2008-2009 ECE ANNUAL REPORT

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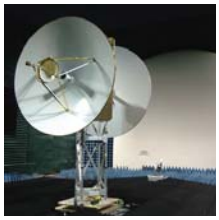
THE OHIO STATE UNIVERSITY



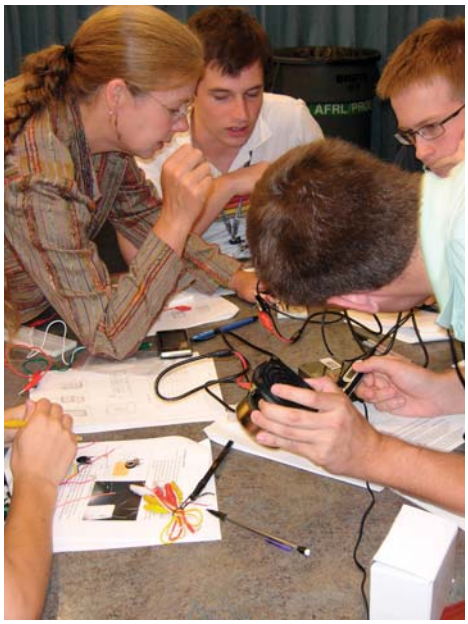
Inside:

ECE Seniors Design and Deliver Hands-on Projects to High Schools

Seniors in several 2008-2009 ECE capstone design courses had the opportunity to do something great for the ECE department: design interesting hands-on activities for high school and middle school students to fire them up about electrical and computer engineering. The design specs were simple: design a project that illustrates a concept in ECE, that can be completed in one to two hours, and costs less than $100 for 30 students to complete. Each design team was assigned a local Columbus high school, interviewed the teacher for guidance and feedback, and designed a project. Then, at the end of the quarter, the ECE students returned to the schools and shared their projects with the high school students.

To begin the design process, each team met with their assigned high school teacher to learn more about the students and their academic backgrounds. After these meetings, the ECE seniors knew the key to a successful project: relate it to things the high school students know, like cell phones and mp3 players. One capstone team developed a capacitive touch sensor project, in which students could test different sensor materials like glass, plastic, wood, and metal, as well as appreciate the technology that goes into their iPhones. Another ECE team introduced audio equalizers to their high school group. The students were able to play their music through low pass, high pass, and band pass filters, and relate this project to physics concepts they were studying. Other projects included a hand-held van de Graaf generator, a DC motor that drives a toy motorboat, and a Jeopardy game buzzer circuit, accompanied by a Jeopardy game that covered topics in geometry the high school class had been covering. The teacher was gratified to find that his students knew what a scalene triangle was, even out of context.

(Seniors - continued on page 5)



The Wright Scholars, a summer STEM initiative for top high school students from the Dayton area, get a visit from ECE where Prof. Betty Lise Anderson and her outreach team taught them to build audio equalizers, LED displays, and working paper speakers.

Research Awards Reach Record $25.3 million

The ECE department has seen a phenomenal rise in research awards in the past two years from $15.5 million in 2006-2007 to $19.2 million in 2007-2008 to $25.3 million in 2008-2009. The increase translates to approximately $580K per faculty member. Much of this increase is due to successful proposals to the state and federal governments for large center-level funding associated with research in sensors, electronic materials, energy, and networking. ■

The Ohio State University

MESSAGE FROM THE CHAIR

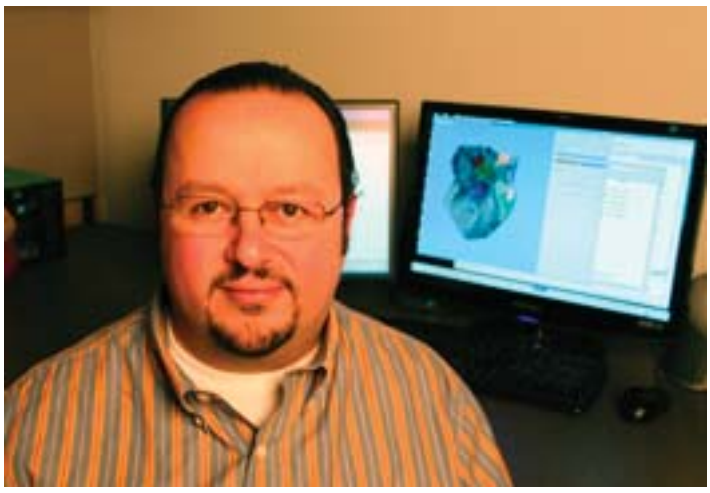
Dr. Robert Lee, Chair

The ECE department is in its 114th year of existence. Our undergraduate student population, which was at 660 students in Autumn 2008, has begun to stabilize after a significant decline in enrollment the past 5 years. Our graduate student enrollment continues to grow with approximately 333 students compared to 310 the previous year. The faculty size has increased slightly to 45 FTE with 23 IEEE Fellows within the department.

A major achievement this year was the growth in extramural research funding. For the 2008-2009 academic year, the department received approximately $25 million in external research awards. This figure represents an increase of 31% from the previous year. The actual research expenditure from both internal and external funding was $19.8 million. In conjunction with the increased funding, department faculty members have also increased their journal publication rate to 3.3 papers/year with the overwhelming majority of the papers in the top journals. The total number of Ph.D. degrees awarded during the past 3 years is 95, which translates to an average of 0.7 Ph.D. degrees per faculty member each year.

Three new faculty members have joined us this past year. Both Siddarth Rajan and Roberto Myers came to us from the University of California at Santa Barbara. These two faculty members were hired under a university Targeted Investment in Excellence (TIE) initiative in materials and energy. These hires were done jointly with the Material Science and Engineering department to further expand the college strength in electronic materials and photovoltaics. Waleed Khalil joined us after a successful career at Intel Corporation. His expertise in RF integrated circuits will complement our current strengths in antennas and microwaves. We also have two faculty members who accepted administrative positions at other universities. Kim Boyer took the Department Chair position at Rensselaer Polytechnic Institute, and Stan Ahalt is now the new director of the Renaissance Computing Institute (RENCI), the multi-campus research center with its home base at the University of North Carolina Chapel Hill.

I hope you will enjoy reading about the variety of activities going on in the department. We feel strongly that our education and research accomplishments will make an impact on the University, the State of Ohio, and the nation.



Dr. Umit Catalyurek

ECE Faculty Awarded 4 year NSF PetaApps Grant and NIH/NCI R01 Grant

ECE and Biomedical Informatics associate professor Dr. Umit Catalyurek, with collaborators from UC San Diego, has been awarded a 4-year NSF Accelerating Discovery in Science and Engineering through Petascale Simulations and Analysis (PetaApps) grant entitled "Enabling Breakthrough Kinetic Simulations of the Magnetosphere via Multi-zone Petascale Computing". This project will develop an advanced 3-D hybrid simulation code (fluid electrons + kinetic ions) that includes the coupling of the magnetosphere to the ionosphere. The successful development of a 3-D global, hybrid simulation of the magnetosphere with realistic coupling to the ionosphere has the potential to transform our ability to

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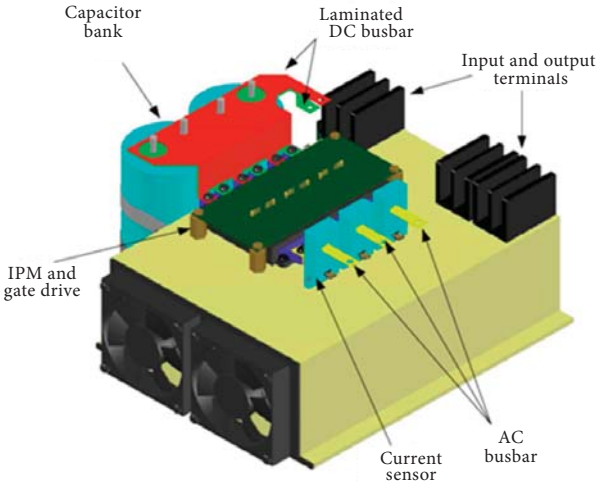
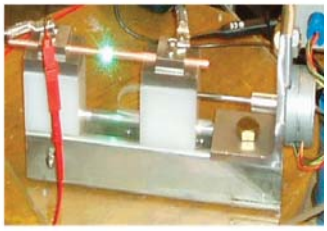
DC Arc Detection for Safe Green Power

Jin Wang, assistant professor of electrical and computer engineering, is researching ways to make green and renewable energy safe for different types of transportation and general households by investigating dc arc applications.





High voltage dc networks have been adopted in both mobile and stationary applications. They are found as main electrical power structures for hybrid electrical vehicles, naval vessels, fighter jets and data centers for the information highway. Most green or renewable energy sources, including fuel cells and photovoltaic panels output dc power, and most of today's electronic devices and energy-efficient designs, such as LED lighting and variable speed washers, are essentially dc based. In the foreseeable future, dc networks could become standard for homes and commercial buildings.

The prevalence of dc based power applications highlights dc arc related safety issues, the focus of Dr. Wang's research. It is well known that dc arc does not dissipate easily, which can result in dangerous fires. Also, the nature of the dc arc is quite chaotic. It covers a large frequency range without an apparent predictable pattern. Furthermore, the power electronics devices that form the backbone of a typical dc network generate noise at a frequency range also covered by the dc arc, making it even harder to detect the arc.

In the new High Voltage and Power Electronics Laboratory (HVPE), Dr. Wang and his students have constructed a 30 kW, 300 V power electronics based dc arc test apparatus. Current research is focused on finding an advanced dc arc detection method and corresponding protection strategy. The project is focused on dc networks in aircraft and electric vehicles, but the research results could be easily adapted for photovoltaic, fuel cell and future in-home dc networks.

The dc arc project is sponsored by the Department of Defense and is now in its second year. The primary goal of the HVPE is to develop an integrated research and teaching program that is dedicated to intelligent high voltage and high power interfaces for green energy resources and different types of energy storage devices. ■

(Grant, continued from page 2)

model and predict how solar wind couples to Earth's magnetosphere and ionosphere.

In collaboration with Drs. Parvin and Huang, OSU Dept. of Biomedical Informatics, Dr. Catalyurek has also been awarded an NIH/NCI R01 grant entitled "Informatics Methods for Identifying Breast Cancer Control Genes and Proteins."

This project combines innovative informatics methods with biological experiments in order to identify proteins that collaborate with breast cancer control genes. Data from gene chips will be analyzed using a variety of informatics tools to identify proteins that function in the same pathways as the breast cancer specific tumor suppressors BRCA1 and BRCA2. Candidate "BRCA" proteins will be tested using biological assays for DNA repair and control of the cellular organelle called the centrosome. Those proteins that are positive in the biological tests will then be tested in breast cancer samples as potential biomarkers for breast cancer. ■

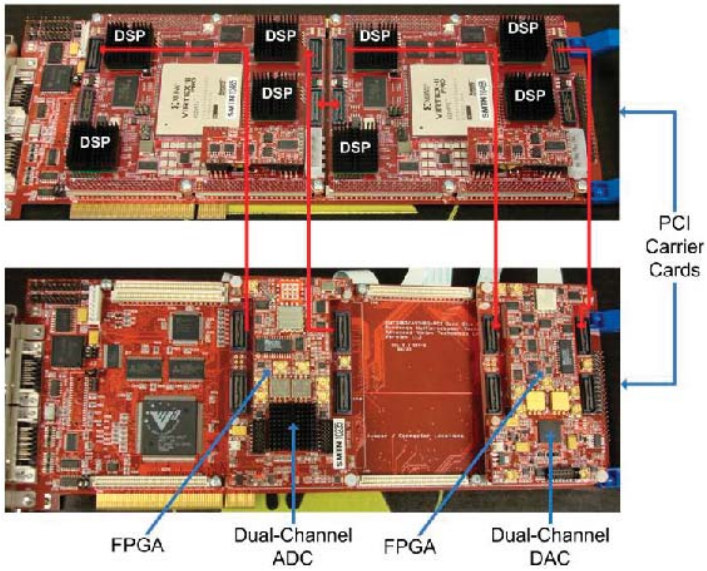
Microwave Remote Sensing at Ohio State: Impacting Future Satellite Sensors

Figure 1. Photo of OSU sensor (lower component in rack) in Twin Otter Aircraft utilized in recent airborne observations.

Sensors on earth observing satellites provide valuable observations for weather forecasting and climate monitoring. Much of the current information regarding global climate change has resulted from satellite observations. Microwaves are an important tool for these efforts due to their ability to penetrate clouds as well as their sensitivity to several atmospheric and surface properties. There are two basic types of microwave sensors: active (radar) or passive (radiometer). Active sensors transmit microwave energy and measure what is returned, while passive sensors observe naturally emitted radiation. The Microwave Remote Sensing group in the ElectroScience Laboratory led by Dr. Joel Johnson is actively developing new sensor technologies for both radar and radiometer systems.

New microwave radiometer technologies to address problems with radio frequency interference (RFI) have been a focus of the group in recent years. Since radiometer systems observe naturally emitted signals, any man-made transmissions using the same frequencies cause problems in measuring climate information. Under the support of NASA and the National Oceanographic and Atmospheric Administration (NOAA), the group has developed new digital receiver systems that greatly improve the radiometer's ability to detect and remove interference. The digital receiver systems developed have been deployed in several ground and aircraft based campaigns in recent years to demonstrate their effectiveness. Recent campaigns included flights in conjunction with a NASA Jet Propulsion Laboratory sensor on-board a Twin Otter Aircraft in September-October 2008 (Figure 1). The OSU system collected data in 62 hours of flights; the resulting information was directly applied to assess possible RFI problems with an upcoming NASA satellite mission (the Soil Moisture Active/Passive- SMAP- mission), and a design similar to the OSU receiver will be incorporated into the satellite. Similar efforts are continuing for other future satellite systems.

Figure 2.



The group has also been active in radar related research, with a recent focus on improving the performance of radar systems in urban environments through the use of "software-defined" radar systems. Such radars use digital transceiver technologies and real-time processing to enable operation in multiple radar modes using a single hardware platform. Figure 2 is a photograph of a 1 giga-sample per second (GSPS) transceiver board that is serving as the processing backbone for a software radar system that is currently under development. The system includes numerous field programmable gate array (FPGA) and Digital Signal Processing (DSP) components to implement radar algorithms in real-time for user defined waveforms, radar properties, integration periods, and other parameters. A complete radar implementation is nearing completion, and will be demonstrated in 2010. ■

NEW FACULTY

Dr. Waleed Khalil

Waleed Khalil joins ECE and the ElectroScience Lab as an assistant professor. He received his Ph.D. from Arizona State University in 2008. Prior to joining OSU, he spent 16 years at Intel Corporation where he held various technical leadership positions in both wireless and wireline groups. His research interests span the areas of RF CMOS circuits and systems for mm-wave and THz applications. He is particularly interested in the development of front-end active and passive technology to enable low-cost and low power RF circuits covering over a decade of frequency range.

Dr. Siddharth Rajan

Siddharth Rajan joins the ECE department as an assistant professor with a co-appointment in Electrical and Computer Engineering and Materials Science and Engineering. Dr. Rajan received his B.E. from Birla Institute of Technology and Science and Ph.D. from UC-Santa Barbara. His current research interests include new innovations for high-speed GaN-based electronic devices, studying new materials such as graphene and diamond, investigating the applications of GaN for biosensing, and studying photonic applications of GaN for photodetectors and photovoltaics.

Dr. Roberto Myers

Roberto Myers joins the ECE faculty as an assistant professor with a co-appointment in Materials Science and Engineering and Electrical and Computer Engineering. He received his B.S.E. in Materials Science and Engineering at the University of Pennsylvania and his Ph.D. in Materials at UC-Santa Barbara. Dr. Myers collaborates with ECE new faculty Dr. Siddharth Rajan in research utilizing a new molecular beam epitaxy system for the growth of group III-nitride heterostructures where high efficiency intersubband optical transitions could be utilized for solid state lighting, telecommunications, and optical storage.

(Seniors, continued from page 1)

One particularly effective capstone project was to build a working speaker- from paper, wire, and a magnet. The teacher predicted the kids would love the project: normally the students were not allowed to bring their mp3 players to school, but on the day of the OSU visit, music was required!

The high school teachers who teamed with the ECE students were enthusiastic about the experience. One school used the Jeopardy game and buzzer circuit to help students study for exams. Many schools now have STEM Clubs (Science, Technology, Engineering and Math) and teachers need projects like these to introduce STEM concepts. Each project included project documentation written specifically for educators, so teachers can complete the activities independently and share them with future students.

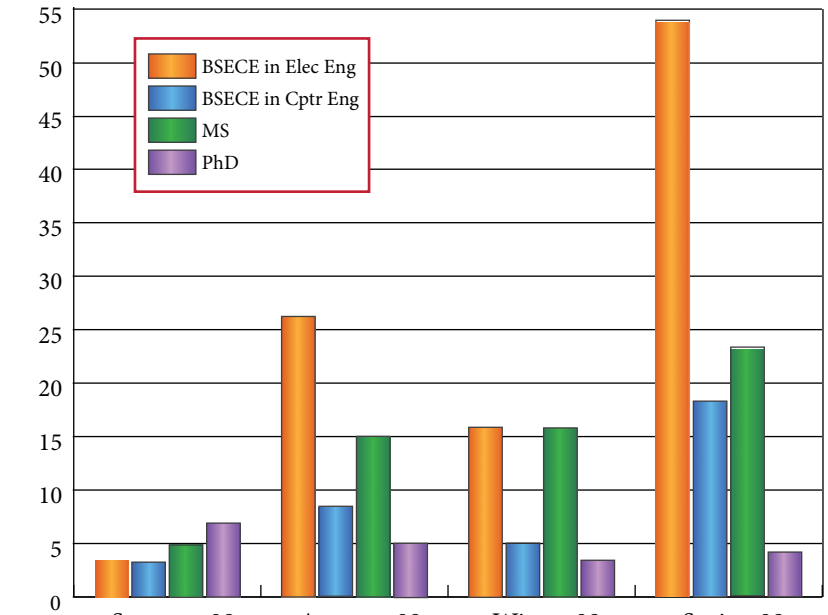
Hannah Gustafson, graduate student and president of the Students for STEM outreach volunteer organization helps a 9th grader from Metro High build a speaker out of paper, a magnet, and some wire.

The ECE students also benefited greatly from the experience. Our students were enthusiastic about creating interesting projects and showing younger students possible career opportunities. ECE undergraduate HKN and IEEE student chapter volunteers can now share these projects with local K-12 students, and are central to the success of the department's outreach program run by Prof. Betty Lise Anderson.

For additional information, please visit Prof. Anderson's website at http://www.ece.osu.edu/~anderson/outreach.html. ■

STUDENT STATISTICS

Degrees Conferred 2008-2009

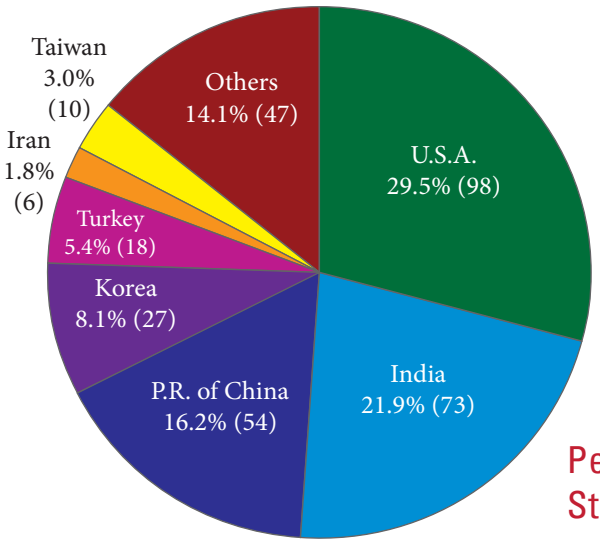


Totals:	18	54	40	99

University and Industry & ECE Supported Students	
Graduate Teaching Associate	22
Graduate Research Associate	117
Graduate Administrative Associate	3
Presidential Fellowship	1
University Fellowship	12
Industry & ECE Fellowships	18
Total:	173

Supported Graduate Students for 2008-2009

Graduate Student Overview 2008-2009	
Number of Applicants	987
Number Admitted	205
Enrolled Students	333
Average GPA Admitted	3.63
Average GRE (verbal)	531
Average GRE (quantitative)	783



Percentage of Graduate Students Enrolled by Country

DISTINGUISHED ALUMS

Burn J. Lin is senior director at Taiwan Semiconductor Manufacturing Company (TSMC), Ltd., a company specializing in microlithography and semiconductor manufacturing technology. Previous positions include president of Linnovation, Inc. and various technical and managerial positions at IBM Corp. where he received 10 IBM Invention Awards and the IBM Outstanding Technical Contribution Award.

In 2008, Dr. Lin was elected to The National Academy of Engineering (NAE). Dr. Lin was recognized for technical innovations and leadership in the development of lithography for semiconductor manufacturing. He is recognized as a technical leader in the semiconductor manufacturing industry and most responsible for 193-nm immersion lithography, a resolution-enhancement process that replaces the air gap between the lens and the wafer surface with a liquid medium, such as purified water. Through Dr. Lin's perseverance, immersion lithography has been adopted by the industry, and manufacturing of 45-nm feature sizes and smaller has become possible.

Dr. Lin is editor-in-chief of the Journal of Micro/nanolithography, MEMS, and MOEMS, a fellow of IEEE and of SPIE. Recent awards include the 2009 IEEE Cledo Brunetti Award, the 2007 Industrial Technology Advancement Award from the Ministry of Economic Affairs of the Republic of China, the 2006 Distinguished Optical Engineering Award from the Optical Engineering Society of the R.O.C. and the 2004 and 2006 TSMC Innovation Awards.

Dr. Lin received his B.S. in electrical engineering from National Taiwan University in 1963 and received his Ph.D. in electrical engineering from The Ohio State University in 1970.

Dr. Lin is the 2009 recipient of the Benjamin G. Lamme Meritorious Achievemnent Medal. Benjamin G. Lamme, ME 1888, was a pioneering inventor and chief engineer for the Westinghouse Electric and Manufacturing Company in Pittsburgh for 21 years. Among his 162 patents were new inventions on railway motors, induction motors, converters, and the developments pertaining to the first Niagara Falls power system.

Matthew Ganz, Ph.D. is vice president and general manager of Boeing Research & Technology, the advanced central research and development unit of The Boeing Company.

Before coming to Boeing in February 2008, Dr. Ganz was president, CEO and general manager of HRL Laboratories in Malibu, CA. Before joining HRL in 2003, he spent two years as sector vice president for strategy and technology for Northrop Grumman Integrated Systems in Irving, TX and El Segundo, CA. At Northrop Grumman, Dr. Ganz helped develop technology strategy for a $3 billion operation that included the B-2 stealth bomber and eight other major military aircraft.

In 2000, Dr. Ganz founded Navigator Technology Ventures in Cambridge, MA as a spin-off from The Charles Stark Draper Laboratory and served as managing director and CEO of the seed-stage venture capital firm until 2001. The previous two years, he was vice president of technology and programs at Draper Laboratory.

Dr. Ganz was with the Defense Advanced Research Projects Agency (DARPA) in Arlington, VA, from 1992 to 1998 as a program manager in the Special Projects Office and as director of the Sensor Technology Office. Previously, he was with the Massachusetts Institute of Technology Lincoln Laboratory Radar Systems Group in Lexington, MA and with Johns Hopkins University Applied Physics Laboratory in Laurel, MD.

Dr. Ganz has been a member or chairman of 10 Defense Science Board and Air Force Scientific Advisory Board study panels. He also has served on the board of several private companies including Scaled Composites, LLC, when it won the X-Prize for the first private manned space launch.

Dr. Ganz holds Doctor of Philosophy, Master of Science, and Bachelor of Science degrees in electrical engineering from The Ohio State University.

Dr. Ganz is a 2009 recipient of a Distinguished Alumni Award. The award recognizes distinguished achievement on the part of alumni in the field of engineering or architecture by reason of significant inventions, important research or design, administrative leadership, or genius in production.

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National Student Awards

Student	Award	Advisor
Jae Young Chung	Finalist, International Union of Radio Science General Assembly Student Paper Competition	John Volakis
Liya Ding	2nd Best Poster, 2008 Kraus Memorial Student Poster Competition	Aleix Martinez
Lisa Fiorentini	Best Paper in vehicle controls, 34th Annual American Institute of Aeronautics and Astronautics Dayton-Cincinnati Aerospace Sciences Symposium	Andrea Serrani
Jon Gallagher	Best Paper, 2009 Int'l Conference on Distributed Computing in Sensor Systems	Randy Moses
Khadir Griffith	Best Paper Award, Position Location and Navigation Symposium 2008	Inder Gupta
Justin Kasemodel	3rd Best Student Paper, 2008 Antenna Measurement Techniques Association Symposium; 2009 IEEE Antennas and Propagation Society Research Award	John Volakis
Lifeng Lai (et al)	Best Paper Award at IEEE Globecom 2008	Hesham El Gamal
T. Lertwiriyaprapa	Best Paper, Int'l Antennas and Propagation Society Conference	Prabhakar Pathak
Will Moulder	3rd Best Poster, 2008 Kraus Memorial Student Poster Competition; IEEE Microwave Theory and Techniques Society Undergraduate Scholarship	John Volakis
Gokhan Mumcu	2nd Best Student Paper, 2008 United States National Committee Radio Science Meeting	John Volakis
Praphun Naenna	Best Student Paper, 2009 United States National Committee Radio Science Meeting	Joel Johnson
Andrew O'Brien	Best Presentation Award, 21st Int'l Technical Meeting of the Satellite Division of the Institute of Navigation; Best Presentation Award, Institute of Navigation, Global Navigation Satellite Systems Conference	Inder Gupta
Vineet Rawat	2nd Best Paper Award, 2008 Int'l IEEE Antennas and Propagation Society Meeting; Best Young Presenter, Conference on Electromagnetic Field Computation	Jin-Fa Lee
Michael Schuette	Best Poster Presentation Award, OSU Institute for Materials Research Materials Week 2008	Wu Lu
Woo-Jun Yoon	Runner-up Best Poster, Photovoltaics Specialist Conference	Paul Berger
Yijun Zhou	Best Poster, 2008 Kraus Memorial Student Poster Competition; 3rd Best Student Paper, 2009 United States National Committee Radio Science Conference	Yakup Bayram, Chi-Chih Chen, John Volakis