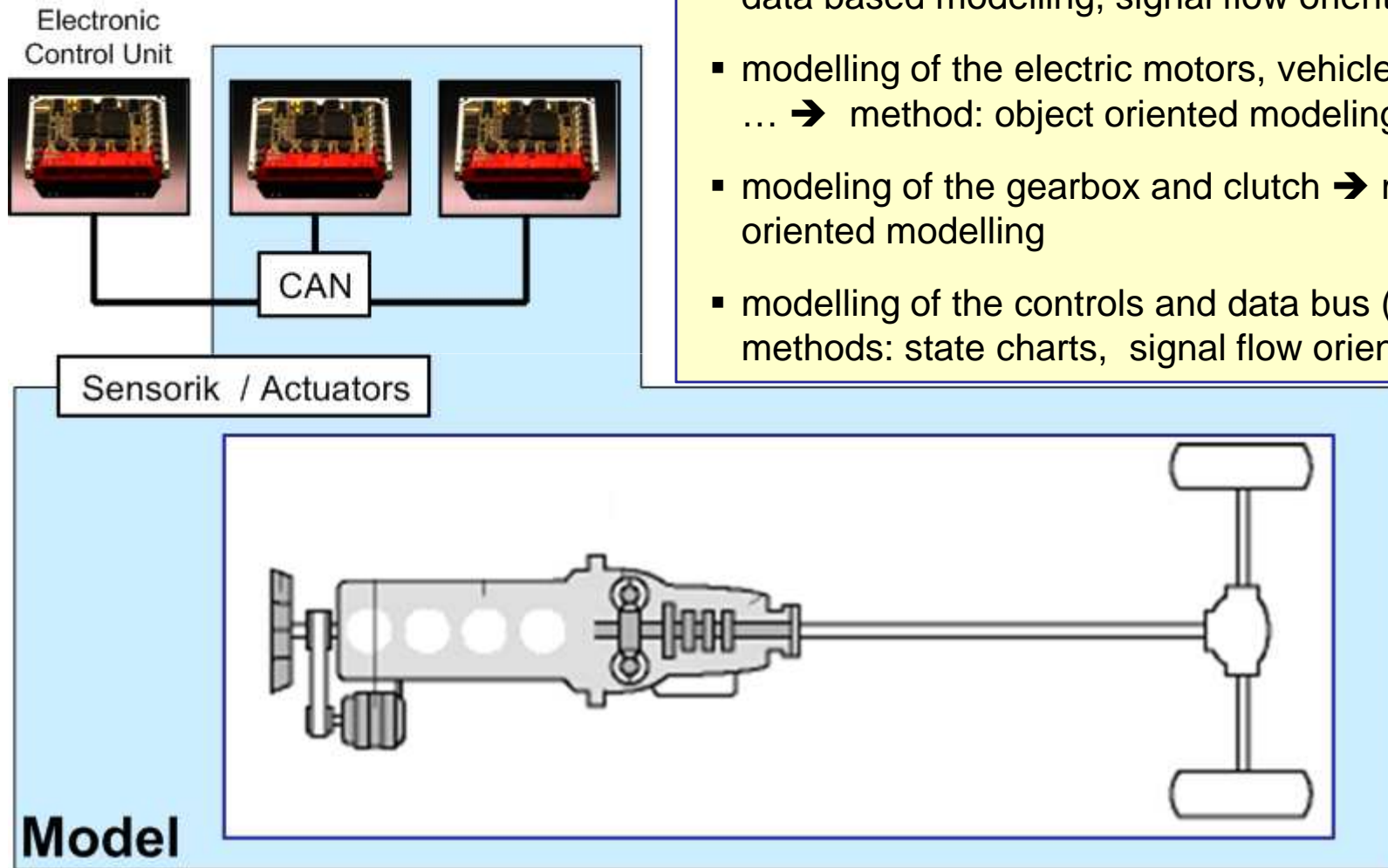

Modelling and Simulation Relevance/Competence   **high:**

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)

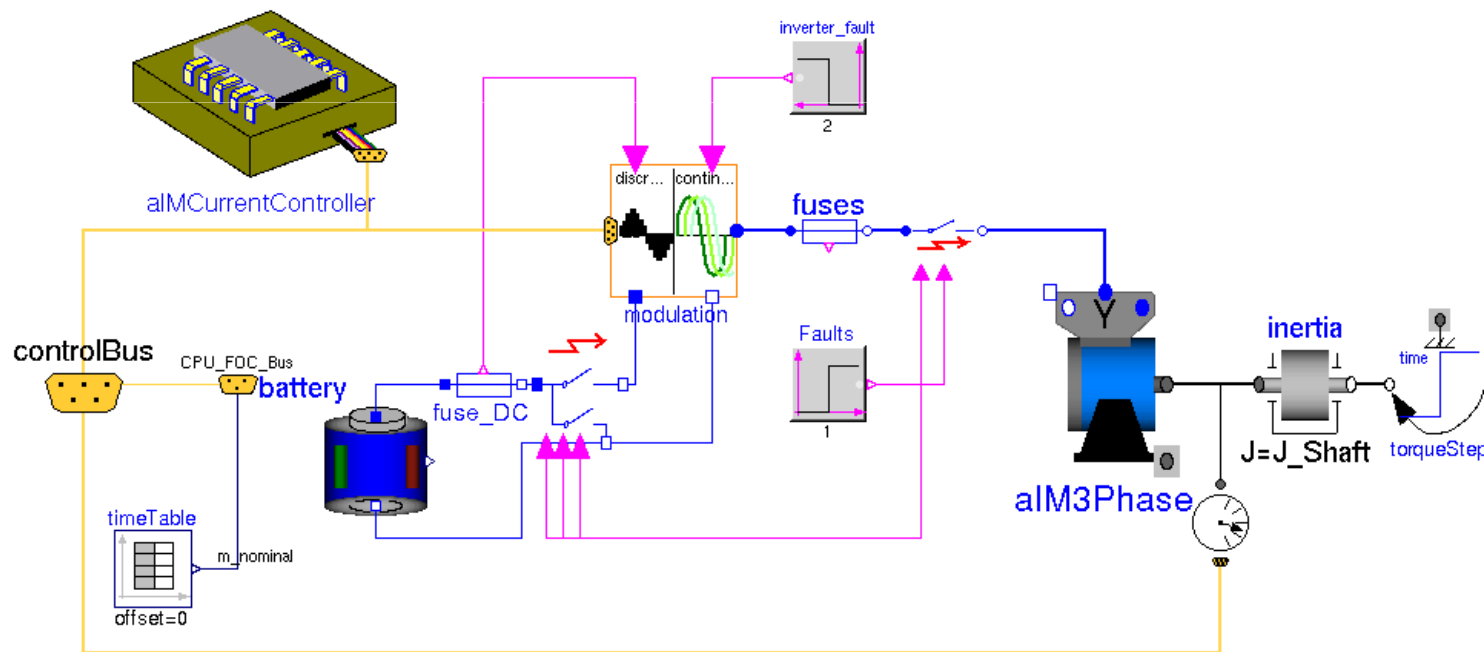– SiL modelling with Silver (Qtronic) co-simulation

– ...

■ Project „Test-bench of the future"

– Modelling of a vehicle-drivetrain in Modelica® in real-time.
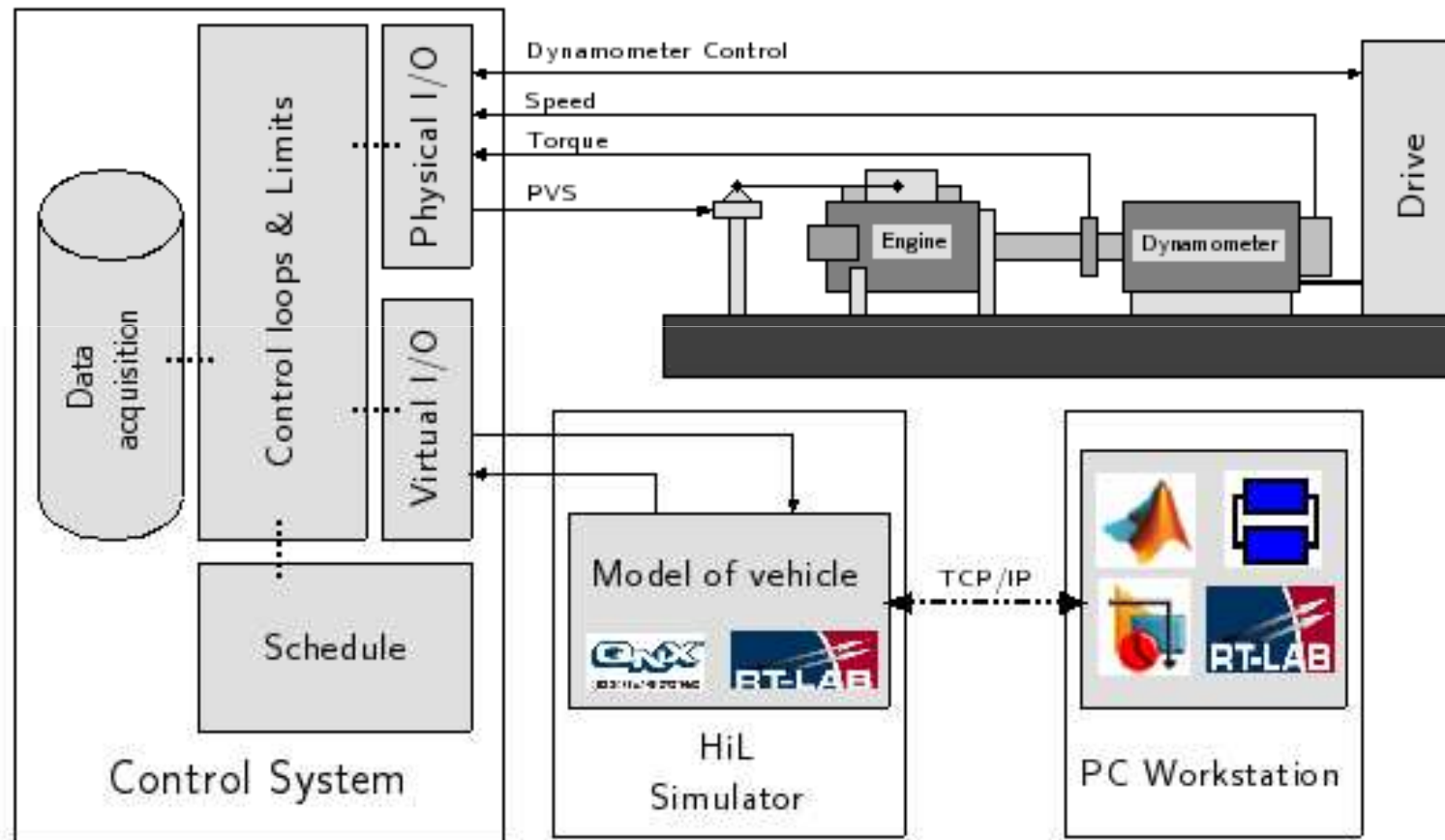
- **Project development of a „free Field-Oriented Control library" (`freeFOClib`)**
  - Electric drives (with fault triggers)
  - Drive controllers
  - Inverters
  - Batteries

■ 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
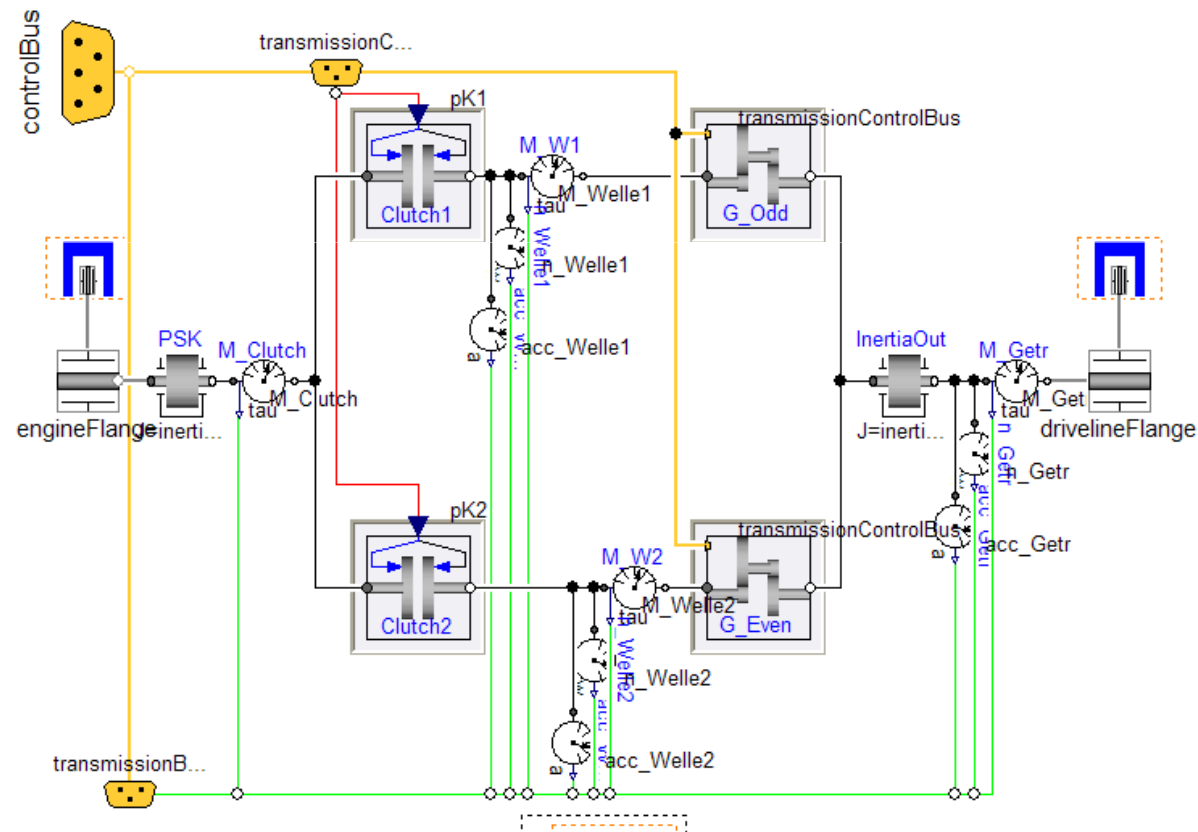
■ **Data Based Methods for Modeling Physical Systems**

- Combination of physical-based models with data-based models

- Identification algorithms

- Artifical 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

- Recommondation label for good textbooks: „Recommended by the Modelica® Association"

■ **Student and lecturers friendly licensing of software tools**