

2006 IEEE Workshop on Computers in Power Electronics

# COMPEL 2006

**Rensselaer Polytechnic Institute**

**Troy, NY, USA**



**July 16 –19, 2006**

## PRELIMINARY PROGRAM

**Industry Co-sponsors**

**Powersim, Inc.**

**and**

**Astec Power**



# COMPEL'06 Preliminary Program

Sunday July 16, 2006

Registration (1:00pm – 2:00pm)

Tutorial (1:30pm – 5:30pm)

Digital Control Generations, *Philip Krein, University of Illinois, Champaign-Urbana, IL*

Workshop Reception (6:00pm – 7:30pm)

Monday July 17, 2006

Registration and Continental Breakfast (7:00am – 9:00am)

Opening Remarks (8:00am – 8:10am)

Jian Sun, Rensselaer Polytechnic Institute

Session 1 (Plenary Session): Power Electronics Systems – Trends, Challenges, and Opportunities (8:10am – 10:40am)

Chair: Jian Sun, Rensselaer Polytechnic Institute

- 1.1. Complex Power Systems and the Impact of Power Electronics, Modeling, and Simulation, *Terry Ericson, U.S. Office of Naval Research*
- 1.2. The Role of Power Electronics in More Electric Airplanes, *Kamiar Karimi, Boeing*
- 1.3. Modeling, Analysis, and Control Challenges for Industrial Applications, *Richard Zhang, Paul Szczesny, Juan Sabate, Rajib Datta, Ravi Raju, GE Global Research Center*
- 1.4. Role of Automation and Control Technology in Addressing Critical Energy Issues, *Nag Patibandla, RPI Future Energy Systems CAT*
- 1.5. Exploring Solutions for Challenges in Power Electronic System Integration in Military Ground Vehicles, *Damian Urciuoli, U.S. Army Research Laboratory*
- 1.6. Modular, Intelligent Power Systems for Space Exploration, *Robert Button, NASA Glenn Research Center*

**Coffee Break (10:40am – 11:00am)**

Session 2: Power Electronic Systems & Control (11:00am – 12:20pm)

Chair: Philip T. Krein, University of Illinois at Urbana-Champaign

- 2.1 Simulating a Multi-Agent Based Self-Reconfigurable Electric Power Distribution System, *Janeth G. Gomez-Gualdrón, Miguel Velez-Reyes, University of Puerto Rico at Mayaguez,*
- 2.2 A Universal Controller for Distributed Control of Power Electronics Conversion Systems, *Gerald W. Francis, Rolando Burgos, Fred Wang, Dushan Boroyevich, Virginia Tech*
- 2.3 Study of Different Implementation Approaches for a Maximum Power Point Tracker, *Florent Boico, Brad Lehman, Northeastern University*

- 2.4 Dynamic Loop Analysis for Modular Masterless Multiphase DC-DC Converters, *Yang Zhang, Regan Zane, Dragan Maksimovic, University of Colorado*

Lunch (12:30pm – 1:30pm, On Site)

Session 3: Advanced Analysis & Control Methods (1:30pm – 3:30pm)

Chair: Miguel Velez-Reyes, University of Puerto Rico at Mayaguez

- 3.1 Envelope Following Analysis of an Autonomous Power Electronic System, *Toshiji Kato, Kaoru Inoue, Yoshinori Kanda, Doshisha University, Japan*
- 3.2 Interleaving and Harmonic Cancellation Effects in Modular Three-Phase Voltage-Source Converters, *Carlos J. Casablanca and Jian Sun, Rensselaer Polytechnic Institute*
- ~~3.3 Dynamic Operation of Sensor-Less Dead Time Optimization in Digitally Controlled Switching Converters, *Bhaskar Ramachandran, Dragan Maksimovic, University of Colorado* (Withdrawn by Authors)~~
- 3.4 Trajectory Paths for DC-DC Converters and Limits to Performance, *Grant E. Pitel, Philip T. Krein, University of Illinois at Urbana-Champaign*
- 3.5 Feasibility of Geometric Digital Controls and Augmentation for ultra-fast DC-DC Converters Response, *Philip T. Krein, University of Illinois at Urbana-Champaign*
- 3.6 Optimal Control of the Parallel Interleaved Buck Converter, *A. Giovanni Beccuti, Georgios Papfotiou, Manfred Morari, Aut. Cont. Lab, Switzerland*

**Coffee Break (3:30pm – 3:40pm)**

Session 4: Aircraft Power Systems (3:40pm – 5:40pm)

Chair: Kamiar Karimi, The Boeing Company

- 4.1 Stochastic Modeling of Twelve-Pulse Rectifiers for Aircraft Applications, *Q. Sun, K. Strunz, University of Washington*
- 4.2 Input Impedance Modeling of Line-Frequency AC-DC Converters by the Method of Impedance Mapping, *Jian Sun, Jorge Colon, Rensselaer Polytechnic Institute; and Kamiar Karimi (The Boeing Company)*
- 4.3 Mathematical Model and Control Design for Sensorless Vector Control of PM Synchronous Machines, *Rolando Burgos, Parag Kshirsagar, Alessandro Lidozzi, Fred Wang, and Dushan Boroyevich, Virginia Tech*
- 4.4 D-Q-0 Synchronous Frame Average Model for Three-Phase Arrays of Single-Phase PFC Converter Loads, *Bin Huang, Rolando Burgos, Fred Wang, Dushan Boroyevich, and Fred C. Lee, Virginia Tech*
- 4.5 Large- and Small-Signal Evaluation of Average Models for Multi-Pulse Diode Rectifiers, *Sebastian Rosado, Rolando Burgos, Fred Wang, and Dushan Boroyevich, , Virginia Tech*
- 4.6 On the Stability of Distributed Simulations, *Carlos Gonzalez, Arindam Das, Mehran Mesbahi, University of Washington*

Dinner (6:30pm – 8:30pm, Location TBA)

Tuesday July 18, 2006

Session 5: (Plenary Session): Digital Control of SMPS – Trends, Challenges, and Opportunities (8:00am – 10:30am)

Chair: Brad Lehman (Northeastern University)

- 5.1 Digital Power Control: A System User Perspective, *Scott Strand, IBM*
- 5.2 Conceptual and Technical Challenges to the Growth of Digital Power Systems, *Geof Potter, Astec Power*
- 5.3 Digital Control Design and Analysis – Software Tools and Simulation, *Hua Jin, Powersim Inc.*
- 5.4 Digital Control Beyond Feedback Loop, *Lee Cleveland and Dimitry Goder, Sipex*
- 5.5 Digital Power: from Marketing Buzzword to Market Relevance, *Francesco Carobolante, Fairchild Semiconductor*
- 5.6 Power Supply Challenges in Deep-Submicron Technologies, *Milivoje Aleksic, ATI*

**Coffee Break (10:30am – 10:40am)**

Session 6: Digital Control Design (10:40am – 12:00pm)

Chair: Regan Zane, University of Colorado

- 6.1 Design and Implementation of a Wide-Bandwidth Digitally Controlled 16-Phase Converter, *Xu Zhang, Yang Zhang, Regan Zane, Dragan Maksimovic, University of Colorado*
- 6.2 Self-Programmable PID Compensator for Digitally Controlled SMPS, *Zhenyu Zhao<sup>1</sup>, Aleksandar Prodic<sup>1</sup>, Paolo Mattavelli<sup>2</sup>, University of Toronto<sup>1</sup>, University of Udine Via delle Scienze<sup>2</sup>, Canada<sup>1</sup>, Italy<sup>2</sup>*
- 6.3 Sensorless Current-Sharing in Multiphase Power Converters, *Raymond Foley, Richard Kavanagh, William Marnane, Michael Egan, University College Cork, Ireland*
- 6.4 Virtual Prototyping and Automatic Code Generation for DSP-Based Digital Control of Power Electronics Equipment, *Guanglei Wang, Dohong Li, Antonello Monti, Enrico Santi, University of South Carolina*

Lunch (12:00pm – 1:00pm, On Site)

Session 7: Digital & Mixed Signal ICs (1:00pm – 3:00pm)

Chair: Hua Jin, Powersim Inc.

- 7.1 Comparison of Two Different High Performance Mixed Signal Controllers for DC/DC Converters, *Lars T. Jakobsen, Michael A. E. Andersen, Technical University of Denmark, Denmark*
- 7.2 Digital Sliding Mode Pulsed Current Averaging IC Drivers for Light Emitting Diodes, *Anindita Bhattacharya, Brad Lehman, Northeastern University*

- 7.3 Hybrid DPWM with Digital Delay-Locked Loop, *Vahid Yousefzadeh, Toru Takayama, Dragan Maksimovic, University of Colorado*
- 7.4 Digital Pulse-Frequency / Pulse-Amplitude Modulator for Improving Efficiency of SMPS Operating Under Light Loads, *Nabeel Rahman, Kun Wang, Aleksandar Prodic, University of Toronto, Canada*
- 7.5 Digitally Controlled 10MHz Monolithic Buck Converter, *Toru Takayama, Dragan Maksimovic, University of Colorado*
- 7.6 Implementation of A 16 Phase Digital Modulator in a 0.35 $\mu$ m Process, *Tony Carosa, Regan Zane, Dragan Maksimovic, University of Colorado*

Dinner Cruise on Lake George: Bus Leaves at 3:30pm

### Wednesday July 19, 2006

#### Session 8: Machines and Drives (8:00am – 9:40am)

Chair: Leon M. Tolbert, University of Tennessee

- 8.1 A Preliminary Investigation of The Utility of the MATLAB<sup>®</sup> Schwarz-Christoffel Toolbox for Electric Machine Design and Analysis, *Timothy C. O'Connell, Philip T. Krein, University of Illinois at Urbana-Champaign*
- 8.2 General Adaptive Scheme for Stator Resistance Estimation in Sensorless Induction Motor Drives, *Han Li<sup>1,2</sup>, Wen Xuhui<sup>1</sup>, Chen Guilan<sup>1</sup>, Chinese Academy of Science<sup>1</sup>, Graduate School of Chinese Academy of Science<sup>2</sup>, China*
- 8.3 Synchronized Voltage Control in Six-Phase Induction Machine Drives, *Valentin Oleschuck, Radu Bojoi, Francesco Profumo, Alberto Tenconi, Alexandar M. Stankovic, Politecnico di Torino, Italy*
- 8.4 DSP Control of Multi-Use Induction Machines with Multiple Stator Windings: Closed-Loop Voltage Regulation and Speed, *Al-Thaddeus Avestruz, Steven B. Leeb, Massachusetts Institute of Technology*
- 8.5 Experimental High Performance Control of Two Permanent Magnet Synchronous Machines in an Integrated Drive for Automotive Applications, *Lixin Tang<sup>1</sup>, Gui-Jia Su<sup>2</sup>, Xianghui Huang<sup>3</sup>, Oak Ridge Associated Universities<sup>1</sup>, Oak Ridge National Laboratory<sup>2</sup>, GE Global Research<sup>3</sup>*

**Coffee Break (9:40am – 10:00am)** Poster presenters set up posters during this time

#### Session 9: Components & Circuits Modeling (10:00am – 12:20pm)

Chair: Toshiji Kato, Doshisha University, Japan

- 9.1 Toward a System for Automatic Extraction of Low-Order Models for Magnetic Devices, *Liyang Qu, Patric L. Chapman, University of Illinois at Urbana-Champaign*
- 9.2 System Modeling and Characterization of SiC Schottky Power Diodes, *Hui Zhang<sup>1</sup>, Leon M. Tolbert<sup>1,2</sup>, Burak Ozpineci<sup>2</sup>, Madhu Chinthavali<sup>2</sup>, Oak Ridge National Laboratory<sup>1</sup>, The University of Tennessee Knoxville<sup>2</sup>*

- 9.3 Automated Parameter Extraction Software for High-Voltage, High-Frequency SiC Power MOSFETs, *Tam H. Duong<sup>1</sup>, A. R. Hefner Jr.<sup>2</sup>, David Berning<sup>2</sup>, University of California, Irvine<sup>1</sup>, National Institute of Standards and Technology<sup>2</sup>*
- 9.4 SPICE Model of SiC JFETs for Circuit Simulation, *Yi Wang, Callaway Cass, Fred Wang, Dushan Boroyevich, T. Paul Chow, Rensselaer Polytechnic Institute*
- 9.5 Analysis and Optimization of Switched-Capacitor DC-DC Converters, *Michael D. Seeman, Seth R. Sanders, University of California, Berkeley*
- 9.6 Small Signal Modeling of Hysteretic Current Mode Control Using the PWM Switch Model, *J. H. Park, B.H. Cho, Seoul National University, South Korea*
- 9.7 Small-Signal Discrete-Time Modeling of Digitally Controlled DC-DC Converters, *Dragan Maksimovic, Regan Zane, University of Colorado*

Lunch (12:20pm – 1:00pm, On Site)

Session 10: Posters & Demonstrations (1:00pm – 3:30pm)

Chair: Aleksandar Prodic, University of Toronto, Canada

(1 minute shotgun presentation for each poster at the beginning)

- 10.1 Interactive Electronic Exercises with Simulation Capability in Power Electronics Teaching, *Hua Jin, Powersim*
- 10.2 GUI-Based Laboratory Architecture for Teaching and Research in Digital Control of SMPS, *Arseny Dolgov, Botao Miao, Regan Zane, Dragan Maksimovic, University of Colorado*
- 10.3 FPGA-Based Digital Network Analyzer for Digitally Controlled SMPS, *Botao Miao, Regan Zane, Dragan Maksimovic, University of Colorado*
- 10.4 Modeling and Simulation of a Digital Control Design Approach for Power Supply System, *G. M. Di Blasi, V Boscaino, P. Livreri, G. Capponi, F. Marino, Universita di Palermo, Italy*
- 10.5 The Full Digital Control Based Switched Mode Power Supply, *Xin Chen, Chun Ying Gong, HuiZheng Wang, Nanjing University of Aero& Astro, Aero-Power& Sci-Tech Center, China*
- 10.6 Hybrid Digital Control for Three Phase Rectifier-Inverter System, *Sumitha Mohan, Martin Rentzsch, Jan Losansky, Henry Guldner, Technical University of Dresden, Germany*
- 10.7 An Efficient Discontinuous-Mode Model of a Switch Pole, *Jonathan W. Kimball, University of Illinois at Urbana-Champaign*
- 10.8 Dynamics Characterization of Coupled-Inductor Boost DC-DC Converter, *Suman Dwari, Saurabh Jayawant, Troy Beechner, Stephanie Miller, Anu Mathew, Min Chen, Jonathan Riehl, and Jian Sun*
- 10.9 Considering Source Dynamics in Computer-Aided Parametric Average-Value Modeling of PWM Converters, *Ali Davoudi<sup>1</sup>, Juri Jatskevich<sup>2</sup>, Patric L. Chapman<sup>1</sup>, University of Illinois at Urbana-Champaign<sup>1</sup>, University of British Columbia<sup>2</sup>, USA<sup>1</sup>, Canada<sup>2</sup>*
- 10.10 Double-Integral Fourier Analysis of Interleaved Pulse Width Modulation, *Saurabh Jayawant, Jian Sun, Rensselaer Polytechnic Institute*

- 10.11 Active Compensation of the Input Filter Capacitor Current in Single-Phase PFC Boost Converters, *Konstantin P. Louganski, Jih-Sheng Lai, Virginia Polytechnic Institute and State University*
- 10.12 Steady State Electro-Thermal Modeling For DC-DC Converters, *Rosa Ciprian, Brad Lehman, Northeastern University*
- 10.13 Modeling and Simulation of Solar PV Arrays under Changing Illumination Conditions, *Dzung D. Nguyen, Brad Lehman, Northeastern University*
- 10.14 Genetic Algorithm Optimization of Power Flow in a Fuel Cell Electrical Vehicle, *Hasan Mehrjerdi<sup>1</sup>, Jamel Ghouili<sup>2</sup>, Pierre Sicard<sup>1</sup>, University of Quebec<sup>1</sup>, University of Moncton<sup>2</sup>, Canada*
- 10.15 Computer-Controlled Characterization of High-Voltage, High-Power SiC Devices, *Jose M. Ortiz-Rodriguez, Allen R. Hefner, David Berning, Colleen Ellenwood, Selim Olcum, National Institute of Standards and Technology*
- 10.16 A Circuit Simulation Model of A Novel Silicon Lateral Trench Power MOSFET for High Frequency Switching Applications, *K.R. Varadarajan, A. Sinkar, T. P. Chow, Rensselaer Polytechnic Institute*
- 10.17 An Assessment of Coupled Inductor Modeling for A Multi-Output Flyback Converter, *F. Farahmand, F. P. Dawson, J.D. Lavers, University of Toronto, Canada*
- 10.18 Nonlinear Feedforward Control of Three-Phase Voltage Source Converter, *Lang Yongqiang, Xu Dianguo, Harbin Institute of Technology, China*
- 10.19 Design of Low-Voltage AC Motor Drives Using Software Tools, *K. J. P. Macken<sup>1</sup>, M. H. J. Bollen<sup>2</sup>, ABB Ltd<sup>1</sup>, STRI AB<sup>2</sup>, Switzerland<sup>1</sup>, Sweden<sup>2</sup>*
- 10.20 Fault Diagnostic and Reconfiguration System for Multilevel Inverter Drive Using a Principal Component Neural Network, *Surin Khomfoi, Leon M. Tolbert, University of Tennessee*
- 10.21 Current Sense Circuit for a DC Powered Three Phase Servo Motor Controller, *Donald E. Fulton, Consulting Engineer, Massachusetts*
- 10.22 Research on Single-Stage Inverter Topology Based on Bi-DC/DC Converter, *Xiaodong Cai, Lin Sun, Chunying Gong, Yangguang Yan, Nanjing University of Aeronautics and Astronautics, China*
- 10.23 Deriving New Topologies of DC-DC Converters Featuring Basic Switching Cells, *Faisal H. Khan<sup>1</sup>, Leon M. Tolbert<sup>1</sup>, Fang Z. Peng<sup>2</sup>, The University of Tennessee<sup>1</sup>, Michigan State University<sup>2</sup>*