ENGINEERING SUCCESS //

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DEPARTMENT OF ELECTRICAL & COMPUTER ENGINEERING
256.824.6316
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Research Thrusts

- Controls and dynamic systems
- Cybersecurity in industrial control (SCADA) systems
- Digital signal and image processing
- Electromagnetics and antenna design
- Mobile health and wellness monitoring systems
- Lasers and optics
- Nano-electronics, nano-photonics, and plasmonics
- Parallel, reconfigurable, GPU-accelerated computing
- Power systems, high-voltage engineering, and smart grid technologies
- Radar systems
- Secure ubiquitous and Internet-enabled big data computing
- Space-based laser systems
It has been an eventful first year as the Chair for me. We went through a successful accreditation by ABET in the fall semester for all of our three undergraduate degree programs, computer, electrical and optical engineering. ABET accreditation is critical for our students as it enables them to pursue careers in industry or obtain advanced degrees in good institutions. In the spring semester, the entire university went through SACSCOC (Southern Association of Colleges and Schools Commission on Colleges) accreditation. SACSCOC deals with both graduate and undergraduate programs. These visits are team efforts and it brings the entire department and the university together as one cohesive unit. The curriculum, laboratory and class facilities, faculty and staff adequacy and quality, feedback from students are all carefully examined.

I am pleased to report that we established several new teaching and research facilities last year. Dr. Maria Pour built an Antennas laboratory that she is using to teach a new senior elective class this semester. Dr. Tommy Morris built a Cybersecurity Research laboratory and my laboratory for Dielectrics Research is up and running. You can read more about these laboratories in this newsletter. These laboratories are critical for attracting external funding and graduating students with advanced degrees. I am pleased to report a significant increase in the number of research proposals submitted when compared to last year and Dr. Morris in particular, has had a phenomenal first year at UAH. Several of our faculty were awarded patents, which is indicative of the commercial impact of their research. Our faculty, Dr. Joiner, Dr. Jovanov and Dr. Wells went on to win the teaching, research and service awards, respectively from the college. Dr. Guo won the Research Award from the College as well as from the University.

We organized visits to companies in the Huntsville area to present our capabilities and seek research cooperation. Building strong relationships with them is mutually beneficial and is high on my priority list.

Our students are the true ambassadors of UAH. They have achieved many wonderful things during the past year and I am sure that they will do us proud.

Sincerely,

Ravi Gorur, Ph.D.
Department Chair
The SCADA Security Lab is used to conduct research to study cybersecurity for Industrial Control Systems (ICS). Researchers search for cybersecurity vulnerabilities, examine the impact of cyber-attacks on Cyber Physical Systems (CPS), develop new cyber architectures to defend ICS from cyber threats, and use machine learning to detect and classify cyber-attacks against CPS.

The SCADA Security Lab includes 3 laboratory scale industrial control systems; a gas pipeline, a water treatment facility, and a storage tank. Each system is a working physical model with commercial actuators and sensors. The actuators and sensors are connected through a wire bridge to a Siemens S7-300 PLC for each system. Each PLC is programmed with ladder logic for distributed control. All 3 PLCs are networked through a set of Siemens switches to a HMI. The HMI is implemented using the Siemens WINCC software product. Each ICS model includes a separate dedicated HMI screen for remote monitoring and control. The lab also includes an OPAL-RT Real Time Digital Simulator. The OPAL-RT supports modelling CPS with MatLab Simulink and performing real time simulation with Hardware in the Loop (HIL). UAH PHD student, Thiago Alves, has developed the first open source Programmable Logic Controller (PLC) called the OpenPLC (http://www.openplcproject.com/). The OpenPLC allows researchers in the lab to conduct research not possible with the closed environments of commercial hardware and software commonly used in the domain. Finally, the lab includes servers personal computers, servers, and other computing systems to support virtualization of Industrial Control Systems (ICS).
DIELECTRICS LAB

The Dielectrics Laboratory at UAH is equipped to perform research on dielectric materials and devices used for power delivery. A stainless steel chamber has been constructed to evaluate overhead line components like line and station insulators and cable terminations under contaminated conditions. A high voltage transformer can provide voltages up to 100 kV. Both salt fog and clean fog tests can be performed on devices employing ceramic, glass and polymer materials. A partial discharge free 100 kVac source, voltage doubler and wave shaping attachments generate ac, dc and impulse voltages for evaluating insulating materials and components. A shielded room permits sensitive measurements of partial discharge. New equipment has been ordered that will enable research on the effect of high voltage, high frequency pulses on insulation used in electric motors powered by variable speed drives. A UV based corona camera is available for observing corona activity in broad daylight. The university has advanced analytical techniques like electron microscopes and spectrometers for characterizing materials and tracking changes during testing or service.

SAFETY AND SECURITY ENGINEERING LAB

Drs. Jeffrey H. Kulick and David J. Coe created the UAH Software Safety and Security Engineering Laboratory to support research and education in the development of safe and secure cyber-physical systems. Our goal is to enhance the safety and security of embedded systems through the development of improved model based engineering and verification methodologies, hardened hypervisors, secure deployment, secure communications and secure execution systems. The laboratory provides students access to industry-standard software development, analysis tools and demonstration platforms including a positive train control test bed and a variety of unmanned aerial and ground vehicles. We are currently developing an automotive systems integration test bed to facilitate research on autonomous smart car safety and security. The test bed will include a mix of virtual and physical components interconnected with a communication fabric that will allow students to identify system vulnerabilities, develop proof-of-concept cyber attacks, evaluate new security measures, and assess the impact of a cyber attack on system safety.
2016 PAUL MICHAEL SALMON OUTSTANDING ENGINEERING DESIGN AWARD WINNERS

The ECE Department gratefully acknowledges the support of Steelcase Corporation, Emerson, and GAN Corporation
Team Li-Fighters

The Optical and Electrical Engineering program students have teamed up to build the first affordable point-to-point LiFi (Light Fidelity) system. The Li-Fighters team consists of Robert Bonds and Andrew Jenkins (EE), Kareem Garriga and Sonia Saladino (OPE).

The major benefit of LiFi over traditional WiFi is based in the area of security. The need to keep our data safe is foremost on the minds of everyone these days. With all the issues of identity theft and data theft in general, the idea of a nearly unhackable network appeals to everyone. Light does not penetrate walls nor will it be able to be tapped into from across a room. The area that LiFi works is simply the area that the LED can spread. The speeds as well are potentially much higher than that of WiFi with little to no bit error rate.

Synthetic Aperture RADAR for Terrain Mapping

Congratulations to ECE Seniors Olesya Berenbak, Jeongeun (Gabby) Park, Rebecca McDonald, Emmanuel Morales- Ramirez. They are the Second Place winners of the 2016 Paul Michael Salmon Outstanding Engineering Design Award. They designed and tested a Synthetic Aperture Radar (SAR) imaging system on an FMCW K-Band radar device. The Sivers IMA RS3400K/00 FMCCW Transceiver Evaluation Kit was donated by Lockheed Martin and has served as the catalyst for various senior design projects. One potential applications of the radar imaging system is low-cost terrain mapping.

THE S.M.A.R.T MIRROR PROJECT

Congratulations to ECE Seniors Adam Ferguson, Robert Nutting and Tyler England. They are the First Place winners of the 2016 Paul Michael Salmon Outstanding Engineering Design Award. The Internet of Things (IoT) is a network of physical objects – devices, vehicles, buildings, and other items – embedded with electronics, software, sensors, and network connectivity that enables these objects to collect and exchange data. The S.M.A.R.T device definitely fits the bill of this label, and it was the team’s objective to make the mirror a way to get information, control devices, and end up as useful device in the eyes of the end users.
Tech Trek’s third outing at The University of Alabama in Huntsville (UAH) drew an all-time high of 65 rising eighth-grade girls from 39 schools across 17 Alabama counties. The weeklong residential camp, an American Association of University Women (AAUW) program, was held on the UAH campus from June 12-18 and featured intensive hands-on experiments and activities to promote campers’ interest in the science, technology, engineering, and math (STEM) fields, because research has shown that middle school is a point at which girls take themselves out of the STEM talent pool.

The girls that attended were chosen through a rigorous selection process that included applications, essays, and interviews from the 196 girls that were nominated by their 7th grade math or science teacher. Factors that played into the decision making include diversity in the number of Alabama counties represented, the number of schools represented, race, ethnicity, leadership potential, and exposure to STEM subjects. Each group of 5 campers had a college age counselor, most of whom are STEM majors. The biggest group of counselors came from UAH but Alabama A&M University, Athens State University, and The University of Alabama at Birmingham were also represented.

“We had an amazing week,” says Camp Director Dr. Rhonda Gaede, an associate professor of electrical and computer engineering at UAH. “The girls did great work in their core classes and in the creative presentations they made about STEM women pioneers at the camp’s closing. Perhaps more important, many new friendships took root and flowered.”

For more details please contact Dr. Rhonda Gaede at 256.824.6573, Rhonda.Gaede@uah.edu
The camp is designed to provide campers with both depth and breadth. The campers list their preferences for the core classes of 1) app development with MIT AppInventor, 2) cybersecurity using a curriculum provided by Symantec, 3) energy in a partnership with Nexus Energy Center and its tiny home, and 4) NASA robotics hosted at the NASA Educational Resource center and facilitated by their personnel. All campers were assigned their first or second choice. During the week, the campers spent 13 hours working in their core classes on projects that were presented at the Tech Trek Expo Friday at noon for donors, local AAUW members, and nominating teachers and principals. Technical breadth was provided for the camper with workshops on water filtration, electroplating, genomics, and sound waves; and field trips to the U.S. Space & Rocket Center, Teledyne, and PPG Aerospace. Professional development was also provided by workshops on communication, college prep and STEAM (STEM plus Arts).

For the majority of campers, however, the biggest takeaway was less educational than it was inspirational. Perhaps the most inspiration came from meeting women from a variety of STEM professions in a speed mentoring format at the camp’s annual Professional Women’s Night event. This year’s event was hosted by Adtran. From these women, and from the camp staff, and from each other, the girls received valuable encouragement, both to pursue their passion for the STEM fields and to persevere in spite of barriers.

The experience was just as meaningful for those who served as volunteers. “It was an unexpected breath of fresh air at the end of a school year, during a typical month of vacation,” says Shannon McClain, a science teacher at Bridgeport Middle School in Jackson County who taught a core course in robotics. “The young ladies were so full of life and excited about learning experiences. I especially admired their acceptance of challenges and their willingness to problem solve with other team members and celebrate each other’s success while in a competition format.”

The UAH Electrical and Computer Engineering Department and Center for Cybersecurity Research and Education (CCRE) conducted two week long workshops to teach Alabama teachers cybersecurity. Two workshops were offered, “Introduction to Computing and Cybersecurity”, and “Advanced Cybersecurity for Secondary Education.” In total 37 teachers attended the workshops. This project was funded by the National Security Agency (NSA) Gencyber program. In the intro camp teachers started the week by assembling a computer and installing an operating system. Throughout the rest of the week teachers completed hands on exercises and training in cybersecurity ethics, Python programming, shell commands, network scanning, cyber threats, defensive techniques, configuring computers for cybersecurity, and digital forensics. The advanced camp was targeted at teachers with cybersecurity teaching experience. Through the week advanced camp attendees completed hands on exercises and training in cybersecurity ethics, advanced cyber threats, denial of service, man in the middle attacks, key logging, using a Cyber Patriot scoring engine, firewall configuration, penetration testing, and advanced digital forensics. Feedback from attendees and evaluators sent by NSA has been very positive.

UAH CCRE Director, Tommy Morris is the Principal Investigator on a new grant from the National Science Foundation (NSF) Cybercorps program. Morris and his co-investigators will develop virtual models of 4 industrial control systems for use in cybersecurity research and education. New virtual models will include a mass damper system, a robotic arm, a distillation column, and a bulk electric generator. The grant is for 3 years, $500,000 and will fund the research of 2 PhD students.
Asma Alqudah, Ph.D.

I was born in 1984 in the rural city of Ajloun at the northern part of Jordan. I received my B.S. and M.S. degrees in Electrical Engineering from Yarmouk University and the Jordan University of Science and Technology (JUST), in 2007 and 2010, respectively. In 2013, I joined the ECE department at UAH as an international graduate student. At UAH, I got to know people from different cultures and backgrounds.

The fact that I lived on UAH campus gave me a whole bunch of advantages that enriched my experience. Everything was close to me, the recreational facilities, the bank, the security provided by the UAH police, the weekly shuttle to give me a ride to get my groceries, and many more. The professors are wonderful and the materials taught were a life-long kind of knowledge to remember. While at UAH I got honored for excelling in my studies, I got the opportunity to teach at the ECE department, and I worked as a research assistant as well. I’ll make use of the best of them once I go back and teach at Yarmouk University in Jordan. I am so proud to be a UAH alumnus and I’ll always be an ambassador of the UAH wherever I go.
Chandrasekhara Bharath Panathula, Ph.D.

I received the B.Tech degree in electrical engineering from Sri Venkateswara University, Tirupati, India in 2010. Motivated and determined, I joined UAH to pursue advanced degrees, receiving M.S degree in 2012 and Ph.D. degree in 2016 in Electrical Engineering with concentration in control and dynamic systems. I had chosen UAH for higher studies because of its outstanding faculty like Dr. Yuri B. Shtessel (a distinguished professor of ECE), and a state-of-the-art facility like advanced robotics laboratory. Combined with my dedication and hard work, this would help me reach my goal of advancing the science of control through research. My hunch was indeed true. UAH helped me nurture through scientific research, and encouraged me throughout my course of study. After my graduation, I was able to land an opportunity in a company that exactly matched my area of interest. Finally, I would like to highly recommend UAH for perspective students, who have a desire to advance in scientific research.

Christopher B. Harris, Ph.D.

Dr. Harris received his Ph.D in Electrical and Computer Engineering from the Department of Electrical Engineering and Computer Science at the University of California, Irvine. He completed his research under the advisement of Dr. Ian G. Harris in affiliation with the Center for Embedded and Cyber-physical Systems. Dr. Harris also holds an MS in Electrical Engineering from the University of Notre Dame, a BS in Computer Engineering from the University of Alabama in Huntsville, and a BS in Applied Mathematics from Oakwood University.

In 2015 Dr. Harris joined the Laboratory for Engineering Man/Machine Systems (LEMS) in the School of Engineering at Brown University and currently holds an appointment as a Presidential Diversity Postdoctoral Fellow.

Dr. Harris is a member of IEEE, ACM, and NSBE. He is also a member of the Eta-Kappa-Nu Electrical Engineering honor society, the Tau Beta Pi Engineering honor society, and the Alpha Chi honor society. His research has been featured as part of the Computing Community Consortium’s series on Great Innovative Ideas. He has also received several fellowship awards including the GEM Consortium Fellowship, the Arthur J. Schmitt Presidential Fellowship, and the University of California Regents Fellowship.
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