



**30TH IEEE POWER ELECTRONICS  
SPECIALISTS CONFERENCE**

**JUNE 27-JULY 2, 1999**

**CHARLESTON PLACE  
CHARLESTON, SC**

**SPONSORED BY**

**THE IEEE POWER ELECTRONICS SOCIETY**

**IN COOPERATION WITH**

**THE DEPARTMENT OF  
ELECTRICAL & COMPUTER ENGINEERING  
AND**

**THE COLLEGE OF ENGINEERING  
UNIVERSITY OF SOUTH CAROLINA**

**AND  
COASTAL SOUTH CAROLINA SECTION, IEEE**



# WELCOME TO CHARLESTON

On behalf of the IEEE Power Electronics Society, welcome to the 30<sup>th</sup> IEEE Power Electronics Specialists Conference in Charleston, one of the oldest cities in the United States. Charles Town (Charleston) was founded at its present site in 1680. The city has a rich history and played important roles in the early economic development and eventual War of Independence that created the United States. Later, Charleston served as a focal point for political activism and military action that began the US Civil War. The conference site, Charleston Place, is a European styled hotel that is in the middle of the historic district of the city. Many art galleries, antique stores, restaurants, live music, historical homes, and other historical sites are all within easy walking distance around the hotel.

PESC continues its tradition as a forum for long-term innovation and original approaches to power conversion problems. This annual meeting is for all engineers and researchers who work or are interested in future developments of power electronics. The 29 technical sessions are our most important activity, but you should be aware that the conference also includes three formal Tutorial Sessions, three informal Rap Sessions, and an industrial tour program.

The final program and Record contains 201 papers, selected from 362 submitted digests through a rigorous review process. Our ten Topic Chairs worked with 187 reviewers worldwide to select the program. The Organizing Committee extends thanks to the authors and reviewers. Your participation and interest are appreciated.

Wednesday will be capped by a banquet at Boone Hall, a historical Southern plantation. The evening's entertainment will include live music and other surprises. On Thursday, we will gather for the Annual Awards Luncheon of the Power Electronics Society. The William E. Newell Award, the highest honor bestowed in the field of power electronics, is traditionally given out at this event. Other major awards include the Young Power Electronics Engineer and the Outstanding Service Awards.

On Friday, several industrial tours are available. These tours include a visit to the Square D Company - Groupe Schneider plant, where conventional industrial switchgear and electronic variable speed drives are manufactured. Another tour is through the co-generation facility at Westvaco Paper Corporation.

We look forward to seeing you in Charleston at PESC'99!

Jerry L. Hudgins  
General Chair

Rene Spee  
Technical Program Chair

## **PESC'99 ORGANIZING COMMITTEE**

General Chair	Jerry Hudgins Univ. of South Carolina
Technical Program Chair	Rene Spee Maxwell Technologies
IEE Technical Liaison	Gerald Hurley National Univ. of Ireland
Region 8 Technical Vice-Chair	Johan Enslin University of Stellenbosch
Region 9 Technical Vice-Chair	Jaime Arau CENIDET, Mexico
Region 10 Technical Vice-Chair	Dean Patterson Northern Territory Univ.
Tutorial Chair	Rudy Severns Springtime Enterprises, Inc.
Rap Session Organizer	Dean Patterson Northern Territory University
Publications Chair	Tom Habetler Georgia Institute of Tech
Finance Chair	Mark Nelms Auburn University
Website Manager	Arthur Kelley North Carolina State Univ.
Technical Program Administrator	Cindy Spee
Program Publication	Sheryl Hudgins Univ. of South Carolina
Guest Arrangements	Sheryl Hudgins Univ. of South Carolina
Industrial Liaison	Chad Kennedy Square D Groupe Schneider
Administration	Robert Myers Myers/Smith, Inc.

## **TECHNICAL PROGRAM COMMITTEE**

Chair	Rene Spee Maxwell Technologies
IEE Technical Liaison	Gerald Hurley National Univ. of Ireland
Region 8 Technical Vice-Chair	Johan Enslin Univ. of Stellenbosch
Region 9 Technical Vice-Chair	Jaime Arau CENIDET, Mexico

Region 10 Technical Vice-Chair

Dean Patterson  
Northern Territory Univ.

Topic Chairs

Arthur Witulski  
University of Arizona  
Trey Burns  
Liebert Corporation  
Tom Habetler  
Georgia Institute of Tech  
Hirofumi Akagi  
Okayama University  
Daniel Mitchell  
Rockwell Avionics & Comm.  
V. Anand Sankaran  
Ford Scientific Research Lab.  
Gerald Hurley  
National Univ. of Ireland  
Seth Sanders  
Univ. of California, Berkeley  
Keyue Smedley  
Univ. of California, Irvine  
Randy Frank  
Motorola Incorporated

## REGISTRATION INFORMATION

Advance registration discounts are available if your form is received by May 27, 1999. The advance fees are US\$390 for IEEE members, \$490 for non-members, \$80 for Life Members, and \$80 for students with valid ID. After May 27, the fees are \$440 for members, \$560 for non-members, and \$100 for Life Members and students. Full registration includes admittance to all technical and rap sessions, printed and CD-ROM copies of the Proceedings, the Welcoming Reception, Banquet at Boone Hall, and the Awards Luncheon. Reduced rate and student registrations include the Proceedings, Reception, and Awards Luncheon, but not the Banquet. Awards Luncheon and Banquet Tickets, and additional printed and CD-ROM versions of the Proceedings, will be available for purchase at the conference. The additional Proceedings will be available for purchase on Tuesday, June 29.

Spouses do not require a registration fee, and may attend technical sessions, rap sessions, and the Welcoming Reception as guests of the Conference. Extra tickets for the Banquet (\$65 each) and Awards Luncheon (\$35 each) can be

purchased for guests. Children of conference registrants and guests are required to have tickets to attend the Wednesday Evening Banquet or Thursday Awards Luncheon. The conference hotel can assist in arranging babysitting services.

The Tutorial Sessions are available to all registrants for a supplemental fee. The advance registration fees are \$75 for members, \$110 for non-members, and \$50 for Life Members and students. After May 27, the fees are \$100 for members, \$135 for non-members, and \$50 for Life Members and students. The tutorial fee covers admission to one session and a workbook. Each tutorial must be registered for separately.

The registration booth is located on the second floor at the top of the grand staircase rising from the hotel lobby. Conference registration is open from 2:00 to 6:00 PM on Saturday, 7:00 AM to 7:00 PM on Sunday, 7:30 AM to 4:00 PM Monday through Thursday, and 7:30 AM to 11:00 AM on Friday.

Visa, Mastercard, American Express, checks, money orders, and cash are acceptable as payment. Advance registration forms should be sent with payment and with all items completed. For additional forms or conference information visit the conference website at: <http://www.pels.org/Comm/Meetings/Conference/pesc/pesc99> or contact:

IEEE PESC99  
3685 Motor Ave.  
Suite 240  
Los Angeles, CA 90034-5750 USA  
Telephone: 1-310-287-1463  
FAX: 1-310-287-1851  
e-mail: [bob.myers@ieee.org](mailto:bob.myers@ieee.org)

## HOTEL INFORMATION

The conference site is the Charleston Place Hotel, an Orient Express Hotel, in the middle of the historic district of Charleston. The location of the hotel is perfect for viewing historic sites, museums, art galleries, antique stores, and dining in varied fine restaurants; all within walking distance. Technical sessions for the conference, as well as the Guest Hospitality Suite are located on the second floor, near the conference registration desk.

A special rate of \$159 per night, single or double occupancy, has been secured for PESC attendees. Additional persons are \$20 per night. Use the attached reservation form, or be sure to mention IEEE-PESC when contacting the hotel. The special rate is guaranteed if you make your reservations by May 27. After that date, the rate is subject to room availability.

Hotel contact information:

Charleston Place  
130 Market Street  
Charleston, SC 29401-3133 USA  
Telephone: 1-843-722-4900  
Toll-Free: 1-800-611-5545  
FAX: 1-843-724-7215

## **SITE AND TRAVEL INFORMATION**

Charleston (Charles Towne) is the oldest and most visible city in South Carolina. When people think of Charleston they think of pastel stucco townhouses with wrought-iron railings, fine restaurants, and cobblestone streets. Her charm and beauty have long proven to be irresistible. You'll see it in the lacy trim of her breezy piazzas, and feel it in the spirit of her rich heritage. A port city steeped in history, barely changed since its founding in 1670. Here you'll find the very best of the South. A genteel nature, so inviting, so gracious, and an indomitable strength that has proudly withstood great fires, earthquakes, pirate rogues, a civil war and a hurricane with little more than a bat of an eye.

The history buff loses himself in Charleston. From the Battery to Fort Sumter to the historic Dock Street Theatre (1805), Charleston has played host to some of our country's most important happenings. It was in Charleston that the British stationed its headquarters during the American Revolution, the Southern plantation culture flourished, and the Confederacy fired shots upon Fort Sumter to begin the War Between the States. Much of the history remains rooted in the wood of the old oaks and architecture of the city. Cathedral spires point above the third-story porches of townhouses that sit side-by-side in Charleston's Battery by the harbor's edge.

A mix of old and new, Charleston gets better with age. Come wander along the cobblestone streets, smell the sea breeze, explore antique shops and boutiques and treat yourself to delicious fresh seafood. Come experience the Charleston area- her streets, her homes, her people.

### **Charleston Weather**

Charleston in late June is usually warm and can be humid, though sea breezes help keep the city cool. The average temperature during the day is 80-90 °F (27-31 °C) and nighttime 70-80 °F (21-26 °C). Afternoon thunderstorms can arise suddenly, but usually do not last long. Lightweight, comfortable clothes are recommended for outdoor activities along with comfortable walking shoes. A sweater or light-weight jacket for air-conditioned buildings or unexpected cooler evenings is suggested. Don't forget a small umbrella and sunscreen.

## TRAVEL INFORMATION

Centrally located on the east coast, Charleston, SC is easily accessible by air, land and sea. The Charleston International Airport is served by Comair, Continental, Delta Midway, and USAir, with dozens of flights arriving and departing daily. Rental cars\*, limousine service and taxis are available. A-Airport Express (shuttle service to downtown) \$10.00 for the first person and \$8.00 for each additional person, reservations required (800) 320-8348. Low Country Limo provides service to downtown at about \$7.00 per person, reservations are required (843) 767-7111. Taxi rates to downtown are approximately \$10.00 for the first person and \$3.00 for each additional person.

Land travelers will find that I-26, which connects with I-20, I-40, I-77, I-85, and I-95, leads directly into the heart of Charleston. US Highway 17, a coastal north-south route, also runs directly through Charleston. If you prefer to sit back and enjoy the scenery instead of driving, Amtrak offers rail service to Charleston.

The conference has arranged for special air carrier discounts with Delta. There is a standard discount of 5% off the lowest applicable published fare with an extra 5% discount if ticketed 60 days prior to departure. Arrangements can be made directly with Delta, through your travel agent, or through:

Columbia Travel  
224 O'Neal Court, Suite 18  
Columbia, SC 29223  
1 (800) 874-7321  
FAX (803) 699-0005

Be sure to mention IEEE-Power Electronics Specialists Conference 1999. The Delta file number is 127004A.

*\*Directions by car from the airport to the conference hotel:* International Boulevard, bear left onto Dorchester Road (HWY 642 East). Bear left onto West Montague Avenue, then bear right onto I 26 East. Bear to left and exit on US HWY 52 East (Meeting Street), turn right onto Meeting Street (US HWY 52) travel straight on Meeting Street for about 1.2 miles to Charleston Place Hotel. Hotel is on the right (corner of Meeting Street and Market Street).

## AUTHOR SERVICES

Paper presenters should plan to attend the Author's Breakfast, beginning at 7:15 am on the day of their session. At this breakfast, biographical information will be gathered by Session Chairs, and final arrangements for sessions will be discussed. Each session room will be equipped with an overhead projector, 35 mm slide projector, screen, and pointer. A computer-operated overhead display unit can be reserved with advance notice. If you have special audio-visual requirements, please contact the Program Chair as soon as possible. An extra charge might be involved if highly specialized equipment is requested.

A presenter's preparation room will be available during registration hours Monday through Thursday. Slide carousels will be available for checkout. The hotel operates a business center that provides copying and other services weekdays.

## GUEST SERVICES

A Guest Lounge will be provided (look for the sign at the registration table), with light refreshments morning and afternoon. In the Lounge, there will be information about area attractions, Charleston's history, gardens, walking tour guide books, as well as discount tickets to take a carriage tour (a "must do" Charleston treat). The Lounge will be staffed with a knowledgeable individual who can assist with everything from restaurants to shopping to transportation.

## KIDS PROGRAM

The hotel offers a wonderful "Kids Program" *for hotel guests only*. Be sure to ask about it at the registration desk. This program is for children who are two years and older. Children must be potty-trained. The hotel also has available a list of bonded and licensed babysitters for evening events. Guests are encouraged to make babysitting arrangements for their children during the Wednesday evening banquet.

## GUEST TOURS

***Monday, June 28, 1999***

### CHARLES TOWNE LANDING

9:00-Noon Cost \$29.00 per person. Private Guide and transportation included.

An unusual park located on the site of the first permanent English settlement in South Carolina. Take a tram ride guided tour of the original 1670 fortification. Board a replica of a 17<sup>th</sup>-century trading ketch, explore seven miles of path-



ways through beautiful English park gardens, walk through the enclosed pathways of the animal forest, and view the Settlers' Life Area where 17<sup>th</sup>-century herbs and plants are grown. This tour is great for children of all ages.

### **CHARLESTON WALKING TOUR**

2:00-4:00 PM Cost \$24.00 per person. Private Guide included.

Enjoy a wonderful tour of the beautiful historic downtown district of Charleston. Begin your walking tour with a private guide. You may visit St. Phillip's Episcopal Church, St. Michael's (circa 1752), the Elizabeth O'Neil Verner studio/museum and many other historic landmarks as well as several beautiful gardens.

### ***Tuesday, June 29, 1999***

#### **MIDDLETON PLACE PLANTATION AND GARDENS**

9:00-12:30 PM Cost \$52.00 per person. Includes round-trip transportation and private guide.

Middleton Place is an 18<sup>th</sup> century river plantation and national Historic Landmark. Home of Henry Middleton, President of the First Continental Congress, and his son, Arthur, a signer of the Declaration of Independence, it has never been deeded out of the family. The Gardens, begun by Henry Middleton in 1741, reflect the symmetry and elegance of 17<sup>th</sup> century France and 18<sup>th</sup> century England and are the oldest formal gardens in this country. The plantation Stable-yards preserves the day-to-day world of the rice and cotton eras. Enjoy ongoing craft demonstrations by the blacksmith, potter, basket weaver, quilters and carpenter. (This tour includes both the gardens and the plantation house.)

### ***Wednesday, June 30, 1999***

#### **FORT SUMTER TOUR**

8:45-12:30 PM Cost \$28.00 per person. Includes round-trip transportation to the City Marina and private guide.

Arrive at the City Marina and board the Fort Sumter boat, which will take you to the famous man-made island, Fort Sumter. The fort is a National Monument, administered by the National Park Services and marks the site where the Civil War began. Located in Charleston's Harbor, it is only accessible by boat, and features an excellent museum containing priceless exhibits. The National Park Service's has many historians conducting interesting and informative tours. In addition to a visit to Fort Sumter, you will enjoy a complete tour of Charleston Harbor, viewing many points of interest.

***Thursday, July 1, 1999***

## **PATRIOTS POINT AND MARITIME MUSEUM**

9:00-11:30 AM Cost \$35.00. Includes round-trip transportation and private guide.

The World's largest naval museum, this guided tour at Patriots Point Maritime Museum features aircraft missiles, guns and mines. The tour also has the Aircraft Carrier "Yorktown"; Destroyer "Laffey"; DD-459 Submarine "Clamagore"; Coast Guard Cutter "Ingham"; and the River Patrol Board, used in South Vietnam.

## **SPECIAL EVENTS**

### **WELCOMING RECEPTION**

The Welcoming Reception will be held Sunday evening from 6:30 PM to 9:00 PM, and is open to all attendees and guests. Be sure to pick up your conference badge for admission. This is a wonderful time of fellowship and will provide the opportunity to see old friends or make new acquaintances. Refreshments and samples of local cuisine will be provided.

### **BREAKFASTS**

*For attendees and guests registered at the Charleston Place Hotel only* a continental breakfast will be provided each morning. Food will be available between 7 and 8:30 AM each morning from Sunday through Friday. Coupons will be given upon registration. Please note that a separate breakfast is held for presenters.

### **SOUTHERN BANQUET**

On Wednesday evening, buses will leave the hotel beginning at 6:30 PM for a twenty-five minute ride to Boone Hall Plantation. Enjoy the Avenue of Oaks as you enter to begin a tour through the house. Guests can walk the grounds and see the historic buildings and dock. While touring the grounds, jazz music and refreshments will be aplenty. Later, a low country buffet dinner will be served under tent. At the end of dinner, the Plantation Singers will perform Songs of the South for our enjoyment. Please don't be concerned about Northern aggressors, because Confederate soldiers will be on patrol during the festivities.

One ticket to the banquet is included with each full regular registration. Additional tickets may be purchased for \$65 each. Anyone attending must have a ticket. Buses will begin the return trip at 10:30 PM.

## **AWARDS LUNCHEON**

The annual IEEE Power Electronics Society Awards Luncheon will be held at noon on Thursday to honor technical and service contributions to our profession. These awards include the highest honor given in the field of power electronics, the Newell Award. Each registration includes a luncheon ticket. Additional tickets for guests can be purchased for \$35 each.

# TECHNICAL PROGRAM

## TUTORIAL SESSIONS

*Sunday, June 27 — Morning — 8:00 – 11:30*

### **1) Advances in Averaged Switch Modeling and Simulation**

Dragan Maksimovic, University of Colorado, Boulder

In this tutorial, we show how averaged-switch modeling approach can be applied consistently not only to basic two-switch converter topologies in both continuous and discontinuous conduction modes, but also to more complicated examples including multiple-output converters, current-mode regulators and power factor correctors. Analytical, simulation and experimental results are presented for a number of power electronic systems. A library of large-signal PSpice models and simulation examples used in the tutorial will be available to attendees.

### **2) Design of Three Phase Rectifier Systems With Clean Input Power Characteristics**

Prasad Enjeti, Texas A&M University

Ira J. Pitel, Magna-Power Electronics

The objective of this tutorial is to present several three phase advanced power factor correction and harmonic reduction approaches for utility interface of power electronic converters. Several active and passive harmonic reduction methods for three phase rectifier systems will be presented. Several low kVA/cost active/passive schemes to realize clean input power will be presented with industry examples. Power electronic design engineers who deal with three phase power conversion such as: adjustable speed ac motor drive systems, switch mode converters, UPS, Battery chargers, rectifiers in electro-plating, Induction heating systems, 50/60/400 Hz power converters etc. will find this course informative and new knowledge gained in this seminar can be immediately applied.

*Sunday, June 27 — Afternoon — 13:30 – 17:00*

### **3) Winding Design For High-Frequency Magnetics**

Rudy Severns, Springtime Enterprises, Inc.

The use of increasingly higher switching frequencies in modern power electronics equipment has had a direct impact on the design of magnetic components. There are many differences between high and low frequency magnetics that must be taken into account in any successful design. This tutorial will provide an overview of the differences and their practical impact on winding design for magnetics. The presentation

will include variations on traditional computational techniques and a critical examination of range of validity. Practical guidelines for minimizing winding losses will be given.

## **RAP SESSIONS**

*Tuesday, June 29 —Evening — 19:00 – 21:00*

### **Power Electronics in Automobiles - The Next and Biggest Market for Consumer Power Electronics.**

Moderator: John M. Miller, Ford Scientific Research Laboratory

During the past two decades the electronics content in automobiles has increased by 21%/yr, but it is primarily applied to information processing, rather than power management. Power electronics in computers and telecommunications costs between \$0.10 and \$0.15/Watt. This is too high for automotive functions by a factor of five. Can we really envision an electrified car in which steering, braking, climate control and engine fluid pumping are electric driven? Is the automobile ready for power electronics?

### **Technology & Applications of Switched Reluctance Motor Drives: Facts & Fiction**

Moderator: Mehrdad Ehsani, Texas A&M University

The Switched Reluctance Motor (SRM) drive is being built or considered for consumer products, manufacturing, computing, aerospace and land vehicles, from a few Watts to over 1MW! Early fears about noise, torque pulsation, efficiency, geometry etc have proven to be fictional. Today, the SRM drive is mature, applicable technology. This RAP session will address both real and fictional issues for the SRM. Questions will be answered directly if possible, or skillfully evaded if not!

### **The PEBB Program - Setting Future Directions for Power Electronics**

Moderator: Narain G. Hingorani, NGH Power Electronics  
The Power Electronics Building Block (PEBB) concept increases modularity and multi-functionality while reducing cost, losses, size, weight, and device stresses. It does this by integrating gate drives, bus work and passive components using advanced packaging, and standardized interfaces. The US Office of Naval Research has driven the PEBB Program, with the support and involvement of many others. Such integration has begun in commercial products. The concept has taken root and there is no turning back.

## **INDUSTRIAL TOURS**

***Friday, July 2, 1999***

### **WESTVACO**

8:00-Noon Cost \$15.00 per person. Includes round-trip transportation.

Westvaco is a major manufacturer of paper, packaging and specialty chemicals headquartered in New York City and employs 2,100 people in South Carolina. Westvaco's North Charleston Kraft Division mill is a major supplier of specialty paper products for the decorative and industrial laminate markets worldwide. Westvaco and SCANA Corp., under a joint venture agreement, have constructed a \$160 million power cogeneration plant for the North Charleston facilities. The cogeneration plant will provide steam to power Westvaco's manufacturing facilities as well as increase the power capacity of South Carolina Electric & Gas (SCE&G), a subsidiary of SCANA.

***Friday, July 2, 1999***

### **SQUARE D -GROUPE SCHNEIDER**

8:00 AM-3:00 PM Cost \$20.00 per person. Includes round-trip transportation and lunch.

The Square D Company Columbia Plant an ISO9001 facility develops and manufactures industrial motor controls for diverse applications and markets. Business operations include adjustable frequency drives, crane control, and low voltage electro-mechanical products. Engineering of customer site requirements and a commitment to quality are integral parts of the plant focus. The plant began operations in Columbia, SC over 25 years ago and today employs more than 550 individuals at the 360,000 square foot facility.

# TECHNICAL SESSIONS

## SESSION 1. PLENARY

*Monday, June 28, 9:00 – 12:00 — MAGNOLIA / LIVE OAK*

*Chair:* J.L. Hudgins, University of South Carolina,  
Columbia, SC, USA

*Chair:* R. Spée, Maxwell Technologies, San Diego, CA,  
USA

### **Paper 1.1. PESC '99 OVERVIEW**

R. Spée, J.L. Hudgins

### **Paper 1.2. INVITED PAPER**

**Power Electronics Technology at the Dawn of  
the New Millennium – Status and Outlook**

J.D. van Wyk, Rand Afrikaans University,  
Auckland Park, Johannesburg, SOUTH AFRICA

### **Paper 1.3. Previously Unobserved Effects of Delay on Current-Mode Control**

E.A. Mayer, R.J. King, University of Toledo,  
Toledo, OH, USA

### **Paper 1.4. Principles of Electronic Ballast for Fluores- cent Lamps - An Overview**

H. Gueldner, K. Lehnert, F. Boehme, Dresden  
University of Technology, Dresden, GERMANY,  
R. Raiser, Osram GmbH, Muenchen, GERMANY

### **Paper 1.5. Ultracapacitor Based Ride-Through System for Adjustable Speed Drives**

M. Corley, J. Locker, R. Spée, Maxwell Technolo-  
gies, San Diego, CA, USA

### **Paper 1.6. Control and Performance of a Flywheel Energy Storage System Based on a Doubly-Fed Induction Generator-Motor for Power Condi- tioning**

H. Akagi, Okayama University, Okayama City,  
JAPAN, H. Sato, High-Energy Accelerator  
Research Organization, Tsukuba City, JAPAN

## **SESSION 2.           LOW POWER, LOW VOLTAGE DC/DC CONVERSION**

*Monday, June 28, 13:30 – 17:00 — CYPRESS*

*Chair:* D.C. Hamill, University of Surrey, Guildford, U.K.

*Chair:* E. Santi, University of South Carolina, Columbia, SC, USA

**13:30   Paper 2.1. An Integrated CMOS DC-DC Converter and Controller for Battery-Operated Systems**

S.-H. Jung, N.-S. Jung, G.-H. Cho, Korea Advanced Institute of Science and Technology (KAIST), Taejon, KOREA

**13:55   Paper 2.2. Development of Low Profile DC/DC Power Card Converter using Switched-Capacitor Circuits and Coreless PCB Gate Drive**

H. Chung, S.Y.R. Hui, S.C. Tang, City University of Hong Kong, Kowloon, HONG KONG

**14:20   Paper 2.3. Switched-Capacitor DC-DC Converter for Low-Power On-Chip Applications**

D. Maksimovic, S. Dhar, University of Colorado, Boulder, CO, USA

**14:45   Paper 2.4. A Comparative Study of Different Buck Topologies for High Efficiency Low Voltage Applications**

A. Consoli, F. Gennaro, A. Testa, University of Catania, Catania, ITALY

**15:10   BREAK**

**15:40   Paper 2.5. Very Fast Transient Voltage Regulators Based on Load Correction**

N.K. Poon, C.K. Tse, J. Liu, Hong Kong Polytechnic University, Hung Hom, HONG KONG

**16:05   Paper 2.6. A DC/DC Boost Converter Towards Fully On-Chip Integration Using New Micromachined Planar Inductors**

S. Iyengar, T.M. Liakopoulos, C.H. Ahn, University of Cincinnati, Cincinnati, OH, USA

**16:30   Paper 2.7. Digital PWM Control: Application in VRM's**

A.M. Wu, S.R. Sanders, University of California Berkeley, Berkeley, CA, USA



### **SESSION 3. RECTIFIERS/INVERTERS: PFC(1)**

*Monday, June 28, 13:30 – 17:00 — DOGWOOD*

*Chair:* J. Arau, Centro Nacional de Investigación y Desarrollo Tecnológico (CENIDET), Cuernavaca, Morelos, MEXICO

*Chair:* J. Locker, Maxwell Technologies, San Diego, CA, USA

**13:30 Paper 3.1. An Efficient PFC Voltage Regulator with Reduced Redundant Power Processing**

M.H.L. Chow, C.K. Tse, Y.S. Lee, Hong Kong Polytechnic University, Hung Hom, HONG KONG

**13:55 Paper 3.2. Analysis of a High Power Factor Rectifier Based on Discontinuous Capacitor Voltage Mode Operation**

V. Grigore, J. Kyyrä, Helsinki University of Technology, Espoo, FINLAND

**14:20 Paper 3.3. One Stage, Fast Response, Buck Based AC-to-DC Converter with Active Input Current Shaping**

A. Fernández, J. Sebastián, P. Villegas, M.M. Hernando, Universidad de Oviedo, Gijón, SPAIN

**14:45 Paper 3.4. Steady-State Analysis of AC-to-DC Converter with Active Input Current Shaper Based on Delayed Forward Output**

J. Sebastián, A. Fernández, P. Villegas, Universidad de Oviedo, Gijón, SPAIN

**15:10 BREAK**

**15:40 Paper 3.5. A Simple Single-Switch Single-Stage AC/DC Converter with Fast Output Voltage Regulation**

O. García, J.A. Cobos, P. Alou, R. Prieto, J. Uceda, Universidad Politecnica de Madrid, Madrid, SPAIN

**16:05 Paper 3.6. A Mixed-Signal ASIC Power-Factor Correction (PFC) Controller for High Frequency Switching Rectifiers**

R. Zane, D. Maksimovic, University of Colorado, Boulder, CO, USA

**16:30 Paper 3.7. A Single Phase Two-Switch Buck-Boost Type AC-DC Converter with a High Power Factor and Sinusoidal Source Current**

V.F. Pires, EST Instituto Politecnico Setubal, Setubal, PORTUGAL, J.F. Silva, Universidade Tecnica de Lisboa, Lisboa Codex, PORTUGAL

## **SESSION 4. CONTROL OF POWER FACTOR CORRECTION & ACTIVE FILTERS**

*Monday, June 28, 13:30 – 17:00 — JENKINS / K. CHARLES*

*Chair:* P. Maranesi, University of Milan, Milan, ITALY

*Chair:* K. Smedley, University of California - Irvine, Irvine, CA, USA

**13:30 Paper 4.1 . Decoupled Control of the Active and Reactive Power in Three-Phase PWM Rectifiers Based on Non-linear Control Strategies**

J.R. Espinoza, G. Joós, L. Morán, Universidad de Concepcion, Concepcion, CHILE

**13:55 Paper 4.2. Control Strategy of an Interleaved Boost Power Factor Correction Converter**

J.R. Pinheiro, H.A. Grüngling, Federal University of Santa Maria, Santa Maria, RS, BRAZIL

**14:20 Paper 4.3. A Fully Digital Control Employing a Dead Beat Technique for Power Active Filters**

A. Campos, J. Kaffka, C.A. Claro, Campus Universitario - Camobi, Santa Maria, RS, BRAZIL

**14:45 Paper 4.4. Development of a Fuzzy Logic Controller for Boost Rectifier with Active Power Factor Correction**

H. Chung, S.Y.R. Hui, E.P.W. Tam, City University of Hong Kong, Kowloon, HONG KONG

**15:10 BREAK**

**15:40 Paper 4.5. Discrete-Time Sliding Mode Control of Unified Active Power Filter**

S. Muthu, J.M.-S. Kim, University of Victoria, Victoria, BC, CANADA

**16:05 Paper 4.6. Internal Model Current Control of VSC-Based Active Power Filters**

M. Sedifhy, S.B. Dewan, F.P. Dawson, University of Toronto, Toronto, ON, CANADA

**16:30 Paper 4.7. Design of Parallel Sources in DC Distributed Power Systems by using Gain-Scheduling Technique**

Z. Ye, D. Boroyevich, K. Xing, F.C. Lee, Virginia Polytechnic Institute and State University, Blacksburg, VA, USA

## SESSION 5. SPECIAL CONVERTERS

*Monday, June 28, 13:30 – 17:00 — DRAYTON*

*Chair:* A. Gandelli, Politecnico di Milano, Milano, ITALY

*Chair:* J. Lai, Virginia Polytechnic Institute and State University, Blacksburg, VA, USA

**13:30 Paper 5.1. A Low Cost 24-Pulse Diode Rectifier for High Voltage and High Power Applications**

S. Choi, J. Oh, K. Kim, Seoul National Polytechnic University, Seoul, KOREA

**13:55 Paper 5.2. Implementation of a Two Steps Commutated Matrix Converter**

M. Ziegler, W. Hofmann, Technische Universität Chemnitz, Chemnitz, GERMANY

**14:20 Paper 5.3. Direct AC/DC Conversion Without Input Rectification**

A. Ikriannikov, S. Cuk, California Institute of Technology, Pasadena, CA, USA

**14:45 Paper 5.4. Decoupled Control of a 4-Leg Inverter via a New 4x4 Transformation Matrix**

M.J. Ryan, R.W. de Doncker, Institute for Power Electronics and Electrical Drives, Aachen, GERMANY, R.D. Lorenz, University of Wisconsin - Madison, Madison, WI, USA

**15:10 BREAK**

**15:40 Paper 5.5. A Serial Regulator Using a Soft Switching PWM AC/AC Full Bridge Converter**

J.C. de Oliveira, F.J. Farias, L.C. de Freitas, J.B. Vieira Jr., Universidade Federal de Uberlandia, Uberlandia, BRAZIL

**16:05 Paper 5.6. A Simplified Auto-Connected Electronic Transformer (SACET) Approach Upgrades 6-Pulse Rectifier Equipment with 12-Pulse Characteristics and Facilitates Harmonic Compliance**

M. Kang, P.N. Enjeti, Texas A&M University, College Station, TX, USA, I.J. Pitel, Magna-Power Electronics, Boonton, NJ, USA

**16:30 Paper 5.7. Continuous Conduction Mode Operation of a Three-Phase Power Factor Correction Circuit with Quasi Tri-Directional Switches**

D. Carlton, W.G. Dunford, University of British Columbia, Vancouver, BC, CANADA, M. Edmonds, Xantrex Technology Inc., Burnaby, BC, CANADA

## **SESSION 6. HARMONICS AND POWER QUALITY I**

*Tuesday, June 29, 8:30 – 12:00 — CYPRESS*

*Chair:* J.H.R. Enslin, University of Stellenbosch, Stellenbosch, SOUTH AFRICA

*Chair:* N. Mohan, University of Minnesota, Minneapolis, MN, USA

**8:30 Paper 6.1. A Series LC Filter for Harmonic Compensation of AC Drives**

F.Z. Peng, C. Su, Oak Ridge National Laboratory, Oak Ridge, TN, USA

**8:55 Paper 6.2. Analysis and Design of a Three Phase Sliding Mode Controller for a Shunt Active Power Filter**

V. Cárdenas, CENIDET, Cuernavaca, MEXICO, N. Vázquez, C. Hernández, Instituto Tecnológico de Celaya, Celaya, MEXICO

**9:20 Paper 6.3. Analysis and Design of a Three Phase Active Shunt Power Filter Based on the Non-Linear passivity Approach**

V. Cárdenas, CENIDET, Cuernavaca, MEXICO, C. Nuñez, ITESRC, MEXICO, M. Oliver, N. Visairo, S. Ramírez, CENIDET, Cuernavaca, MEXICO, H. Sira-Ramírez, Universidad de los Andes, VENEZUELA

**9:45 Paper 6.4. A Resonant Inverter as a Controlled Reactance**

Y. Berkovich, Holon Center of Technological Education, Beer-Sheva, ISRAEL, G. Ivensky, S. Ben-Yaakov, Ben-Gurion University of the Negev, Beer-Sheva, ISRAEL

**10:10 BREAK**

**10:40 Paper 6.5. Three-Phase Active Filter Topology Based on a Reduced Switch Count Voltage Source Inverter**

K. Haddad, MTE Corporation, Menomonee Falls, WI, USA, G. Jóos, Concordia University, Montreal, QC, CANADA

**11:05 Paper 6.6. The Method Based on a Generalized dqk Coordinate Transform for Current Detection of an Active Power Filter and Power System**

B. Zhang, M.H. Pong, Hong Kong University, HONG KONG

**11:30 Paper 6.7. A New Control Scheme of Series Hybrid Active Filter**

B.N. Singh, University of Quebec, Montreal, QC, CANADA, B. Singh, Indian Institute of Technology Delhi, Hauz Khas, New Delhi, INDIA, A. Chandra, K. Al-Haddad, University of Quebec, Montreal, QC, CANADA

## **SESSION 7.        SOFT-SWITCHED DC/DC CONVERTERS I**

*Tuesday, June 29, 8:30 – 12:00 — DOGWOOD*

*Chair:* J. Cobos, Univ Politecnica de Madrid, Madrid, SPAIN

*Chair:* J. Sun, Rockwell Collins, Advanced Technology Center, Cedar Rapids, IA, USA

**8:30    Paper 7.1. ZVS-PWM Full-Bridge Converter Using Active Current Clamping with Synchronous Rectifiers**

K. Yoshida, N. Nagagata, T. Ishii, H. Handa, Matsushita Electric Industrial Co., Ltd., Osaka, JAPAN

**8:55    Paper 7.2. A Novel Pulse Width Control Scheme for Fixed Frequency Zero Voltage Switching DC-to-DC PWM Bridge Converter**

F. Hamdad, A.K.S. Bhat, University of Victoria, Victoria, BC, CANADA

**9:20    Paper 7.3. An Isolated ZVS-PWM DC-to-DC Converter with Half of the Input Voltage Across the Switches**

I. Barbi, E. Deschamps, Federal University of Santa Catarina, Florianopolis, SC, BRAZIL

**9:45    Paper 7.4. ZVS-PWM-Controlled Parallel-Resonant Converter Applied to a Constant-Current Power Supply**

T. Ninomiya, T. Hashimoto, H. Tanaka, R.P. Tymerski, Kyushu University, Fukuoka, JAPAN

**10:10   BREAK**

**10:40   Paper 7.5. A Modified Zero Voltage Switching Forward Converter Topology with Self Core Reset**

Y. Xi, P. Jain, Y. Liu, R. Orr, Concordia University, Montreal, QC, CANADA

**11:05   Paper 7.6. Design of a Novel ZVT Soft-Switching Chopper**

H. Yu, B.M. Song, J.S. Lai, Virginia Polytechnic Institute and State University, Blacksburg, VA, USA

**11:30   Paper 7.7. Improving the Operation of ZVT DC-DC Converters**

P.J.M. Menegáz, M.A. Có, D.S.L. Simonetti, J.L.F. Vieira, Federal University of Espirito Santo, Vitoria, ES, BRAZIL





## **SESSION 8. RECTIFIERS/INVERTERS: PFC(2)**

*Tuesday, June 29, 8:30 – 12:00 — JENKINS / K. CHARLES*

*Chair:* J. Sebastian, Universidad de Oviedo, Gijón, SPAIN

*Chair:* E.E. Landsman, American Power Conversion Corp., Billerica, MA, USA

**8:30 Paper 8.1. Low-Distortion Control of Unity-Power-Factor Converters in Discontinuous Conduction Mode**

E. Santi, University of South Carolina, Columbia, SC, USA, Z. Zhang, TESLaco, S. Cuk, Caltech, Pasadena, CA, USA

**8:55 Paper 8.2. Problems Using LISN in EMI Characterization of Power Electronic Converters**

J.C. Crebier, J. Roudet, J.L. Shanen, Institut National Polytechnique de Grenoble, Saint Martin-d'Heres Cedex, GRENoble, FRANCE

**9:20 Paper 8.3. A Low-Inductance Line-Frequency Commutated Rectifier Complying with IEC 1000-3-2 Standards**

J.A. Pomilio, University of Campinas, Campinas, BRAZIL, G. Spiazzi, University of Padova, Padova, ITALY

**9:45 Paper 8.4. Performance Improvement of Half Controlled Three Phase PWM Boost Rectifier**

J. Kikuchi, M.D. Manjrekar, T.A. Lipo, University of Wisconsin - Madison, Madison, WI, USA

**10:10 BREAK**

**10:40 Paper 8.5. A Novel Single-Stage DC-UPS with Power Factor Correction**

E. Rodríguez, N. Vazquez, J. Arau, CENIDET, Cuernavaca, MEXICO

**11:05 Paper 8.6. Design Aspects of Paralleled Three-Phase DCM Boost Rectifiers**

P.M. Barbosa, F.C. Lee, Virginia Polytechnic Institute and State University, Blacksburg, VA, USA

**11:30 Paper 8.7. A Novel Rectifier/Inverter with Adjustable Power Factor**

D. Shmilovitz, D. Czarkowski, Z. Zabbar, S.-Y. Yoo, Polytechnic University, Brooklyn, NY, USA



## SESSION 9. POWER SEMICONDUCTORS

*Tuesday, June 29, 8:30 – 12:00 — DRAYTON*

*Chair:* M. Cotorogea, Centro Nacional de Investigación y Desarrollo Tecnológico (CENIDET), Cuernavaca, Morelos, MEXICO

*Chair:* W.M. Portnoy, Texas Tech. University, Lubbock, TX, USA

**8:30 Paper 9.1. Thermal Instability in High Current Capability Power MOSFETs**

A. Consoli, G. Cosentino, F. Gennaro, A. Testa, University of Catania, Catania, ITALY, F. Frisina, R. Letor, A. Magri, ST Microelectronics, Catania, ITALY

**8:55 Paper 9.2. High-Frequency AC-AC Converter Using Integrated 3-in-1 Bilateral Switches and Adaptive Commutation**

J. Chang, Rockwell Science Center, Thousand Oaks, CA, USA

**9:20 Paper 9.3. A PSPICE Model of the DGEST based on the Ambipolar Diffusion Equation**

P.R. Palmer, B.H. Stark, University of Cambridge, Cambridge, UK

**9:45 Paper 9.4. A Novel High Accuracy Analog Behavioral IGBT Spice Macromodel**

G. Maxim, A. Maxim, Technical University <<Gh. Asachi >>, Iasi, ROMANIA

**10:10 BREAK**

**10:40 Paper 9.5. 2.65 MHz High Efficiency Soft-Switching Power Amplifier System**

J. Qian, G. Bruning, Philips Electronics North America Corporation, Briarcliff Manor, NY, USA

**11:05 Paper 9.6. Measurement of IGBT Switching Frequency Limits**

K. Sheng, B.W. Williams, Heriot-Watt University, Edinburgh, UK, X. He, Z. Qian, Zhejiang University, Hangzhou, CHINA, S.J. Finney, Heriot-Watt University, Edinburgh, UK

**11:30 Paper 9.7. Power GTO with Compensated Ring Anode-Short**

C. Zhang, N. Xu, Xi'an Power Electronics Research Institute, Xi'an, CHINA, Z. Chen, Xi'an University of Technology, Xi'an, CHINA

## SESSION 10. HARMONICS AND POWER QUALITY II

*Tuesday, June 29, 13:30 – 17:00 — CYPRESS*

*Chair:* D. Schröder, Technische Universität München, München, GERMANY

*Chair:* E.R. Collins, Clemson University, Clemson, SC, USA

**13:30 Paper 10.1. Power Factor Correction of Linear and Non-Linear Loads Employing a Single Phase Active Power Filter Based on a Full-Bridge Current Source Inverter Controlled Through the Sensor of the AC Mains Current**

I. Barbi, F. Pöttker, Federal University of Santa Catarina, Florianopolis, SC, BRAZIL

**13:55 Paper 10.2. A Multilevel Converter-Based Universal Power Conditioner**

L.M. Tolbert, F.Z. Peng, Oak Ridge National Laboratory, Oak Ridge, TN, USA, T.G. Habetler, Georgia Institute of Technology, Atlanta, GA, USA

**14:20 Paper 10.3. A New Parallel Hybrid Filter Configuration Minimizing Active Filter Size**

S. Park, J.-H. Sung, K. Nam, POSTECH University, Pohang, KOREA

**14:45 Paper 10.4. Design and Implementation of the Parallelable Active Power Filter**

S.J. Chiang, J.M. Chang, National Lien Ho College of Technology and Commerce, Miao-Li, TAIWAN

**15:10 BREAK**

**15:40 Paper 10.5. Resonant Characteristics of Inverter-Based Transmission Line Series Compensators**

B.S. Rigby, R.G. Harley, University of Natal, Durban, SOUTH AFRICA

**16:05 Paper 10.6. Control Algorithms for Series Static Voltage Regulators in Faulted Distribution Systems**

K. Haddad, MTE Corporation, Menomonee Falls, WI, USA, G. Jóos, Concordia University, Montreal, QC, CANADA

**16:30 Paper 10.7. Harmonic Evaluation of the Traction System by Monte Carlo Simulation**

Z.M. Ye, M.H. Pong, E. Lo, G.H. Yeun, Hong Kong University, HONG KONG

## **SESSION 11.      SOFT-SWITCHED DC/DC CONVERTERS II**

*Tuesday, June 29, 13:30 – 17:00 — DOGWOOD*

*Chair:* T. Ninomiya, Kyushu University, Fukuoka, JAPAN

*Chair:* R. Steigerwald, GE Corporate Research & Development, Niskayuna, NY, USA

**13:30    Paper 11.1. A Novel Soft-Switching DC-DC Converter with Wide ZVS Range and Reduced Filter Requirement**

R. Ayyanar, N. Mohan, University of Minnesota, Minneapolis, MN, USA

**13:55    Paper 11.2. Small-Signal Characterization of a Zero-Voltage Switching DC/DC Converter for Pulse-Load Applications**

J. Sun, G.K. Schoneman, D.E. Jenkins, Rockwell Collins, Inc., Cedar Rapids, IA, USA

**14:20    Paper 11.3. New ZVZCS PWM DC-DC Converters With One Auxiliary Switch**

S.-H. Ryu, D.-Y. Lee, S.-B. Yoo, D.-S. Hyun, Hanyang University, Seoul, KOREA

**14:45    Paper 11.4. A New Family of Zero-Current-Switching PWM Converters**

F.T. Wakabayashi, M.J. Bonato, C.A. Canesin, Paulista State University, Ilha Solteira, SP, BRAZIL

**15:10    BREAK**

**15:40    Paper 11.5. Adaptive Off-Time Control for Variable-Frequency, Soft-Switched Flyback Converter at Light Loads**

Y. Panov, M.M. Jovanovic, Delta Products Corporation, Research Triangle Park, NC, USA

**16:05    Paper 11.6. A Soft-Switched Boost Converter for High Frequency Operation**

R. Gurunathan, AKS Bhat, University of Victoria, Victoria, BC, CANADA

**16:30    Paper 11.7. Low Peak Current Class E Resonant Full-Wave Low  $dv/dt$  Rectifier Driven by a Voltage Generator**

S. Bîrca-Galateanu, I.U.F.M. of the Academy of Nantes, Nantes, FRANCE

## **SESSION 12. INDUCTION MOTOR DRIVES**

*Tuesday, June 29, 13:30 – 17:00 — JENKINS/K. CHARLES*

*Chair:* A.M.N. Lima, Federal University of Paraiba, Campina Grande, PB, BRAZIL

*Chair:* T.M. Jahns, University of Wisconsin – Madison, Madison, WI, USA

**13:30 Paper 12.1. Economic Three-Phase Induction Motor Drive for Single-Phase AC Power Source**

C.B. Jacobina, M.B.R. Correa, A.M.N. Lima, E.R. da Silva, Federal Universidade Federal da Paraiba, Campina Grande, PB, BRAZIL

**13:55 Paper 12.2. Luenberger Flux and Speed Observer for High Speed Sensorless Induction Motor Drives**

F. Profumo, G. Griva, A. Tenconi, M. Abrate, Politecnico di Torino, Torino, ITALY

**14:20 Paper 12.3. A Novel Quasi-Resonant DC-Link PWM Inverter for Induction Motor Drive**

J.J. Jafar, B.G. Fernandes, Indian Institute of Technology Kanpur, Kanpur, INDIA

**14:45 Paper 12.4. High Bandwidth Direct Adaptive Neurocontrol of Induction Motor Current and Speed Using Continual Online Random Weight Change Training**

B. Burton, R.G. Harley, University of Natal, Durban, SOUTH AFRICA, T.G. Habetler, Georgia Institute of Technology, Atlanta, GA, USA

**15:10 BREAK**

**15:40 Paper 12.5. A Soft Switched Current Controlled Converter for Induction Machine Driving**

D.A. Andrade, R.M. Finzi Neto, F.J. Farias, L.C. de Freitas, J.B. Vieira Jr., Universidade Federal de Uberlandia, Uberlandia, BRAZIL

**16:05 Paper 12.6. Induction Motor Neural Stator Flux Estimation Using Active and Reactive Power for Direct Torque Control**

J. Ghouili, A. Chériti, Université du Québec à Trois-Rivières, Trois-Rivières, QC, CANADA

**16:30 Paper 12.7. A High Performance PWM Current Source Inverter Fed Induction Motor Drive with a Novel Motor Current Control Method**

M. Salo, H. Tuusa, Tampere University of Technology, Tampere, FINLAND

## **SESSION 13. CONTROL ISSUES I**

*Tuesday, June 29, 13:30 – 17:00 — DRAYTON*

*Chair:* S. Ben-Yaakov, Ben-Gurion University of the Negev, Beer-Sheva, ISRAEL

*Chair:* S. Bhowmik, Southwest Research Institute, San Antonio, TX, USA

**13:30 Paper 13.1. A Novel Control of Three-Phase PWM Rectifier Using Single Current Sensor**

Y.-C. Lee, T.-J. Kweon, D.-S. Hyun, T.-K. Lee, Hanyang University, Seoul, KOREA

**13:55 Paper 13.2. A New Instantaneous Output Current Control Method for Inverter Arc Welding Machine**

Y.-M. Chae, J.-S. Gho, H.-S. Mok, G.-H. Choe, S.-W. Han, Konkuk University, Seoul, KOREA

**14:20 Paper 13.3. Microprocessor-Based Control System for High-Speed Three-Phase Voltage-Source Inverters with LC-Output-Filter**

C. Fritsche, P. Schmitt, Swiss Federal Institute of Technology Zurich, Zurich, SWITZERLAND, C. Gerster, Sulzer Electronics AG, Geschäftseinheit NTI, SWITZERLAND

**14:45 Paper 13.4. An Instantaneous Phase Angle Detection Algorithm Under Unbalanced Line Voltage Conditions**

H.-S. Song, H.-G. Park, K. Nam, POSTECH University, Pohang, KOREA

**15:10 BREAK**

**15:40 Paper 13.5. A Reversible Step-Up Voltage Source Inverter Controlled by Indirect Sliding Mode**

I. Barbi, I.E. Colling, Federal University of Santa Catarina, Florianopolis, SC, BRAZIL

**16:05 Paper 13.6. Random Modulation Techniques with Fixed Switching Frequency for Three-Phase Power Converters**

M.M. Bech, F. Blaabjerg, J.K. Pedersen, Aalborg University, Aalborg East, DENMARK

**16:30 Paper 13.7. DSP Control of UPS Inverters with a Current Limit using a Droop Method**

M. Mon, R. Johnson, Exide Electronics, Raleigh, NC, USA

## **SESSION 14.      MAGNETIC COMPONENTS I**

*Wednesday, June 30, 8:30 – 12:00 — CYPRESS*

*Chair:* J. Madden, PEI Technologies, Cork, IRELAND

*Chair:* S.B. Bayne, Naval Research Lab, Washington, DC, USA

### **8:30      Paper 14.1. In-Board Magnetics Processes**

Y.E. Zhang, S.R. Sanders, University of California Berkeley, Berkeley, CA, USA

### **8:55      Paper 14.2. Analytical Method for Generalization of Numerically Optimized Inductor Winding Shapes**

J. Hu, C.R. Sullivan, Dartmouth College, Hanover, NH, USA

### **9:20      Paper 14.3. 1D Magnetic Component Model for Planar Structures**

R. Prieto, J.A. Oliver, J.A. Cobos, J. Uceda, Universidad Politecnica de Madrid, Madrid, SPAIN

### **9:45      Paper 14.4. Optimizing the AC Resistance of Multilayer Transformer Windings with Arbitrary Current Waveforms**

W.G. Hurley, National University of Ireland, Galway, IRELAND, E. Gath, University of Limerick, Limerick, IRELAND, J.G. Breslin, National University of Ireland, Galway, IRELAND

### **10:10      BREAK**

### **10:40      Paper 14.5. Experimental Evaluation of Losses in Planar Inductors for Model Validation**

T.G. Imre, W.A. Cronje, J.D. van Wyk, Rand Afrikaans University, Auckland Park, GAUTENG, SOUTH AFRICA, J.A. Ferreira, Delft Technical University, Delft, Netherlands

### **11:05      Paper 14.6. An Advanced SPICE-Compatible Model for High Frequency Multiwinding Transformers**

P.F. Okyere, Dresden University of Technology, Dresden, GERMANY, L. Heinemann, ABB Corporate Research Center, Heidelberg, GERMANY

### **11:30      Paper 14.7. Model of Integrated Magnetics by Means of Finite Element Analysis Techniques**

R. Prieto, J.A. Cobos, O. García, P. Alou, J. Uceda, Universidad Politecnica de Madrid, Madrid, SPAIN

## **SESSION 15.      TRANSPORTATION AND UTILITY APPLICATIONS**

*Wednesday, June 30, 8:30 – 12:00 — DOGWOOD*

*Chair:* J.A. Ferreira, Delft University of Technology, Delft,  
THE NETHERLANDS

*Chair:* F.Z. Peng, Oak Ridge National Laboratory, Oak Ridge,  
TN, USA

### **8:30    Paper 15.1. Control Strategy of a Power Line Conditioner for Cogeneration Plants**

D. Casadei, G. Grandi, University of Bologna, Bologna, ITALY, R.K. Jordan, Technical University of Budapest, Budapest, HUNGARY, F. Profumo, Politecnico of Turin, Torino, ITALY

### **8:55    Paper 15.2. Control Design of Three-Level Voltage Source Inverter for SMES Power Conditioning System**

N. Celanovic, D.-H. Lee, D. Peng, D. Borrojevic, F.C. Lee, Virginia Polytechnic Institute and State University, Blacksburg, VA, USA

### **9:20    Paper 15.3. The Bootstrap Variable Inductance: A New Facts Control Element**

D.C. Hamill, M.T. Bina, University of Surrey, Guildford, UK

### **9:45    Paper 15.4. Transient Analysis of a Unified Power Flow Controller, and its Application to Design of the DC Link Capacitor**

H. Fujita, Y. Watanabe, H. Akagi, Okayama University, Okayama City, JAPAN

### **10:10   BREAK**

### **10:40   Paper 15.5. New Approach to Photovoltaic Array Maximum Power Point Tracking**

A. Brambilla, Politecnico di Milano, Milano, ITALY, M. Gambarara, A. Garutti, F. Ronchi, FIAR S.p.a., a Finmeccanica Company, Milano, ITALY

### **11:05   Paper 15.6. Improvement of Drive Range, Acceleration and Deceleration Performance in an Electric Vehicle Propulsion System**

X. Yan, D. Patterson, Northern Territory University, Darwin, NT, AUSTRALIA

### **11:30   Paper 15.7. Half-Cycle Amplitude Shift Keying as a Means of High-Speed Data Transfer in Applications using Inductively Power Devices**

J.S. Mueller, A.W. Kelley, North Carolina State University, Raleigh, NC, USA

## SESSION 16.      **SOFT SWITCHING TECHNIQUES**

*Wednesday, June 30, 8:30 – 12:00 — JENKINS / K. CHARLES*

*Chair:* A. Kawamura, Yokohama National University,  
Yokohama, JAPAN

*Chair:* R.V. White, Artesyn Technologies, Broomfield, CO,  
USA

**8:30    Paper 16.1. Implementation of a ZCT Soft Switching Technique in a 100 kW PEBB Based Three-Phase PFC Rectifier**

J. Wu, H. Dai, K. Xing, F.C. Lee, D. Borrojevic, Virginia Polytechnic Institute and State University, Blacksburg, VA, USA

**8:55    Paper 16.2. Three-Phase Current-Fed Soft Switching PWM Converter with Switched Capacitor Type Resonant DC Link**

Y. Konishi, Fuji Electric Co. Ltd., Kobe, JAPAN, M. Ishibashi, N. Baba, M. Nakaoka, Yamaguchi University, Ube, JAPAN

**9:20    Paper 16.3. Evaluation of Soft Switching Techniques for the Neutral-Point-Clamped Inverter**

X. Yuan, Swiss Federal Institute of Technology, Zurich, SWITZERLAND, I. Barbi, Federal University of Santa Catarina, Florianopolis, SC, BRAZIL

**9:45    Paper 16.4. A Family of Isolated Single-Stage ZVS-PWM Active-Clamping Converters**

T.-F. Wu, S.-A. Liang, C.-H. Lee, National Chung Cheng University, Chia-Yi, TAIWAN

**10:10    BREAK**

**10:40    Paper 16.5. A New Soft Recovery Pulse Width Modulation Quasi-Resonant Converter with Multiple Order Valley-Fill Network**

J.-K. Chung, G. Chae, G.-H. Cho, Korea Advanced Institute of Science and Technology (KAIST), Teajon, KOREA

**11:05    Paper 16.6. A Single-Switched PWM Resonant Converter for a Boost Rectifier**

I.-H. Oh, Samsung Electronics, Puchon city, KOREA

**11:30    Paper 16.7. Soft-Switched High Power Factor Boost Type AC/DC Converter**

M. Nagao, K. Harada, Kumamoto Institute of Technology, Kumamoto, JAPAN



## **SESSION 17.      MODELING AND ANALYSIS OF RECTIFIERS AND INVERTERS**

*Wednesday, June 30, 8:30 – 12:00 — DRAYTON*

*Chair:* W. Schumacher, Technische Universität Braunschweig,  
Braunschweig, GERMANY

*Chair:* S.R. Sanders, University of California Berkeley, Ber-  
keley, CA, USA

**8:30      Paper 17.1. Modeling and Design of Three-Phase  
Systems Using Complex Transfer Functions**

S. Gataric, Lockheed Martin Control Systems,  
Johnson City, NY, USA, N.R. Garrigan, GE Corpo-  
rate Research and Development Center, Niskayuna,  
NY, USA

**8:55      Paper 17.2. Dynamic Modeling of Distributed  
Power Systems with Power Factor Correction**

G. Zhu, I. Batarseh, University of Central Florida,  
Orlando, FL, USA, K. Siri, The Aerospace Corpora-  
tion, El-Segundo, CA, USA

**9:20      Paper 17.3. Characterization of Single Stage 3  
Phase Power Factor Correction Circuit using  
Modular Single Phase PWM DC-to-DC Convert-  
ers**

Y.D.E. Ho, S.Y.R. Hui, Y.S. Lee, City University of  
Hong Kong, Kowloon, HONG KONG

**9:45      Paper 17.4. Analysis and Measurement of DCM  
Power Factor Correctors**

K.-S. Fung, W.-H. Ki, P. Mok, Hong Kong Univer-  
sity of Science & Technology, HONG KONG

**10:10      BREAK**

**10:40      Paper 17.5. Analysis of Three-Phase Rectifiers  
with Constant-Voltage Loads**

V.A. Caliskan, D.J. Perrault, T.M. Jahns, J.G.  
Kassakian, Massachusetts Institute of Technology,  
Cambridge, MA, USA

**11:05      Paper 17.6. Dynamic Analysis of Three-Level  
Voltage-Source Inverters Applied to Power Regu-  
lation**

S. Alepuz, Mataro School of Engineering, Mataro  
(Barcelona), SPAIN, J. Bordonau, J. Peracaula,  
Universitat Politècnica de Catalunya, Barcelona,  
SPAIN

**11:30      Paper 17.7. Dynamic Modeling of an Inverter-  
Based Compensator**

B.K. Perkins, University of Manitoba, Winnipeg,  
MANITOBA, CANADA

## **SESSION 18. MAGNETIC COMPONENTS II**

*Wednesday, June 30, 13:30 – 17:00 — CYPRESS*

*Chair:* W.G. Hurley, National University of Ireland, Galway, IRELAND

*Chair:* C.R. Sullivan, Dartmouth University, Hanover, NH, USA

### **13:30 Paper 18.1. A New Spice Behavioral Macromodeling Method of Magnetic Components Including the Self-Heating Process**

A. Maxim, Technical University <<Gh. Asachi>>, Iasi, ROMANIA, D. Andreu, J. Boucher, ENSEEIH - INP University Toulouse, Toulouse, FRANCE

### **13:55 Paper 18.2. Volume Considerations of Planar Integrated Components**

I.W. Hofsjager, J.D. van Wyk, Rand Afrikaans University, Auckland Park, SOUTH AFRICA, J.A. Ferreira, Delft Technical University, Delft, Netherlands

### **14:20 Paper 18.3. Characterization of Coreless Printed Circuit Board Transformer**

S.C. Tang, S.Y.R. Hui, H. Chung, City University of Hong Kong, Kowloon, HONG KONG

### **14:45 Paper 18.4. Characterization of Windings Coupling in Multi-Winding Magnetic Components**

R. Asensi, J.A. Cobos, P. Alou, R. Prieto, J. Uceda, Universidad Politecnica de Madrid, Madrid, SPAIN

### **15:10 BREAK**

### **15:40 Paper 18.5. Integrated Planar Inductor Scheme for Multi-Module Interleaved Quasi-Square-Wave (QSW) DC/DC Converter**

W. Chen, F.C. Lee, X. Zhou, P. Xu, Virginia Polytechnic Institute and State University, Blacksburg, VA, USA

### **16:05 Paper 18.6. Study the Feasibility of Lamination Technique for Mn-Zn Cores**

D.M. Zhang, C.F. Foo, Nanyang Technological University, SINGAPORE

### **16:30 Paper 18.7. Measurement and Modelling of Stray Capacitances in High Frequency Transformers**

H.Y. Lu, J.G. Zhu, University of Technology - Sydney, Sydney, NSW, AUSTRALIA, S.Y.R. Hui, City University of Hong Kong, Kowloon, HONG KONG, V.S. Ramsden, University of Technology - Sydney, Sydney, NSW, AUSTRALIA

## **SESSION 19. CONTROL ISSUES II**

*Wednesday, June 30, 13:30 – 17:00 — DOGWOOD*

*Chair:* F. Blaabjerg, Aalborg University, Aalborg Ost, DENMARK

*Chair:* W. Burns, Liebert Corporation, Columbus, OH, USA

### **13:30 Paper 19.1. Dynamic Control of a Fixed Pattern Rectifier**

J. Ghijselen, A. van den Bossche, J. Melkebeek, University of Gent, Gent, BELGIUM

### **13:55 Paper 19.2. A New Space Vector Modulation Technique for Inverter Control**

T.-P. Chen, National Taiwan University of Science & Technology, Taipei, TAIWAN, Y.-S. Lai, National Taipei University of Technology, Taipei, TAIWAN, C.-H. Liu, National Taiwan University of Science & Technology, Taipei, TAIWAN,

### **14:20 Paper 19.3. Switch Mode Rectifier with Indirect Current Control**

M. Dawande, G.K. Dubey, University of Roorkee, Roorkee, UP, INDIA

### **14:45 Paper 19.4. New Sensorless Control of Three-Phase Bi-Directional Converter using Space Vector Modulation**

S. Mazumder, A.H. Nayfeh, D. Borojevic, Virginia Polytechnic Institute and State University, Blacksburg, VA, USA

### **15:10 BREAK**

### **15:40 Paper 19.5. PWM Strategy for Switching Loss Reduction in a High Frequency Link DC to AC Converter**

M.A. Rodrigues, E.R. da Silva, A.M. de Lima, C.B. Jacobina, Federal University of Paraiba, Campina Grande, PB, BRAZIL

### **16:05 Paper 19.6. A Simple Control Strategy Applied to Three Phase Rectifier Units for Telecommunication Applications Using Single Phase Rectifier Modules**

M.L. Heldwein, A.F. de Souza, I. Barbi, Federal University of Santa Catarina, Florianopolis, SC, BRAZIL

### **16:30 Paper 19.7. Analysis and Experimental Study of the Buck, Boost and Buck-Boost Inverters**

N. Vázquez, Instituto Tecnológico de Celaya, Celaya, MEXICO, J. Alvarex, CINVESTAV-IPN, Mexico City, MEXICO, J. Almazán, C. Aquilar, J. Arau, CENIDET, Cuernavaca, MEXICO

## **SESSION 20. SRM AND PM MOTOR DRIVES**

*Wednesday, June 30, 13:30–17:00—JENKINS/K. CHARLES*

*Chair:* F.-J. Lin, Chung Yuan Christian University, Chung Li, TAIWAN

*Chair:* M.E. Elbuluk, University of Akron, Akron, OH, USA

**13:30 Paper 20.1. A Bi-Directional Switched Reluctance Drive with High Power Quality**

J.Y. Zhu, S.Y.R. Hui, H. Chung, City University of Hong Kong, Kowloon, HONG KONG

**13:55 Paper 20.2. Robust Controller Design for a Synchronous Reluctance Drive**

M.-T. Lin, T.-H. Liu, National Taiwan University of Science and Technology, Taipei, TAIWAN

**14:20 Paper 20.3. Digital PLL Technique for Precise Speed Control of SR Drive**

J.-W. Woo, University of Wisconsin - Madison, Madison, WI, USA, S.-G. uOh, Chingu National University, KOREA, C.-U. Kim, Y.-M. Hwahn, Pusan National University, Pusan, KOREA

**14:45 Paper 20.4. Adaptive Torque-Ripple Minimization in Switched Reluctance Machines Using Observer-based Back-stepping**

I. Agirman, A.M. Stankovic, G. Tadmor, Northeastern University, Boston, MA, USA

**15:10 BREAK**

**15:40 Paper 20.5. New Soft-Switched Power Converter Topologies for Variable Reluctance Machine Drives**

E.R. da Silva, L.P.B. de Oliveira, C.B. Jacobina, Federal University of Pernambuco, Campina Grande, PB, BRAZIL

**16:05 Paper 20.6. Inductance Based Position Encoding for Sensorless SRM Drives**

G. Suresh, B. Fahimi, K.M. Rahman, M. Ehsani, Texas A&M University, College Station, TX, USA

**16:30 Paper 20.7. Sensorless Direct Control of Brushless Inverter Fed Permanent Magnet Excited AC Motor Drive System**

H.J. Gutt, V. Bosch, D. Reismayr, University of Stuttgart, Stuttgart, GERMANY

## SESSION 21      EMI/EMC

*Wednesday, June 30, 13:30 – 17:00 — DRAYTON*

*Chair:* F. Maddaleno, Politecnico di Torino, Torino, ITALY

*Chair:* D.M. Mitchell, D.M. Mitchell Consultants, Cedar Rapids, IA, USA

**13:30   Paper 21.1.   A Novel Approach Base on Electric Field Analysis to Reduce Crosstalk Problem on PCB**

W. Xin, C.M. Lee, M.H. Pong, Z. Qian, Hong Kong University, HONG KONG

**13:55   Paper 21.2.   A Modified Single Phase Inverter Topology with Active Common Mode Voltage Cancellation**

A. Rao, A.L. Julian, T.A. Lipo, University of Wisconsin - Madison, Madison, WI, USA

**14:20   Paper 21.3.   A New Method for EMI Study in Boost Derived PFC Rectifiers**

J.C. Crebier, M. Brunello, J.P. Ferrieux, Institut National Polytechnique de Grenoble, Saint Martin-d'Heres Cedex, GRENoble, FRANCE

**14:45   Paper 21.4.   Analysis of Conducted EMI Emissions from PWM Inverters Based on Empirical Models and Comparative Experiments**

H. Zhu, Y. Tang, J. Lai, Virginia Polytechnic Institute and State University, Blacksburg, VA, USA, A.R. Hefner, National Institute of Standards and Technology, Gaithersburg, MD, USA

**15:10   BREAK**

**15:40   Paper 21.5.   Some Electromagnetic Aspects of Coreless PCB Transformers**

S.C. Tang, S.Y.R. Hui, H. Chung, City University of Hong Kong, Kowloon, HONG KONG

**16:05   Paper 21.6.   Design and Evaluation of an Active Ripple Filter with Rogowski-Coil Current Sensing**

M. Zhu, D.J. Perreault, S. Guttowski, J.G. Kassakian, Massachusetts Institute of Technology, Cambridge, MA, USA

**16:30   Paper 21.7.   Conducted Electromagnetic Emissions in Unity Power Factor AC/DC Converters: Comparison Between PWM and RPWM Techniques**

J. Mahdavi, S. Kaboli, Sharif University of Technology, Tehran, IRAN

## **SESSION 22.      PARALLEL CONVERTERS AND DISTRIBUTED SYSTEMS**

*Thursday July 1, 8:30 – 12:00 — CYPRESS*

*Chair:* C.K. Tse, Hong Kong Polytechnic University, Hung Hom, HONG KONG

*Chair:* K. Fellhoelter, Lucent Technologies, Coppel, TX, USA

**8:30    Paper 22.1. Impedance Specification and Impedance Improvement for DC Distributed Power System**

X. Feng, Z. Ye, K. Xing, F.C. Lee, D. Borrojevic, Virginia Polytechnic Institute and State University, Blacksburg, VA, USA

**8:55    Paper 22.2. An Active Bus Conditioner for a Distributed Power System**

K. Xing, F.C. Lee, D. Borrojevic, Virginia Polytechnic Institute and State University, Blacksburg, VA, USA

**9:20    Paper 22.3. A Classification and Evaluation of Paralleling Methods for Power Supply Modules**

S. Luo, Z. Ye, R. Lin, F.C. Lee, Virginia Polytechnic Institute and State University, Blacksburg, VA, USA

**9:45    Paper 22.4. PWM Power Conversion Amplifier with Two Paralleled Four Quadrant DC Chopper in Producing Magnetic Field for MRI Systems**

S. Watanabe, Yamaguchi University, Ube, JAPAN, H. Takano, Hitachi Medical Co., JAPAN, M. Nakaoka, H. Yamamoto, Yamaguchi University, Ube, JAPAN

**10:10   BREAK**

**10:40   Paper 22.5. Application of a Novel Parallel Regulation Technique in a Two Output Forward Converter**

A. Ferreres, J.A. Carrasco, E. Sanchis, J.M. Espí, University of Valencia, Burjassot, SPAIN

**11:05   Paper 22.6. Cross Regulation in Flyback Converters**

C. Ji, K.M. Smedley, University of California Irvine, Irvine, CA, USA

**11:30   Paper 22.7. Input Filter Interactions in DC-DC Switching Regulators**

M. Alfayyumi, A.H. Nayfeh, D. Borrojevic, Virginia Polytechnic Institute and State University, Blacksburg, VA, USA

## **SESSION 23.      ADVANCED TOPICS IN MOTOR DRIVES**

*Thursday July 1, 8:30 – 12:00 — DOGWOOD*

*Chair:* F. Profumo, Politecnico di Torino, Torino, ITALY

*Chair:* T.G. Habetler, Georgia Institute of Technology, Atlanta, GA, USA

**8:30      Paper 23.1. Momentary Interruption and Voltage Sag Ride-Through for Adjustable Speed Drives with Active Rectifiers**

A. van Zyl, Oregon State University, Corvallis, OR, USA, R. Spée, Maxwell Technologies, San Diego, CA, USA

**8:55      Paper 23.2. Analysis of Common Mode Voltage - “Neutral Shift” in Medium Voltage PWM Adjustable Speed Drive (MV-ASD) Systems**

D. Rendusara, E. Cengelci, P. Enjeti, Texas A&M University, College Station, TX, USA, V.R. Stefanovic, Consultant, Afton, VA, USA, W. Gray, Toshiba International Corporation, Houston, TX, USA

**9:20      Paper 23.3. Pulse Width Modulation for Four Switches Three Phase Inverters**

C.B. Jacobina, M.B.R. Correa, E.R.C. da Silva, A.M.N. Lima, Federal University of Paraiba, Campina Grande, BP, BRAZIL

**9:45      Paper 23.4. An Ultrasonic Motor Drive Using LLC Resonant Technique**

F.-J. Lin, R.-Y. Duan, H.-H. Lin, Chung Yuan Christian University, Chung Li, TAIWAN

**10:10      BREAK**

**10:40      Paper 23.5. Proposal of Practical Load Speed Observer for AC Servo System with Two-Mass Mechanically-Resonant Load and Its Experimental Evaluation**

J. Yoshitsugu, Yamaguchi University, Ube, JAPAN, K. Inoue, Shinko Electric Co., Ltd, JAPAN, M. Nakaoka, Yamaguchi University, Ube, JAPAN

**11:05      Paper 23.6. The Reduction of Conductive Emissions and Motor Bearing Currents in the Current Source PWM Inverter Drives**

T. Halkosaari, H. Tuusa, Tampere University of Technology, Tampere, FINLAND

**11:30      Paper 23.7. Assessment of Medium Voltage PWM VSI Topologies for Multi-Megawatt Variable Speed Drive Applications**

Y. Shakweh, CEGELEC Project Ltd., Rugby, WARWICKSHIRE, UK

## **SESSION 24. TOPICS IN AC POWER CONVERSION**

*Thursday July 1, 8:30 – 12:00 — JENKINS / K. CHARLES*

*Chair:* J. Uceda, Universidad Politecnica de Madrid, Madrid, SPAIN

*Chair:* A.W. Kelley, North Carolina State University, Raleigh, NC, USA

**8:30 Paper 24.1. Half-Bridge Resonant Inverter with Load-Adaptive ZVS PFM Control Scheme for Induction Heating Applications**

Y.-S. Kwon, S.-B. Yoo, D.-S. Hyun, Hanyang University, Seoul, KOREA

**8:55 Paper 24.2. A Novel ZVT Three-Phase Inverter with Coupled Inductors**

J.Y. Choi, D. Boroyevich, F.C. Lee, Virginia Polytechnic Institute and State University, Blacksburg, VA, USA

**9:20 Paper 24.3. High Frequency Transformer Assisted a New Passive Clamp ZVS Quasi-Resonant DC-Link PWM Inverter with Low Voltage Stress Across the Switches**

A.S. Ba-Thunya, Indian Institute of Technology Bombay, Mumbai, INDIA

**9:45 Paper 24.4. Input Filter Interaction in Three Phase AC-DC Converters**

S. Chandrasekaran, D. Borrojevic, D.K. Lindner, Virginia Polytechnic Institute and State University, Blacksburg, VA, USA

**10:10 BREAK**

**10:40 Paper 24.5. A New Technique for Reducing Switching Losses in Pulse-Width-Modulated Converters**

Y. Jang, M.M. Jovanovic, Delta Products Corp., Research Triangle Park, NC, USA

**11:05 Paper 24.6. Feasible Performance Evaluations Digitally-Controlled Three Phase Soft-Switching Inverter with Auxiliary Resonant Commutation Snubbers for High Power Applications**

E. Hiraki, M. Yamamoto, M. Nakaoka, Yamaguchi University, Ube, JAPAN

**11:30 Paper 24.7. Design of UPS Topologies Based on Series-Parallel Resonant Converters**

H. Pinheiro, P. Jain, G. Jóos, Concordia University, Montreal, QC, CANADA



## **SESSION 25      SYNTHESIS, MODELING & ANALYSIS OF POWER CONVERTER CIRCUITS**

*Thursday July 1, 8:30 – 12:00 — DRAYTON*

*Chair:* Y. Kuroe, Kyoto Institute of Technology, Kyoto, JAPAN

*Chair:* V.A. Niemela, Bell Labs - Lucent Technologies, Mesquite, TX, USA

**8:30      Paper 25.1. A Generic Power Converter Modeling Method to Support Computer-Aided Design and Synthesis**

L.E. Amaya, P.T. Krein, University of Illinois, Urbana-Champaign, Urbana-Champaign, IL, USA

**8:55      Paper 25.2. Automatic Synthesis of Large Signal Models for Power Electronic Circuits**

P. Maranesi, M. Riva, Università degli Studi di Milano, Milano, ITALY, A. Monti, A. Rampoldi, Politecnico di Milano, Milano, ITALY

**9:20      Paper 25.3. A Structural Approach to Synthesizing and Analyzing Quasi-Resonant and Multi-Resonant Converters**

T.-F. Wu, Y.-K. Chen, C.-H. Yang, S.-A. Liang, National Chung Cheng University, Chia-Yi, TAIWAN

**9:45      Paper 25.4. Rectifier-Compensated Fundamental Mode Approximation Analysis of the Series-Parallel LCLC Family of Resonant Converters with Capacitive Output Filter and Voltage-Source Load**

J.G. Hayes, GM Advanced Technology Vehicles, Torrance, CA, USA, M.G. Egan, University College, Cork, IRELAND

**10:10      BREAK**

**10:40      Paper 25.5. A SPICE Compatible Model of High Intensity Discharge Lamps**

M. Shvartsas, S. Ben-Yaakov, Ben-Gurion University of the Negev, Beer-Sheva, ISRAEL

**11:05      Paper 25.6. Aliasing Effects in PWM Power Converters**

V.J. Thottuvelil, Bell Laboratories, Mesquite, TX, USA, G.C. Verghese, Massachusetts Institute of Technology, Cambridge, MA, USA

**11:30      Paper 25.7. A New Approach to Simplify the Steady-State Problem of a Power Converter**

F. Tourkhani, University of Moncton, Moncton, NB, CANADA, P. Viarouge, Université Laval, Sait Foy, QC, CANADA, T.A. Meynard, LEEI, ENSEEIHT, Toulouse, FRANCE, R. Gagnon, Université du Québec à Rimouski, Rimouski, QC, CANADA

## **SESSION 26.      MULTI-LEVEL CONVERTERS**

*Thursday July 1, 13:30 – 17:00 — CYPRESS*

*Chair:* V. Ramsden, University of Technology Sydney,  
Sydney, NSW, AUSTRALIA

*Chair:* T.A. Lipo, University of Wisconsin - Madison, Madison,  
WI, USA

**13:30    Paper 26.1. Investigation on the Clamping Voltage Self-Balancing of the Three Level Capacitor Clamping Inverter**

X. Yuan, Swiss Federal Institute of Technology, Zurich, SWITZERLAND, I. Barbi, Federal University of Santa Catarina, Florianopolis, SC, BRAZIL

**13:55    Paper 26.2. Modular, Pinched DC-Link and Soft Commutated Three-level Inverter**

J. Chang, J. Hu, Rockwell Science Center, Thousand Oaks, CA, USA

**14:20    Paper 26.3. Experimental Comparisons of Space Vector Neutral Point Balancing Strategies for Three-Level Topology**

D. Zhou, D. Rouaud, Rockwell Automation, Mequon, WI, USA

**14:45    Paper 26.4. An analysis of DC-Link Poteintial and Control Scheme for Four-level Inverter**

R.-Y. Kim, Y.-H. Lee, D.-S. Hyun, Hanyang University, Seoul, KOREA

**15:10    BREAK**

**15:40    Paper 26.5. High Voltage Multilevel Converter with Regeneration Capability**

J. Rodriguez, Universidad Técnica Federico Santa Maria, Valparaiso, CHILE, Luis Morán, Universidad de Concepcion, Concepcion, CHILE, Antonio González, César Silva, Universidad Técnica Federico Santa Maria, Valparaiso, CHILE

**16:05    Paper 26.6. A DC-Link Voltage Balancing Algorithm for 3-Level Converter Using the Zero Sequence Current**

S.-K. Lim, J.-H. Kim, K. Nam, POSTECH University, Pohang, KOREA

**16:30    Paper 26.7. A Direct Power Feedback Method of Dual PWM Three-Level Voltage Source Converter System**

L. Wei, Tsinghua University, Beijing, CHINA, C. Li, The Automation Institute of M.M.I., Beijing, CHINA, F. Li, Tsinghua University, Beijing, CHINA

## SESSION 27. APPLICATIONS

*Thursday July 1, 13:30 – 17:00 — DOGWOOD*

*Chair:* J.D. van Wyk, Rand Afrikaans University, Auckland Park, Johannesburg, SOUTH AFRICA

*Chair:* B.V. Murty, General Motors R&D Center, Warren, MI, USA

**13:30 Paper 27.1. Electronic Ballast with Modified Valley Fill and Charge Pump Capacitor for Prolonged Filaments Preheating and Power Factor Correction**

G. Chae, Y.-S. Youn, G.-H. Cho, Korea Advanced Institute of Science and Technology (KAIST), Taejeon, KOREA

**13:55 Paper 27.2. Analysis of Tapped-Inductor Inverters as Low-Power Fluorescent Lamp Ballasts Supplied from a Very Low Input Voltage**

E.L. Corominas, J.M. Alonso, A.J. Calleja, J. Ribas, E.L. López, M. Rico-Secades, J. Sebastian, Universidad de Oviedo, Gijón, ASTURIAS, SPAIN, J. Arau, M. Ponce, CENIDET, Cuernavaca, México.

**14:20 Paper 27.3. Investigation of a Novel High-Power-Factor Electronic Ballast Based on the Input Current Shaper**

J.M. Alonso, A.J. Calleja, J. Ribas, E. López, M. Rico, J. Sebastián, Universidad de Oviedo, Gijón, SPAIN

**14:45 Paper 27.4. Designing a Dimmable High Power Factor Electronic Ballast for Fluorescent Lamps**

R.N. do Prado, S.A. Bonaldo, Universidade Federal de Santa Maria, Santa Maria, RS, BRAZIL

**15:10 BREAK**

**15:40 Paper 27.5. Phase-Controlled Dimmable Electronic Ballast for Fluorescent Lamps**

W.-H. Ki, J. Shi, E. Yau, P. Mok, J. Sin, Hong Kong University of Science & Technology, HONG KONG

**16:05 Paper 27.6. Features and Design of the Voltage-Fed “L-LC” Resonant Inverter for Induction Heating**

J.M. Espí, University of Valencia, Burjassot, SPAIN, E.J. Dede, GH ELIN International, SPAIN, E. Sanchis, A. Ferreres, University of Valencia, Burjassot, SPAIN

**16:30 Paper 27.7. Improved Induction-Heating Inverter with Power Factor Correction**

H. Calleja, R. Ordóñez, Cenidet - Electronica, Cuernavaca, MEXICO

## SESSION 28. TOPICS IN DC/DC CONVERTERS

*Thursday July 1, 13:30 – 17:00 — JENKINS / K. CHARLES*

*Chair:* H. Matsuo, Nagasaki University, Nagasaki, JAPAN

*Chair:* D. Maksimovic, University of Colorado, Boulder, CO, USA

**13:30 Paper 28.1. Multiple Output DC/DC Converters Based in PWM and Pulse Delay Control (PWM-PD)**

A. Barrado, E. Olías, A. Lázaro, R. Vázquez, J. Pleite, Universidad Carlos III De Madrid, Madrid, SPAIN

**13:55 Paper 28.2. New Very Low Power, High Efficiency, DC/DC Power Supply for Leo Satellite Constellation**

E. Sanchis-Kilders, University of Valencia, Burjassot, SPAIN, A. Capel, ALCATEL, Espace, FRANCE, J.A. Carrasco, E. Maset, J.M. Espí, University of Valencia, Burjassot, SPAIN

**14:20 Paper 28.3. Dynamic Modeling and Control in Average Current Mode Controlled PWM DC/DC Converter**

C. Sun, B. Lehman, R. Ciprian, Northeastern University, Boston, MA, USA

**14:45 Paper 28.4. DC-TO-DC Buck Converters with Novel Current Mode**

Z. Yang, P.C. Sen, Queen's University, Kingston, ONTARIO, CANADA

**15:10 BREAK**

**15:40 Paper 28.5. A Zero-Ripple Technique Applicable to any DC Converter**

D.C. Hamill, University of Surrey, Guildford, UK, P.T. Krein, University of Illinois, Urbana, IL, USA

**16:05 Paper 28.6. DC-Link Control for a MVA-3Hz Single Phase Power Supply**

F. Jenni, H.-U. Boksberger, G. Irrminger, Paul Scherrer Institute, Villigen PSI, SWITZERLAND

**16:30 Paper 28.7. A PDM Controlled Series Resonant Multi-Level Converter Applied for X-Ray Generators**

T.-F. Wu, J.-C. Hung, National Chung Cheng University, Chia-Yi, TAIWAN

## **SESSION 29. CONTROL AND THE EFFECTS OF DELAY**

*Thursday July 1, 13:30 – 17:00 — DRAYTON*

*Chair:* D. Patterson, Northern Territory University, Darwin, NT, AUSTRALIA

*Chair:* P.T. Krein, University of Illinois, Urbana, IL, USA

**13:30 Paper 29.1. Stationary Frame Current Regulation of PWM Inverters with Zero Steady State Error**

D.N. Zmood, D.G. Holmes, Monash University, Clayton, VIC, AUSTRALIA

**13:55 Paper 29.2. Adaptive Control of an Inductive Power Transfer Coupling for Servomechanical Systems**

D.K. Jackson, S.B. Leeb, Massachusetts Institute of Technology, Cambridge, MA, USA

**14:20 Paper 29.3. Forbidden State Space Trajectories of PWM Converters: Implication to Digital Control**

G. Rahav, S. Ben-Yaakov, Ben-Gurion University of the Negev, Beer-Sheva, ISRAEL

**14:45 Paper 29.4. Disturbance Rejection and Robustness Considerations in DC/DC Converters**

B. Tomescu, Space Systems/Loral, Palo Alto, CA, USA, H.F. van Landingham, Virginia Polytechnic Institute and State University, Blacksburg, VA, USA

**15:10 BREAK**

**15:40 Paper 29.5. Delay Effects in Averaged Modeling of PWM Converters**

J. Sun, D.M. Mitchell, D.E. Jenkins, Rockwell Collins, Inc., Cedar Rapids, IA, USA

**16:05 Paper 29.6. Analysis of Converter Operation with Phase Legs in Daisy-Chained or Ring Type Structure**

I. Milosavljevic, Z. Ye, D. Borojevic, C. Holton, Virginia Polytechnic Institute and State University, Blacksburg, VA, USA

**16:30 Paper 29.7. Effectivity Reduction of PWM-Converter Based Dynamic Filter by Signal Processing Delay**

W. le Roux, J.D. van Wyk, Rand Afrikaans University, Auckland Park, SOUTH AFRICA