



President's Column Student Competition

News flash! The Power Electronics Society is joining with several partners to establish an important new Student Competition, with total prize money of at least US\$100,000. Over the past few months, we have been negotiating with several sponsors to set up this major activity. Student team projects are very powerful at augmenting



the education experience. My own students have participated in a few advanced electric vehicle competitions over the years, and there are strong benefits to them in terms of

learning how to manage projects, learning to implement their designs, and carrying through on advanced technology. Power electronics offers a wealth of project opportunities, and we are pleased to introduce the 2001 Future Energy Challenge competition to highlight interdisciplinary challenges in our field. We hope this will become the first in a biannual series of student engineering competitions.

What is the topic area of the 2001 Challenge? An important progressive development in electric utility systems right now is distributed generation (or disbursed generation), in which small energy sources spread throughout the grid replace or supplement large power plants. The basic concept is not new, but the new feature is to take advantage of fuel cells, solar generation, microturbines, or other novel sources, and connect them to the grid. The energy conversion requires an inverter, protection hardware, and perhaps active filtering to address power quality concerns. At present, the cost and reliability levels achieved by inverters for energy system interfaces do not meet the needs, and there is little systematic evaluation of filtering approaches and protection concerns. The new 2001 Future Energy Challenge competition encourages engineering student teams to take on the challenge of inverter design to make the necessary system improvements.

What is involved? Schools that want to participate will need to gather a group of

Continued on page 5

New IEEE Fellows

The Institute of Electrical and Electronics Engineers elevated 248 Senior Members to Fellow Grade effective 1 January 2000. The membership grade of Fellow is conferred each year on not more than one-tenth percent of the total IEEE membership to recognize distinction in the field of electrical and electronic engineering.

Recognition of new Fellows is the culmination of a rigorous evaluation process that begins almost a year in advance. The process begins with the nominator, who is responsible for preparing the Fellow Grade Nomination Form, soliciting five to eight references capable of assessing the

Continued on page 9

Awards to be Presented at PESC® 2000

The annual PELS Awards Luncheon will be held on Friday, June 23, 2000, in Galway, Ireland, at PESC 2000. The William E. Newell Power Electronics Award will be presented for the twenty-fourth year. The PELS Distinguished Service Award and the Richard M. Bass Outstanding Young Power Electronics Engineer Award will be presented for the fourth year. The Society will also present the PELS Transactions Prize Papers Awards to the authors of the three papers judged by the Associate Editors to be the best papers published in the PELS Transactions in 1999.

The ceremonies will also recognize members of PELS who have been elected to Fellow Grade in the IEEE effective January 1, 2000. These ceremonies will also be the occasion for PELS to present IEEE Third Millennium Medals to persons nominated last year by the Society.

A ticket for the Awards Luncheon is included in the Conference Registration Fee. Additional tickets for your guests can be ordered on the advance registration form, which is available at the PESC 2000 web site. This site is linked to the PELS web site (<http://www.pels.org>).

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Educational Workshop Initiative

Are you interested in running a workshop on Power Electronics, including Education Issues? Are you thinking of doing this outside of North America? Would US \$5000 make a difference to the viability of such a workshop? If so read on.

In early 1999 the PELS AdCom was approached to support a workshop entitled the "US-Jordan Workshop - Teaching and Research in Power Electronics, and its Applications", at the University of Jordan, in May 1999. After considerable discussion,



since this was a quite new initiative for the AdCom, it was decided to support the event with funding to allow a Power Electronics Specialist (president Phil Krein) to attend with a brief to (a) be an expert, (b) promote IEEE and PELS, and (c) to report back to the AdCom on how it all went.

The result was a passionately supportive report to the AdCom from Phil, on the significance of the event in terms of our outreach and education aims to actively support our members around the world.

Continued on page 3

In This Issue

| | |
|--|----|
| President's Column | 1 |
| New IEEE Fellows | 1 |
| Awards to be Presented at PESC | 1 |
| Educational Workshop Initiative | 1 |
| Book Review | 2 |
| APEC® 2000 Recap | 2 |
| PESC® 2000 Announcement | 3 |
| Transactions Electronic Submittal | 3 |
| PACE Activities | 4 |
| IWIPP Announcement | 4 |
| COMPEL® 2000 Announcement | 5 |
| Automotive Electronics | 5 |
| WPET 2000 Call for Papers | 6 |
| Tricks of the Trade® | 7 |
| 2001 Future Energy Challenge | 8 |
| Education in Electrical Technologies . | 9 |
| APEC® 2001 Call for Papers | 11 |
| Meetings of Interest | 12 |

Book Review: *Fundamentals of Power Electronics*

Robert W. Erickson, author
Chapman & Hill, 1997
ISBN 0-412-08541-0
TK7881.15.E75

Reviewed by Arthur F. Witulski

In my first semester of graduate school at the University of Colorado in 1983 I took a course from a newly-hired professor in the obscure (at the time) field of power electronics. The new professor generated neatly written lecture notes, and each student received a copy before class. A few semesters later it became clear that one semester wasn't enough time to cover all the necessary topics in power electronics, and I took Power Electronics II the first time it was offered, for which the professor also

generated course notes. A few years later, I became a professor myself and had the opportunity of teaching students myself from those same notes. Little did I know that those course notes would grow year by year, until they became a significant textbook in the field: *Fundamentals of Power Electronics*, by Robert Erickson.

Having experienced the material in the book both as a student and a teacher, I can attest to the fact that the book is remarkable achievement in both the depth of the technical knowledge and the clarity of its exposition and organization. To some extent, the depth of the treatment is the result of a decision of Bob Erickson to limit his coverage to a subset of power electronics, and not attempt to cover the whole field in one volume. Consequently there is relatively little material dedicated to what might be deemed the motor drive domain concerning dc/ac and ac/ac conversion. Neither is there an in-depth discussion of power devices at the semiconductor level. Instead, the book is primarily converter-oriented and circuit-oriented, covering dc/dc and ac/dc conversion in great detail.

The book consists of 20 chapters that are organized into 5 sections, which are outlined in the following paragraphs. The first section deals with switching converter topologies in equilibrium, introducing principles of converter analysis for DC/DC converters in continuous and discontinuous modes. The section also includes a chapter on the implementation of switches, with a good introduction of the primary power semiconductor devices.

The second section deals with converters in dynamic (non-equilibrium) operation. It begins with a discussion of a basic ac modeling method, then enlarges the discussion to include state-space averaging, averaged-switch modeling, and circuit averaging. One bonus in the book at this point is that the book contains many of the techniques of Design-Oriented Analysis, developed by Bob's former professor at Caltech, Dr. R. David Middlebrook. This material comes in especially useful in this section in characterizing converter transfer functions and closing the feedback loop. There is an extended discussion of compensation and closed-loop converter performance as well. The second section concludes with ac modeling techniques applied to converters in discontinuous mode and current-programmed mode (current-

Continued on page 6

APEC® 2000: a Big Hit in the Big Easy

After a 12 year absence, the Applied Power Electronics Conference (APEC) and Exposition returned February 6-10 to its birthplace in New Orleans, also called the "Big Easy," with a record setting turnout. Over 1100 individuals paid to attend the Professional Education Seminars, Technical Sessions, or both, setting new records in all three categories. Over 200 attendees from 30 foreign nations (another record) traveled from as far away as Australia and Uzbekistan to attend APEC 2000. Over 85 (another APEC record) spouses and guests of APEC attendees participated in our bus tour of the city and walking tour of the French Quarter in this world renown location. The records established this year reflect the continuing strong support of the three APEC sponsors—the IEEE Power Electronics and Industry Applications Societies (PELS & IAS), and the Power Sources Manufacturers Association (PSMA)—and the dedication of the 190 volunteer representatives of the Conference and Program Committees.

Over its 15-year history APEC attendees and participants comprise a "Who's Who of Power Electronics." Perhaps one day we will create a photo album with biographies of our distinguished conference participants.

Before summarizing various elements of the conference I would like to share some trivia and history. Over 11,000 pounds of proceedings, books, and mugs was shipped to the hotel for attendees. To accommodate the 12-pound, 2-volume Proceedings, and 3 Professional Education Workbooks, each attendee was given a huge, rugged APEC 2000 bag to carry this wealth of information. A dozen buses were used to transport over 800 guests who signed up for our banquet at Blaine Kern's Mardi Gras World.

What a difference a decade makes! When Bob White was General Chair in 1990 there were 2 dozen exhibitors. APEC 2000 sold out all of its 105 booth spaces last March. The 132 booth spaces for APEC 2001 were snapped up within an hour after they became available. In the past few years the exhibitors have started a friendly competition to see who will get the first booth selection. This year the first exhibitor in line for the 7 A.M. space selection was Elcon



Continued on page 10

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News items should be sent to: Gene Wester, Editor, *PELS Newsletter*, Jet Propulsion Laboratory, M/S 303-300, 4800 Oak Grove Drive, Pasadena, CA 91109-8099, USA; TEL: +1 818 354-3489; FAX: +1 818 393-4272; email: gwester@jpl.nasa.gov. Deadlines for copy are March 15, June 15, September 15 and December 15. Submission of items by email in plain-text format is preferred. Plain-text (straight ASCII) submissions on 3.5" diskettes are welcome, and should be accompanied by a backup printout. Fax submissions are acceptable, but are least desirable. Full-page calls for papers and announcements of PELS-sponsored conferences are welcome and should be sent as both high-quality hard copy and RTF format file.

The editor gratefully acknowledges the Jet Propulsion Laboratory for significant support of his editorial activities.

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CONFERENCE ANNOUNCEMENT

31st Annual

Power Electronics Specialists Conference

June 18-23, 2000

Galway, Ireland

<http://pesc00.nuigalway.ie/>

PESC provides an international forum for specialists in power electronics to present and discuss papers on forward-looking topics in this fast-evolving field.

PESC promotes interdisciplinary discussions of new ideas and the latest advances in the fields of power electronics.

- Technical program consists of 264 papers from 37 countries
- Four professional education tutorials
- Active social program for participants and guests, featuring regional tours, music, and food
- Presentations of the Newell, Richard M. Bass, and Distinguished Service Awards

Make plans now to attend PESC 2000. For the latest news and information on PESC, please consult the website above, which includes photographs and downloadable registration forms. The photographs alone might convince you to go. For additional information, contact:

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PESC is sponsored exclusively by the IEEE Power Electronics Society

Educational Workshop *from pg 1*

The educational activities committee met at PESC '99 in Charleston, and agreed to ask AdCom to set aside funding of US \$5000 to allow us to support workshops of this kind, initially one every two years. The AdCom warmly approved this action at APEC 2000 in New Orleans, so we are now seeking "expressions of interest" to run such an event, sometime in the 2001-2002 time frame.

The process should be relatively informal as we develop the nature of this support. At the educational activities committee meeting we thought in terms of providing access to "IEEE distinguished lecturers" without having to be part of an IEEE Chapter or other recognised subgroup, but you should not limit your plans too narrowly.

Further information on the Jordan event can be obtained from Issa Batarseh, at the

University of Central Florida, (batarseh@mail.ucf.edu), who was the project organizer, or from Phil Krein (krein@ece.uiuc.edu).

I'd be pleased to get a 1-2 page proposal from you by email if you are interested in running an event in 2001 – 2002. If proposals come in within the next few weeks we could discuss them at PESC '00 in Galway, enter into some dialog with the most promising ones, and then make a decision which to support at IAS 2000 in Rome. I hope to hear from you soon!

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PELS Transactions Moves to Electronic Submission

The IEEE Transactions on Power Electronics has revamped its submission requirements. Effective immediately, electronic submission will be accepted and encouraged. The information for authors printed in each copy of the Transactions will reflect these changes in the July 2000 issue. In the meantime the updated requirements are available at the PELS www site at <http://www.pels.org/Comm/Publications/Transactions/Transactions.html>.

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PACE Activities Now Within PELS

As recently-appointed PACE Chair for PELS, I would like to explain how PACE can benefit each member. PACE stands for Professional Activities Committee for Engineers. PACE activities are non-technical and fall into two categories: (1) assistance to the engineer to optimize his/her productivity, and (2) efforts to optimize the career environment for engineers.

Such activities are relevant because each member is involved not only in technology, but also in pursuing a career. Society membership enhances the member's expertise in a technology. PACE activities enhance the member's career, totally aside from technical expertise.

Here are some examples of activities that optimize an engineer's productivity. They are session titles from the PACE Conference (renamed PRODEVCON) that took place in Ft. Worth, TX on September 3-6, 1999.

1. Communication skills
2. Secrets of persuasion
3. Mentoring
4. Speaking ability
5. Listening skills
6. Managing programs/projects
7. Effective negotiations
8. Advancing your career

An example of efforts to optimize the career environment is IEEE testimony to the U.S. Congress on topics such as Federal

R&D budget and pension reform. IEEE offers Congressional testimony because Congress is the source of legislation that vitally affects the professional well-being of an engineer. Note the IEEE consensus for this testimony was developed from input from the Sections, Regions and Divisions. IEEE testified in favor of ERISA, which mandated more extensive funding of pension plans and accelerated vesting of these plans. IEEE also testified in favor of R&D budgeting, which benefits careers of members involved in federal programs. While these activities pertain only to the U.S. career environment, I'm willing to learn about the career environment of other countries. Are there career concerns that can be addressed by professional activities in other nations?

The model for PACE activities that I envision is IEEE-USA. IEEE-USA is simply the IEEE entity that oversees PACE activities within the USA. It has active committees in the following areas: intellectual property, licensure & registration, engineering employment benefits, workforce, career maintenance, employment assistance, and pre-college education. These committees can provide information on their respective topics of activity and could benefit careers of members in every country.

(As a historical note, IEEE-USA used to be called the United States Activities Board (USAB) when there were no PACE activities outside of the USA, but after Sections in other countries engaged in similar activities, the name was changed from USAB to IEEE-USA.)

I am not proposing to single-handedly execute all of the above programs, but what I would like to accomplish this year is:

1. Help PELS Chapters to establish PACE Chairs in their Chapter,
2. Communicate with Chapters to suggest PACE programs that suit the Chapter,
3. Help set up and run Chapter PACE programs,
4. Coordinate various Chapter PACE programs,
5. Put together a presentation for the PACE 2000 Conference (PRODEVCON) that will take place in Scottsdale, AZ on Labor Day weekend. It will tell about PELS PACE activities during 2000.

PELS members interested in having a PACE activity can request a copy of the *PACE Leaders Handbook* from IEEE-USA, 1828 L Street NW, Suite 1202, Washington, DC 20036-5104, TEL: +1 202 785-0017, ieeusa@ieee.org (www.ieeeusa.org). The Handbook contains a wealth of useful information, including a 'Project Plan and Financing Request,' that is needed to obtain funding from the Divisional PACE Coordinator baruber@aol.com, and a 'Project Report Form.' It also contains samples of filled-out forms.

I hope to hear from PELS Chapters interested in having a PACE activity.

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WORKSHOP ANNOUNCEMENT

International Workshop on Integrated Power Packaging (IWIPP)

July 14 – 15, 2000 (Friday and Saturday) at the Westin Hotel

Waltham, Massachusetts USA

www.ieee.org/conferences/IWIPP

Participate, Vacation and Learn

The Workshop provides a forum for technical communications focused on the needs and interests of the power electronics components and systems engineers. Presentations will cover the design, analysis, fabrication, testing and application of advanced components and systems packaging technologies.

Short course
Rap session

Plenary session of emerging technologies

Technical sessions
Luncheon Speaker

Saturday spouse and family program

Register by June 7 at the Workshop website (see above), or contact:

Bob Alongi, 240 Bear Hill Road #202B, Waltham, MA 02451-1017, Sec.Boston@ieee.org

For additional information contact:

Douglas C. Hopkins, Workshop General Chair, d.hopkins@ieee.org

IWIPP is sponsored by the IEEE-CPMT, -PELS, and -EDS Societies, IMAPS, the PSMA, the Energy Systems Institute - UB, HiDEC-Univ of AK, Center for Power Electronic Systems - NSF ERC and IEEE Boston Section CPMT Chapter.



The 7th Workshop on Computers in Power Electronics

COMPEL[®] 2000

ANNOUNCEMENT

July 16–18, 2000



Donaldson Brown Hotel and Conference Center · Virginia Tech · Blacksburg, Virginia

The Seventh IEEE Power Electronics Society Workshop on Computers in Power Electronics (COMPEL 2000) will focus on areas of electronic computing with regard to design, analysis, control, and operation of power electronic circuits. The goal of this workshop is to provide a lively venue for discussing these and other issues.

Workshop Format

| | |
|--------------------------|--------------------|
| Sunday, July 16, PM: | Technical sessions |
| Monday, July 17, AM, PM: | Technical sessions |
| Tuesday, July 18, AM: | Technical sessions |
| Tuesday, July 18, PM: | Computer demos |

Format of Technical Sessions

Tutorials
Paper presentations
Panel discussions
Poster sessions

Social Event

Monday evening dinner party

Spouses' Program

Tour of Natural Bridge
Tour of Château Morrisette Winery, Blue Ridge Parkway

Deadlines

| | |
|----------------------------------|----------------------|
| Earlybird registration discount: | June 1, 2000 |
| Campus Lodging: | June 16, 2000 |

For More Information:

Conference Email and Online Registration

COMPEL2000@vt.edu
<http://www.conted.vt.edu/compel.htm>

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High Interest in Automotive Electronics at APEC[®]

The Automotive Panel at APEC'00 in New Orleans drew around 100 people interested in discussing the next generation of power for vehicles. Dr. John Miller from Ford Motor Company brought together a panel of automotive and semiconductor experts, including Professor John Kassakian from the MIT/Industry Consortium on Advanced Automotive Electrical/Electronic Components and Systems. The panel discussed the need for higher voltage, the rationale for choosing 42 volts, and associated specification concerns.

Increases in automotive loads are averaging 4 to 5% per year. Concerns that the current 12V power supply system will be inadequate to meet the need of future automotive electronics system requirements have united automotive electronics industry in pursuit of a new voltage standard. While architecture and timing of implementation vary greatly within the industry and generate interesting discussions in open forums, the 42V specification for the charging voltage and associated voltage limits have received wide-spread support. For those interested in more information, the

Workshop on Power Electronics in Transportation (*see call for papers in this issue—editor*) to be held in Dearborn, Michigan in October will focus on 42V systems.

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President' Column from page 1

students across several disciplines. The objective is a practical low-cost inverter, so students with interests in power electronics, thermal systems, controls, packaging, manufacturing, and other topics will be needed. I could envision a group with students from electrical engineering, mechanical engineering, industrial engineering, and materials engineering. This group will be asked to prepare a proposal outlining their plans and general design concepts. The competition sponsors hope to generate some seed funding for the schools with the best proposals. During the 2000-2001 academic year, student teams will design the inverter system, analyze the expected cost in a production environment, and prepare prototype hardware.

What is the nature of the competitive part? The Power Electronics Society, working with the other sponsors, will gather a team of volunteers to judge the results. (We are looking for volunteers if you are interested!) They will assist in creating the final scoring system and rules, in the evaluation of proposals, and in scoring of final reports and prototypes. We plan that a small group of finalists will have their prototypes tested in an industrial or government laboratory to be arranged. A \$50,000 prize will be awarded to the best end result if it can meet key performance requirements. An additional \$50,000 in prizes will be awarded to the best work in each of several categories, including engineering design, cost analysis, packaging and thermal design.

This is a tremendous opportunity. [*Submission deadlines are June 10 for a Letter of Intent, and July 15 for the full proposal.—editor*] More information can be found through the link on our home page, <http://www.pels.org> and on page 8 herein.

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ANNOUNCEMENT AND CALL FOR PAPERS
WPET 2000
The 6th Biennial
Workshop On Power Electronics in Transportation
42V Power Systems for the Next 100 Years
October 19 – 20, 2000
University of Michigan
Dearborn, Michigan USA

WPET 2000 will address the 42 V systems that are being pursued from industry consortiums, standards organizations, individual suppliers and vehicle manufacturers. The need for a higher voltage system has gained prominence during the last decade and certainly will be implemented in vehicles during this decade.

This workshop will feature papers and panel sessions from invited industry experts. We are also accepting papers from a limited number of contributors who are developing solutions or who have performed system analysis on specific aspects of the impact of a higher system voltage in vehicles.

The workshop follows Convergence 2000, the International Congress on Transportation Electronics, to be held in Dearborn from October 16-18, 2000. Workshop participants have the opportunity to network with other industry experts and contribute to the development of power electronics for future transportation systems.

Preparation Of Summary

Since this Call for Papers is being published after the scheduled April 14 deadline, prospective authors are advised to contact the Workshop Chair regarding program openings before preparing a 300 to 500 word proposal summary.

Submit the summary of your paper to: Randy Frank, WPET Chair, ON Semiconductor, 5005 E. McDowell Rd (MD: A102), Phoenix, Arizona 85008 USA; TEL: +1 602 244 5654, FAX: +1 602 244 3345, Email: Randy.Frank@ONSEMI.com

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|----------------------------------|--------------------------------|
| DEADLINES: April 14, 2000 | Submission of summary |
| May 15, 2000 | Notification of acceptance |
| August 31, 2000 | Submission of final manuscript |

For workshop registration and other information please contact the Conference coordinator: Susan Guinn, University of Michigan-Dearborn, Engineering Professional Development, 2200 Engineering Complex, 4901 Evergreen Road, Dearborn, MI 48128-1491; TEL: +1 313 593 4000, FAX: +1 313 593 4070, Email: sguinn@umich.edu

WPET is sponsored by the IEEE Power Electronics Society, IEEE Southeastern Michigan Section
 In cooperation with the MIT/Industry Consortium on Advanced Automotive Electrical/Electronic Components and Systems

Book Review

from page 2

mode control).

The third section deals with the topic of magnetics in switching converters. It begins with a review of the topics of basic magnetics, including basic forms of Maxwell's laws (with a minimum of mathematical formalism), magnetic equivalent circuits, and transformer modeling. The rest of this chapter is devoted to a discussion of losses in magnetic devices including an extended discussion of eddy current losses in transformers. The remaining chapters present design procedures for inductors and transformers based on the geometrical-core-constant (Kg) approach. A bonus in this section is an appendix showing a clever way to calculate the rms value of an arbitrary piecewise voltage or current waveform.

The fourth section deals with rectifiers and power system harmonics. It opens with

a general definition of power factor and how it relates to the harmonic content of line waveforms. The following chapter is on conventional rectifiers, meaning line frequency switching by either diodes or phase-controlled rectifiers. Surprisingly, Design-Oriented Analysis comes into play again here with a discussion of harmonic traps for line current filters. The next two chapters discuss the modern active high-power factor rectifiers, which are based on PWM converter topologies and switch at much higher frequencies than the line frequency. The discussion begins with deriving the loss-free resistor model of an ideal rectifier. One chapter deals with steady-state devices of (lossless) rectifiers, both single and three-phase, while a second is concerned with modeling the efficiency of rectifiers and their performance in dynamic conditions. This lends to a discussion to different kinds of control

schemes, as well as low-frequency small-signal models of rectifiers for feedback loop design.

The fifth and final section of the book is devoted to an introduction to resonant power conversion. After briefly introducing the concept of applying switched waveforms to resonant networks, both approximate and exact techniques for solving for the output voltage and current of resonant converters are presented, as well as a description of the many operating modes possible in fully resonant converters. The final chapter deals with analysis of soft switching, or quasi-resonant converters. It includes a discussion of both zero-current and zero-voltage topologies, as well as illustrating how to solve for output voltage and current and find mode boundaries, and how to find their small-signal models.

Each chapter concludes with a summary

Continued on page 7

Tricks of the Trade

Isolated Feedback With Optocouplers And Integration®

Contributed by Phil Krein

University of Illinois at Urbana-Champaign

Isolation is a standard requirement of power supplies and many other systems. The most typical dc-dc converters perform control from the “hot” input side of the supply. This avoids the need to isolate gate drives or PWM control circuits. Proper feedback control, however, requires information from the output so corrective action can be taken. A few engineers use optocouplers for feedback in isolated converters. This usually requires clever design, since optocouplers are nonlinear and tend to drift substantially over time and with temperature. The objective is to get an accurate representation of the output voltage through a high level of isolation.

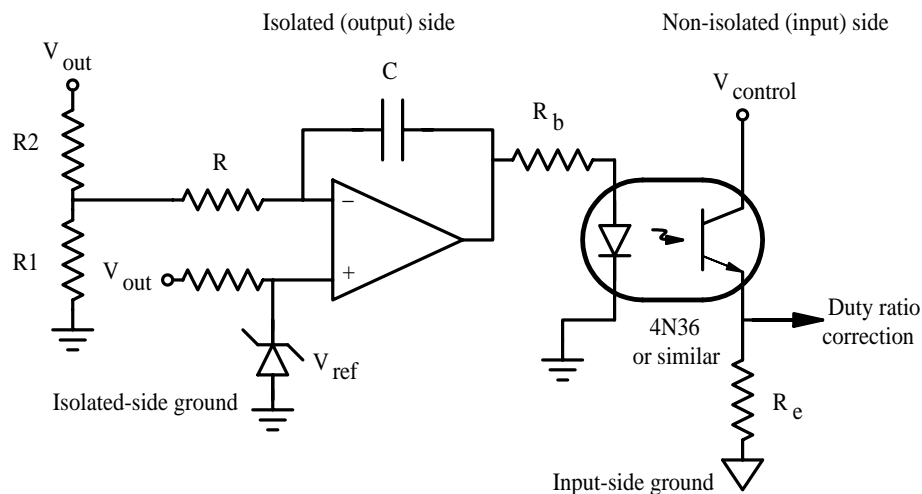
Here is a simple method that allows an optocoupler to be used for isolated feedback, without concern about linearity. The figure shows the approach. In this application, the reference voltage for the control system is located on the “low” output side of the isolation barrier. The optocoupler is driven by an op-amp that integrates the error between the output and the reference. In this context, integral control is a very useful tool. A qualitative description might help explain the action: If the output is too high, the net integral input is negative, and the integrator output ramps down. The LED in the optocoupler gets dimmer, and presumably the input-side control will reduce a duty ratio. If

the output is too low, the integrator will ramp up, causing the LED to brighten and directing the control to raise a duty ratio.

Pure integral control can have overshoot problems, but in a power converter application, these drawbacks can be minimized. For example, a conventional

conventional feedback control drives a fast response. If the load regulation is imperfect, the optocoupler will command a slow adjustment until the output is exactly proportional to the reference.

In the circuit shown, the integrator has gain equal to $1/(RC)$. The optocoupler output will change until the divided output voltage $V_{out} R_1/(R_1+R_2)$ exactly matches V_{ref} . The LED is biased with a current V_{ref}/R_b , and R_b can be chosen to make this any convenient current level.



approach such as current-mode control or feedback from an auxiliary output can be used for “rough” control of the output. The optocoupler can be used with a low-gain integrator for fine-tuning of the output. This gives near-ideal performance for the overall converter: when fast transients occur, a

Editor's note: You are invited to send your own favorite Trick of the Trade for publication in the PELS Newsletter. Just send it in any convenient medium, spelling out symbols such as Greek letters. Also, send along a recent photo, color or b/w of any size, for insertion along with your favorite Trick.

Book Review

from page 6

of key points and a list of key papers pertaining to the material in the chapter, which can be a helpful reference for further research on a given topic. Each chapter also has a number of homework problems, often with multiple parts (1a, b, etc.) that give the reader a workout on the material on the chapter.

Additional information about the book is available from Bob's web page (ece-www.colorado.edu/~pwrelect/book/index.html). For its size (762 pages) there are relatively few errors, and the known errors are documented on the errata page on the web site. (I should note that Bob is at work on a second edition that should be published some time during the coming year that will correct these errors and revise portions of the text.) The web site also has a list of Adobe Acrobat files of all the typeset slides Bob has generated for his course lectures, as well as a few files pertaining to specific topics in the book. To my knowledge, a solutions manual

for the problems has not been published, but answers to a few selected problems are also posted on the web site.

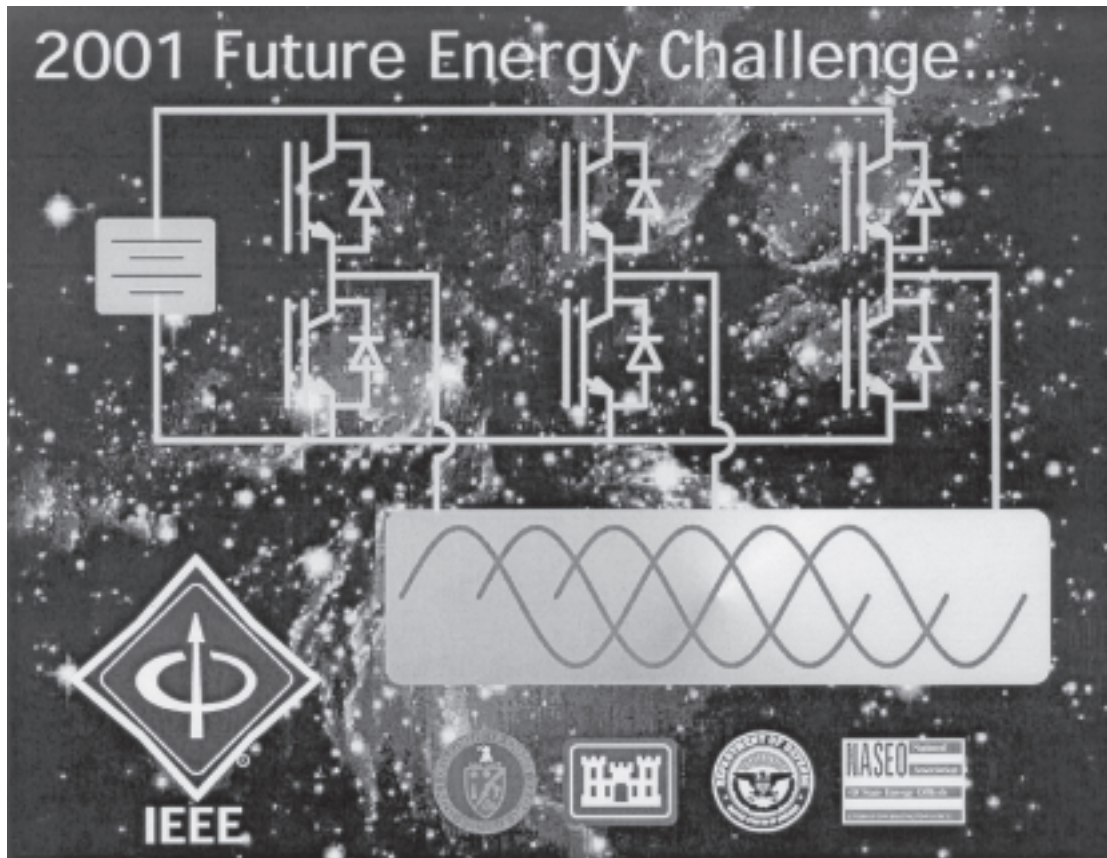
As with any text, it has its strengths and weaknesses. The reaction of my students to the text has been very positive, with only a few comments to the effect that there should be more examples (as we all know, there can never be too many examples). As an instructor, I've found that students tend to struggle with the method of implementing power switches in chapter four, which they view as somewhat abstract. I've also found the order of topics in the magnetics section to be a little awkward. I often skip the discussion of eddy currents in chapter 12 and come back to it after we've discussed transformers in chapter 14, by which time students are more comfortable with transformers and magnetic concepts. An instructor might wish for a few more short “ramp-up” problems at the beginning of each problem section, to get student's ready for the longer, more significant problems later on. Finally, I've found that the sheer

abundance of information in the book can be a little confusing to students. I find myself periodically having to pause and return to the “big picture” to place the specific information in context.

Aside from these minor quibbles, I can unreservedly recommend *Fundamentals of Power Electronics* as a trustworthy and enjoyable guide to the field of power electronics. The book will provide a helpful introduction to those new to the field and a valuable reference for practitioners of the art for years to come.

Reviewed by Arthur F. Witulski
University of Arizona

Editor's note: Believing there is value from personal referrals in selecting great books from among the good, we are launching a new series of technical book reviews in the PELS Newsletter. You are invited to contribute a book review to the series. Please send the editor a short prioritized list of outstanding technical books that you would be willing to review and share with your colleagues. See page 2 for editor's address.



A Plan to Halve Costs for Crucial Fuel Cell Component; Funds Competition for Engineering Schools

The U.S. Department of Energy and the Department of Defense will fund a competition to design and build—at one half or less of the cost of today's equipment—a key low-cost fuel-cell component for converting direct current into alternating current in ten-kilowatt or smaller fuel cells.

In collaboration with the National Association of State Energy Officials (NASEO) and the Institute of Electrical and Electronics Engineers (IEEE), DOE and DOD are offering over \$75,000 in cash awards for qualified college and university engineering teams to build a prototype, low-cost inverter in a competition titled the **2001 Future Energy Challenge**. The availability of low-cost inverters will contribute to accelerating the deployment of fuel cells. These electrochemical systems generate high-quality electricity that is virtually pollution and noise free. The expanded use of low-cost fuel cells to produce power and heat can also cut the emissions of carbon dioxide, and can create an alternative to construction of costly utility grid infrastructures. Inverters comprise up to a third of the cost of fuel-cell systems. The high cost of inverters is particularly significant for these smaller fuel cells, where overall costs far exceed competitive market alternatives. Today's power electronics industry lacks the incentives to create low-cost inverters for these small fuel cells because market demand remains low.

The department published a Federal Register notice announcing the competition on January 25, 2000. A prestigious panel of experts from the IEEE will administer the competition, scheduled to run during the 2000-01 school year. Additional support from State energy offices is expected through coordination with NASEO. Competing schools will be judged on the basis of design quality, a formal engineering report, cost and cost analysis, prototype quality, and operational results. The school with the most cost-effective fully-functional design will win an award of at least \$50,000. The best results in individual categories will win special awards of approximately \$5,000 each.

Interested schools can receive an information package for the 2001 Future Energy Challenge by **contacting:** Robert Myers, Administrator, IEEE Power Electronics Society, 799 N. Beverly Glen, Los Angeles, CA 90077 USA, TEL: +1 (310) 446-8280, FAX: +1 (310) 446-8390, Email: bob.myers@ieee.org

$$E = T_e M^2$$

Tomorrow's Education in Electrical Technologies

Two questions are frequently discussed among Electrical Engineering professors:

1. How can I teach Power Electronics or Electrical Machines or ... in 15 hours? And what should I teach?
2. How can I attract more students to Electrical Engineering?

On the other side, the industry needs experienced practitioners and is reluctant to give them time to attend continuous education classes to help them to keep up with the latest technology.

New education methods using Information and Communication Technologies are bringing possible solutions to these problems. The EPE Association is inviting academics and industrialists for an International Conference on *Tomorrow's Education in Electrical Technologies: Revisited Methods and Tools for Renewed Motivation* ($E = T_e M^2$).

The conference will take place in Liège (Belgium) March 14-16, 2001, in conjunction with Electralis 2001. The strong industrial background and support of EPE Association will ensure that the contents of the conference

will be oriented towards the actual needs of the industry regarding basic education as well as continuous education. The conference will include:

- invited papers by leading players in the field;
- forum discussions on various themes related to education in Electrical Engineering and its future;
- dialogue sessions where authors are invited to present their thoughts, actions and results on posters and have discussions with other attendees;
- demonstrations of discussed methods;
- a visit to "Campus", an Electralis 2001 event where RTD laboratory projects will be presented.

Some topics for the forum discussions:

- Distance Learning (DL): towards an upgraded quality of our education?
- Coping with student expectations and professional requirements: Distance Learning as a customization tool for the learner's project
- Tutors, monitors, moderators – upcoming professions and new actors of Distance Learning
- Virtual campus – which collaborations between institutions and which recognition of diplomas?

- Long-distance evaluation: formative or certificative?
- Europe's position in the globalization of education

The Call for papers will only relate to dialogue sessions presentations as the conference will focus on forum discussions and some keynotes. Some topics for the Call for papers are:

- Adapting the curriculum of Electrical Engineering, feedback from experiences
- Self-study, new materials set-up (DL, CD-ROM, Internet sites, ...)
- Distance learning, new materials, new methods
- Inter-university collaboration, feedback from experiences
- University/industry collaboration, feedback from experiences

The deadline for the Call for Papers is May 15, 2000. For further information contact:

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EPE Association
c/o VUB-TW
Pleinlaan 2
B-1050 Brussels, Belgium
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<http://www.epe-association.org>

New IEEE Fellows *from page 1*
candidate's contributions, and identifying the IEEE Society/Council whose evaluating committee will assess the candidate's technical qualifications and contributions.

Next the Fellow Committee, comprised of 25 members plus a chair, has the main task of recommending candidates to the Board of Directors in accordance with the following criteria: a current Senior Member with five years of service in any membership grade, individual contributions, evaluation by the Society/Council selected by the nominator, evidence of technical accomplishment, confidential opinions of references, service to other professional engineering societies, and total years in the profession.

Each candidate is rated numerically, scores are computationally normalized, and candidates are then ranked. Using these rankings, and subject to bylaw limitations on the number of newly elected members, the Fellow Committee prepares its final list of candidates for submission to the Board of Directors in late fall. The Board acts upon those recommendations at its year-end meeting.

Following is an alphabetical list of the eleven new Fellows who are members of the Power Electronics Society:

- Alfio Consoli, University of Catania, Catania, Italy; for contributions to modeling and control of saturated induction motors and permanent magnet motor drives.
- Prasad N. Enjeti, Texas A&M University, College Station, TX, USA; for contributions to solutions of utility interface problems in power electronic systems and harmonic mitigation
- Caio Alexandre Ferreira, CDF Engineering, Huntington Beach, CA, USA; for contributions to the development of switched reluctance motors and generators applied to advanced electric aircraft.
- Sumio Kobayashi, Toshiba Corporation, Tokyo, Japan; for contributions to the development of advanced high voltage light-fired thyristors.
- Philip T. Krein, University of Illinois, Urbana-Champaign, Urbana, IL, USA; for technical, educational and professional contributions to the analysis, design and control of power electronic and electrostatic systems.
- Hirofumi Matsuo, Nagasaki University, Nagasaki City, Japan; for contributions to the education, research and development of efficient electronic power conversion, and switching power conditioning circuits.
- Istvan Nagy, Technical University of Budapest, Budapest, Hungary; for contribu-

tions to industrial electronics.

- Gerhard Pfaff, University of Erlangen-Nuernberg, Erlangen, Germany; for contributions to university-based research analysis, design and industrial application of electrical drives, power electronic converters and computer control.
- Seung-Ki Sul, Seoul National University, Seoul, Korea; for contributions to the development of pulse-width-modulated inverters and ac motor drives.
- Tore Marvin Undeland, Norwegian University of Science and Technology, Trondheim, Norway; for leadership in education and discoveries in the field of power electronics.
- Alan Keith Wallace, Oregon State University, Corvallis, OR, USA; for contributions to the development of electric machines.

The complete list of new fellows, along with details of the nomination process, can be found at <http://www.ieee.org/about/awards/fellows/fellows.htm>

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APEC in the Big Easy *from page 2*
at 10:50 P.M., followed quickly by Cableco at 11 P.M. By 4 A.M., eight companies were in line. Tom Johnson, Sr. V.P. Elcon, showed his hospitality by having room service deliver coffee, juice and pastry at 2 A.M. and again at 4 A.M. to these dedicated exhibitors. Courtesy Associates, our conference management team, is negotiating with the Disneyland Hotel for additional space to accommodate exhibitors on the waiting list.

APEC 1990 offered the attendee 6 Seminars in 3 parallel tracks. Ten years later, APEC 2000 offered 15 Professional Education Seminars in 5 parallel tracks. During the same 10-year period our Technical Sessions have expanded from 16 Sessions in 3 parallel tracks to 26 Sessions in 5 parallel tracks. Although this represents a major increase in presentations, due to space and time limitations we could accept only 45 percent of over 400 abstracts received this year. With this sustained high level of interest in APEC we could probably host two conferences per year. That decision rests with the Conference Steering Committee.

Each of the three sponsors conducts business meetings in conjunction with APEC. One such forum, the Technology Roadmap, sponsored by the Power Sources Manufacturers Association, (PSMA), was held on Saturday Feb. 5th. Several attendees told me that this was one of the highlights of this year's conference. Seventeen presentations were reviewed in this all-day workshop. Members of this volunteer consortium included experts from IBM, Intel, and Sun Micro Systems. I would encourage PSMA to provide an overview of this in-depth research at next year's conference.

Individuals at this year's conference had the opportunity to attend professional-education seminars, multi-speaker technical sessions, vendor application seminars, RAP sessions, the exhibit hall, the 14th annual micromouse competition and our banquet at Blaine Kern's Mardi Gras World, the largest float builder in the world.

APEC 2000 opened on Sunday morning with five of the 15 half day Professional Education Seminars being presented by seasoned industry and academia professionals. Once again the topics were selected to appeal to the widest cross-section of APEC attendees. The newly established record of 430 paid Seminar registrants attests to the growing popularity of the Seminars among the APEC attendees.

Seminar #12, The State of Power Electronics Packaging, was presented by a panel



APEC 2000 Photos: Top - Conference Chair Bob White brandishes a sledge hammer as the ultimate OFF switch for pagers and phones that are not otherwise turned off during presentations; More than 85 persons participated in the spouses/guests program, including this orientation reception. Bottom - The international flavor is typified at a session speakers breakfast shared by authors from Finland, Germany, Japan, China, Portugal, and the USA; Friendships are made and extended during social opportunities, as enjoyed here by Tom Wilson, Ira Patel, and Phil Krein. Photos courtesy of Larry Gilbert. Note: Additional photos taken during the conference can be viewed at the APEC website: <http://www.apec-conf.org/00/photos00.htm>

of 10 industry and academia experts. Their presentations was the culmination of 18 months of work, resulting in a 420 page independent benchmarking research report commissioned by the PSMA. These experts provided a comprehensive update on future power supply and power supply component packaging design to meet the challenges of the 21st Century.

With 708 paid attendees, APEC's technical registration surpassed the 1999 record set for this segment of the Conference. While opening the Plenary Session, General Chair Bob White provided a brief history of the APEC conference. After asking attendees to turn off all cell phones and pagers during technical sessions, Bob humorously got his message across by brandishing a large sledge hammer which he described as the ultimate OFF switch.

For the ninth consecutive year the Exposition Hall was "sold out." Exhibitors provided information, expert advice, and demos and samples of their newest components, power supplies, and design tools. Exhibitors also conducted 12 one-hour seminars. Once again the Conference Committee made sure that ample food and beverages were on hand during the Exhibit Hall

receptions. Based on feedback from attendees, Exhibits Chair John Bassett presented awards to Cheryl Peckham of Artesyn and Mary Wicker of AVX who tied for "best giveaway," Lisa Harrison of IR for "best booth," and Sharon Sugarek of Lucent Technologies as the "happiest salesperson."

Another annual APEC highlight, the Micromouse contest, was attended by over 150 people. Eight mice were on hand, including 3 from foreign teams. *Varam* from Korea came in first. *Ning 2* from Singapore finished second, and *Min*, also from Singapore, received third. The best student prize went to Cho Nam Young, handler of *Varam*. [A separate article on the APEC Micromouse Contest will be published in the newsletter at a later date. -editor]

Looking ahead, APEC 2001 will be held March 4-8, 2001 at the Disneyland Hotel in Anaheim, CA. For additional information see the announcement on the facing page, refer to the APEC website, or contact Courtesy Associates (see announcement for details).

Larry Gilbert
Chair, APEC Publicity
LGPwr@aol.com



CALL FOR PAPERS AND SEMINARS

SIXTEENTH ANNUAL

Applied Power Electronics Conference and Exhibition

☆ MARCH 4-8, 2001 • THE DISNEYLAND HOTEL • ANAHEIM, CALIFORNIA ☆

The Sixteenth Annual Applied Power Electronics Conference and Exposition (APEC 2001) will address the application of new components and circuits, design-oriented analysis techniques, and current trends in the design and manufacture of power electronic products and systems.

CONFERENCE HIGHLIGHTS

- Full technical program of presented papers.
- Professional Education Seminars on important topics for power electronics professionals including anyone involved in marketing, quality and manufacturing.
- Exposition featuring component, equipment and service leaders in the power electronics industry.

Participation is solicited in all areas of power electronics, including those listed below. Suggestions for other related topics are welcomed and encouraged.

- | | | |
|-----------------------------------|---|--------------------------------------|
| • DC-DC Converters | • Aerospace/Defense Systems | • EMI & EMC Issues |
| • AC-DC Converters | • ICs for Power Electronics | • Market Analysis & Strategies |
| • Inverters & Cycloconverters | • Design & Analysis of Magnetic Devices | • Product & Technology Roadmaps |
| • Soft Switching Techniques | • New Developments in Capacitors | • The Voice of the Customer |
| • Lamp Ballasts | • High Density Packaging | • Identifying New & Emerging Markets |
| • Adjustable Speed Drives | • Thermal Management | • Benchmarking Results |
| • Power Factor Correction | • Distributed Power Systems | • Quality Programs & Data |
| • Design for High Efficiency | • Uninterruptible Power Systems | • JIT & Material Management |
| • Modeling & Analysis | • Battery Systems | • Vendor Qualification |
| • High Frequency Design | • Electric Traction Systems | • Manufacturing Processes |
| • Control of Converters & Systems | • Automotive Applications | • Design for Manufacturability |
| • Simulation Tools & Techniques | • Protection of Converters & Systems | • Technology Transfer |
| • CAD/CAE Tools & Techniques | • Preventing & Controlling EMI | • Standardizing Specifications |
| • Power Semiconductors | | • Regulatory Requirements |

DEADLINE FOR SUBMISSION OF ABSTRACT AND DIGEST IS AUGUST 10, 2000

Notification that a paper was accepted or declined will be mailed no later than October 6, 2000

Manuscripts in final camera-ready form will be due at the publishers no later than December 8, 2000

Prospective authors are asked to submit a 50-word Abstract and a three-to-five page Digest of their planned presentation. Both the Abstract and Digest should be typed double-spaced on 8.5"x11" paper. The heading of the Abstract must include: Title of the presentation, Corresponding Author(s), Affiliation(s), Mailing address, and Daytime telephone, Fax number and email address. The heading of the Digest should include **the title only**. The Digest should clearly state: a) The purpose of the paper, b) The approach used, and c) The specific results. **Eight copies of all materials should be mailed to:**

APEC 2001

2000 L Street, N.W., Suite 710, Washington, DC 20036 • (202) 973-8664 • FAX: (202) 331-0111
 For more information on exhibiting at the Exposition, call: (202) 973-8664 or FAX: (202) 331-0111
 or E-mail apec@courtesyassoc.com • Website: www.apec-conf.org

APEC is sponsored by the IEEE Power Electronics and Industry Applications Societies and the Power Sources Manufacturers Association

Meetings of Interest to PELS Members

ISPSD 2000, the 12th International Symposium on Power Semiconductor Devices & ICs, takes place May 22-25 in Toulouse, France. Sponsored by IEEE/ED, IEE Japan, and EPE. See <http://www.laas.fr/ISPSD2000/> for further information.

PESC® 2000, 31st Annual IEEE Power Electronics Specialists Conference, will be held June 18-23 at the National University of Ireland, Galway. PESC is sponsored exclusively by the IEEE Power Electronics Society. See page 3 herein for additional information.

IWIPP, the International Workshop on Integrated Power Packaging, will be held July 14-15, 2000 in Waltham, MA, USA. See page 4 of this *Newsletter* for more information.

COMPEL® 2000, the 7th IEEE Workshop on Computers in Power Electronics, is scheduled for July 16-18 at Virginia Tech in Blacksburg, Virginia. It is sponsored by the IEEE Power Electronics Society. See page 5 of this *Newsletter* for more details.

IECEC, 35th Intersociety Energy Conversion Engineering Conference, will be held July 24-28 in Las Vegas, NV. Sponsored by AIAA, ASME, IEEE, AIChE, ANS, and SAE, the 2000 theme

is "Energy and Power in Transition." Visit <http://www.aiaa.org/calendar/iecec00cfp.html> for information.

INTELEC® 2000, the 22nd International Telecommunications Energy Conference, is set for September 10-14, 2000 in Phoenix, Arizona. Visit <http://www.intelec.org> for additional information.

IAS 2000, the 35th Annual Meeting of the IEEE Industry Applications Society, will be held in Rome, Italy, October 8-12, 2000. This world conference is organized by AEI and IEEE/IAS, and co-sponsored by IEE, IEEE/IAS, and IEEE/PELS, in cooperation with EPE. See <http://www.aei.it/ias2000.html> for details.

CIEP 2000, the 7th IEEE International Power Electronics Congress, will be held October 15-19, 2000 in Acapulco, Mexico. For additional information visit <http://www.cenidet.edu.mx/ciep2000/>.

WPET 2000, the 6th Workshop on Power Electronics in Transportation, takes place October 19-20 at the University of Michigan in Dearborn, MI. For further information, see page 6 of this *Newsletter*.

POWERCON 2000 International Conference on Power System Tech-

nology, is set for December 4-7, 2000 in Perth, Western Australia. Organized by IEEE Power Engineering Society, Western Australia Chapter. See <http://www.ee.uwa.edu.au/~aips/powercon/> for further information.

ISIE 2000, the IEEE International Symposium on Industrial Electronics, will take place December 4-8, 2000 in Puebla, Mexico. Visit the website at <http://www.udlap.mx/~centia/isie2000/> for further information.

APEC® 2001, the 16th Annual IEEE Applied Power Electronics Conference, sponsored by the IEEE Power Electronics Society, the IEEE Industry Applications Society, and the Power Sources Manufacturers Association, will be held at the Disneyland Hotel, Los Angeles, CA, USA, March 4-8, 2001. Digests are due August 10. See the call for papers on page 11 of this *Newsletter* for details.

E-TEM2 is scheduled March 14-16, 2001 in Liege, Belgium. Sponsored by the European Power Electronics Association, the conference theme is tomorrow's education in electrical engineering. The deadline for digests is May 15. See page 9 of this *Newsletter* for further information.

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