

## Continuation of Power Seminars

EPPEI has continued its series of power seminars, coordinated by Dr. Ali Abur, for students and individuals in the electric power industry. The last seminars included a discussion of *Synchronous Motor Drives Performances under Load Commutation* by Houcine Zeroug, *Experimental Investigation of Distribution Transformer Solid Insulation* by Mirrasoul J. Mousavi and *Implementation of Two-Stage State Estimation for Topology Error Identification* by Shan Zhong.

**For more information on these Power Seminars, or to see the power point presentations, visit our website at <http://eppe.tamu.edu/powseminar.shtml>**

## First Texas Electric Energy Forum-TxEEF: Partnership for Electricity

The inaugural meeting of TxEEF is being organized by Texas universities that have an electric power and power electronics (EPPE) program. The purpose of such an event is to provide and facilitate an independent forum for exchange of ideas and issues surrounding the development of the state's electricity sector through the year 2030.

The forum, which is scheduled for November 19-20 at the George Bush Conference Center in College Station, TX, is expected to attract representatives from the state and Federal governments, utility companies with Texas service areas and vendors and consultants with Texas business interests. Institutions of higher education, as well as other government and private interest groups, are also invited. The forum will address the following major issues:

- The goals for future development of the state electricity sector and those goals' relation to the DOE vision of the National Grid 2030.
- The human resources, technology developments and regulatory issues that need to be pursued to accomplish the vision of the Texas grid 2030.
- The role of Texas universities with related educational and research programs in achieving the future developments of the state electricity sector.
- The way state resources can be combined with Federal and private resources to develop both research and development partnerships that will benefit all the stakeholders in the state and beyond.

The following primary outcomes of the meeting are expected:

- Indication of research needs and objectives related to the electricity sector in the state and beyond.
- Preliminary sketch of a possible research roadmap for the development of the state electricity sector.
- List of future efforts to be undertaken by the Federal and local governments, the private sector and academia to develop a comprehensive vision for the state.
- Ideas for future research and development partnerships leading to a national technology test-bed located in Texas, as well as participation from local universities and ERCOT.

## EPPEI Recognizes...

### 2004 Industry Partners

Oncor Electric Delivery Company

CenterPoint Energy

For more details, visit us at <http://eppe.tamu.edu/>.

### EPPEI Faculty

Dr. Ali Abur

Dr. Karen Butler-Purry

Dr. Mehrdad Ehsani

Dr. Prasad Enjeti

Dr. Garng Huang

Dr. Mladen Kezunovic

Dr. B. Don Russell

Dr. Chanan Singh

Dr. Hamid Toliyat

## Awards and Honors

- Ali Abur received the American Electric Power Faculty Fellowship from the Dwight Look College of Engineering.
- Karen Butler-Purry received the Charles W. Crawford Service Award by the Dwight Look College of Engineering at Texas A&M.
- Mehrdad Ehsani received the BP Amoco Teaching Excellence Award. Ehsani also received a "Spirit of Innovation" award from the Technology Licensing Office (TLO) with his graduate student, Sebastien Gay, for the "2000th Disclosure." Ehsani also was named the winner of 2003 IEEE Undergraduate Teaching Award, selected Distinguished Speaker of IEEE Vehicular Technology Society, 2003-2004, appointed to the Research Visionary Board, Chief Technology Office, Motorola Corporation, 2003 and invited for a Distinguished Lecture in the Department of Computer Engineering Illinois Institute of Technology, Chicago, Ill.
- Prasad Enjeti was named recipient of the Association of Former Students 2004 Distinguished Achievement Award at Texas A&M University.
- Mirrasoul J. Mousavi received the Best Paper Award at the 2003 IEEE/Power Engineering Society (PES) Transmission and Distribution Conference in Dallas for his paper titled, "Classification of Load Change Transients and Incipient Abnormalities in Underground Cable Using Pattern Analysis Techniques." It was co-authored by Dr. Karen Butler-Purry and Dr. Ricardo Gutierrez-Osuna.
- Graduate Student, Li Qi won a prestigious scholarship, offered for the first time ever by the Institute of Electrical and Electronics Engineers (IEEE)-Houston in honor of its 75th Anniversary. Currently she is working with Dr. Karen Butler-Purry.
- B. Don Russell chaired a briefing for congressional and federal agency staff on the August 2003 blackout of the northeastern United States.
- Hamid Toliyat was recipient of the Association of Former Students College Level Distinguished Achievement Award at Texas A&M. He also was the recipient of the IEEE PES 2004 Cyril Veinott Award.

## Lab Improvements

### Power Engineering Lab

#### Hardware

2 GPIB cards from NI  
8 new workstations  
DELL OPTIPLEX  
GX260 (Pentium 4  
2.4G/512M/80G)

#### Software

ATP Draw 3.7 (free  
software)  
CAPE 2003  
Matlab 6.5  
MS Office XP  
Netomac 2003  
GE PSLF 14.0  
Symantec Ghost 7.5

### EPPEI Graduate Student Travel Grants

EPPEI provides matching support travel grants up to \$300 for undergraduate and graduate students for attendance of professional meetings. The following students are the recipients so far this year:

**Maja Harfman Todorovic** and **Woojin Choi** received travel grants for the 2004 Applied Power Electronics Conference.

**Shan Zhong** received a travel grant for the 2003 IEEE PES Summer Meeting.

### From the Editor...

I am proud to report that our Electric Power and Power Electronics (EPPE) program is drawing high interest among electrical engineering majors and improving its quality.

In the past academic year (03/04) the undergraduate enrollment in the four EPPE courses was close to 250 students, with each course being over 50 students.

With an expansion of ELEN 460 and 450 into four credit hour courses, all four of our undergraduate EPPE courses are now worth four credit hours and have elaborate lab exercises.



Recent gifts to the EPPE program allowed us to improve the quality of our labs by purchasing state-of-the-art equipment and installing most advanced software packages for EPPE studies.

Our graduate activity, with more than 60 graduate students enrolled in the research projects, is also going very strong. If one is looking for high quality educational environment for either pursuing a degree or hiring exceptional professionals, our EPPE program is indeed worth considering.

**Mladen Kezunovic**

### EPPE Group Participation in PSerc Activities

At present, four EPPE faculty are actively involved in eight research projects presently funded by PSerc. For further details, please visit <http://eppe.tamu.edu/pserc.shtml>.

Participating faculty were also involved in major presentations, short courses and seminars given by PSerc at the Industry Advisory Board Meetings, during individual visits to PSerc industry member sites or at other events sponsored by PSerc.

TAMU's participation in PSerc has been a rewarding experience, since through PSerc projects TAMU faculty has had a chance to collaborate with a half dozen colleagues from other PSerc universities, an occasion that would have not materialized if it was not for the PSerc collaboration vision. As we move forward we can expect more contribution from TAMU faculty in future PSerc activities.

### Students visit Tomball substation to learn about power systems



Students in the ELEN 459 Power System Fault Analysis and Protection class learned more about power systems while visiting the CenterPoint Energy Tomball Substation.

The goal of the field trip was to give the students a better familiarity with the utility substation apparatus, physical layout, protection, monitoring and control of the substation.

The tour began at the CenterPoint Energy service center in Cypress, Texas, where students were given a brief company overview by Sandra Mondragon of CenterPoint Energy College Relations, and a safety review by Earl Windsor of

CenterPoint Energy Safety. Next, Don Sevcik of CenterPoint Energy Substation Projects briefly explained what students would find at the substation and how everything worked. This was followed by a tour of the substation, which included the switchyards (12 kV, 35 kV, 138 kV & 345 kV) and the control houses.

CenterPoint Energy is one of the largest combined electricity and natural gas delivery companies with almost five million metered customers.

With more than 11,000 employees, CenterPoint Energy and its predecessor companies have been in business for more than 130 years. CenterPoint Energy is the third largest energy company employer in the greater Houston metropolitan area.

CenterPoint Energy's electric operations unit serves 1.82 million customers in a 5,000-square-mile area that includes Houston, the nation's fourth largest city.



**Faculty Research Feature**-This and future issues will highlight joint research projects of EPPEI faculty aimed at solving multidisciplinary problems

## Research on Distribution Fault Anticipation

Preventive maintenance is a tool that utility companies historically have used to maintain an acceptable level of reliability on their distribution circuits. Though expensive to practice, it can help them find failing equipment before it causes problems.

Drs. Don Russell and Karen Butler-Purry and Mr. Carl Benner are collaborating on a joint project for the Electric Power Research Institute (EPRI), entitled "Distribution Fault Anticipation." EPRI's Distribution Product Line Council ranks this project very high on their list of projects in the electric distribution area.

The project's objective is to develop real-time monitoring and diagnostics to detect and identify incipient failure conditions on electric distribution circuits prior to catastrophic failures occurring. Through prior field work performed on another EPRI project, the research team found that many distribution faults and equipment failures produce incipient "signatures" in advance of full failures. These signatures previously went unrecognized because they often are several orders of magnitude smaller than normal loads. Now, using advanced signal processing, pattern recognition and digital techniques, the research team has developed identification algorithms capable of detecting and classifying numerous types of power system events, including multiple failure mechanisms for failing distribution equipment.

The research team has progressed through a proof-of-concept phase on this project and has proceeded to a demonstration phase involving the development and installation of multiple Distribution Fault Anticipator (DFA) Prototypes (Figure 1). Equipment failures are bad when they happen, but fortunately for utility companies and their customers, they are infrequent. More than 10 EPRI-member utility companies are participating in this phase of the project, using Prototypes to monitor dozens of distribution circuits in the United States and Canada. The result is the recording and documentation of more failures and incipient failures, thereby providing the basis for development of robust recognition algorithms.

As an example, algorithms have been developed to detect arcing in switches and failure of capacitor banks and other equipment from analysis of the relatively small signals resulting from initial arcing associated with the failure. Routine patrolling to identify these types of incipient failures can be prohibitively expensive. Further, some of these failures develop in ways that normal maintenance and testing procedures would not identify. Fault anticipation can reduce normal maintenance costs. It also can reduce repair

costs and customer outages, an ever-growing concern for utilities paying more attention to reliability indices as they enter the competitive arena.

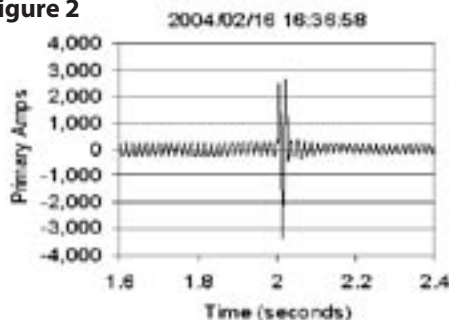
To date, the Prototype equipment has seen instances of a wide variety of equipment failures, from lightning arrester failure to voltage regulator failure to oil/air switch failure. As time goes on, DFA Prototypes continue to collect data on additional failures, thereby providing the basis for development and refinement of new and existing diagnostic algorithms. The project's ultimate goal is to improve the efficiency of distribution maintenance while, at the same time, enhancing the reliability of the system for the utility company and its customers.



Figure 1

DFA Prototype monitors distribution circuits in a substation, looking for precursor signals to anticipate failures and faults.

Figure 2



Capacitor failed, causing fault. DFA technology noted problems with the capacitor bank weeks before failure.

### EPPEI Undergraduate/Graduate Scholarships For Power Engineering Students

Several scholarships are available to power engineering students provided by the Electric Power and Power Electronics Institute and funded by Oncor Electric Delivery Company and CenterPoint Energy. Deadline for application submission is May 1 for scholarships starting in the Summer and Fall of 2004 and November 1 for scholarships starting in the Spring of 2005. Interested students can visit <http://eppi.tamu.edu/fincaid.shtml> for more information.

## Theses

**Leonardo Manuel Palma Fanjul**, 08/03, "Some new applications of supercapacitors in power electronic systems," Chair: P. Enjeti.

**Neeraj Shidore**, 12/03, "An Omni-Directional Design Tool for Series Hybrid Electric Vehicle Design," Chair: M. Ehsani.

**Leonardo Fanjul**, 08/03, "Some New Applications of Supercapacitors in Power Electronic Systems," Chair: P. Enjeti.

**Dragan Ristanovic**, 12/03, "New Methodology for Transmission Line Relay Testing and Evaluation Using Advanced Tools," Chair: M. Kezunovic.

**Xuefeng Song**, 12/03, "Dynamic Modeling Issues for Power System Applications," Chair: G. Huang.

## Dissertations

**Hyunchul Kim**, 08/03, "Evaluation of Power System Security and Development of Transmission Pricing Method," Chair: Dr. Chanan Singh.

**Hyung-Woo Lee**, 12/03, "Advanced Control for Power Density Maximization of the Brushless DC Generator," Chair: Dr. Mehrdad Ehsani.

**Yan Ou**, 12/03, "Development of Techniques to Evaluate Available Transfer Capability and Associated Issues," Chair: Dr. Chanan Singh.

**Sanjeev K. Srivastava**, 12/03, "Multi Agent System for Predictive Reconfiguration of Shipboard Power System," Chair: Dr. Karen Butler-Purry.

**Slavko Vasilic**, 12/03, "Fuzzy Neural Network Pattern Recognition Algorithm for Classification of the Events in Power System Networks," Chair: Dr. Mladen Kezunovic.

**Shan Zhong**, 12/03, "Measurement Calibration/Tuning & Topology Processing in Power System State Estimation," Chair: Dr. Ali Abur.

## In Other News...EPPEI faculty new and ongoing contracts & grants

- NSF/PSerc Grant, "Performance Assessment of Advanced Digital Measurement and Protection System," May 2003 - May 2005, PI: G. Karady, Co-PI, M. Kezunovic.
- NSF/PSerc Grant, "Automated Integration of Condition Monitoring and Maintenance Scheduling for Circuit Breakers and Power Transformers," PI: J. McCalley, Co-PIs, M. Kezunovic, C. Singh and V. Honavar.
- NSF/PSerc Grant, "Enhanced Reliability of Power System Operation Using Advanced Algorithms and IEDs for On-line Monitoring," June 2002-June 2005, PI: M. Kezunovic, Co-PIs, A. Abur, S. Meliopoulos and R. Shoureshi.
- NSF/PSerc Grant, "Detection, Prevention and Mitigation of Cascading Events," June 2002-June 2005, PI: V. Vittal, Co-PIs: M. Kezunovic and M. Venkatasubramanian.
- NSF/PSerc Grant, "MicroGrid Protection and Control," June 2002-June 2005, PI: R. Lasseter, Co-PI: M. Kezunovic.
- NSF/PSerc Grant, "Smart Sensor Development for Power Transmission and Distribution," June 2002-June 2005, PI: M. Simoes, Co-PIs: M. Kezunovic and R. Shoureshi.
- NSF/PSerc Grant, "Extended State Estimation for Synchronous Generator Parameters," June 2002-June 2005, PI: G. Karady, Co-PIs: G.T. Heydt, K. Holbert, V. Vittal, C. Singh and G. Huang.
- NSF/PSerc Grant, "Reliability Assessment Incorporating Operational Considerations and Economic Aspects for Large Interconnected Grids," 2004-2006, PI: G. Gross, Co-PIs: C. Singh, S. Meliopoulos and R. Schuler.
- Honeywell, "Vehicle Power and Energy Research," 2001-2008, PI: M. Ehsani.
- NSF, "Importance based visualization of energy networks," June 2003-May 2005, PIs: A. Abur and E. Akleman.
- "Hybrid drive train based on StarRotor engine research," PI: M. Ehsani.
- "Hybrid and advanced vehicle survivability research," PI: M. Ehsani.
- "Development of sensorless control techniques for brushless DC motor drive," PI: M. Ehsani.
- "Maximization of brushless DC generator power throughput," PI: M. Ehsani.
- "Load vibration damping using motor drive control," PI: M. Ehsani.
- "Oscillatory motor research," PI: M. Ehsani.
- UDLP, "Redundant and Fault Tolerant Traction Motor Drives," 2003-2004, PI: H. Toliyat.
- EISG, "A Novel Integrated Doubly-Fed Electric Alternator/Active Filter (IDEA) for Wind Power Applications," 2003-2004, PI: H. Toliyat.
- NSF, "Impact Analysis and Development of New Protection Schemes for Distributed Generators in Distribution Systems," 2002-2005, PI: K. Butler-Purry.
- Electric Power Research Institute, "Online Detection of Underground Distribution Cable Failure," 2002-2004, PIs: K. Butler-Purry and B. D. Russell.
- Electric Power Research Institute, "Distribution Fault Anticipator Phase II: Field Demonstration," 2001-2004, PIs: K. Butler-Purry, B. D. Russell and C. Benner.
- Texas Higher Education Coordinating Board, "Improving the Quality, Quantity and Diversity of Electrical and Computer Engineering Graduates," 2004-2006, PI: C. Singh.

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Texas A&M University  
Department Of Electrical  
Engineering  
College Station, Texas  
77843-3128

Phone (979) 845-1814  
Fax (979) 845-9887

Editor  
Mladen Kezunovic

Design, Photography,  
Layout  
Deana Totzke

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**Electric Power & Power Electronics Institute**  
Department of Electrical Engineering  
Texas A&M University  
College Station, TX 77843-3128

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