

Modeling and Simulation of Hybrid Electric Vehicles

Prerequisites:

- Basic knowledge of Modelica
- Basic knowledge of Electrical Engineering and Electrical Machines

This Tutorial consists of three parts:

1. Object-Oriented Modeling of Electrical Machines

As an introduction, the excitation of the rotating magnetic field in the airgap will be explained. The rotating magnetic field is common for the following machine types:

- Asynchronous induction machines
 - with squirrel cage
 - with slipring rotor
- Synchronous machines
 - with electrical excitation
 - with permanent magnets
 - with reluctance rotor

The spatial fundamental wave of the magnetic field can be described by means of space phasors. After the introduction of this transformation, the equations of the airgap will be explained. Furthermore, the mechanical concept of the machine models will be shown.

Finally the thermal concept of the machine models will be discussed in detail:

- Loss models
- Exchange of heat flow with a thermal model

2. Object-Oriented Modeling of Inverters (SmartElectricDrives Library)

First, the concept of field-oriented control is introduced. The necessary control blocks / components will be presented. For energy conversion between DC and AC, two models are discussed:

- Power balance models
- Ideal switching models

For connecting a DC interlink circuit to the grid, the concept of voltage-oriented control will be explained.

3. Object-Oriented Modeling of Electrical Energy Storages

Two different battery models are discussed:

- StaticResistance
- LinearDynamicImpedance

These models are mainly different in terms of the internal impedance. The concept of a battery stack will be explained. Furthermore two examples (cycling a battery stack and discharging a single cell with a current profile from a real life driving cycle) will be presented.