COLLEGE OF ENGINEERING
THE UNIVERSITY OF ALABAMA IN HUNTSVILLE

Department of
ELECTRICAL & COMPUTER ENGINEERING
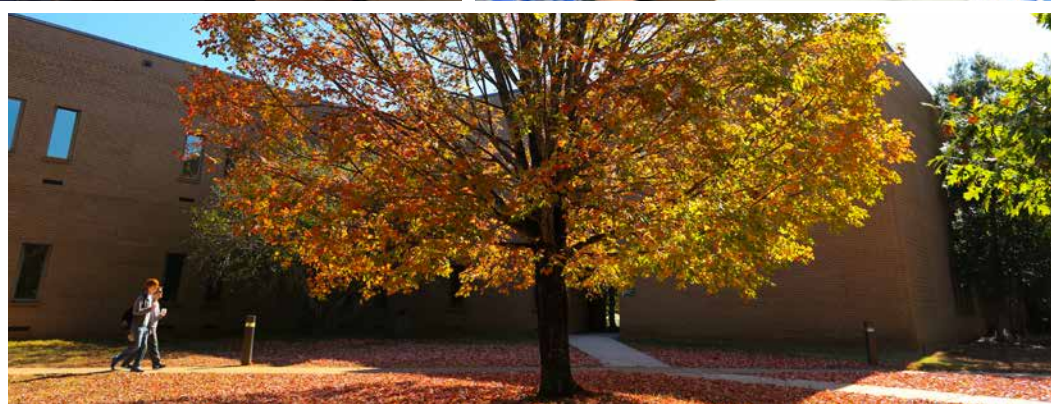
CHAIR'S MESSAGE

This past academic year was my second year at UAH, and I am pleased to say that the department has made progress on several fronts.

Dr. Maria Pour won the prestigious NSF CAREER Award. Dr. Tommy Morris continues his phenomenal run of successful proposals in the area of cybersecurity. We have been discussing new programs and enhancements to existing programs that will attract good students to UAH. We are delighted to welcome two new faculty members, Dr. Biswajit Ray and Dr. Tauhidar Rahman, into our ranks. Both were hired as tenure-track assistant professors. Dr. Ray works in the area of solid-state electronic devices, and Dr. Rahman works in the area of cybersecurity. Several of our faculty won accolades from UAH's College of Engineering (COE). Dr. Morris won the outstanding Senior Faculty Award; Dr. Pour won the Outstanding Junior Faculty Award, the Outstanding Research Award, and the Oak Ridge Associated Universities' Ralph E. Powe Junior Faculty Enhancement Award; and Dr. Emil Jovanov won the 2017 IEEE Outstanding Educator Award. You will be pleased to read about our self-driving car efforts, a project spearheaded by Dr. Kulick and Dr. Coe.

We are proud to showcase our student project winners. They design, develop, build, and test wonderful things in their senior design capstone class.

Dr. Richard Fork retired this year, and Dr. Pat Reardon decided to pursue his research full time at the Center for Applied Optics and so is no longer a faculty member in the department. We sincerely thank them for their service and wish them the best.

Sincerely,

Ravi Gorur, Ph.D.
Department Chair, Professor

Dr. Jeffrey Kulick and Dr. David Coe watch cybersecurity student Christina Lamos as she uses the test bed's first-person driving controls and OpenDS driving-simulation software.

UAH SOFTWARE SAFETY AND SECURITY ENGINEERING LABORATORY
Driving Innovation

Artificial intelligence and autonomous vehicles are emerging as the game-changing productivity enhancement technologies of the 21st century.

The UAH Software Safety and Security Engineering Laboratory has recently constructed an autonomous vehicle test bed to provide students and faculty with an opportunity to contribute to the research, development, and deployment of these technologies. The centerpiece of the test bed is an immersive driving simulator that allows for the training and testing of machine-learning algorithms, which are at the heart of autonomous vehicles.

For automotive cybersecurity research, the test bed offers the ability to inject an array of simulated cyberattacks such as brake failure, stuck accelerator, and delayed response. It also allows for the observation of the response of the driving algorithm in real-time as the system experiences the attack.

The test bed's mobile platform allows the simulator to be transported to STEM outreach and recruiting activities.

UAH SUPERVISORY CONTROL AND DATA ACQUISITION LABORATORY

The UAH Supervisory Control and Data Acquisition (SCADA) Laboratory has developed a sophisticated high-fidelity virtualization framework that provides SCADA researchers with the capability to virtualize huge physical industrial control systems (ICS). This framework exhibits high fidelity not only during normal operation, but it also models a response during SCADA attacks like man-in-the-middle, replay, denial-of-service, and command injection.

Currently the UAH SCADA lab has five fully functional full-scale ICS models that are optimized in a portable framework and that can be used by SCADA researchers to study and counter existing and new threats to the ICS: cryogenic pipeline, midstream oil terminal, governor of a power generator, water tank, and gas pipeline.

Due to the low computational power of ICS legacy controllers, the implementation of intrusion detection systems using real-time data mining at the edge is a research challenge. In a SCADA network, once an attacker gains access to the operational network, he or she can issue any operational commands from these trusted nodes to the programmable logic controllers on the field. An optimized universal clustering algorithm is being devised that would be able to detect network intrusion from trusted nodes, and a real-time data collection methodology is being formulated that can be used by researchers to collect data and to train machine learning intrusion detection systems on the fly.

UAH MOBILE HEALTH LABORATORY

The UAH Mobile Health (mHealth) Laboratory is dedicated to improving health outcomes, health care services, and health research through the use of mobile wireless communication devices.

mHealth systems promise to fundamentally change the way health care services are delivered and used. They allow an individual to closely monitor changes in her or his vital signs and provide feedback to help maintain an optimal health and wellness status. They can be used as part of a diagnostic procedure, an optimal maintenance of a chronic condition, and a supervised recovery from an acute event or surgical procedure. They can also be used to monitor adherence to treatment guidelines (e.g., regular cardiovascular exercise) or to monitor effects of drug therapy.

The mHealth infrastructure was designed to facilitate the development of new sensors and systems; to address critical design issues in the next generation of health monitoring systems, including their functionality, reliability, and energy efficiency; and to enable rapid prototyping of new health monitoring applications. It integrates wearable sensors, personal devices like smart-

phones or tablets, and mHealth servers capable of capturing vital signs and physical activity parameters during daily activities or specialized medical tests. A new, personalized, three-segment model has been developed in collaboration with Dr. Yuri Shtessel to quantify torques/forces on the body and to assess the optimality of each sit-to-stand transition using a smartphone's inertial sensors' data as inputs. The model has been tested on geriatric patients undergoing a mobility improvement program in collaboration with Dr. Karen Frith from UAH's College of Nursing and Dr. Zaheer Khan from the Center for Aging in Huntsville, AL.
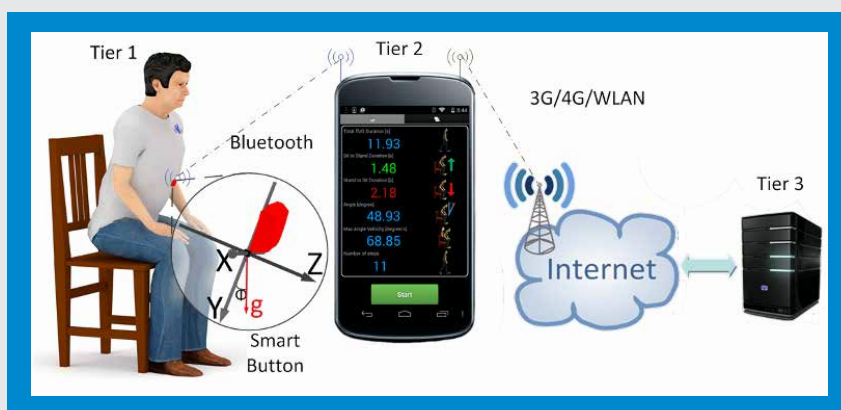
UAH SmartKart

A team of UAH seniors may have a revolutionary method of giving potential students tours in the near future: an autonomous go-kart.

The UAH SmartKart is a fully electric wireless go-kart with voice controls and a sound system. Powered by a 1000 W motor and three 12 V car batteries, the kart has enough juice to cruise along with a driver. Completely wireless controls allow it to be remotely operated, similar to unmanned vehicles and drones, but it is also able to respond to basic voice commands and to communicate via email and Twitter.

Not surprisingly, all of these high-tech features involve a lot of programming and circuit design. Team members first took on the task of troubleshooting the acceleration and braking algorithms, and rewiring the entire rear electronics rack mount, before installing a mechanical brake and consolidating the number of control boards.

MowLazy

British engineer Edwin Beard Budding invented the lawn mower in 1830, and motorized versions began appearing in the 1890s. Today, an estimated 65% of U.S. homeowners own a push lawnmower.

The goal of this project was to convert a gasoline-powered lawn mower into a remote-controlled one – called the MowLazy – that would preclude homeowners from having to be physically present for it to function.

The MowLazy was fabricated in UAH's machine shop and uses two 24 V brushless DC motors and wheels from a motorized wheelchair. Rechargeable batteries are used to power the DC motor.

SOFA-QAI

Steelcase Order Fulfillment Accuracy – Quality Assurance Implementation (SOFA-QAI), a computer engineering senior design project, was selected for the first-place award in a competition sponsored by Steelcase Corporation and coordinated by ECE faculty member Dr. Earl Wells.

The project involved the development of a custom portable hardware/software device that could increase the probability that the full set of component items (and only that set) in a furniture packaging assembly line would be placed in the shipment packaging in a manner that would not decrease their targeted production quota.

The three students constructed a working prototype that was portable, low-powered, and ergodically designed; that met weight and height restrictions; that factored in safety and interoperability consideration; and that employed the latest in touchscreen technology.

Their project was successfully demonstrated at the Steelcase facility in an actual production run. The prototype is currently being expanded and converted into an internal product that is expected to be used by Steelcase in the future.

Computer engineering seniors Westley Burdeshaw, Jonathan Farr, and Homer Lewter won first place for SOFA-QAI.

From left, James Hunter Jr., Bill Sabados and Andy Su work on a cybersecurity problem at the GenCyber camp.
Credit: Alabama Institute for Deaf and Blind

GENCYBER

The UAH Center for Cybersecurity Research and Education (CCRE) developed and hosted several GenCyber camps this summer, teaching a total of 58 individuals about cybersecurity principles, cryptography, networking, programming, ethics, online safety, curriculum development, and offensive cyberattack demos.

GenCyber is a national NSF/NSA program dedicated to providing cybersecurity summer camp experiences to both public school students and teachers.

The CCRE taught two teacher camps in June and one student camp in July. The first camp targeted teachers and teachers-in-training from North Alabama, while the second targeted teachers from the Alabama Institute for Deaf and Blind (AIDB).

The CCRE then partnered with AIDB and the Rochester Institute of Technology National Technical Institute for the Deaf (RIT NTID) to bring deaf and hard-of-hearing high school students from across the Southeast to UAH for GenCyber. This camp specifically created for deaf and hard-of-hearing students is the first and only GenCyber program of its kind.

TECH TREK

A weeklong residential camp, Tech Trek features intensive hands-on experiments and activities to promote interest in the science, technology, engineering, and math (STEM) fields among rising eighth-grade girls.

A total of 64 girls from 46 schools in Alabama participated in this year's Tech Trek, an American Association of University Women (AAUW) program, held on the UAH campus from June 18 to June 24.

2017 Tech Trek participants enjoyed courses on topics including NASA robotics, cybersecurity, app design and creation and everyday energy; field trips to aerospace giant PPG Industries; a tour of HudsonAlpha Institute for Biotechnology; a visit to the iconic U.S. Space & Rocket Center; workshops on careers in science and preparing for college; and a Professional Women's Night at the Huntsville/Madison County Chamber of Commerce.

"I have seen such transformative experiences for the campers over the past two years – the shy ones who find their voice surrounded by their peers and the outgoing ones who shine as peer leaders," says Michele Tisler, an alumni of UAH's College of Nursing and three-time Tech Trek volunteer. "Tech Trek not only allows the girls to grow, but it also allows the staff to be able to have purposeful and intentional interactions with the campers. Giving girls the confidence and direction to influence the future of STEM – that is the best part."

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NEW FACULTY

Dr. Biswajit Ray,
Assistant Professor

Dr. Ray received his Ph.D. in electrical and computer engineering from Purdue University in 2013. Prior to his doctoral study, he completed his master's degree in engineering at the Indian Institute of Science, Bangalore, India, in 2008, and his Bachelor of Technology degree at the National Institute of Technology, Trichy, India, in 2002. From 2013-2016, he worked as a senior device engineer at SanDisk Corporation in Milpitas, CA, on the research and development of 3-D flash memory.

His research interests include understanding electronic transport in disordered materials, reliability physics of electronic devices and utilizing device characteristics for exploring new applications for addressing the challenges in the areas of security, sensing and energy harvesting. Dr. Ray has published 16 research papers in international journals and has presented several contributed talks at international conferences. He is the recipient of the 2009 Technoinventor Award from the Indian Semiconductor Association for his master's thesis and the Best Poster Award from the 38th IEEE Photovoltaic Specialist Conference in 2012, and he won first prize in SanDisk's Innovation Bazaar Contest in 2014.

Dr. Tauhidur Rahman,
Assistant Professor

Dr. Rahman earned his Ph.D. degree in electrical and computer engineering from the University of Florida. He obtained his master's degree from the University of Connecticut, Storrs, and his bachelor's degree from the Bangladesh University of Engineering and Technology.

His research interests include hardware-enhanced security and trust, supply chain risk management and security, embedded security, counterfeit electronics detection and prevention, and reliable circuit design. He is a recipient of the 2014 Richard Newton Young Student Fellow award and the SRC Techcon best in-session award in 2016. He has published more than 23 peer-reviewed articles in top journals and conferences. His hobbies include fishing, hiking, and all other outdoor activities.

GRANTS & HONORS

NSF CAREER AWARD
Dr. Maria Z. A. Pour,
Assistant Professor

Dr. Pour was awarded a five-year, $500,000 National Science Foundation (NSF) Early Career Development Program (CAREER) award, which she plans to use for new research in phased array antenna engineering and new antenna engineering classes.

CAREER awards are NSF's most prestigious awards and support "junior faculty who exemplify the role of teacher-scholars through research, education and the integration of education and research within the context of the mission of their organizations."

Dr. Pour's research will focus on phased array antennas, an array of antenna elements that create a beam of radio waves that can be electronically steered to point in different directions without moving the antennas.

IEEE FELLOW
Dr. Timothy Boykin,
Professor

Dr. Boykin was named a 2018 Fellow of the Institute of Electrical and Electronics Engineers (IEEE) in recognition for his contributions to atomistic models for semiconductor device simulation.

IEEE Fellow is the highest grade of membership and is recognized by the technical community as a prestigious honor and an important career achievement.

Dr. Boykin's research focuses on nanoelectronic devices, combining accurate materials modeling, numerical methods and device simulations.

Dr. Priyanka Madhushri

Dr. Madhushri is an Internet of Things (IOT) ideation engineer at Stanley Black & Decker (SBD), Atlanta, GA. She works with the innovation team and brings new ideas to a variety of projects. As a researcher, she provides proof-of-concept (POC) to various SBD teams and assists in the development of company software and hardware. Currently she provides POC for various augmented reality applications for smartphones as well as smart glasses. Her research interests include IOT, mobile computing, wireless sensors networking, embedded systems, biomedical signal processing, short-range radar, and wearable monitoring.

Dr. Madhushri received her master's in electrical engineering from India's premier engineering university, the Indian Institutes of Technology Roorkee, in 2012. She earned her Ph.D. in electrical engineering from UAH in May 2017. Her dissertation is entitled "A Model-Based Mobility Assessment of Older Adults Using Wearable Systems."
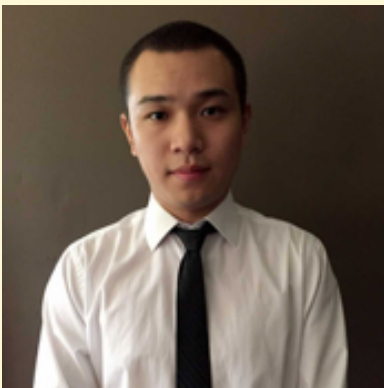
Dr. Hongda Shen

Dr. Shen is a data scientist at Johnson & Johnson Health and Wellness Solutions. He is working on building forecast models for human health behaviors using modern artificial intelligence (AI) techniques. He received his Ph.D. in electrical engineering from UAH in 2016.

As a doctoral candidate, Dr. Shen published over ten peer-reviewed conference and journal papers on developing new machine-learning methods for data compression and recognition problems under the guidance of his advisor, Dr. David Pan. He also taught undergraduate-level fundamental electrical and computer engineering courses, and mentored several students on their AI and big data research projects.

Dr. Vahid Heydari

Dr. Heydari received his master's degree in cybersecurity and his Ph.D. in electrical and computer engineering from the UAH in 2016 and 2017, respectively. He is currently an assistant professor of computer science at Rowan University, in Glassboro, NJ. He is a member of the Association for Computing Machinery, the IEEE Computer Society, and the Communications Society.

Dr. Heydari's research interests lie within wireless ad hoc network security and moving target defenses used to prevent remote cyber-attacks. He has worked on detecting different attacks against mobile ad hoc networks and reliability of data collection in wireless sensor networks; he also proposed a queuing analysis for delay calculation in wireless ad hoc networks.

The ECE Department is pleased to announce the Dr. William (Buddy) Y. and Mrs. Rosemarie M. Bishop Award for deserving undergraduate students in electrical and computer engineering. This award will recognize academic excellence, and the recipient will be selected by the ECE Awards Committee in consultation with the Dean of Engineering.

The Dr. William (Buddy) Y. and Mrs. Rosemarie M. Bishop Award

Dr. Buddy Bishop has been affiliated with UAH for many years, first as a master's student then as a Ph.D. student. He has served as the chair of the ECE's Industry Advisory Board, and he has taught as a part-time faculty member of the department since 1978 through the present day. Dr. Bishop enjoys teaching, and it is apparent from student feedback that students hold him in very high regard.

Dr. Bishop spent much of his professional life at Redstone Arsenal working for the U.S. Army, and served as chief engineer for two large-scale missile development programs. His late wife, Rosemarie Bishop, worked as an English teacher and librarian in the Huntsville City School System at Grissom High School.

The Dr. William (Buddy) Y. and Mrs. Rosemarie M. Bishop Award reflects the couple's deep care for UAH's students and the education they receive from the university.

IAB (Industry Advisory Board)

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An Equal Opportunity University

UAH's Department of Electrical and Computer Engineering offers a full range of accredited degree programs through the Ph.D. level, in addition to separate interdisciplinary master's degrees in software engineering and cybersecurity. Our programs are designed to not simply train students to be users of current technology, but also to educate them so that they actually understand how this technology works. As a result, our graduates can be found throughout the world, actively impacting industry, government, and academia. For more information about our department or to learn more about our degree programs, please visit **www.uah.edu/eng/departments/ece**.