Tutorial 2:
Object Oriented Modeling and Simulation of Electric and Hybrid Electric Vehicles with Modelica

Thomas Bäuml, AIT - Austrian Institute of Technology (Vienna, Austria)
Email: thomas.baeuml@ait.ac.at

Dr. Markus Einhorn, AIT - Austrian Institute of Technology (Vienna, Austria)
Email: markus.einhorn@ait.ac.at

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Abstract

Shrinking sources of oil and gas and the concern about green house problems has made the development of hybrid electric vehicles or electric vehicles a very prosperous field of application. Pushing the utilization and the efficiency of each component, simulation has become a necessary and powerful tool. Because of the massive interconnection between different physical systems in a vehicle, not only simulations on component level, but on the whole vehicle system level are of greater importance than ever. Best performance of the vehicle can only be achieved if it is regarded as one system and optimised components are working in an optimised environment. Therefore a multiphysical simulation approach is inevitable. Optimizing heat flows between electric machine, battery and passenger cabin is a challenging task as well as determining the feedback from the drivetrain to the electric circuit.

The tutorial gives an overview about object-oriented, component based multiphysical modelling by means of the powerful Modelica simulation language (http://modelica.org) and its associated technology. With Modelica a whole range of application areas can be represented and it thus can be seen as an almost universal approach to high level computational modelling and simulation. It provides general notation as well as powerful abstractions and efficient implementations.

In the tutorial the usability of Modelica for modeling and simulating electric and hybrid electric vehicles will be demonstrated on some basic application models which will then be assembled to an electric or hybrid electric vehicle model. Furthermore more detailed application examples will be shown to demonstrate the complexity and applicability of the simulation environment.

Speakers Biographies

Thomas Bäuml studied mechatronics at the University of Applied Sciences in Wiener Neustadt. He is currently working at the Austrian Institute of Technology and pursuing the Ph.D. degree at the Vienna University of Technology. His main activities are focused on vehicle simulations and energy management strategies as well as thermal simulations of electrical machines and systems. He is member of the Modelica Association and has presented several tutorials concerning vehicle modeling.

Dr. Markus Einhorn was born in Vienna, Austria in 1984, received the BSc. degree and the Dipl.-Ing. degree in electrical engineering and the Ph.D. degree in technical chemistry from the Vienna University of Technology in 2008, 2009 and 2011, respectively. He is currently working at the Mobility Department, Electric Drive Technologies at the AIT Austrian Institute of Technology in Vienna, Austria as a Research Associate. His recent work is focused on design and modeling of power electronics and battery systems. Dr. Einhorn is a member of the Austrian Electrotechnical Association (OVE) and the Modelica Association.

References

Simic, D.; Bäuml, T.: Implementation of Hybrid Electric Vehicles using the VehicleInterfaces and the Smart-ElectricDrives Libraries, 6*th International Modelica Conference, Bielefeld, Germany,* 2008

Pirker, F.; Simic, D.; Bäuml, T.; Noll, M.: Modeling, Optimization and Realization of an Electrical Off-Road Motorbike, *European Ele-Drive Conference, EET 2008, Geneva, Switzerland,* 2008

Bäuml, T.; Simic, D.: Simulation and Comparison of different Energy Management Strategies of a Series Hybrid Electric Vehicle, *IEEE Vehicle Power and Propulsion Conference, VPPC, Harbin, China,* 2008

Simic, D.; Baeuml, T.; Pirker, F.: Modeling and Simulation of different Hybrid Electric Vehicles in Modelica using Dymola, *International Conference on Advances in Hybrid Powertrains, Paris, France,* 2008

Simic, D.; Bäuml, T.; Pirker, F.: Simulation, Design and Realisation of an Entire Electrical Off-Road Motorbike, *SAE International - Advanced Hybrid Vehicle Powertrains, Detroit, USA, 2009*

D. Simic, Simulation, Design and Evaluation of an entire Hybrid Electric All Terrain Vehicle, *IEEE Vehicle Power and Propulsion Conference (VPPC), Dearborn, USA, 2009*

T. Bäuml, Modelling, Simulation and Validation of an Electrical Zero Emission Off-Road Motorcycle, *IEEE Vehicle Power and Propulsion Conference (VPPC), Lille, France, 2010*