

DYMOLA – Smart Electric Drives Library

Overview:

- Modeling and simulation of complete electric drive systems

Key Features

- Includes simulation of energy storages, converters (power electronics) and controls for electric machines
- Simulation of transient effects in electric drives
- Development and optimization of various control strategies
- Ability to control machines from the Modelica® Standard Library
- Quasi stationary models for different machine types
- Large variety of different model complexities
- Easy to handle models

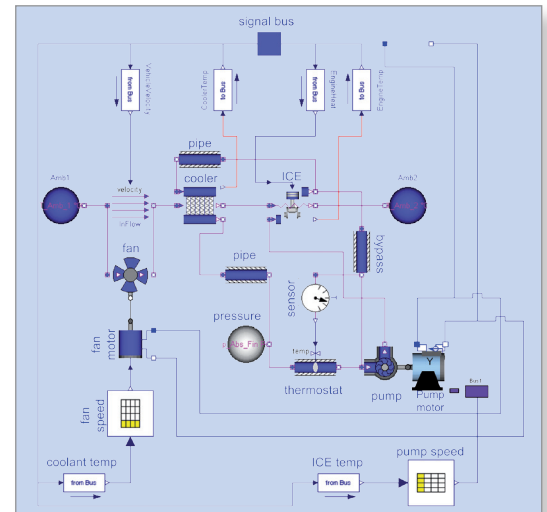
Benefits:

- Ideal for simulation of hybrid electric vehicles and new alternative concepts with electrical auxiliaries
- Demonstrated fuel savings in hybrid vehicles

Investigation of a hybrid concept showed that an efficiency increase of 17% of the whole electric drive leads to a fuel saving of the hybrid vehicle of 13%. This demonstrates the important role of simulation in the design and development of the electric drive train.

With the Smart Electric Drives Library all components of the electric drive train, such as energy storages, power electronics, controls and electric machines can be simulated.

Thermal management with an electrically operated water pump.



Smart Electric Drives Library for transient and quasi stationary applications

> Machines

- Direct current machines
- Asynchronous induction machines
- Permanent magnet synchronous machines
- Brushless DC machines

> Controls

- Voltage/Frequency control
- Field oriented control
- Speed and position control

> Power electronics

- Rectifiers (AC/DC-converters)
- Inverters (DC/AC-converters)
- DC/DC-converters
- Idealized and real converters
- PWM (Pulse Width Modulation)

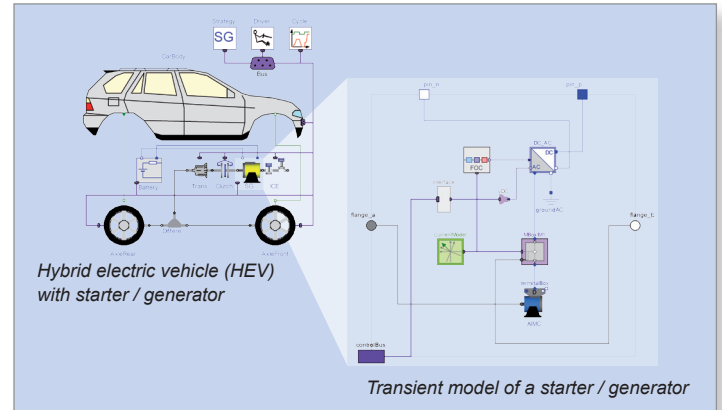
> Energy storages

- Batteries
- Supercaps
- Fuel cells (PEM)

> Field of Applications

- Hybrid electric vehicles (HEV) in combination with the PowerTrain Library
- Starter / generator
- Electrically operated water pump
- Electrically operated oil pump
- Electrically operated air conditioning system
- Industrial drives

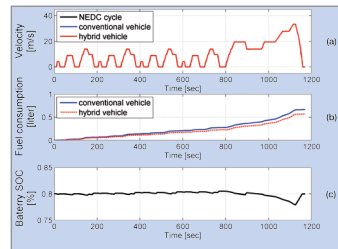
Example of a hybrid electric drive train



In hybrid electric vehicles, the electric traction machine has to be torque-controlled. In this example an induction machine control is based on magnetic field orientation. This technique allows the fast and accurate torque generation. For the torque controller, flux has to be modeled, so that the torque and magnetic field can be controlled independently. Battery supply, the dc/ac converter and measurement equipment are also modeled in the shown example. This model of an electric drive can be implemented easily in a longitudinal dynamics simulation of a hybrid electric vehicle.

The image on the left shows results when comparing the hybrid vehicle example with a conventional vehicle.

The Smart Electric Drives Library is designed, implemented, and maintained by AIT Austrian Institute of Technology, a Dassault Systèmes technology partner.



(a) compared NEDC cycle and velocity of the conventional and the hybrid vehicles

(b) comparison of the fuel consumption of the conventional and the hybrid electric vehicles

(c) battery SOC of the hybrid vehicle

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