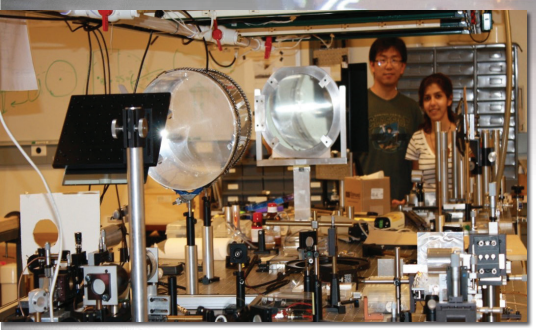
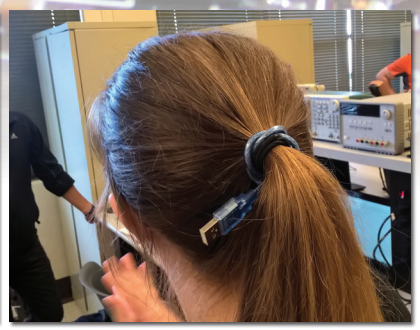
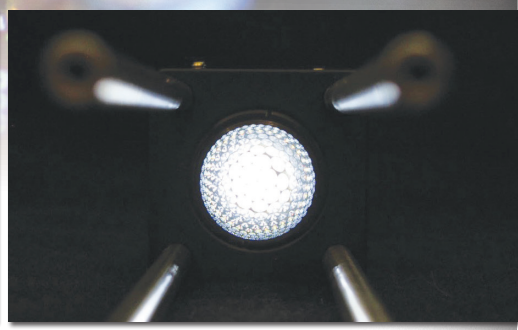
ECE NETWORKS 2016 | ELECTRICAL & COMPUTER ENGINEERING




OKLAHOMA STATE UNIVERSITY
COLLEGE OF
Engineering, Architecture and Technology

LETTER FROM THE DEPARTMENT HEAD

WELCOME!

The School of Electrical and Computer Engineering (ECE) is pleased to issue the latest edition of its annual newsletter. As a result of the creative input of the ECE Publicity Committee, the format and title of the newsletter has been changed to provide our constituents with a broader perspective of the School's educational programs, activities, and research.

In the 2016 edition of "ECE Networks," we have chosen to highlight a portion of the School's research portfolio, feature the accomplishments and activities of our students and showcase alumni stories and alumni participation with the School. For example, did you know that the School is research-active in energy harvesting, green energy, static random access memory, robotic companions for health monitoring, biophotonic surgery methods and radar imaging? Are you familiar with our international Mercury Robotic Competition and our innovative senior design projects that bridge the intense mathematics of control theory with fun, hands-on projects? Did you know that the School is an OSU leader in providing scholarships to our professional school students? Have you heard about the achievements of our alumni? If the answer is "no" to any of these questions, then please read this newsletter to discover fascinating stories about the life of the School of Electrical and Computer Engineering.

The School was pleased to hire two new assistant professors this past year—Drs. Yanmin Gong and Sabit Ekin. Gong recently graduated from the University of Florida and bolsters our computer engineering program with an emphasis in network security. Ekin graduated from Texas A&M University in 2012 and worked for three years at Qualcomm as a senior modem engineer. He specializes in communication theory and wireless systems. I am confident that both Drs. Ekin and Gong will make a positive impact in our educational programs and research enterprises.

Speaking of faculty, we wish Daniel Grischkowsky, Ph.D. who retired in May 2016, a wonderful retirement. Grischkowsky's career of almost 50 years is remarkable with landmark achievements in THz research. Please turn to the interior of our newsletter to learn why he was named a "pioneer of THz science."

In 2016 the School inaugurated the first ECE Distinguished Seminar Series to stimulate intellectual thought within the School, college and university. The six invited speakers for this series were world-renowned experts in imaging processing, data storage channels, internet-of-things, computer architecture, engineering education and X-ray imaging. Financial support of this series was made possible by the generous donations of alumni and friends of the School. We look forward to hosting our second series in 2017 with another set of distinguished speakers. Dates and times will be posted on our ECE web page.

You may recall in our 2015 edition of our newsletter my discussion regarding the vision of the new undergraduate teaching laboratory. I am pleased to announce in this edition that the vision is turning into reality. In November 2016 the College of Engineering, Architecture and Technology hosted the official groundbreaking ceremony of a 75,000 square foot, $35,000,000 building with an expected occupancy in fall 2018. This building will host a vast array of engineering and technology laboratories for electrical, fluid, thermal, material, energy, robotic, chemical, senso and environmental experiments and demonstrations. It will feature a two-story arena for autonomous vehicle testing and an outdoor energy arena for renewable energy generation. The third floor will be mostly electrical laboratories, maker spaces and design spaces. A new RF/communications/optics laboratory will showcase the newest and most innovative instruments for all things dealing with communications technologies. We in the college truly believe that this building will be a game-changer for engineering education.

The School operates in part on the gifts from our alumni, friends and constituents. The cost of education that is borne by our students is offset by scholarships and other forms of financial aid. All in all, I cannot stress enough my gratitude for your financial partnership with the School's students. Both large and small gifts make a difference in the life of the School's students. On behalf of the entire School, we say, "Thank you!" To learn more about how to give to the School's various foundation funds, please turn to the back of this newsletter.

While this publication is designed to provide you with an annual overview of activities in the School, our ECE web and Facebook pages have been created to give you more up-to-date information, keeping you current on the ECE happenings at OSU. Please bookmark our web page and "friend" our Facebook page. As you read our stories of this past year, please feel free to share your stories with us. We would love to hear from you and, with your permission, share your story on our Facebook page. And should you find yourself in Stillwater, please stop by and visit with us. Go Pokes!

Sincerely,
Jeffrey L. Young
ECE Professor and Head

P.S. As with so many things in the School, the ECE faculty perform many invaluable service activities to ensure our success. One such example is the publicity committee, who worked countless hours writing and editing this newsletter. My genuine thankfulness is extended to them.

P.S.S. Did you know that ECE students are fashion setters? Take another look at the front cover to learn the more about the latest in ECE fashion.

ECE undergraduate students activate automatic control theory in fun and accessible projects

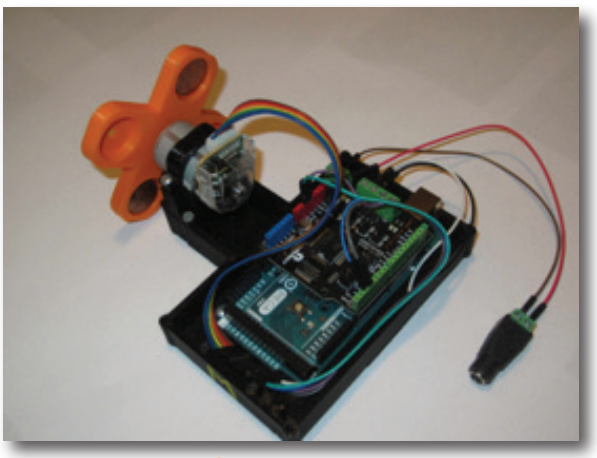
ECE undergraduate students test their understanding of automatic control theory in hands-on projects built at home. Student understanding is enhanced by hands-on lab experiences. Unlike many theory courses where there are well-established, low-cost laboratory materials to consolidate the understanding of theoretical components, developing accessible hands-on experiences in automatic control courses has been challenging. How can we increase the access to laboratory experiences in courses where no such experiences currently exist, and also ease the pressure on existing laboratories with increasing enrollments?

In ECE, a group of graduate and undergraduate students have been developing a new take home labs (THL) concept (thl.okstate.edu) to address these issues, under the supervision of ECE professor Martin Hagan. Over the past three years, ECE Ph.D. graduate Amir Jafari, MS graduates Carion Pelton and Sean Hendrix, current MS student Trevor Eckert and several undergraduate capstone design teams have been developing lab experiments for automatic control systems that students can do at home.

The THL concept is based on the following guiding principles:

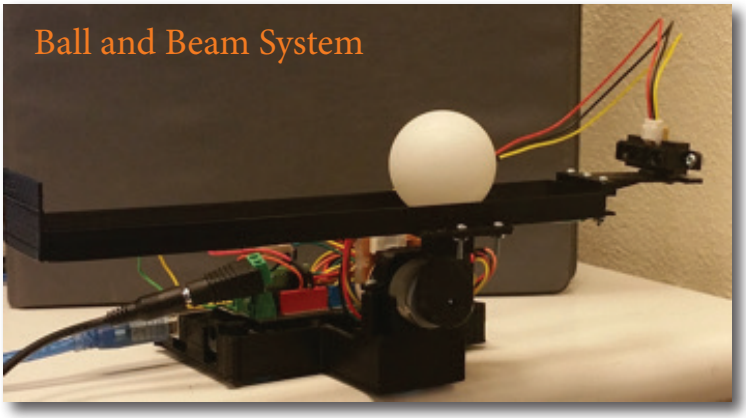
1. Experiments will be done at home, with minimal equipment required.
2. Materials and parts will be inexpensive (less than the price of a textbook) and available online or by 3D printing.
3. No teaching assistants will be required to assist the students with the experiments.
4. The central component of most experiments will be inexpensive, open-source microcontrollers.
5. Experiments will be designed so that students can concentrate on learning the theory, and observing and accounting for the differences between theory and practice, rather than worrying about technical hardware/software details.
6. All material needed to conduct the experiments will be available from the THL website located at thl.okstate.edu.

It is quite a challenge to develop interesting automatic control experiments that cost less than the price of a textbook. Companies like Quanser and ECP provide control experiments of high quality, but the cost is typically thousands of dollars. ECE students have leveraged low-cost microcontrollers, like the Arduino and the Rasberry Pi, the ubiquity of 3D printers and their own ingenuity to come up with many clever solutions.



Motor Control System

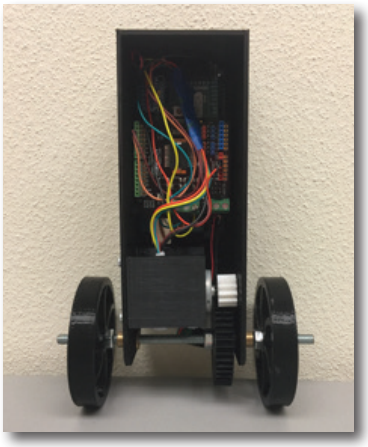
To date, the students have developed 14 experiments, starting with introductory experiments to turn lights on and off with an embedded microcontroller, to complex, balancing robots. The photo on the previoius page shows one of the basic experimental systems that the students use to control the position of a DC motor. The setup consists of an inexpensive DC motor with an encoder, an Arduino microcontroller and a companion h-bridge for driving the motor. The remaining platform and adjustable load are produced with a 3D printer. The cost is approximately $60, and the setup can support seven different experiments. These experiments were incorporated into our Systems I course in the fall of 2015.


Ball and Beam System

The students have also developed more sophisticated experiments for more advanced automatic control classes. These labs demonstrate how the 3D printer can be used to conveniently create custom parts at a minimum cost. The photo to the left shows one experiment Carion Pelton has created based on the classic ball and beam control experiment. A ball is placed on a horizontal beam and the controller must move the ball to a desired location by rotating the beam. The hardware is the same as that used for the motor control labs, but the motor load is replaced by a beam and an infrared sensor is used to measure the ball position. This system can be used for experiments that cover a variety of automatic control concepts (PID, lead-lag, optimal control, Kalman filtering, etc.).

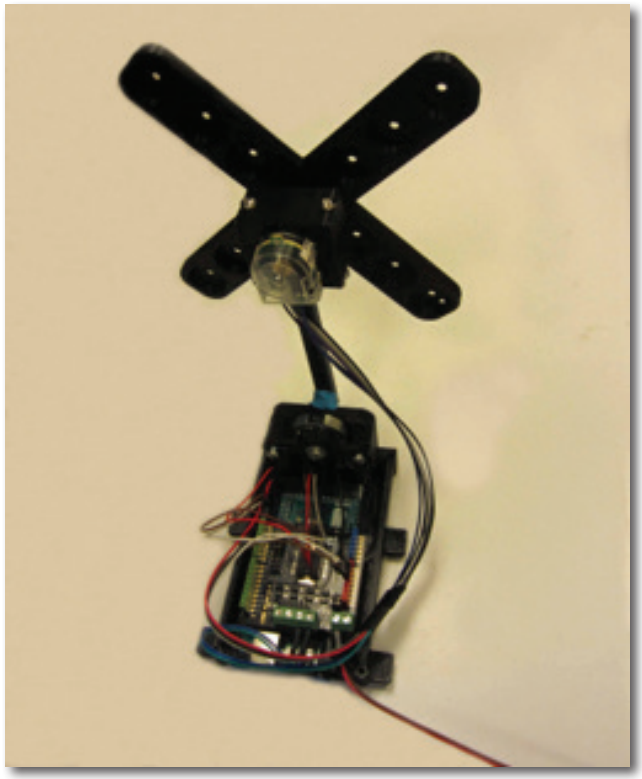
An experiment by Sean Hendrix uses a Furuta pendulum (or rotary inverted pendulum) system, as shown in the photo on the right. A beam is attached in a horizontal position to a motor. A pendulum is attached to the end of the beam, and is free to rotate in the vertical plane. This system uses similar hardware as in the motor control labs, but the motor is mounted vertically. A second encoder is attached to the pendulum to measure the pendulum angle. With knowledge of pendulum beam angles and velocities, the automatic control system determines the motor voltage to balance the pendulum.


Futura Pendulum


Mini-Segway

Another interesting experiment the students have developed is a mini-Segway system, as shown in the photo to the left. This system operates on the same principles as a full-scale Segway. An inexpensive inertial measurement unit, with gyro and accelerometer, is used to sense the angular rate and position of the body of the Segway, while an encoder is used to sense the forward movement of the wheels. The automatic control system must determine the amount of voltage to be applied to the motor in order to keep the Segway in an upright position. All of the mechanical parts, including gears, were manufactured with a 3D printer.

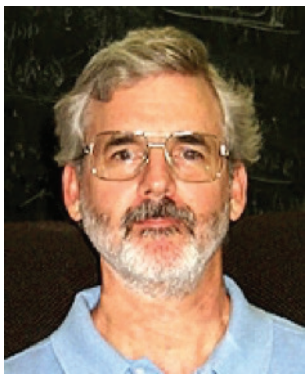
The students also developed a reaction wheel inverted pendulum, which borrows concepts used in controlling the orientation of satellites in space. This system, shown in the photo on the following page, has a motor/load combination at the end of the pendulum. When the motor is torqued, a reaction



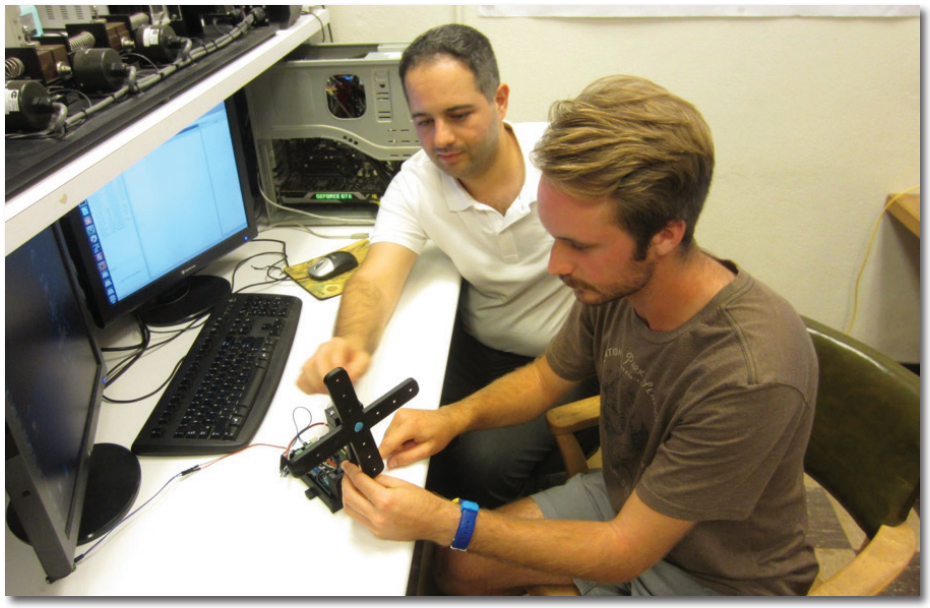
Reaction Wheel Pendulum

torque is generated on the pendulum, which can be used to keep the pendulum in balance. One encoder on the pendulum measures the pendulum angle and the motor encoder measures the angle of the load. The automatic control system uses this information to determine the voltage to apply to the motor.

The THL concept for building low-cost, hands-on projects that put automatic control theory in action has gained rapid popularity with ECE undergraduate students. Senior design students are "fighting" to get into the team assigned for a THL project each and every semester, and what they have learned from these THL projects will have long-lasting benefits.



Martin Hagan, Professor



Master's student Trevor Eckert (front) and Ph.D. graduate Amir Jafari working on the reaction wheel pendulum experiment. Eckert was the team leader on this senior project in spring 2016. Jafari helped the team (and all of the previous THL teams)

ECE SCHOLARSHIPS

ECE proudly announces the following scholarship funds during the 2016/2017 fiscal year:

- Stewart Family Endowed Scholarship Fund
- Dr. Rao Yarlagadda Graduate Fellowship in Electrical & Computer Engineering
- Dale C. Richey Endowed Scholarship
- Naeter Memorial Scholarship
- Frontiers of Power/Bill Hughes Scholarship
- Ransom Scofield Kenyon Memorial Scholarship Fund
- Norton E. Fincher Endowed Scholarship Fund
- Steven M. Wear Endowed Scholarship
- Bacon Family Scholarship in Electrical and Computer Engineering
- Leo J. Peters & Josie Mosely Peters Scholarship in Electrical Engineering

ECE congratulates the following 70 students who accepted one of the ECE scholarships:

Brandon Alexander
Raymond Anderson
Jacob Augustyn
Joseph Austin
Jonathan Ballew
Asaph Barbosa
Bonnie Jean Bavido
Kyle Bennett
Shawn Blackwell
Zach Brundage
Rahul Chidurala
Wei Loon (Alan) Chim
Austin Colby
Andrew Cordray
Kamran Coulter
Chandler Cowan
Hannah Cox
Jennifer Karfer Campbell
Rachel Campbell
William Davis
Samantha Degenero-Scheib
Anushka Dissanayake
Samer Elkhalid
Akram Gawedar
Gregory Gentry
Ian Gibson
Blake Giles
Thatcher Gillespie
Kristofer Hale
Ivin Hinojosa
Cyruss Husting
David Jennings
Devasi Karani
Aaisha Khalid
Jonathon Kitzrow
Brenna Reese Lane
Sam Leavell
Kelvin Leu
Fangyao Liu
Kara Mayfield
Connor McCurley
Dewey Oard
Stephen Osborne
Lloyd Overacker
Clay Patterson
Amanda Paust
Alex Perry
Evan Paterson
David Reddout
Antonio Rodriguez
Tyler Sekine
Shane Shannon
Logan Sirbaugh
Kari Strecker
Xihong Su
Franklin Tackett
Matt Thibodeauz
Caleb Teague
John Tobola
Haines Todd
James Touthang
John Tran
Michael VanCamp
Phil Vannoy
Kathikeyan Vasudevan
Edgar Viveros
Haley Welch
Tyler Weppler
Jerry West
Joshua White
Zac Williams
Shannon Wide
Brandon Wong
Cheemeng Xiong

The scholarships have made impacting differences in the education of many outstanding ECE students. The smiles of these scholarship recipients express their appreciation:

1. How has the scholarship you received helped you academically?

"The Myron Johnson CEAT Dean Award and Leo and Josie Mosely Peters scholarship have helped give me more time to focus on my coursework because I am not pressured into taking on more hours at work than I can manage to avoid taking out loans." - *Rachel Campbell*

"Being a recipient of the Leo and Josie Mosley Peters has motivated me to do my best academically." – *Samer Elkhalid*

2. What is your plan for your future career?

"My plan is to become a software developer or hardware designer. I want to create applications that impact people in a positive way." - *Rahul Chidurala*

"After graduation, I plan to attend graduate school here at Oklahoma State University. Upon obtaining a master's degree in electrical engineering, I hope to develop a career at a semiconductor company working in ASIC design." - *John Tobola*

"I plan to work as a creative electrical engineer that creates more surprising and convenient devices or tools for humans to use." - *Fangyao Liu*

3. What do you want to say to the donor of the scholarship awarded to you?

"Thank you so much for your help. I am a first-generation college student, and I do not come from a wealthy family. It is people like you who have made it possible for me to come this far, and I will remember it throughout my career. I hope to make the same difference in someone's education, career and life as you have made for me." - *Nick Overacker*

"I would want to say to my donor that I am so thankful for their gift. They are so generous and it is an amazing thing that they would be willing to help a student in their endeavor for an engineering degree. Thank you." - *Kara Mayfield*

"I hope that I can one day leverage the opportunities your contributions have given me to become a donor myself." - *Kamran Coulter*


Rachel Campbell


Samer Elkhalid


Rahul Chidurala


John Tobola


Fangyao Liu

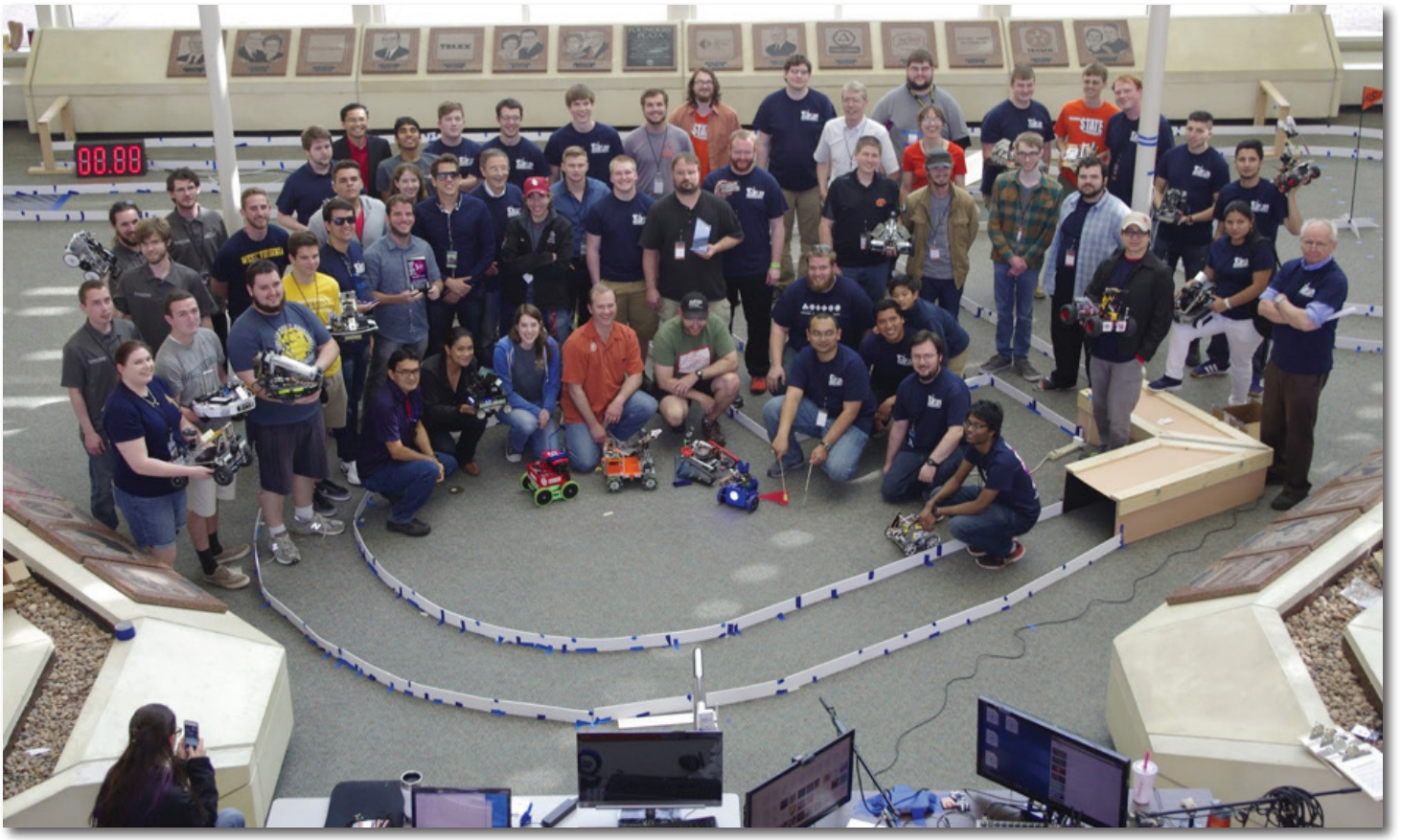

Nick Overacker


Kara Mayfield


Kamran Coulter

THE MERCURY REMOTE ROBOT CHALLENGE

An ECE tradition that strives and grows



All teams and organizers from the 2016 Mercury Robot Challenge

History

It began in 2007 as an experiment in utilizing cell phones for long-range robot control. Wira Mulia, an undergraduate student and Carl Latino, Ph.D. and associate professor both from ECE, were interested in investigating this challenge, just for fun. They experimented with several strategies and prototypes before concluding that cell phones were deficient, and decided to switch the communications system to the Internet. Interest in the research grew and in 2010, on suggestion of Ph.D. graduate student David Fritz, the OSU ECE department hosted the first annual Mercury Remote Robot Challenge.

The event was a modest affair hosting six robots, including the first international participant (and second place finisher), a team from UPAEP in Puebla, Mexico. The 2010 robots ran on a track delineated by painter's tape set up in the student union and the drivers were in engineering south; both buildings were located on the OSU Stillwater campus, separated by several hundred yards.

The first Mercury Challenge champion was the team from New Mexico State University. The competition grew in popularity, and the challenges grew in complexity and scope requiring more sophisticated robot systems: the two-dimensional track became three-dimensional and the early robots evolved into semi-autonomous machines. The seventh annual Mercury Remote Robot Challenge boasted 32 robot entries from four countries and a dozen universities. The 2016 champion was a team from Paraiba, Brazil with the second place winner being a team from OSU-Tulsa. Of the 32 registered robots, only eight were able

to successfully complete the challenge. The rules, new track and challenge for the 2017 event are can be found at: mercury.okstate.edu/content/mercury-challenge.

The International Dimension

From the onset, the Mercury Remote Robot Challenge has attracted teams from different states and countries. In fact, Paraiba, Brazil; Puebla, Mexico; and Bogota, Columbia have all hosted Mercury competitions of their own. The Mercury Remote Robot Challenge has enhanced the competition and collaboration between universities on an international scale.

The two robot entrants from Brazil were first and second-place finishers at a Mercury type event held in Paraiba, Brazil. CUN, a university in Bogota, Colombia, held their first Mercury competition and introduced a scaled-down competition for high school students in 2016. This latter competition is an excellent way to introduce younger competitors to the exciting field of remote controlled robots.

To be competitive, each year the robot quality and sophistication has to improve. The robots must now overcome obstacles and perform a mission. The robot mission and track layout are changed to keep the challenge fresh.

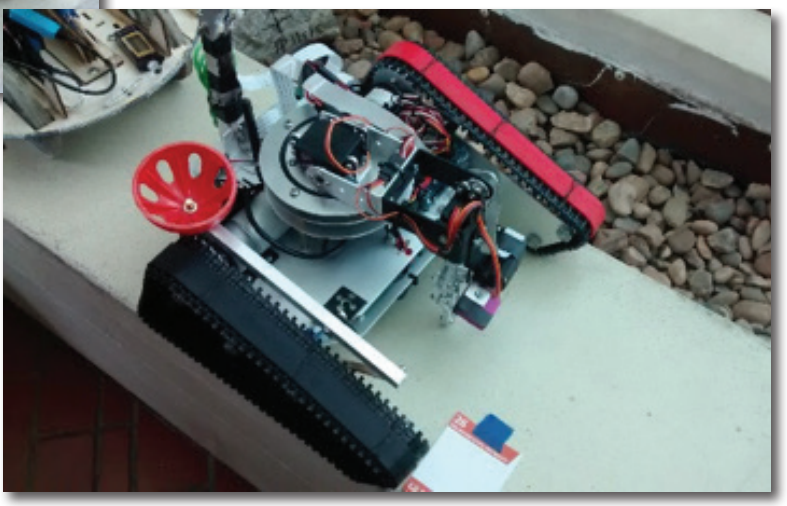
The Technical Challenge

Building a Mercury robot requires building a motion platform, a long-range wireless communications system, mechanical vehicle, control systems and many other components using a true multi-disciplinary team of designers. These requirements make for excellent engineering senior design projects. In fact many universities, such as the University of West Virginia, assign Mercury robots as senior design projects.

To be competitive, the robots must be maneuverable, able to climb and descend 30-degree inclines, capture, transport, deliver objects and finish in a sprint. All of this must be accomplished while the driver is over 50 miles away. At the 2016 Mercury event, robots were being driven from Indiana, Mexico, Colombia and even Japan. Driving a robot at a great distance introduces a lag time in communicating between robot and driver. Driving these robots requires considerable amount of practice. To assist the drivers, many robots employed sensor systems and anti-collision software in order to be competitive.

Brazilian team members with Carl Latino (third from left)

Mercury 2016 Champion Robot



Lil Deuce, OSU-Tulsa's robot (second place winner in 2016)

The Educational Dimension

Designing a robot that includes many subsystems is a true engineering undertaking. Before even starting on the construction, the team must understand the challenge. As an example, the 2016 Mercury robot had to capture a two-ounce beanbag, transport it over a seesaw with 30-degree inclines, launch the beanbag to a flag located six feet away and then travel the last 45 feet of the track at top speed.

The driver must have access to a device that enables him/her to drive the robot as well as operate the manipulators. The robot must be capable of bidirectional communications and understand when the communication signal is lost. The motion platform must have torque and traction for climbing inclines, and also be fast enough to handle the sprint section. The on-board robot computer must communicate with the driver while converting the received commands into signals that drive the motors, steering mechanism and control manipulators. Due to the lag times introduced by the communications system, robots must be semi-autonomous to assist the driver and avoid collisions.

Faculty judges computing scores on robot design and presentations

The overall system requires mechanical hardware design, electronic hardware design, software design, system integration and comprehensive testing. In brief, the design and construction of a competitive Mercury robot requires creativity, teamwork and just plain hard work. These robots are an ideal exercise for demonstrating engineering design.

A New Student Organization is Born

Impressed by the challenge and seeing a need, Lee Easten, an ECE undergraduate student, wanted to establish an OSU student robotics organization. In 2013, Easten took the leadership role, motivated students and became the first president of the Mercury Robotics student organization. The organization, although separate from the Mercury Remote Robot Challenge, attracts students from many different disciplines, builds robots and offers instructions on hardware and software topics. But above all, the main tasks of the Mercury Robotics organization are the registration of robot teams and overall operation of the Mercury Remote Robot Challenge.

Nathan Lea (left), Mercury Robotics president and Jeffrey Szcinski (right), Mercury MC

Sponsorship

Operating the Mercury Remote Robot Challenge is expensive both in terms of money and manpower. Travel and lodging for participants participating in the event is often the biggest expense. To publicize the event and entice participation, OSU has offered lodging and food to some of the participants. Companies such as ABB, Chesapeake and others have provided funding to enable OSU ECE to host these quality engineering competitions. In return, ABB has found Mercury Robotics to be a great source for engineering talent. They have hired numerous members from Mercury Robotics for summer internships and permanent positions. The OSU ECE department is deeply thankful and hopes that the symbiotic relationship continues.

Carl Latino, Ph.D. and Associate Professor

IEEE ACTIVITIES

An engineer from Textron Aviation speaks to IEEE-OSU student members about job opportunities in the aviation industry

The OSU student branch of the IEEE exists to educate students and interested parties on aspects of electrical and computer engineering. OSU IEEE hosts monthly meetings featuring industry speakers to enlighten students regarding career and employment opportunities that lie at the end of their stay here at OSU. We try and illuminate what can be done with an ECE degree.

OSU IEEE also sponsors a fall picnic with an intense volleyball competition and a spring banquet. During the 2015 - 2016 school year, OSU IEEE hosted presentations by representatives from ABB, American Airlines, Sandia National Labs, Valero, Georgia Pacific, Zeeco and American Electric Power.

The annual spring banquet, held at Meditations, featured ECE graduate Christine Huckleberry and associate B.J. Potter from the FAA, who talked about air traffic control techniques and procedures. The ECE department head, Jeffrey Young, also announced numerous scholarship awards made possible through the generosity of donors to ECE via the OSU Foundation. New HKN inductees and OSU IEEE student officers for the 2016 -2017 school year were also introduced.

This banquet set a new attendance record, in part because ticket costs were kept low thanks to the corporate sponsorship of Phillips66, Valero and Sandia National Labs. As usual, due to the efforts and kindness of former graduates who attended (representing over 20 companies), many door prizes, including a five-pound candy bar and a Lenovo laptop, were awarded at the end.

Also of note this past year, OSU students Rahul Chidurala, Jo Sands and Brandon Twilley participated in the 2015 IEEEXtreme 24-hour programming competition, where student teams from around the world try to solve a set of programming problems. This was the first time OSU students participated in this event.

George Scheets, Ph.D and Associate Professor
OSU-IEEE Advisor

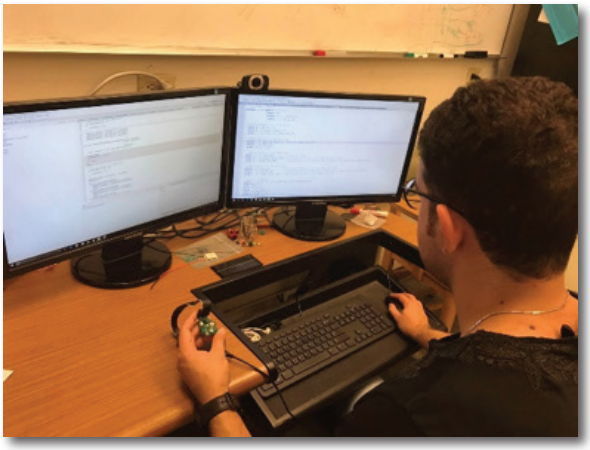
Green Wearable

Dr. Jingtong Hu

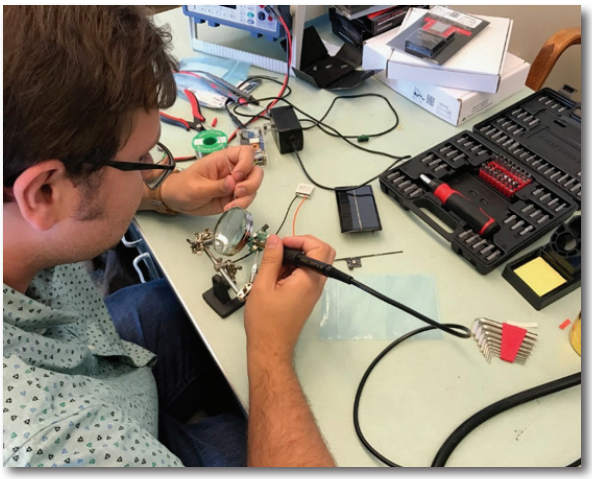
Stable green wearable works under unstable power supply

ECE professor Jingtong Hu has received a two-year, $175,000 grant from the National Science Foundation to develop wearable devices that are running on energy harvested from the ambient environment. Perpetual running computing devices seem like a dream. However, energy harvesting techniques, which generate electric energy from their ambient environment using direct energy conversion techniques, provide a promising way to realize this dream. Self-powered computing devices that can run for decades with little maintenance are especially attractive to many sensor applications for which it is challenging to employ traditional battery or cable power since it is inconvenient, costly or even dangerous to replace or service them. Examples of such applications include implantable sensors, wearable health monitors, water pipelines or building HVAC status monitors, soil or water pollution monitors, etc. Energy harvesting can eliminate the need for batteries or wires and enable the long-term running of these systems.

However, there is an intrinsic drawback with harvested energy sources. They are intermittent. Since almost all traditional computer systems are designed based on the assumption of a stable power supply, none of them can make significant progress under frequently interrupted power. In order to take advantage of unlimited free energy supply, a new computing paradigm, which can make progress even under intermittent power supply, is needed. This project will develop new architecture and software to ensure correct and efficient program execution under unstable power supply. The success of this project will enable a new class of self-powered sensing/monitoring systems that can last for years and require the least maintenance effort in various non-timing critical applications. It will simplify system installation and maintenance in many areas such as health care, building monitoring and maintenance, traffic, agriculture and environment monitoring, and even crisis management.



Weaving the Internet of Things. A Ph.D. student is debugging the program on the battery-less device



Power the Battery-less. A graduate student is building a system that does not need a battery and is powered by energy harvesting techniques

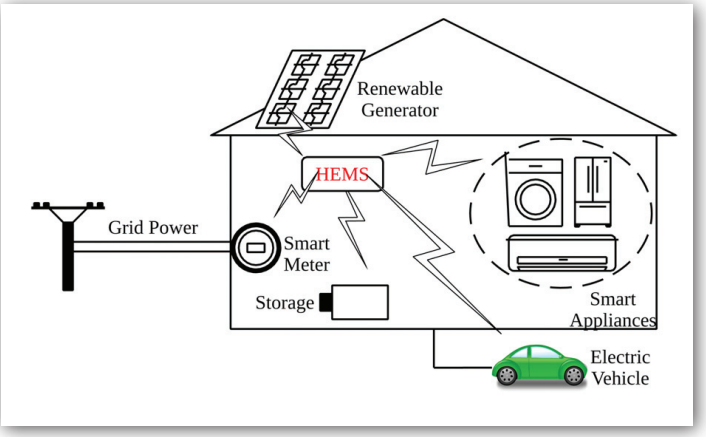
Solar Energy Integration

Dr. Yuanxiong Guo

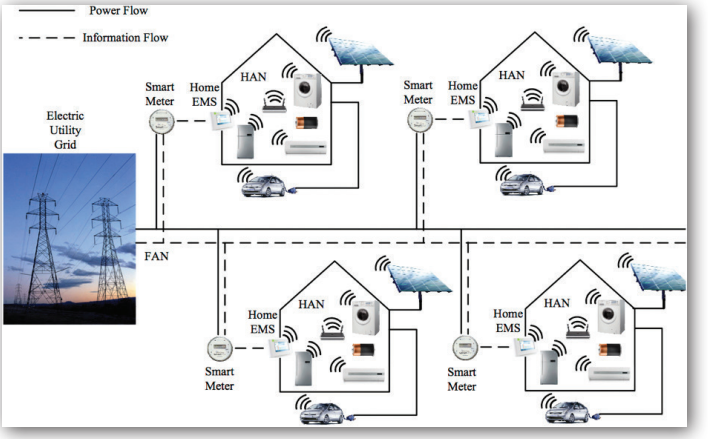
Smart inverters bring more solar energy into power grid

ECE professor Yuanxiong Guo has received a grant from the National Energy Solutions Institute-Smart Energy Source (NESI-SES) Association to investigate power grid solar energy integration issues. Solar energy is very different from conventional energy sources such as coal and gas in the sense that its availability is uncontrollable, intermittent, and hard to predict. The connection of solar generators, such as roof-top solar panels into the power distribution grid, can cause serious power, quality and stability issues, particularly when these generators become more prevalent. The current practice to mitigate these adverse effects is to limit the installed capacity of solar generators, which hinders the potential of solar energy to provide green electricity and reduce carbon emissions.

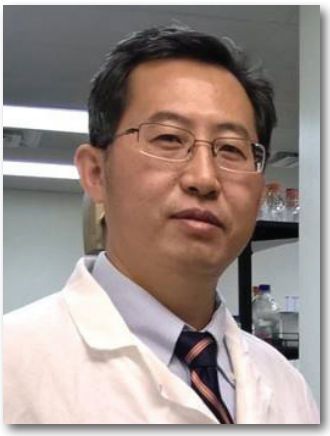
It is observed that direct current (DC) to alternative current (AC) inverters are needed for connecting solar panels to the grid. Such DC/AC inverters have the capability to inject or absorb reactive power in addition to active power. These inverters could be further made ``smart" by putting sensing, communication and computing capabilities into them, and then adaptively controlling their reactive power injecting and absorbing amounts based on the grid voltage conditions. Novel centralized and distributed control algorithms, as well as the supporting communication network, will be developed in this project. Numerical simulations based on realistic distribution feeders and solar generation data will be conducted to show the effectiveness of the proposed approaches. Such smart inverters will enable the power grid operator to control the power output from the solar panels, so that power quality can be maintained even under a very high penetration level of solar energy.



A future smart home with roof-top solar panels, electric vehicle, smart appliances and energy storage managed by the home energy management system (HEMS)



A future smart neighborhood with a community of smart homes managed by the electric utility company using field area network (FAN) and home area network (HAN)

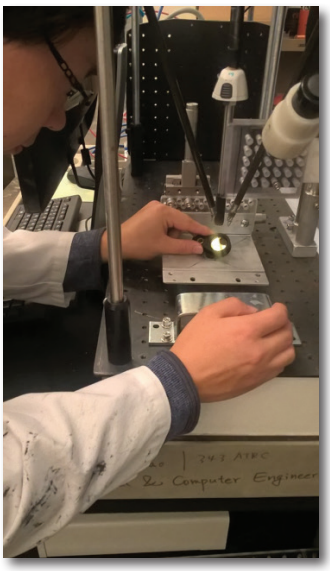


A New Vision for Minimally Invasive Surgery

Dr. Daqing Piao

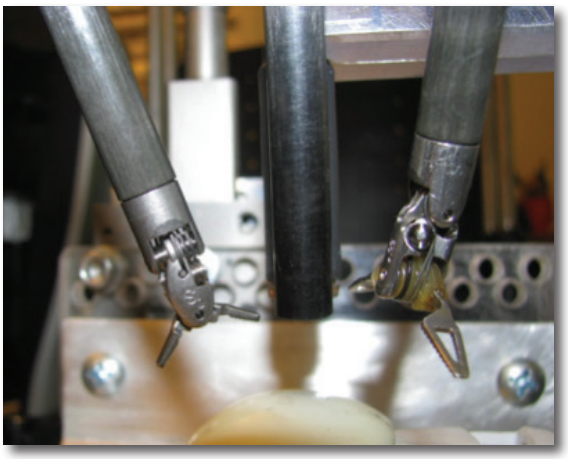
ECE researchers develop a new intraoperative imaging device that could enhance outcomes of minimally invasive prostate surgery

Daquing Piao's surgical biophotonics laboratory is developing a new laparoscopic imaging device that is expected to differentiate more accurately critical tissues in minimally invasive prostate surgery. Prostate cancer remains the most commonly diagnosed cancer in men and is the second most common cause of male death from cancer. Minimally invasive surgeries, including pure laparoscopic and robot-assisted laparoscopic procedures, are increasingly performed to remove a cancerous prostate when the cancer has not spread to other parts of body.



A graduate student in the surgical biophotonics laboratory examines a prototype laparoscopic imaging instrument

During minimally invasive surgeries wherein there is no or reduced tactile sensation and the vision of the surgical field is not as adequate as in open surgery, surgeons are challenged in completely removing the cancerous prostate organ and preserving critical peripheral tissues such as those controlling erectile activity. Piao and Sanjay Patel, Ph.D., a urologic surgeon at the OU Health Sciences Center (OUHSC), have invented a new laparoscopic imaging technology that may, in the future, give the surgeons an intraoperative imaging instrument for objectively differentiating critical normal tissues from cancerous tissues. Oklahoma State University's Technology Business Development Program has been supporting the advancement of this technology towards building a system for initial testing with surgical specimens.



A new imaging applicator probe under development (middle) is placed alongside robotic surgical instruments

A fiber-optical array for medical research is being cured under ultraviolet light

Smart Robots for Elderly Care

Dr. Weihua Sheng & Dr. Guoliang Fan

ECE faculty works to make helpful robot for the elderly people

ECE professors Weihua Sheng (PI, above) and Guoliang Fan (Co-PI, below) received a three-year, $725,000 grant from the National Science Foundation to develop smart robot companions that can be used in elder-care.

This three-year project, funded by the National Robotics Initiative (NRI) program of the National Science Foundation, aims to develop a robot companion that can monitor the daily activities of an older adult living alone. In urgent situations, such as when the older adult falls on the floor, the robot can respond by alerting caregivers, or even coming to the rescue.

To monitor human daily activities and detect behavioral anomalies, various sensors are used, which include several motion sensors worn on the human body and a camera on the robot. The data from these sensors are analyzed by intelligent algorithms to extract meaningful information regarding human activities and indoor environment. To test and evaluate the proposed idea, the PIs have constructed a smart home testbed mimicking a small apartment. A few robot prototypes have been built as well.

Robot companions are one of the enabling technologies for realizing "aging-in-place," which allows older adults to stay as long as possible in their own home as they age. As the baby boomers enter their retirement age, there is growing demand for such technologies. It is expected that older adults should have a much better quality of life if smart robots are available to help in their daily life.

Sheng's graduate students, Francisco Erivaldo Fernandes Jr. (left) and Ha Do (right), working on developing social intelligence for two home service robots in the smart home testbed within the Laboratory for Advanced Sensing, Computation and Control (LASCC)

Imaging Radar

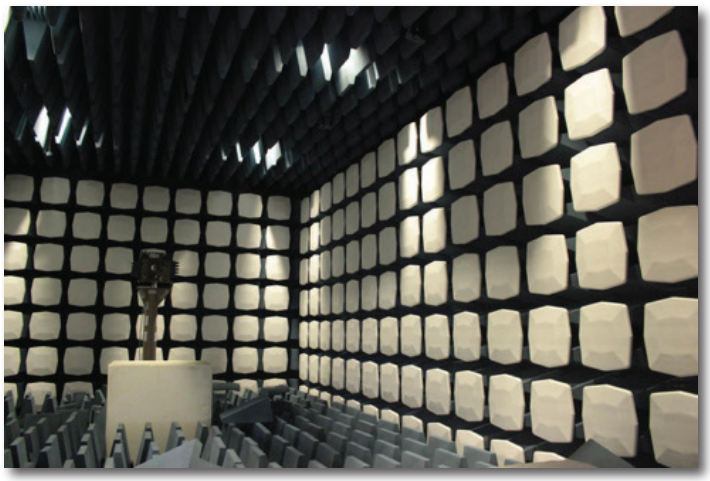
Dr. James West

ECE and Sandia researchers team up to improve the quality of radar imaging of the Earth's surface

ECE professor James West is working with Sandia National Laboratories to improve the quality of synthetic radar images of large areas of the Earth's surface.

Synthetic aperture radar is a specialized, remote-sensing radar that uses both the strength and the phase of the radar returned signal from a land or water area to form high resolution images that can approach photographic quality. Synthetic aperture radar can be used in conditions that prevent photographic sensing, such as nighttime conditions and cloud coverage. High resolution may be obtained with radar systems mounted on both aircraft and spacecraft, giving flexibility to obtain timely coverage of most places on the planet. Typical applications for synthetic aperture radar imaging are terrain mapping, sea-ice monitoring, measurement of crop yield, tracking of deployed equipment and vehicles and measurement of sea wave height and currents.

Deviations from the expected flight path of airborne systems, due to weather, turbulence or aircraft limitations, introduce unknown errors in the phase of the radar returned signal from the land areas that cause blurring of the images, if not corrected. Removal of these errors is called "focusing" of the image. OSU and Sandia National Laboratories researchers have been working to improve the reliability of automated focusing techniques when applied to images that provide limited information on the errors in the signal phase, such as low-image contrast or limited-area coverage or that include large phase errors resulting from significant deviations from the intended aircraft flight path. The goal is to insure the ability to rapidly obtain high quality images of otherwise inaccessible areas at any time of day under any weather conditions.



Testing facilities of the Robust Electromagnetic Field Testing and Simulation (REFTAS) Laboratory at OSU

OpenRAM: An Open Memory Array Compiler Infrastructure

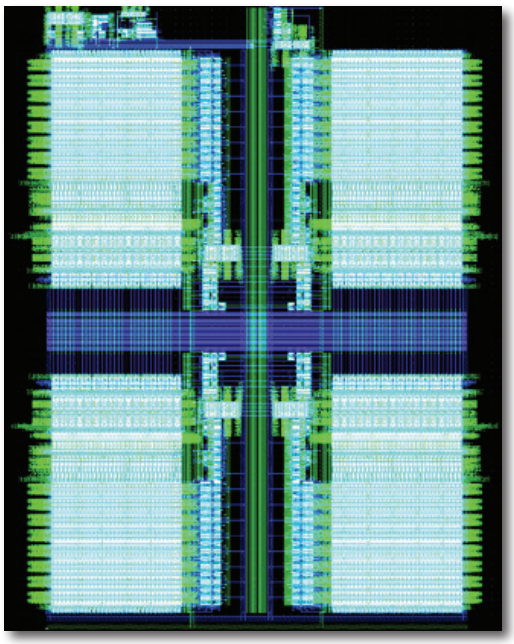
Dr. James Stine

ECE faculty member investigates high performance VLSI computer architecture circuits and systems research

ECE professor James Stine is working with the Air Force Research Laboratory (AFRL), Semiconductor Research Corporation (SRC) and the National Science Foundation (NSF) to address critical areas of very large scale integration (VLSI). Of particular importance to the VLSI community is static random access memories (SRAMs). SRAMs have become a standard component embedded in all system-on-a-chip (SoC), application-specific integrated circuits (ASIC) and microprocessor designs. Their wide application leads to a variety of requirements in circuit design and memory configuration. However, manual design is unfortunately very time consuming. The regular structure of memories leads well to automation that produces memory size and configuration variations quickly, but developing this with multiple semiconductor fabrication technologies and VLSI tool methodologies is challenging. In addition, memory designs play a significant role in the overall system performance of a system, so optimization is important. Thus, a memory compiler is a critical tool.

Many standard-cell process design kits (PDKs) are available from foundries and vendors, but these PDKs frequently do not come with memory arrays or memory compilers. If a memory compiler is freely available or exists, it often only supports a generic process technology that is not fabricable. PDKs may have options to request "black box" memory models, but these are also not modifiable and have limited available configurations. These restrictions and licensing issues make comparison and experimentation with real world memories impossible. Most importantly, circuits and system research for digital systems are virtually impossible without some solution to generate memories efficiently.

Stine's OpenRAM project aims to provide an open-source memory compiler development framework for memories and to be a foremost leader in this technology. It provides reference circuit and physical implementations in a SRC-funded generic 45nm technology called FreePDK45 and fabricable scalable CMOS (SCMOS), but it has also been ported to several commercial technology nodes. OpenRAM also includes a characterization methodology, so that it can generate timing and power characterization results, in addition to circuits and layout, while remaining independent of specific commercial tools. This innovation, along with designs for memory, allows Oklahoma State University to address methodologies and options for the design of cutting-edge VLSI implementations for application-specific and general-purpose computer architectures.



A 4-bank VLSI layout of memory generated from OpenRAM

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ENGINEERING DISTANCE EDUCATION

College of Engineering, Architecture & Technology

DATA DEFENSE

Chris White, B.S., 2004

Oklahoma State University's College of Engineering, Architecture and Technology (CEAT) has nationally top-ranked undergraduate and graduate programs. Chris White, a proud OSU alumnus, says the programs CEAT offers are exceptional and played a key role in his success after earning his undergraduate degree.

"During my time at OSU, as an undergrad, I felt like I had amazing opportunities because of faculty, research and research groups," says White.

White remembers the countless group projects and research activities he was involved in, which helped him become a strong candidate for graduate schools.

"When I left OSU to apply to graduate programs, all of these made me a much stronger candidate than others," says White.

White graduated from the School of Electrical and Computer Engineering (ECE) at OSU in 2004. He currently works as a principal researcher and partner at Microsoft. His team is working to develop software for data science with a focus on the cross between artificial intelligence and business intelligence for scalable integration with data.

Prior to his job at Microsoft, White worked as a program manager developing advanced technologies for data science and led the big data efforts at the United States Defense Advanced Research Projects Agency (DARPA). During his time at DARPA, White developed Memex, a suite of Internet tools that help local law enforcement obtain crucial information about illegal activities, such as human trafficking. Due to his efforts with Memex, White was awarded the prestigious Presidential Award for extraordinary efforts to combat trafficking in persons.

White credits his OSU education for his success and encourages students to take advantage of the opportunities the school provides.

"I feel like students may not realize how great of a school and education they're getting," says White. "They're not taking advantage of the opportunities they have, and if they did, they would find that they are well prepared to enter the work force and graduate schools."

White has received high honors and recognition in his work, including the Secretary of Defense Medal for outstanding public service, a Department of Treasury Intelligence and Analysis medallion and the Department of Defense Joint Meritorious Unit award.

His work has been featured in multiple media outlets including CBS 60 Minutes, CNN, the Wall Street Journal (cover S&T), Rolling Stone Magazine and TEDx.

Nidal Sammur, Ph.D., 1992

After attending school at the University of Tulsa and earning his degree in electrical engineering, Nidal Sammur began searching for a home to complete his doctorate. Martin Hagan, Ph.D. and a key professor in Sammur's educational success, was going to work in the College of Engineering, Architecture and Technology (CEAT) at Oklahoma State University.

"He's the one who kind of sold me on OSU," says Sammur. "The year he was moving to OSU, I was also working with him on a couple of things while finishing my masters."

Sammur remembers all of the opportunities that were offered while completing his Ph.D. program at Oklahoma State.

"OSU had the rigorous curriculum and faculty support; the university and ECE in particular helped me shape myself by offering me both research associate and teaching assistant positions," says Sammur.

Sammur spent five and a half years at Oklahoma State teaching classes and labs while doing industrial research with grants, all of which landed him his current job at FlightSafety.

"I was exposed to teaching experiences and research experience in multiple areas from three different institutions," says Sammur.

In 1992, Sammur received his Ph.D. in electrical and computer engineering from OSU and joined the FlightSafety international team, focusing on targeted development of control loading, motion, avionics interfaces and cockpit I/O. He worked on fixed-wing, rotary-wing and tilt-rotor aircraft simulators.

Sammur's company comes back to Oklahoma State to recruit high caliber students.

"We try to go to job fairs to recruit interns, and OSU is at the top of our list," says Sammur. "We had interns from OSU this year and last year, and have had good success, so normally we turn around and hire them the next year if things work out."

In 2011, Sammur was promoted to director of engineering for FlightSafety because of his contributions to the design, manufacture and support of FlightSafety's advanced technology flight simulation equipment.

His education from Oklahoma State gave him experience and expertise in engineering, along with strong leadership skills.

"I want to stress the fact that OSU is a good school with a great program - the facilities are great, everyone wants to see you succeed and they will help you to achieve that goal," says Sammur. "When you go to a program and you have done research with different companies in the area you're interested in, if you perform well, you'll be able to go and do more work after you leave OSU. That's the big selling point."

ECE Scholarships

Under the leadership of President Burns Hargis, Oklahoma State University is committed to affordable higher education. OSU provides high educational value at low cost relative to its aspirational peers. Nearly 50% of all OSU students graduate with no debt. How is this possible? Fund raising, enrollment growth, and operational cost controls. With the cost of education being front and center in the minds of students and parents alike, the School is committed to financially assisting our students through the ECE Scholarship Program.

The 2016/2017 academic year is an exciting year for the School of Electrical and Computer Engineering. The School awarded over $125,000 in scholarships from ten scholarship funds to about 70 students with an average award of $1,750. This is in addition to the 130 scholarships that were award by the College of Engineering, Architecture and Technology to ECE students. All in all ECE students received over $370,000 in scholarship support for the current academic year. To celebrate our commitment to affordable higher education, awards were announced at the School's IEEE Annual Banquet in April 2016. Our students are most fortunate to have the following ECE funds contributing to their academic success:

- Bacon Family Scholarship in Electrical and Computer Engineering
- Dale C. Richey Endowed Scholarship
- Dr. Rao Yarlagadda Graduate Fellowship
- Frontiers of Power/Bill Hughes Scholarship
- Leo J. Peters and Josie Mosely Peters Scholarship in Electrical Engineering
- Naeter Memorial Scholarship
- Norton E. Fincher Endowed Scholarship
- Ransom Scofield Kenyon Memorial Scholarship
- Steven M. Wear Endowed Scholarship
- Stewart Family Scholarship

In cooperation with Mechanical and Aerospace Engineering (MAE), our School is pleased to announce a new scholarship fund made possible by Jerry and Delores Etter. Jerry is an alumni of MAE and Delores attended OSU before finally receiving her PhD in electrical engineering from the University of New Mexico in 1979. Among her many accomplishments, she was the Assistant Secretary of the Navy (2005-2007) under President George W. Bush (https://en.wikipedia.org/wiki/Delores_M._Etter). The Etter Scholarship will be awarded to both ECE and MAE students who have demonstrated remarkable leadership as Eagle Scouts. As with many of our scholarship funds, the Etter Fund is there to recognize meritorious achievement and to financially empower our students.

Although the 2016/2017 academic year was a banner year for ECE scholarships, we are not content to maintain the status quo. We have developed a set of SMART (specific, measureable, achievable, realistic, and time-oriented) goals in cooperation with the CEAT Scholarship Office and the OSU Foundation to grow our scholarship program. These goals include:

- Increase the average GPA in the ECE Professional School by awarding scholarships to top scholastic performers.
- Increase under-representative group (Women, Hispanics, Native Americans, etc.) enrollments in the ECE Professional School with the focus on scholastic achievement.
- Increase enrollments in the ECE Graduate School by recruiting undergraduate scholarship recipients.
- Increase the ECE scholarship applicant pool.
- Increase scholarship funding awards.

To achieve these goals, the on-going financial support of ECE alumni, partners, friends, and other stakeholders is needed. Whether that support is large or small, regularly or irregularly offered, it is ever so much appreciated. Scholarships make a wonderful difference in the lives of our students and in the ECE culture. Please consider making contributions to the scholarship funds listed on page 31 of this newsletter.

Meet One of Our Donors

Earl Glimp of Drumright, OK, is a semi-retired partner in an oil company and ranching operation. He graduated with his bachelor's degree in electrical engineering from OSU in January of 1966.

"To me, OSU was the logical choice," says Glimp. "It had a good engineering program."

Glimp has been donating to OSU for decades, but this is the first year he has sponsored a professorship for the School of Electrical and Computer Engineering through the university and the OSU Foundation.

"I had the funds to donate, and it was time to sponsor either a scholarship or professorship so that I could give a little back to ECE for how much it's given me with my education," says Glimp. "Hopefully the professorship will be able to impart knowledge to ongoing students, and then those students will be successful and able to give back in the future, long after I'm gone."

Glimp returns to campus often and is impressed with how much OSU and CEAT have progressed since his time there.

"It's really changed a lot in the last 15 years; there's new buildings and a new research center, and now CEAT is getting ready to build a new laboratory building for undergraduates," say Glimp. "I'm glad that the school is progressing; it's what you have to do to keep up with all of the new students coming in."

Glimp is fond of the memories he made during his four and a half years at OSU. He still keeps in touch with many of his engineering friends to this day.

"It was a great education, a great time, and I don't think the students going through school now fully understand," says Glimp. "They're going to look back in 20-30 years and say, 'yeah, it was hard, but this was a really good time in my life.'"

Glimp says without his education from OSU he would not be where he's at today and would not be able to give back to the ECE school.

"OSU gave me a lot, and I hope to give back to it and ECE so that other people can get a good education," says Glimp. "Each year it seems like the funds from the state are continually cut so people need to contribute. I really enjoyed the time I spent in the ECE school, so hopefully the little I can give back will do some people some good."

ECE INDUSTRIAL ADVISORY BOARD

ECE Industrial Advisory Board Bleeds Orange

(from left, to back, to right, to front) Mike Black, Raytheon (retired); Steve Thornton, L3-Communications Holdings, Inc.; Bryan Burns, Sandia National Laboratory; Edward Daniel, The Boeing Company; James Beauchamp, The Boeing Company; J. Gregory Smith, Frontier Electronic Systems; Kurt Jarvis, Tinker Air Force Base; Curtis Tabb, Garmin Ltd.

The mission of the School of Electrical and Computer Engineering (ECE) at OSU is to provide a high quality, comprehensive electrical and computer engineering education for both undergraduate and graduate degree-seeking students. With a passion to mold successful students, capable of meeting the challenges in the fast-pace world of electrical and computer engineering technologies, the school shares that passion with the ECE Industrial Advisory Board (IAB).

The IAB is comprised of ECE alumni who volunteer countless hours dedicated to strengthen the undergraduate academic programs of ECE. Members of the IAB are surrounded by current trends in electrical and computer engineering industries and work with the school to ensure all programs are relevant.

The School of Electrical and Computer Engineering met with the industrial advisory board in spring 2016, during which meeting members of the IAB strongly endorsed the ECE curriculum.

IAB members, such as Ed Daniel from Boeing, praised ECE for its thriving, student-focused program.

"[ECE] has a good balance of teaching and research; you get it from the professors doing the research, not their TAs," Daniel says. "For the industries that we represent, ECE is a viable education."

ECE professors and staff are known for giving their students the tools they need to succeed outside of the classroom, and IAB member Bryan Burns, with Sandia National Laboratory, commends professors and staff for their accessibility to their students.

"The professors and the staff here at OSU are very interested in seeing their students succeed and they're willing to spend time with students to give them the tools they need to succeed outside the classroom," Burns says. "They're available to students outside, simply put. That's a big deal."

IAB members applaud ECE for their student-focused program. They also laud the strong work ethic and caliber of the ECE students upon entering the industry in their first entry-level position.

"ECE grads from OSU come equipped with the skills they need to take our products to the next level," Garmin International employee and IAB member Curtis Tab says.

While the IAB praises the work professors and staff put towards the success of ECE students, they also give recognition to Jeffrey Young, Ph.D. and ECE department head, for the passion he exudes for the program.

"Dr. Young's excitement, enthusiasm and charisma is contagious," Daniel says.

The quality of education and knowledge students gain in ECE drives employers to continuously recruit and retain OSU-ECE graduates in Oklahoma.

"We're pleased with the quality of graduates that we get from OSU," Kurt Jarvis from Tinker Air Force Base says. "Hiring OSU grads is keeping Oklahoma strong, keeping them in the state, and ensuring that we can continue the Oklahoma growth."

ECE WELCOMES TWO NEW FACULTY MEMBERS

Yanmin Gong, Ph.D.

Yanmin Gong, Ph.D. joined the School of Electrical and Computer Engineering at Oklahoma State University in August 2016 as the newest member in the computer engineering program. She received her doctorate from the Department of Electrical and Computer Engineering at the University of Florida under the supervision of Yuguang "Michael" Fang in 2016. She received her bachelor's degree in electronics and information engineering at Huazhong University of Science & Technology in Wuhan, China, in 2009, and master's degree in information and communication engineering at Tsinghua University in Beijing, China, in 2012. Her research interest includes security and privacy in big data with an emphasis on healthcare, mobile systems and energy.

Sabit Ekin, Ph.D.

Sabit Ekin, Ph.D., joined the School of Electrical and Computer Engineering, Oklahoma State University, as an assistant professor in August 2016. He has four years of industrial experience from Qualcomm, Inc. as a senior modem systems engineer in the department of Qualcomm mobile computing. He received his doctorate in electrical and computer engineering at Texas A&M University, College Station, TX, 2012, his M.S. in electrical engineering from New Mexico Tech in NM, 2008 and his B.S. in electrical and electronics engineering from Eskisehir Osmangazi University in Turkey, 2006. He was working as a visiting research assistant in the electrical and computer engineering program at Texas A&M University at Qatar (2008–2009). During the summer of 2012, he worked with the Femto-cell interference management team in the Corporate R&D division at the New Jersey Research Center, Qualcomm Inc. After his Ph.D. study, he joined Qualcomm Inc. in San Diego, CA, where he has received numerous Qualstar awards for his achievements and contributions. His research interests are in the areas of design and performance analysis of communications systems from both theoretical and practical points of view, particularly interference management and statistical modeling of interference in next-generation wireless systemssuch as: 5G, mmWave, HetNets, visible light communications and cognitive radio networks.

ECE LAUNCHES DISTINGUISHED SEMINAR SERIES

As a new initiative in the School of Electrical and Computer Engineering, the Distinguished Seminar Series presents the work of internationally recognized researchers. This seminar series is intended to provide an open platform for the faculty and students to have a dialog with leading researchers in various fields of electrical and computer engineering and to build a dynamic and vibrant culture of research and academic exchange in the ECE school. In 2016, there were six distinguished speakers who presented technical seminars to ECE faculty and students.

Phase Sensitive X-ray Imaging for Cancer Diagnosis

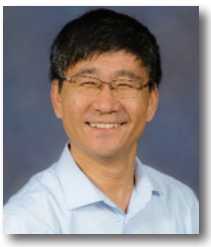
12: 30 p.m. - 1:30 p.m., Tuesday, March 22 | ATRC 102

Dr. Hong Liu - Charles and Jean Smith Chair in Biomedical Engineering, George Lynn Cross Professor of Electrical and Computer Engineering, University of Oklahoma

Next Generation Engineering Education

2: 30 p.m. - 1:30 p.m., Monday, April 4 | ATRC 102

Dr. Robert G. Olsen - Professor at the School of Electrical Engineering and Computer Science at Washington State University



Enabling Connected Things for Information, Intelligence and Control

12: 30 p.m. - 1:30 p.m., Thursday, April 21 | ATRC 102

Dr. Yuguang "Michael" Fang - Professor at the Department of Electrical and Computer Engineering at University of Florida

Technology, Computer Architecture and Memory

12:30 - 1:30 p.m. Thursday, September 29 | ATRC 102

Dr. Mark D Hill - Gene M. Amdahl and John P. Morgridge Professor of Computer Sciences, University of Wisconsin-Madison

Engineers Help Unravel the Mysteries of the Brain

12:30 - 1:30 p.m. Tuesday, October 11 | ATRC 102

Dr. Scott T. Acton - Professor of Electrical & Computer Engineering and of Biomedical Engineering, University of Virginia

Present and Future Challenges of Data Storage Channels

12:30 - 1:30 p.m. Wednesday, November 16 | ATRC 102

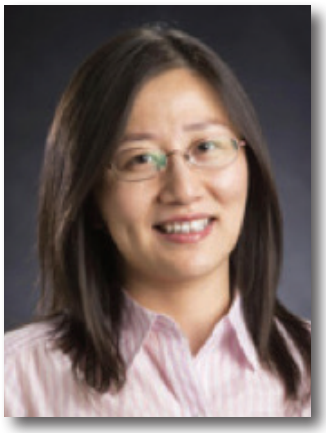
Dr. J.R. Cruz - Director and Tilley Chair Professor, School of Electrical and Computer Engineering, University of Oklahoma

FACULTY AWARDS

Congratulations to **Aaron (Jingtong) Hu, Ph.D.**, recipient of the College of Engineering, Architecture and Technology Outstanding New Faculty award. Hu, assistant ECE professor, joined the School of Electrical and Computer Engineering in August 2013 as a member of the school's computer engineering team. Two of his research projects in the area of non-volatile computer processors and field programmable gate arrays (FPGA's) are funded by the National Science Foundation (NSF). His research project on addressing FPGA security issues using memristors is funded by the Air Force Research Lab (AFRL) and his research project on wearable devices is sponsored by the OSU Technology Development Center (TDC). He teaches in the core area of computer engineering including digital logic design, computer-based systems, computer architecture and parallel architecture and programming.

Please join ECE in congratulating **Rama Ramakumar, Ph.D.** for his recent 2016 IEEE Distinguished Service award.

"It was an honor to present the 2016 Distinguished Service award to you last night. Your dedication, technical leadership, service and inspiration to EE's in our community made this year's selection an easy choice. Your achievements have created a legacy for future engineers to grow and continue developing the exciting field of power engineering and renewable energy." - Robert A. Johnson, Electrical Consultants, Inc.

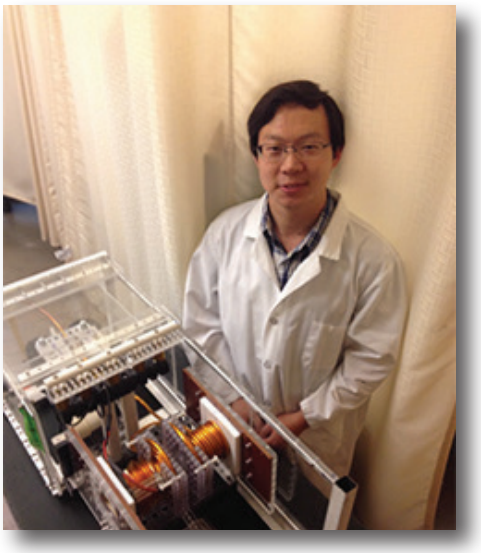


Qi Cheng, Ph.D. and associate professor of electrical and computer engineering, along with Sandeep Gutta, ECE Ph.D. student, Hoa D. Nguyen, ECE Ph.D. student who graduated in 2013 and Bruce A. Benjamin, Ph.D. and associate professor of physiology and associate dean for biomedical sciences, won the Jean-Pierre Le Cadre Best Paper award at the International Conference on Information Fusion 2016 in Heidelberg, Germany. The paper titled, "*Model-based Data-driven Approach for Sleep Apnea Detection*" presented a new framework for obstructive sleep apnea (OSA) detection using wearable sensors in which the sensor data is fused with the cardiorespiratory system model information. OSA is a serious sleep disorder that affects millions of people worldwide. This new approach has the potential to evolve into an efficient and low-cost OSA monitoring system that is not currently available on the market. This award recognizes excellence among researchers and scientists in information fusion, which was a central theme throughout Jean-Pierre Le Cadre's distinguished career.

STUDENT AWARDS

ECE Ph.D. student **Mahdi Yazdanpour** received the Outstanding Teaching Assistant award for the 2015-16 academic year. The Outstanding Teaching Assistant award is given annually to teaching assistants in College of Engineering, Architecture and Technology (CEAT) in recognition of superior teaching and going above and beyond the call of duty to make an impact on other students' success. Yazdanpour was the TA for ECEN 2011, experimental methods.

ECE's doctoral student **Tengfei Sun** has been selected by OSU's graduate college to receive a 2016 Graduate College Summer Fellowship. Sun has been actively involved in a multidisciplinary project developed between Ashish Ranjan's drug-delivery research in the department of physiological sciences in the Center for Veterinary Health Sciences, and Daqing Piao's bio-photonics research in the School of Electrical and Computer Engineering in the College of Engineering, Architecture and Technology. With this fellowship, Sun will study the optimization of a novel device for magnetically guiding magnetotactic bacteria and localized hyperthermia for treating drug-resistant infections.



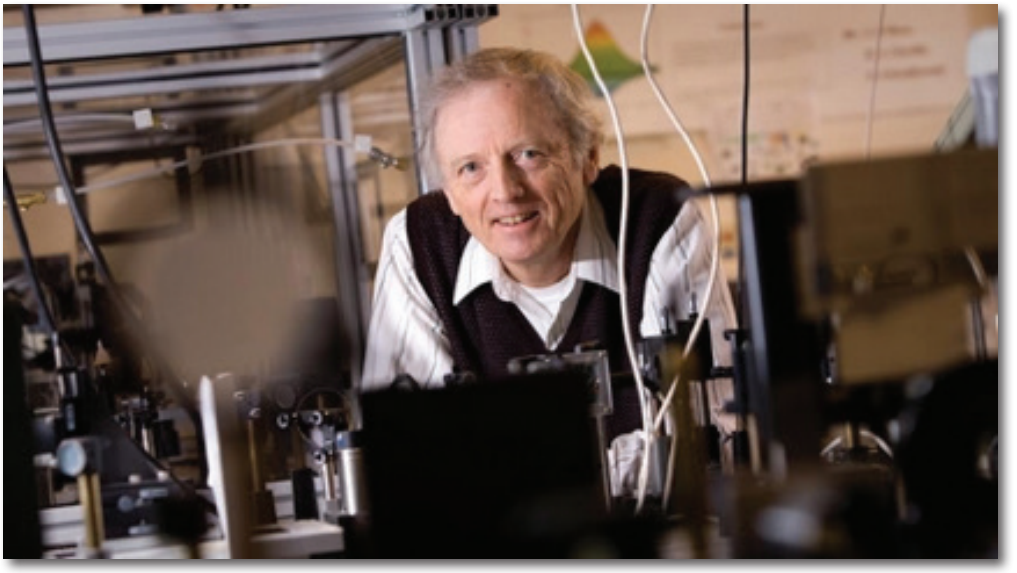
ECE Ph.D. student **Mimi Xie** won the 2016 Women's Faculty Council Research award. This is an award for research and scholarship by OSU women since 2006. Xie earned this award for her research on energy harvesting powered nonvolatile embedded systems for next generation IoT. Her advisor is Jingtong Hu.

ECE undergraduate student **John Tobola** was awarded a Wentz Research Scholar award for 2016-2017. The Wentz Research award rewards undergraduate students who are involved in research. The award reflects the spirit and generosity of Lew Wentz, as well as the desire of OSU to reward the most motivated and talented undergraduate students. His research is entitled, "*An Exploration of Design Alternatives to Increase Efficiency in Low-Power Application Specific Integrated Circuits*" and his adviser is James Stine, who is a professor in the School of Electrical and Computer Engineering. For his project, he is designing energy efficient hardware to be utilized for secure mobile-based applications, such as cellular phone communication. The project will involve several key designs that are targeted at integrated circuits for specialized application-specific hardware.

ECE Ph.D. student **Zeel Maheshwari** won the CEAT Three Minute Thesis competition. Maheshwari also won the People's Choice award. Zeel is a Ph.D. student of Dr Rama Ramakumar. The Three Minute Thesis (3MT®) is a research communication competition that challenges graduate students to present a compelling oration on their thesis/dissertation topic and its significance in just three minutes using just one slide. 3MT® develops academic, presentation and research communication skills and supports the development of research students' capacity to explain their research effectively in a language appropriate for a non-specialist audience.

2016 Frontiers of Power/Bill Hughes Scholars received their awards during the opening session of the 49th Annual Frontiers of Power Conference. L-R, front row, **R. Ramakumar**, Regents Professor, PSO/Naeter Professor and Director of the Engineering Energy Laboratory; **Bonnie Jean Bavido**, ECE senior. Second row, **Paul Tikalsky**, Dean, College of Engineering, Architecture and Technology; **Jeffrey Young**, Head, School of Electrical & Computer Engineering; **Akram Gawedar,** Ph.D. candidate; **Connor McCurley**, ECE senior; **Anushka Dissanayake**, Ph.D. candidate. The FOPC/Hughes Scholarship was established by former ECE Department Head, William L. Hughes, to encourage students to "get seriously involved in the energy/power area of electrical engineering."

RETIREMENTS



Dan Grischkowsky, Ph.D.

ECE celebrates the retirement of Dan Grischkowsky

It was not an understatement when the IEEE Transactions on Terahertz Science and Technology named Daniel Grischkowsky, Ph.D., a "Terahertz pioneer" in 2012. Terahertz signals, which oscillate more than a trillion times per second, are a special class of signals that will be the enabling feature of future, advanced communication systems, due to their ability to carry massive amounts of information (e.g., high definition video streaming).

Although the technological and societal benefits of terahertz science have been known for a long time, it took a few pioneers in the 1970s, 1980s and 1990s to lead the way in creative scientific discovery in which the path and outcomes were far from certain. Grischkowsky was one such pioneer.

Grischkowsky's formative years began in 1969 as a scientist at the IBM Watson Research Center. After a very productive career at IBM, he joined the School of Electrical and Computer Engineering in 1993. During his career of 46 years, he wrote 179 papers in prestigious, international peer-reviewed journals and had more than 11,400 citations, per the web of science scientific citation index. He is a Fellow of the American Physical Society (1982), Fellow of the Optical Society of America (1988) and Fellow of IEEE (1992). He received the Boris Pregel award from the New York Academy of Sciences (1985), the Kenneth J. Button Prize from the International Society of Infrared, Millimeter and Terahertz Waves (2011), the R.W. Wood award from the Optical Society of America (1989) and the William F. Meggers award from the Optical Society of America (2003). In May 2016, he announced his retirement.

We wish Grischkowsky a most fulfilling retirement and will be mindful of his never-ending challenge to "search for truth and beauty."

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- Jeffery Young,
ECE Professor and Head


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