Tutorial: Advanced Modeling and Simulation of Power Electronic Systems

EPE 2011, Birmingham

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Morning	Afternoon	
09:00	14:00	**Registration**
09:15	14:15	**Introduction**
		Simulation of Power Electronic Systems • Different levels of simulation • Physical vs. behavioural component models • Variable and fixed step operation
		Simulation of Continuous Systems • Taylor series approximation as the basis of a solver algorithm • Non-stiff/explicit solvers, stiff/implicit solvers • Stability region of stiff and non-stiff solvers • Typical causes of stiffness • Step size control • Event detection and handling of discontinuities • Avoiding missed events • Solver function calls during major and minor time steps
11:00	15:00	**Coffee Break**
11:30	15:30	**Tips to Achieve a Fast Simulation** • Simulation tuning to maximise time step and minimise calculations • Averaged converter modeling • Efficient generation of PWM
		Fast Thermal Simulations • Overview of lookup table approach • Electrical feedback of thermal losses • Techniques for calculating the steady-state operating point - online average cycle loss calculation and Newton Raphson analysis.
13:00	17:00	**End of Tutorial**

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Tutorial Objectives

The goal of this tutorial is to provide insight into the operation of the continuous variable-step solvers that are used for simulating power electronic systems. The solver is often viewed as a 'black box' since this is typically not a topic that is taught in electrical engineering courses. The idea is to shed light on the inner workings of the solver so that the user can understand better how to configure the solver for the problem at hand. The solver operation will be presented within the context of power electronic system simulation and real-life examples will be given in order to reinforce the presented concepts.

The second objective is to explain practical techniques for speeding up a large system model that comprises dozens of states. The correct simulation approach can make the difference between a simulation that takes several minutes or several hours. Averaged converter modeling will be discussed since this can speed up the simulation by over an order of magnitude. Thermal modeling will also be discusses because simulating a combined electrical-thermal model can be problematic due to the large thermal time constant.

Target Audience

The target audience is power electronics engineers who use simulation tools as a part of their tool chain and who wish to learn more about solver operation and advanced simulation techniques.