COLLEGE OF ENGINEERING

DEPARTMENT OF ELECTRICAL ENGINEERING

PENNSTATE

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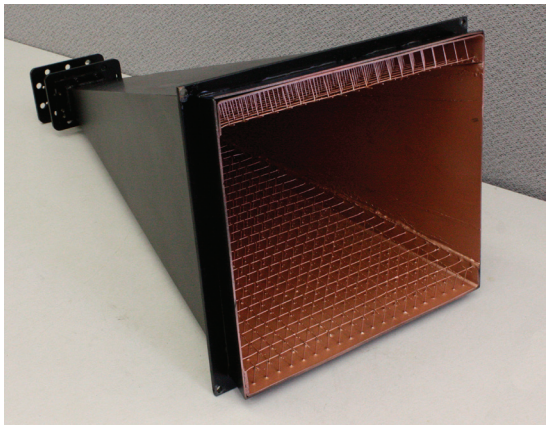
The Society of Penn State Electrical Engineers recently voted to change their name to Penn State Electrical Engineering Society at their spring meeting on April 6. The following officers were elected to serve a two-year term: President – Dale Hoffman; Vice President – Jim Blazer; Secretary/Treasurer – Eric Kline. For more information on the department alumni society, please visit our website.

METAMATERIAL USE IN HORN ANTENNA ACHIEVES RESULTS



Doug Werner, professor of electrical engineering, and his research group have developed a better horn antenna using electromagnetic metamaterials. Metamaterials are engineered materials which have properties not found in nature. The group's work was featured in a recent issue of Nature Materials, in an article titled "An Octave-Bandwidth Negligible-Loss Radiofrequency Metamaterial." The goal of their work was to demonstrate how metamaterials can be used to enhance a practical device by creating a lighter horn antenna for use on communications satellites. Reducing weight dramatically reduces the cost of launching a satellite into space.

The metamaterials used in the horn antenna were designed to have properties that allow it to work over a broad band of frequencies with negligible loss. Loss reduces the power, and ultimately, the clarity, of the signal received by everyday devices, such as televisions or GPS receivers. "We make our metahorn antenna work by putting a wire grid metamaterial on the inner walls to control the distribution of electromagnetic fields within the antenna, and thus the radio waves leaving the horn. Our metamaterial is unique because it's one of the first electromagnetic metamaterials, if not the first, that is practical enough to be used in a real-world product," stated Clinton Scarborough, graduate student in electrical engineering.

Werner's research group built and experimentally tested a prototype horn which measures ten inches wide, nine inches high, and 20 inches long (see Picture A). The researchers compared the measured performance of the prototype to the computer simulations to ensure optimum results. Experience gained from the initial prototype also gives the researchers valuable insights for designing even better horn antennas.

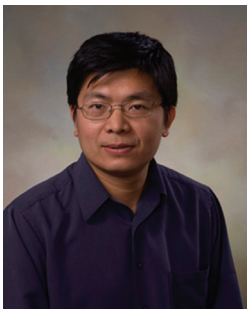
"While metamaterials can improve antennas, electromagnetic devices that are found everywhere, our metahorn antenna opens the door for metamaterials to improve a host of other conventional devices," stated Jeremy Bossard, postdoctoral fellow in electrical engineering.

In addition to Scarborough, contributors to this project include Qi Wu, postdoctoral fellow in electrical engineering and Erik Lier, Lockheed Martin Corporation.

The research is funded by a grant from Lockheed Martin.

E. Lier, D. H. Werner, C. P. Scarborough, Q. Wu and J. A. Bossard, "An octave-bandwidth negligible-loss radiofrequency metamaterial," Nature Materials, Vol. 10, Issue 3, pp. 216-222, March 2011. Online version.

Faculty Spotlight



Zhiwen Liu, associate professor of electrical engineering, is originally from Ganzhou in the Jiangzi Province of China. He received his bachelor's and master's degrees in radio electronics from Peking University in 1992 and 1995, respectively. Liu moved to the U.S. in 1995 with an offer from the California Institute of Technology. He received his master's and doctoral degrees in electrical engineering in 1997 and 2002, respectively.

"When I was a graduate student, I thought about going into industry since, at the time, optics, especially fiber optical communication, was a really hot area due to the Internet boom," stated Liu. "But my interest was mainly in research. I never seriously considered not being in academia."

Following a one year postdoctoral fellow appointment, Liu joined the electrical engineering department in 2002 in the optical materials and devices area. "I enjoy working with the students. It is fun to collaborate with them during research. I also feel rewarded seeing their growth in skills and knowledge upon graduation, said Liu.

Liu's lab is the Ultrafast and Nonlinear Optics Lab. Their research has been focused on the area of ultrafast and nonlinear optics, including nonlinear optical imaging, nonlinear optical spectroscopy, ultrafast optics, and nanophotonics.

Liu's research group has developed a new type of nonlinear nanoprobe for nanometer-femtosecond scale spatiotemporal characterization of ultrafast optical near fields in collaboration with Yong Xu, assistant professor at Virginia Tech. This work addresses an important challenge at the intersection of ultrafast optics, which deals with ultrafast time scale, e.g., femtosecond scale, and nanotechnology, which is concerned with nanometer scale spatial dimensions. Although near-field scanning optical microscopy can achieve nanoscale spatial resolution and various ultrashort pulse diagnostic tools can characterize femtosecond laser pulses, yet such capability to non-invasively characterize the nanoscale characteristics of femtosecond pulses in all three spatial dimensions remains elusive.

Developing this capability is crucial both for coherent control of photons in nano-femto spatiotemporal scale and for elucidating the interaction of ultrafast optical fields and nanoscale systems and devices. "In collaboration with Dr. Yong Xu's research group, we have demonstrated a nonlinear nanoprobe comprising functional nonlinear particles attached to a single nanowire, which is in turn attached to an optical fiber taper," explained Liu. "We have made a breakthrough recently and demonstrated a second-order nonlinear nanoprobe capable of retrieving both the amplitude and the phase of ultrashort pulses." This new class of nanoprobe represents a significant step towards non-perturbative full nano-femto mapping of optical near fields. It can have far-reaching impact on many areas, ranging from fundamental studies of ultrafast dynamics at nanoscale to nonlinear micro- and nano-scopy.

Liu was on sabbatical for the fall 2010 semester. During that time, he was able to visit École polytechnique fédérale de Lausanne in Switzerland, as well as his research collaborators at Washington University, North Carolina State University, Duke University, and Virginia Tech. Liu also traveled to China to meet with researchers at Peking University, Tsinghua University, and Zhejiang University. Liu stated, "As a result of these sabbatical visits, I have developed additional collaborative research projects."

Liu and his wife have two children and live in State College.

Student Spotlight

Shawn Moffit, senior in electrical engineering, has taken a non-traditional route on his path to his bachelor's degree. Moffit, originally from Monongahela, PA, initially enrolled at Penn State in 1996. He benefitted from two six-month internships at Telecommunications Techniques Corp and Microsoft in 1998 and 2000, respectively. Moffit stated that along with technical acumen, both internships helped him develop verbal and writing skills essential for collaboration in team environments and complex problem solving. "Being at Microsoft as a program manager was a truly unique experience," said Moffit. "In my first internship, I was leading a team of 24 of the most intelligent and capable individuals I had ever met - it set the bar for the type of life and career I wanted to have." He had the opportunity to visit Bill Gates at his house with the other interns, and experience the culture of the area. "Microsoft has a vibrant and competitive culture which pushed me to achieve at a high level, and being there helped me to see what makes a company great. I returned to Microsoft for internships the following two summers – these work experiences have helped shaped me into who I am today."

Moffit left Penn State in December 2001 with a desire to become an entrepreneur. Moffit and his business partner founded Metropolitan Investment Group in Philadelphia. They own and manage 17 properties worth more than $3 million. While this experience has been rewarding, Moffit always had a desire to return to Penn State to finish his degree.

Moffit returned to Penn State in January 2010. "I hadn't done an integral or math problem in a long time, so I studied at home for a few months before returning," commented Moffit.

Moffit is a Freescale Semiconductor student scholar. In this capacity, he and his team including electrical engineering undergraduate students, Pat Hughes, Andrew O'Connell, and Ziqui Li, have augmented their senior design project. They built an autonomous vehicle platform that will serve as a reference for the future international Freescale cup competition. Their small car, which uses a RC chassis, is centralized around the Kinetis ARM Cortex - M4 32 bit microprocessor. "We've added complexity and capability to our project by incorporating this much faster processor instead of the 8 bit processor required, the trade off is that it takes significantly more effort to get it working," stated Moffit. They also included a camera instead of IR sensors; and are building a prototyping board that can be used by robotics enthusiasts in the Freescale tower system.

"In addition to what our group has committed to do on this project, as a Freescale scholar, I'm working to produce documentation and technical designs which Freescale will use as a reference for the Freescale Cup international robotics competition," explained Moffit.

Upon graduation in December 2011, Moffit stated that he would like to develop skills and experience to help him become an important part of the robotics and automation industry. "I think that originally I'll go into a technical position in software development, most likely embedded systems, but I'm also considering technical marketing and sales."

Moffit is also involved in the electrical engineering undergraduate student advisory committee and the student chapter of IEEE. He has received the Anderson Consulting Engineering Leadership Award and the Robert J. Foster Award for Engineering Design and Graphics.

Department Updates

Julio Urbina, assistant professor of electrical engineering, has been recognized by the National Science Foundation (NSF) with its Faculty Early Career Development (CAREER) award. Urbina will receive $488,000 to support his latest research, "A Cognitive VHF Radar System Approach to Study Ionospheric Irregularities."

The project is to build, test, and deploy a new coherent imaging radar system at Huancayo Observatory in Peru that will utilize cognitive sensing techniques in order to allow the radar to respond dynamically to the sensed environment by changing operating modes to optimize the received signal. The ionospheric observations acquired by the new radar will be used to address several questions regarding climatological dependencies of the generation and evolution of equatorial plasma irregularities.

The NSF CAREER Program supports junior faculty who exemplify the role of teacher-scholars through outstanding research, excellent education and the integration of education and research within the context of the mission of their organizations.

A paper, titled "Transformation Electromagnetics: An Overview of the Theory and Applications," authored by Doug Werner, professor of electrical engineering, and Do-Hoon Kwon from the University of Massachusetts, was recently selected as the recipient of the inaugural 2011 IEEE Antennas and Propagation Edward E. Altshuler Prize Paper Award of the IEEE Antennas and Propagation Society. The paper was published in the IEEE Antennas and Propagation Magazine in February, 2010.

William Higgins, distinguished professor of electrical engineering, presented four papers related to his work in image-guided intervention systems and 3D imaging and participated in other activities related to conference organization, at SPIE Medical 2011, held in Orlando, FL in February. Co-authors on the papers were current graduate students, Duane Cornish and Rahul Khare; and former students, Brett Flood, Pinyo Taeprasartsit, and Lav Rai.

Mohsen Kavehrad, W. L. Weiss Chair Professor of Electrical Engineering, was invited to participate in FutureHetNets 2011 workshop at NASA Ames Research Center in Mountain View, CA, in March. FutureHetNets 2011 is sponsored by the Large Scale Networking Coordinating Group of the Networking and Information Technology Research and Development interagency community, supported by the National Science Foundation and NASA.

Sven Bilén, associate professor of electrical engineering, and Allen Kummer, graduate student in electrical engineering, presented "The Role of Suborbital Flights for Education and Technology Development within Penn State's Student Space Programs Laboratory" at the Next Generation Suborbital Research Conference in Orlando, FL, Feb-March.

Mohsen Kavehrad, the W.L. Weiss Chair Professor of Electrical Engineering, was named a scientific advisory board member for the National Science Foundation Smart Lighting Engineering Research Center (ERC). Kavehrad will advise the center's leadership on the technical strengths and weaknesses of ERC's strategic plan.

Raj Mittra, professor of electrical engineering, was an invited speaker at the electromagnetics group workshop, held in Dhahran, Saudi Arabia, in February. This workshop was sponsored by the Department of Electrical Engineering of the King Fahd University of Petroleum and Minerals (KFUPM), School of Engineering Sciences. Mittra's talk was titled "Some New Challenges in Computational Electromagnetics and How We Are Meeting Them." Mittra holds the position of a distinguished professor (adjunct) at KFUPM.

Mittra was an invited speaker at a technical seminar held at the National University of Singapore in March. His talk was titled "Strategies in Computational Electromagnetics for Solving Real-World Problems." This seminar was co-organized by the Temasek Laboratories of the National University of Singapore and the IEEE Singapore EMC & MTT/AP Chapters.

Mittra was an invited speaker at the 2011 IEEE International Workshop on Antenna Technology, held in Hong Kong in March. His talk was titled "Some Recent Developments in that the Metamaterial-Based Antennas, EMC/EMI, Plasmonics and Electromagnetic Absorber Designs." Mittra was also joined by fellow colleagues to deliver a talk titled "A Numerically Efficient Approach to Metamaterial (MTM) Modeling."

Mittra visited Taipei, Taiwan, in his capacity as an international advisor and distinguished professor (adjunct) at the Yun Ze University in Taipei in March.

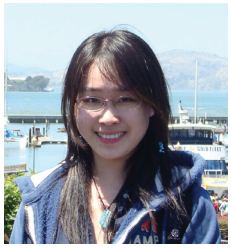
Vishal Monga, assistant professor of electrical engineering, has been selected as a faculty fellow for the 2011 Air Force Summer Faculty Fellowship Program. The program offers hands-on exposure to Air Force research challenges through research residencies at participating Air Force Research Facilities for full-time science and engineering faculty at U.S. colleges and universities.

Sven Bilén, associate professor of electrical engineering, was awarded the best paper of session award at the 11th Spacecraft Charging Technology Conference held in Albuquerque, NM. The paper titled "Electrodynamic Tethers for ChipSats and Nanospacecrafts" is coauthored by aerospace graduate student, Jesse McTernan.

Ken Jenkins, professor and head of electrical engineering, attended the Electrical and Computer Engineering Department Heads Association annual conference and ECExpo that was held in Phoenix, AZ in March. The main focus at this year's meeting was the need for ECE departments to play a central role in developing new educational opportunities in the area of sustainable power and energy.

IBM Fellowship Awards

Dheeraj Mohata and Huichu Liu, Ph.D. candidates in electrical engineering, were recently awarded the prestigious IBM Ph.D. fellowship for the 2011-2012 academic year.



Huichu Liu

Dheeraj Mohata

The IBM Ph.D. Fellowship Awards Program is an intensely competitive worldwide program, which honors exceptional Ph.D. students who have an interest in solving problems that are important to IBM and fundamental to innovation in many academic disciplines and areas of study. These include: computer science and engineering, electrical and mechanical engineering, physical sciences, mathematical sciences, business sciences, and service science, management, and engineering.

In addition to a stipend for one academic year, Mohata and Liu will be matched with an IBM mentor according to their technical interests, and they are strongly encouraged to participate in at least one internship at IBM while completing their studies.

Mohata is a member of the Nanodevices and Circuits Lab in the area of Electronic Materials and Devices and his adviser is Suman Datta, the Monkowski Associate Professor of Electrical Engineering.

Liu is a member of the Mayer Research Group in the area of Electronic Materials and Devices and her adviser is Theresa Mayer, professor of electrical engineering.

Annual IPAC Meeting

The Department of Electrical Engineering Industrial and Professional Advisory Council (IPAC) met in March on the University Park campus to review the department, meet with faculty and students, and provide recommendations on improvements to the department.

The IPAC is a select group of alumni from industry and government agencies who advise the department on academic issues and on current trends and future directions in engineering.

This year's IPAC members include: John Croteau, John Golombeck, Dale Hoffman, Forrest Hunsberger, Leslie Melaragno, Rick Pieper, Tom Roell, Doug Schultz, Ed Singel (Chairman), Scott Thompson, Joe Trench, and Bill Wannisky.

We thank Rick Pieper and Dale Hoffman for their service on IPAC as they both finish their second three-year term.

Bose Memorial Library Dedication

The Bose Memorial Library will be dedicated on April 22, at 3:30 p.m. in 204 Electrical Engineering West. Nirmal Bose, HRB-Systems Professor of Electrical Engineering died on Nov. 22, 2009, at the age of 69, while on sabbatical at the University of Wuppertal in Germany.

Bose was a member of the Penn State faculty since 1986. His research centered on the development of multidimensional systems theory and applied it to the processing and coding of degraded signals. Specifically, he investigated the restoration and high resolution reconstruction of blurred and noisy images and suggested a computationally efficient scheme for tracking multiple targets in clutter. Bose's wife, Chandra Bose, donated his extensive library to the Department of Electrical Engineering. The library will be house in the Christopher Raspanti Memorial Digital Signal Processing Laboratory.

Faculty, staff, alumni, students and friends are invited to attend. Light refreshments will be served.

Kenji Uchino, professor of electrical engineering, was recently awarded the Penn State Engineering Alumni Society Premier Research Award. This award recognizes and rewards an individual whose contributions in scientific knowledge through research are exemplary and internationally acclaimed. These research awards are established to confer honor on individuals who, by their contributions to knowledge, have brought recognition to themselves, the College, and Penn State.

Early Career Recognition Alumni Award

The Society of Penn State Electrical Engineers and the Department of Electrical Engineering is looking for nominations for the Early Career Recognition Alumni Award. This award honors outstanding Penn State electrical engineering alumni at the outset of their career. Nominations are due by May 15 and can be made by anyone with knowledge of the career progression and accomplishments of the nominee.

The nomination form as well as award criteria will be sent as an attachment to this e-newsletter. In addition, forms are available on our website here and in the electrical engineering office. The information can be mailed or faxed upon request.

Please contact Cathy McClellan, cls118@psu.edu or 814-863-0253 with any questions.

Contact Information:

Department of Electrical Engineering, 121 Electrical Engineering East, University Park, PA 16802, Phone: 814-865-7667, FAX: 814-865-7065

Web: www.ee.psu.edu

Please submit news items to: Cathy McClellan at **cls118@psu.edu**