ACCURATE AND FAST MODELLING AND SIMULATION FRAMEWORKS FOR POWER ELECTRONICS

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Abstract
This talk addresses the seemingly inevitable compromise between modeling fidelity and simulation speed in power electronics. Higher-order effects are considered at the component and system levels. Order-reduction techniques are applied to provide insight into accurate, computationally efficient component-level (via reduced-order physics-based model) and system-level simulations (via multiresolution simulation). At the component level, dynamic high-fidelity magnetic equivalent circuits are introduced for laminated and solid magnetic cores. Automated linear and nonlinear order-reduction techniques are introduced for linear magnetic systems, saturated systems, systems with relative motion, and multiple-winding systems, to extract the desired essential system dynamics.

At the system level, a framework for multiresolution simulation of switching converters is developed. Multiresolution simulation provides an alternative method to analyze power converters by providing an appropriate amount of detail based on the time scale and phenomenon being considered. A detailed full-order converter model is built based upon high-order component models and accurate switching transitions. Efficient order-reduction techniques are used to extract several lower-order models for the desired resolution of the simulation. The resulting rapid-to-integrate component models and flexible simulation frameworks could form the computational core of future virtual prototyping design and analysis environments for energy processing units.

Biography
Ali Davoudi is currently an assistant professor in the electrical engineering department of the University of Texas-Arlington. He received his B.S. degree in electrical engineering from Sharif University of Technology, his M.S. degree from University of British Columbia, and his Ph.D. degree from the University of Illinois in 2010. He was a visiting scholar at the University of British Columbia, and a visiting lecturer and post-doctoral research associate at the University of Illinois. Dr. Davoudi has received UBC International Student Fellowship, UIUC's Henry Ford II scholar award and M E. Van Valkenburg Graduate research awards. He also worked for Philips Electronics, Texas Instruments, and SolarBridge Technologies. Dr. Davoudi is an associate editor for IEEE Trans. on Vehicular Technology. His research interests are modeling, simulation, and control of grid-interconnected renewable energy sources, finite-inertia power systems, energy harvesting, and energy source diversification.

Mr. Lotfifard received his B.Sc and M.Sc degrees both in electrical engineering from University of Zanjan and University of Tehran, Iran in 2004 and 2006 respectively. He is currently pursuing his Ph.D. in Electrical Engineering at Texas A&M University, under the supervision of Prof. Mladen Kezunovic. His research interests include power system protection and control, intelligent monitoring and outage management, distribution automation, and application of statistical methods in power systems. His current focus is on intelligent monitoring and outage management for realization of self healing networks, which is one of the most attractive features of "smart grid."