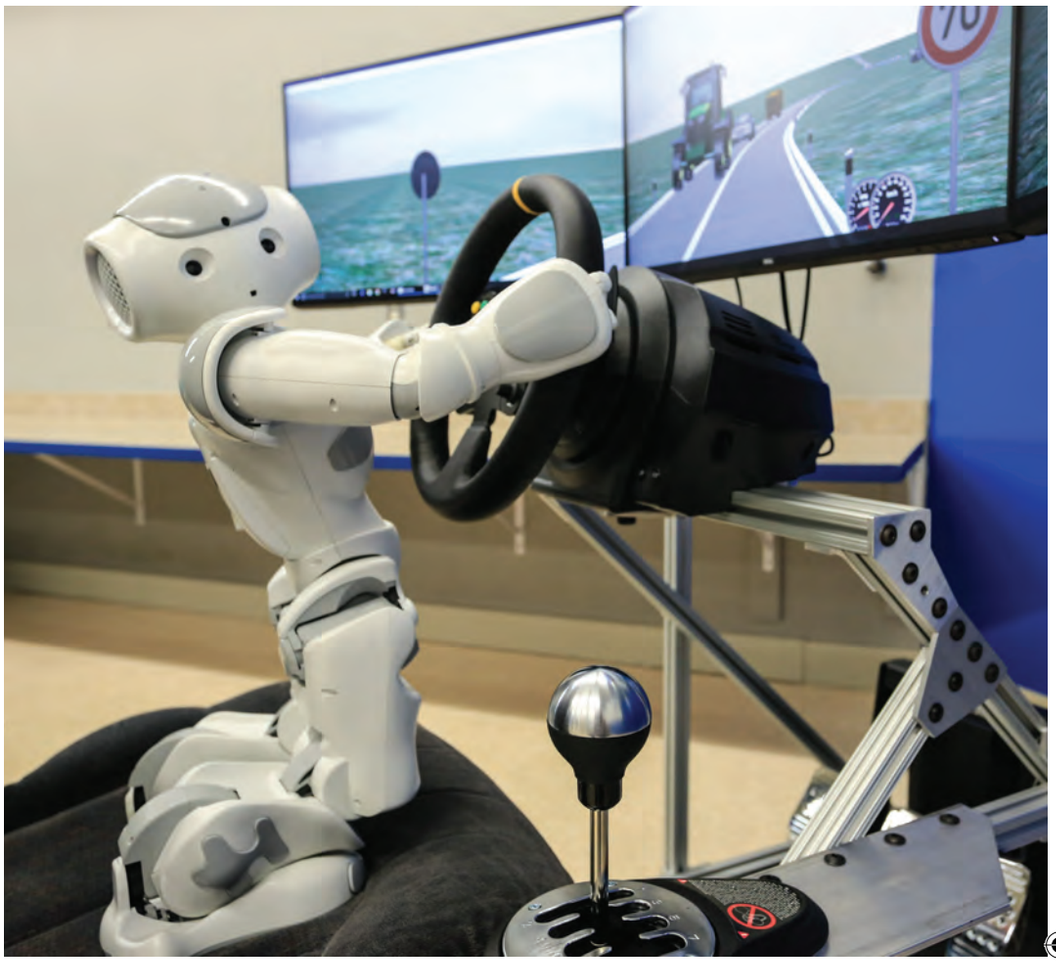
COLLEGE OF ENGINEERING
THE UNIVERSITY OF ALABAMA IN HUNTSVILLE

Department of

ELECTRICAL & COMPUTER ENGINEERING



FALL 2018

CHAIR'S MESSAGE

INSIDE

I am pleased to share some of the success stories of the Department in this newsletter. First and foremost, we witnessed a rise in the *U.S. News & World Report* rankings of the Electrical and Computer Engineering Programs. Electrical Engineering rose from 107 in 2018 to 85 in 2019, and Computer Engineering, which was not ranked in previous years, is now ranked at 107. The ranking is based on 214 engineering schools in the U.S. granting Ph.D. degrees. We streamlined our undergraduate programs by sunsetting Optical Engineering and creating a new concentration in Optics and Photonics within the Electrical Engineering Program. The Optical Engineering Program has received full ABET accreditation until September 2022, which should give ample time for students in the program to graduate. We retained the important courses in the new concentration and believe that this enhances the opportunities for students to take classes related to electro-optics, which is a field that is rapidly growing.

I am pleased to announce a brand-new undergraduate program in Cybersecurity* offered by our Department. While there are cybersecurity programs and concentrations in several universities that are more focused on information systems, ours represents the first (in Alabama) within the College of Engineering. The program has the right mix of hardware, software and information systems classes. We expect to recruit new students starting fall 2019. Existing students in the Department will now have more choices when it comes to electives.

We hired Dr. Jianqing Liu in the area of Cybersecurity. Dr. Liu joins Dr. Rahman and Dr. Morris, and with several faculty in the Computer Engineering Program being actively involved in Cybersecurity related research projects, it puts the Department in a position of strength in this important field.

You will find featured in this newsletter Dr. Maria Pour's new state-of-the art anechoic chamber for research on antennas, Dr. Ray's research on hardware reliability and exciting developments on the self-driving car, headed by Dr. Coe and Dr. Kulick. Dr. Junpeng Guo was named Fellow of the SIE for his contributions to research in the field of optical materials. It is always a pleasure to share a few exciting projects that our undergraduate students have worked on.

Ravi Gorur, Ph.D.
Professor and Department Chair

*Pending approval

DR. MARIA POUR
ESTABLISHES ANTENNA LAB

We are pleased to announce that Dr. Maria Pour has recently established an Antenna Laboratory (AntLab), which is equipped with the Starlab near-field test range for rapid antenna measurements. The test system is capable of measuring antenna radiation properties, with aperture sizes as large as 0.45 m, over a wide frequency range from 0.65 GHz to 18 GHz with applications in radars, unmanned aerial vehicles, global positioning systems, phased array systems, satellite communications, CubeSat, microwave remote sensing, and wireless communications. The AntLab is a spherical near-field test range placed in a 2.44×2.44×2.44 m^3 anechoic chamber covered by microwave absorbers, allowing Dr. Pour and her research group to conduct cutting-edge research on emerging antenna technologies, based on conventional and engineered substrates, such as electromagnetic metamaterials and phase tuning materials, liquid crystals, and other emerging materials for the aforementioned applications. In addition, it will bolster UAH's collaboration with other universities in the state of Alabama and beyond, and with the local companies and federal agencies in the city of Huntsville, which is home to the Cummings Research Park, the second-largest corporate Research and Technology Park in the United States.

The AntLab will help in growing both undergraduate and graduate enrollment at UAH, attracting post-doctoral fellows, research scientists, and visiting scholars. It will also increase UAH's capacity to train and educate undergraduate and graduate students in antennas and applied electromagnetics.

Dr. Pour is the recipient of the 2017 CAREER award from the U.S. National Science Foundation. She has been serving as an Associate Editor for the IEEE Transactions on Antennas and Propagation since August 2016. She has coauthored six book chapters and over 65 journal papers and conference proceedings. Her research interests are in the areas of antennas, applied electromagnetics, and remote sensing. In particular, her research is focused on antenna theory, design, and analysis, including phased arrays, wideband multi-mode scatterers, adaptive apertures, reconfigurable displaced phase center antennas, parabolic reflectors, conjugate matched feeds, waveguides and horns, wireless sensors for structural health monitoring, RF energy harvesting antennas or green antennas, and many others.

Autonomous Car News @ UAH

2018-2019 Senior Design: Autonomous Car Platooning Project

A team of computer engineering senior design students shall develop an autonomous model car that can autonomously platoon with other autonomous vehicles. In Fall 2018, the students shall refine project requirements and produce an initial design. In Spring 2019, the students shall focus on implementation and testing of their solution.

Dr. David J. Coe // coed@uah.edu

2018 MSSE Capstone: LIDAR/Camera Correlation Project

Students in the Masters of Software Engineering (MSSE) studio course are working with data produced by a 16-channel Velodyne LIDAR and a pair of high-resolution FLIR cameras to obtain object classification and velocity vectors for each object recognized by a neural network. The object recognizer software has been derived from last year's software engineering studio project to develop an image synthesis and neural net training system. Once completed this data will be input to an AI based path planning system to help plan safe paths for the vehicle.

Dr. Jeffrey H. Kulick // kulickj@uah.edu

2018 Outreach: Autonomous Car Experience for K-12 Engineering Summer Camps

Several groups of K-12 summer camp students explored the use of supervised learning to train autonomous cars. Using a fleet of Donkey Cars constructed by Jason Winningham, each student manually drove a car to assist in the gathering of training data for the neural network. The driving data samples were then moved to a server for execution of the training algorithm. The trained algorithm was then deployed back to the model autonomous car to evaluate its driving performance. This work was made possible by a generous grant from the Toyota Foundation.

Dr. Rhonda K. Gaede // gaeder@uah.edu
Jason Winningham // jason.winningham@uah.edu

2017-2018 Senior Design: Autonomous Car Navigation Project

A team of senior design students explored the use of synthesized data for training autonomous cars. As part of this project, the students constructed a virtual model of the UAH Engineering Building and trained a neural network to navigate the virtual model. Subsequently, the students deployed the trained neural network on an autonomous model car to evaluate the effectiveness of the training.

Dr. David J. Coe // coed@uah.edu
Dr. Jeffrey H. Kulick // kulickj@uah.edu

2017 MSSE Capstone: Autonomous Car Image Classifier Project

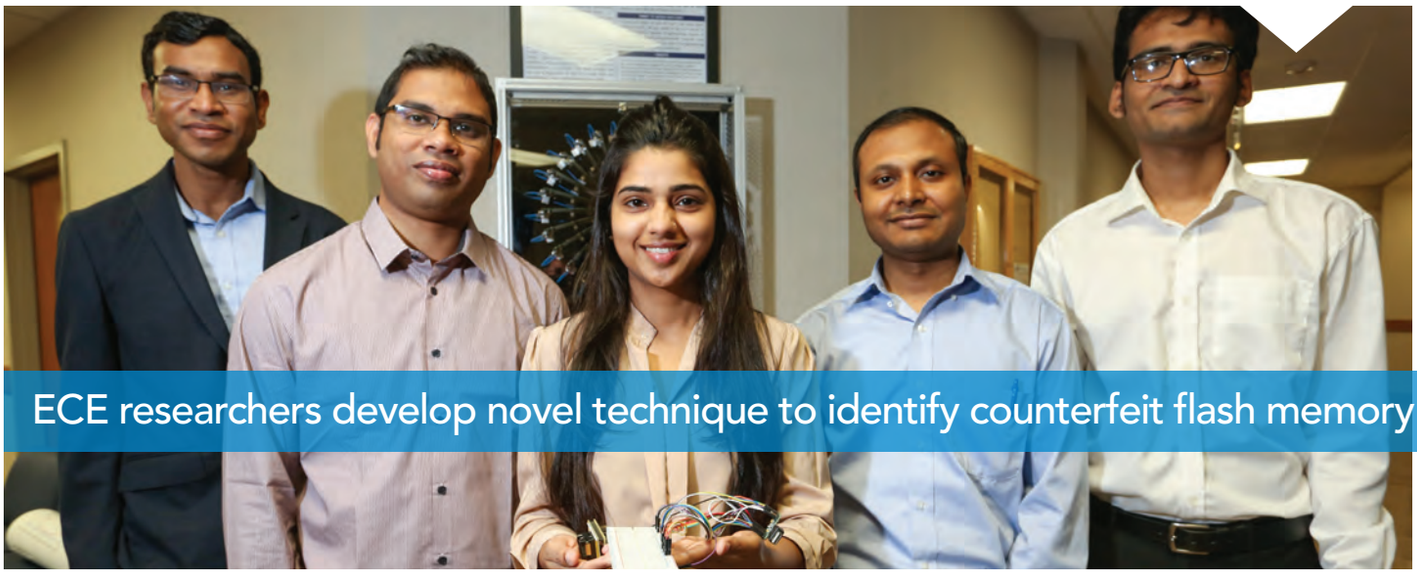
As a capstone project for the UAH Masters in Software Engineering (MSSE) degree, teams of graduate students generated synthetic imagery that they used to train image classifiers to recognize street signs, pedestrians, and potholes. Classification accuracy was assessed using imagery gathered from dash cam footage.

Dr. Jeffrey H. Kulick // kulickj@uah.edu

2017 Research: Autonomous Car Simulation Test Bed

Our autonomous car simulation test bed augments open source driving simulation software with the ability to simulate a variety of cyber attacks against either a human or AI driver.

Dr. David J. Coe // coed@uah.edu
Dr. Jeffrey H. Kulick // kulickj@uah.edu
Jason Winningham // jason.winningham@uah.edu



ECE researchers develop novel technique to identify counterfeit flash memory

Counterfeiting electronic components may sound like a plot point lifted from a technothriller by Daniel Suarez or Michael Crichton, but it's a very real – and growing – threat to the safety and reliability of our critical infrastructure.

"Nowadays we use consumer electronics for a year or so, but the components in them remain 'alive' for up to 10 years," says Dr. Biswajit Ray, an assistant professor in the Department of Electrical and Computer Engineering at UAH. "As a result, there's an incentive to bring them back to market by harvesting them from scrapped printed circuit boards and re-using them in spite of the adverse effects that these counterfeit components can have because of their limited endurance."

The problem has been further exacerbated in recent years as the semiconductor supply chain has shifted from a vertical to a horizontal model. "Because of manufacturers' enhanced reliance on independent suppliers," says Dr. Ray, "these electronic systems are at a lot more risk of counterfeiting and piracy than ever." And as counterfeiters get more and more savvy, it can be harder and harder to tell whether the components in any given electronic system are fresh or recycled – that is, he says, "until they stop working and the consumer blames the manufacturer for making a faulty product!"

The team presented their research at the 2018 IEEE International Symposium on Hardware Oriented Security and Trust, which was held from April 30 to May 4 in Washington, D.C.

At particularly high risk of counterfeiting is flash memory, a nonvolatile digital storage medium that stores data on a chip. "Flash is a major target because of its presence in the most electronic systems – it's used for everything from space applications to consumer electronics," says Dr. Ray. "But detection of recycled flash with high confidence is challenging due to the variability among different flash chips." Few feasible solutions have been proposed, however, and those that have rely on the maintenance of an extensive database or on manufacturers' willingness to adopt sensor-based approaches.

Until now, that is. Together with his colleague Dr. M. Tauhidur Rahman and graduate students Preeti Kumari, M.S. Bahar Talukder, and Sadman Sakib, Dr. Ray has developed a novel method of detecting counterfeit flash memory based on a combination of the statistical distribution of various timing characteristics of memory and the number of faulty bits.

"Most researchers focus on fail bit count or how fast the chip can read and write – they never worry about program-erase time," explains Talukder of the team's approach. "But while fail bit count and read and write time do show changes, program-erase time is the best metric because it shows the most amount of variation." It's also more consistent across manufacturers and tends to increase noticeably even after just a few program-erase cycles. "We found that we were getting a 100 percent confidence level – a decision metric that measures whether we can detect a recycled memory accurately – for a flash with just 3 percent usage," says Sakib. Just as important for any future consumers, the technique is "inexpensive, non-destructive, and requires no additional hardware," says Kumari, who is now looking into testing it against temperature and voltage variations.

The team has already filed several patent applications to protect their detection method, which they hope to one day turn into both a smartphone application and a browser extension. But far from hoping to profit personally from the endeavor, they're more interested in helping safeguard the electronic systems used by our nation's most vital infrastructure sectors. "Failure of flash memory in critical applications can have catastrophic effects, from simply corrupting the system to enabling a hardware Trojan attack," says Dr. Rahman. "So there is a big demand for this ability to detect counterfeit flash with high confidence."

Smart Phone Based Real-Time Radiation Monitoring

Throughout the world, radiation exposure has been on the rise due to the increased use of nuclear power, medical procedures and space exploration. For example, it is estimated that there has been a 600 percent increase in human radiation exposure since 1980 just from medical procedures alone. In addition, the adverse effects due to the use of nuclear weapons or natural disasters affecting power plants such as Fukushima can persist for decades. Increased exposure to radiation has been shown to have short and long term detrimental effects to the human body and the environment. Thus, it is important to accurately and continuously monitor the human body for radiation exposure to help prevent radiation induced effects.

Dr. Ray and his research team in Hardware Reliability and Security (HRS) Lab are developing novel techniques for real-time monitoring of radiation environment using hand held devices like smartphone application. More specifically, the research team is investigating the effects of radiation exposure on Flash memory chip by correlating the radiation induced data corruption rate. The team plan to evaluate the raw fail bit count from Flash memory using smartphone application to measure the radiation dose. The research will enable creating real-time radiation map of the world through billions of distributed (low-cost) smart devices. In addition, the team is developing techniques in order to distinguish between radiation type (such as X-ray, gamma ray, neutron strike, etc.), which is not possible with standard dosimeters.

Current radiation dosimeters require monthly to quarterly replacement, regardless of exposure to radiation. With this technology, there is no need to replace, or send anything out for testing. Instant data processing allows for faster assessment of potential damages as well. The log created also allows one to review radiation exposure levels years later. Potential correlations between health issues, such as cancer, and workplace radiation exposure will also be reviewable.

FACULTY SPOTLIGHT

Dr. Jeffrey Kulick (pictured right with Dean Mahalingam) studied at New York University's College of Engineering, receiving a degree in Engineering Physics after which he received his M.Sc. and Ph.D. at The University of Pennsylvania in Electrical Engineering. He then spent a postdoctoral year in India at the Tata Institute of Fundamental Research before visiting Everest Base Camp in Nepal. In 1973 he joined Queen's University in Kingston, Ontario, Canada, in the Computer Science Department where he worked on medical image processing and Positive Emission Tomography imaging., developing algorithms to visualize the 3-D PET data.

Dr. Kulick then spent a two year leave of absence at the MIT Media Laboratory, working in the area of computer generated holography, producing a number of unique computer generated holograms, including one of the first holograms of electron microscope imagery.

He joined UAH in 1990 where he began work on developing a holographic television system. Funded by DARPA and the U.S. Army the work received two patents. Following this, Dr. Kulick helped design and prototype an optical interconnect for parallel computers called the Some-Bus.

More recently, Drs. Kulick and Coe have been developing a laboratory for teaching and research in safety critical software engineering. Several cyber-physical systems have been created including a large HO model train layout to research implementation of the Positive Train Control System following the DO-178c safety process model.

NEW FACULTY

DR. JIANQING LIU

Dr. Jianqing Liu joined the Department of Electrical and Computer Engineering in August 2018 as an assistant professor. He received his Ph.D. degree from the University of Florida in 2018 and B.Eng. degree from the University of Electronic Science and Technology of China in 2013.

Dr. Liu's research interests include wireless networking, network security and data privacy for various information systems like advanced communications networks, mobile health, clouding computing, IoT, etc. His research approach is to bring convex optimization, game theory, cryptography and statistical tools (e.g., Bayesian models, differential privacy) to develop high-efficiency and security protocols and to validate design both in simulations and experiments.

Dr. Liu is the recipient of the 2018 Best Journal Paper Award from IEEE Technical Committee on Green Communications & Computing (TCGCC) and the Best Paper Award from 2012 IEEE Workshop on Microwave and Millimeter Wave Circuits and System Technology (MMWCST). He also served as the system administrator for IEEE Transactions on Vehicular Technology from 2014 to 2017.

SENIOR DESIGN PROJECTS

Countering Upcoming Drone Threats

In recent years, the price of drones has plummeted; consequently, their presence has become more prevalent. In 2017, the FAA estimated the number of hobbyist drones in the U.S. would triple from 1.1 million in 2016 to 3.55 million in 2021. While this is good news for hobbyists, not every user's intent is harmless. Criminals are using drones to counter-surveil police, scope out homes for robbery, smuggle drugs across national borders and much more. Anti-drone security measures have become a necessity.

Enter the UAH senior design team, also known as team Wubba Lubba Dub Dub. Composed of four members, team Wubba Lubba Dub Dub has set out to do something about the rising threat posed by drones to residential areas. Their solution? Create an early warning detection system that is able to indicate and locate drones when they have flown onto a person's property. In addition to this, the team says the system will be able to track the unwanted drone as long as it's in your yard and show a video of it on a graphical user interface, or GUI.

Ryan Chianelli, Kesrah Chianelli, Dane Rich, and Jacob Whitten.

The system, as described by Kesrah Chianelli, is composed of a Pan-Tilt Unit, GUI, and Gigabyte Ethernet (GigE) camera. All of these elements work together to produce a system capable of tracking a drone. "The Pan-Tilt unit," says Ryan Chianelli, "is the key to the systems dynamic abilities. It not only provides a platform for the camera, but has a motor to move and keep up with a flying drone." The camera that this Pan-Tilt unit is supporting is an Allied Vision GigE camera. It outputs high speed frame rates as well as clear video footage. This video footage is then sent to the GUI, the central control hub of the whole operation.

"The GUI is what lets the user in on the action," Jacob Whitten explains, "It's what gives the user the control, while also providing footage of the unwanted drone." All of this wouldn't be helpful, however, without the tracking algorithm. "Can't track a drone without the brains to do it," says Dane Rich with a chuckle, "the tracking algorithm is the brains. It takes the information from the video and GUI and uses that to detect and track the drone."

Metal Detecting Vehicle Upgrade

Four Electrical Engineering students (Team S.O.C.K. Ethan Swinea, Justin Oakley, Stacy Coggin, Kyle Kennedy) set out to improve upon the development of the Metal Detecting Vehicle. The problems with the existing vehicle design included multiple battery sources, a metal detection system that provided an audible notification that was not very noticeable, and a live video streaming capabilities restricted the vehicles range because it had to be connected to a local Wi-Fi network. All of these problems provided motivation to improve the vehicle's capabilities and initiated an UPGRADE.

Team S.O.C.K. set out to improve upon the "user friendliness" of the vehicle by consolidating the power sources, providing a new metal detection circuit that was more obvious in regards to indication, improving the video streaming capabilities, and optimizing the controls. The circuitry for the power was consolidated to use only one battery source. By doing so two other batteries could be eliminated, and the consumer would not have to charge multiple batteries.

A new metal detecting circuit was designed around a proximity detector IC that outputs a signal only when metal is detected. When metal is detected LEDs are illuminated on several areas of the vehicle for visual indication while also outputting a sound from a speaker for audible notification.

Kyle Kennedy, Stacy Coggin, Ethan Swinea, and Justin Oakley.

SENIOR DESIGN PROJECTS

The onboard computer broadcasts its signal to the user's device where a camera viewing app is installed and the live video stream can be viewed. The controller was replaced by a bluetooth controller with a device clip to hold the user's phone. The new controls give the user a more game style feel and video feedback at the users fingertips.

The senior design project for Team S.O.C.K. was a rewarding experience. Much of the coursework has proven beneficial during the progression of the Metal Detecting Vehicle Upgrade. The project allowed each team member to utilize the knowledge that has been acquired here at UAH and further develop technical and communication skills.

Shading Detection System for Solar Panels

Three students in the electrical engineering senior design class developed an automatic shading detection system using an Arduino.

Paul Hudson, Ryan Thornton, and Levi Davies.

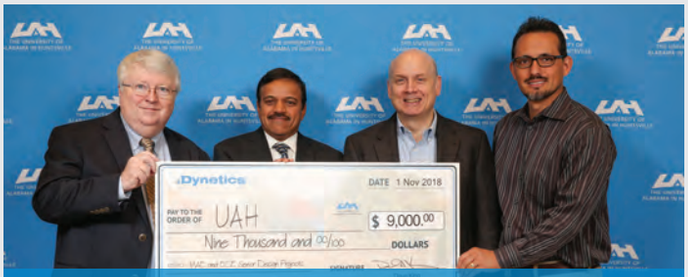
Solar panels are on the forefront of clean energy solutions. They can provide a means of charging electronics, powering homes, or adding to a city's power source. Photovoltaic (PV) panels utilize light to produce energy; however, these panels can become shaded due to numerous reasons, such as cloud coverage or shade from a tree. When a PV panel becomes shaded its performance is affected. In worst case scenarios, a panel becomes partially shaded. This can cause more damage to a system than if the module is uniformly shaded. It can possibly cause the costly replacement of the malfunctioned panels.

Conventional methods for mitigating partial shading effects, such as implementing a bypass diode or microinverter, are costly. The objective for this project was to detect partial shading conditions in a solar module that could cause harm to the system with a cost-effective method

Solar panels can be characterized by their current and voltage output when they drive different loads. These loads can run close to short circuit all the way to essentially an open circuit. In analyzing these we can create an IV (current vs. voltage) curve.

To monitor shading conditions, this IV curve needs to be obtained. This trend is used to find short circuit current, open circuit voltage, and experimental maximum power. These values are essential to calculating the fill factor (FF). The FF is usually represented as a percentage and is to measure of the quality of a solar cell, or the result of maximum power divided by short circuit current and open circuit voltage multiplied. The importance of finding the fill factor is its correlation to shading conditions.

ECE THANKS DYNETICS AND TVA FOR SUPPORTING SENIOR DESIGN PROJECTS



Dr. Hollingsworth (MAE), Dr. Gorur (ECE), Dr. Berinato and Dr. Barajas (Dynetics).

Aaron Mashburn, Charles Box, and Lauren Vandiver (TVA), Dennis Hite, Alex Mitchell, and David Haynes.

Ph.D. Graduates in the ECE Department in 2018

John Bland
Dissertation: "Machine Learning of Cyberattack and Defense Strategies"
Advisor: Dr. Mikel Petty

Kenneth Lee Collier, Jr.
Dissertation: "Collaborative Global-Positioning-System Interference Reduction Through Multi-Node Antenna Arrays and Selection Combining"
Advisor: Dr. Laurie Joiner

Longfei Cui
Dissertation: "Characterization of Outdoor Dielectrics for Power Systems Application"
Advisor: Dr. Ravi Gorur

Hong Guo
Dissertation: "Nanostructure Plasmonics for Biochemical Sensing"
Advisor: Dr. Junpeng Guo

Seyed Sadreddin Mirshafieyan
Dissertation: "Ultrathin Perfect Light Absorbers as Color Filters and Modulators"
Advisor: Dr. Don Gregory

Linda F. Mohaisen
Dissertation: "Energy and Mobility Aware Routing Protocol for Hybrid Network of Vanet-SWN"
Advisor: Dr. Laurie Joiner

Wonkyu Kim
Dissertation: "Plasmonic Metamaterials for Enhanced Light Transmission, Absorption, and Antireflection Coating"
Advisor: Dr. Junpeng Guo

Gregory Michael Reynolds
Dissertation: "Dynamic Wavefront Capability for Anti-Jam Electronics and Controlled Reception Pattern Antenna"
Advisor: Dr. Laurie Joiner

Leif Sandstrom
Dissertation: "Characterization of Optical Beat Noise in a Direct Modulation Directs Detection Correlation OTDR"
Advisor: Dr. Laurie Joiner

Benjamin J. Schmid
Dissertation: "Monocular Camera Scene Reconstruction Using Oriented Feature Constellations"
Advisor: Dr. Reza Adhami

Abubaker Mustafa Tareki
Dissertation: "Longitudinal Stratified Structure as Tunable Platform using Liquid Crystal at Terahertz Regime"
Advisor: Dr. Robert Lindquist

Emily Willis
Dissertation: "Temporal Evolution of the Plasma Sheath Surrounding Solar Cells in LEO and its Effect on Spacecraft Charge Collection"
Advisor: Dr. Maria Pour

HEARTY CONGRATULATIONS TO ALL!

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UAH ENGINEERING FORUM

The College of Engineering at UAH hosted the first UAH Engineering Forum (UAH-EF), held in conjunction with the 2018 Southeast Symposium on Contemporary Engineering Topics (SSCET). The event took place on Friday, Aug. 3 at UAH Charger Union Theatre and the Shelby Center for Science & Technology.

"The UAH Engineering Forum is an opportunity for engineers, students, and faculty from UAH and universities in the Southeast to network and discuss solutions to modern engineering problems," says Dr. Tommy Morris, UAH-EF chair and director of UAH's Center for Cybersecurity Research and Education. An additional benefit to hosting the forum at UAH, says Dr. Morris, is the opportunity to show off "our campus, our students, and many of our new faculty."

The UAH-EF featured presentations from technical experts and faculty from companies and universities across the Southeast, including UAH's College of Engineering. Its purpose was to explore and discuss state-of-the-art engineering solutions to modern engineering problems. The event kicked off on Thursday, Aug. 2, with an evening reception and dinner for speakers and patrons at the U.S. Space & Rocket Center.

Topics covered during the track sessions included industrial and systems engineering; aerospace; biomedical and biotechnology; chemical and petroleum engineering; civil, environmental, and coastal engineering; cybersecurity; electric power; electrical and computer engineering; ethics and engineering education; mechanical engineering; and student research.

The 6th Annual IEEE International Conference on Wireless for Space and Extreme Environments (WiSEE 2018)

December 11–13, 2018

Spaceflight involves critical sensing and communication in extreme environments such as planetary surfaces, space vehicles, and space habitats. The many challenges faced in space sensing and communication are extremely diverse and overlap significantly with those found in many terrestrial examples of extreme environments such as extreme hot or cold locations, extreme high- or low-pressure environments, critical control loops in aircraft and nuclear power plants, high-speed rotating equipment, oil/gas pipelines and platforms, etc. All of these environments pose significant challenges for radio-frequency or optical wireless sensing and communication and will require the application of a broad range of state of the art technologies in order to generate reliable and cost effective solutions. Although the specific challenges vary significantly from the environment to environment, many of the solutions offered by sensing, communication, and statistical signal processing technologies can be applied in multiple environments, and researchers focusing on space applications can benefit greatly from understanding the problems encountered and solutions applied in alternative environments.

This IEEE conference will bring together investigators from the National Aeronautics and Space Administration (NASA), the Canadian Space Agency (CSA), the European Space Agency (ESA), and other space agencies, along with aerospace and space defense industries and academic researchers, in an effort to understand and solve the emerging problems facing wireless sensing and communication in space and related extreme environments.

Full-length research papers (6 pages) and posters abstracts (3 pages) are sought that address solution to problems in all areas of wireless sensing and communication in space and extreme environments related to spaceflight. Accepted and presented papers will be published in the conference proceedings and submitted to IEEE Xplore as well as other Indexing databases.

ECE faculty member Dr. Laurie Joiner is a Technical Program Committee Chair and Dr. Ravi Gorur is one of the general co-chairs of this conference.

IEEE Region 3 Technical, Professional, and Student Conference (SoutheastCon 2019)

April 11–14, 2019

As the premier conference for the IEEE Region encompassing Jamaica and the Southeastern United States, it brings together Computer Scientists, Electrical, and Computer Engineering professionals, faculty, and students to share the latest information through technical sessions, tutorials, and exhibits. It is the most influential conference in Region 3 for promoting awareness of the technical contributions made by our profession to the advancement of engineering and science and to the community.

Attendance and technical program participation from areas outside IEEE Region 3 are also cordially encouraged and welcomed. The conference schedule includes:

- **A technical program with seminars, tutorials and workshops**
- **A student program with student competitions**
- **Exhibits**
- **IEEE regional meetings**

ECE faculty members Drs. Laurie Joiner and John Piccirillo chair the robotic competition and Dr. Ravi Gorur serves as the Chair of the Technical Program Committee.