

FALL 2020



COLLEGE OF ENGINEERING

Department of
**ELECTRICAL & COMPUTER
ENGINEERING**





A LOOK INSIDE

2 CHAIR'S MESSAGE

3 ECE FACULTY

5 SENIOR DESIGN PROJECTS

7 MASTERS & PH.D. GRADUATES

9 FACULTY PROJECTS

11 FACULTY RECOGNITION

13 ANNOUNCEMENTS



THE UNIVERSITY OF
ALABAMA IN HUNTSVILLE



A MESSAGE FROM DR. GORUR & DR. GAEDE

What a year 2020 has been with the COVID-19 pandemic? Every facet of life went through changes, and university operation was no exception. We are pleased to say that our faculty, staff, and students rose to the occasion and we were able to perform all functions associated with higher education, namely, teaching, research, and service, admirably. During the spring semester, we went completely online in mid-March, conducted summer sessions completely online, and executed the fall semester with a mix of hybrid, online, and traditional classes.

Faculty and staff meetings were completely online, as was office hours. In some laboratory classes, we provided students with kits so that they could do the experiments at home. Amid these changes, we can point out a huge positive - we all became more tech-savvy. This will benefit all of us in the future. It also opens up new avenues of teaching. Our newly launched undergraduate degree program in Cybersecurity was renamed BS in Cybersecurity Engineering. This name is more indicative of the training students receive. We have over 150 students in this program and we expect to go for ABET accreditation soon. The enrollment in computer engineering has also increased, while electrical engineering is showed a small decline, and this is consistent with national trends. We had an impressive amount of students who graduated with advanced degrees, Masters, and Ph.D. Our heartfelt congratulations to all of them. Many of them have taken up employment in industry and research laboratories. Our faculty continue to win research grants from government and industry. In this issue, we are pleased to highlight the projects in the Hardware Reliability and Security Laboratory of Dr. Biswajit Ray, along with the mHealth Laboratory Project by Dr. Emil Jovanov. Our undergraduate students are excited to participate in innovative projects and our graduate students are presenting papers at international conferences. You can read about all of these in this newsletter.

Dr. Jeffrey Kulick and Ms. Jackie Siniard have been with the ECE Department for over 20 years. Both of whom have decided to retire from UAH. We wish them a very happy retirement. We extend a warm welcome to Ms. Danniele Worsham who has joined as a senior staff assistant, Mr. Timothy Carver who has joined as a lecturer, and Mr. David Foreman our new Computer Systems Engineer.

Sincerely,

Dr. Ravi Gorur

Dr. Rhonda Gaede

ECE FACULTY



RAVI GORUR



RHONDA GAEDE



AUBREY BEAL



RON BOWMAN



TIMOTHY BOYKIN



TIMOTHY CARVER



DAVID COE



JUNPENG GUO



DENNIS HITE



FAT DUEN HO



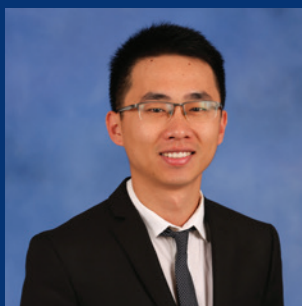
LAURIE JOINER



EMIL JOVANOV



ROBERT LINDQUIST



JIANQING LIU



ALEKSANDAR MILKENKOVIC



THOMAS MORRIS



DAVID PAN



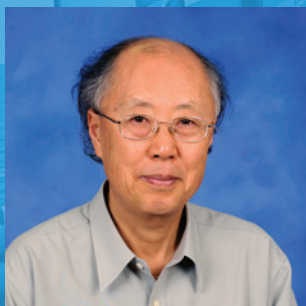
MARIA POUR



BISWAJIT RAY



EARL WELLS



SEONG-MOO YOO



TAUHIDUR RAHMAN



JENNIFER ENGLISH

SENIOR DESIGN PROJECTS

Wireless Impedance Analyzer for Remote Sensing

Team Members: Michael Reyes-Brunick, Josh Pinkard, Douglas Marr, M. Andrew Finocchio, Jr

Faculty Advisor: Dr. Biswajit Ray & Mr. Dennis Hite

The goal of this project is to develop a low-cost sensor to monitor the phosphorus levels of soil in real-time via the use of modern graphene technology. Potential applications of this could be for agricultural development sites. The wireless impedance analyzer will remove the age-old randomness and chance associated with planting crops in soil that is more or less viable. This project allows for speedy evaluation of the soil's suitability and no longer requires the traditional harvest wait time, thus, removing the randomness and uncertainty that previously existed.



Chaotic RNG Circuit

Team Members: Austin Davis, Austin Handley, Kenny Brainerd, Jonathan Kuhn

Faculty Advisor: Dr. Aubrey Beal & Mr. Dennis Hite

The goal of this project is to create a true random number generator through the use of a Tent Map and hybrid electronics. While most random number generators involve a pseudo-random sequence, this circuit is capable of generating truly random sequences supported by a first-principles theory. Overall, this project provides a pathway for random number generation using simple circuits to elevate security in applications such as encryption to protect government and national security, prevent cheating in casinos, and secure private company intellectual property.

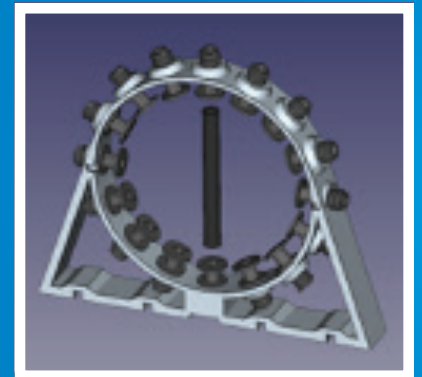


Correlated Electromagnetic Levitation Actuator (CELA)

Team Members: Emily Yardumian, Austin Bumbalough, Daniel Smith, Joshua Sachar

Faculty Advisor: Dr. Aubrey Beal & Mr. Dennis Hite

This project involved electromagnetic levitation and was sponsored by the Stem Engagement Office at NASA's Marshall Space Flight Center through the Alabama Space Grant Consortium. NASA has begun to research alternative methods of developing attitude control systems. This project uses electromagnetic levitation and actuation instead of traditional mechanical parts. It also consists of two concentric spheres separated by an air gap, with the center sphere electromagnetically rotated at varying speeds among three degrees of freedom. A prototype displaying levitation by using both permanent magnets and electromagnet coils was developed.



RF Phase Shifters

Team Members: Lucas Smith, Jacob Hatcher, and Shane Clark

Faculty Advisor: Mr. Dennis Hite

This project aimed to correct the temperature drift that is often unaccounted for during calibration by Phase Shifters. RF Phase Shifters alter the phase angle of an input signal. Phase Shifters are often calibrated to ensure little room for error in the phase angle they output. MATLAB was used to set up the network analyzer to the correct settings required for the test. Once the test was completed, the temperature drift will be recorded to provide correction tables to ensure the devices are properly calibrated before use in other tests.



SENIOR DESIGN PROJECTS

Metal Detection Vehicle: Conversion to Module

Team Members: Collin Robinson, Tyler Thompson, Levi Shareck, Andrew Smirl
Faculty Advisor: Mr. Dennis Hite

This project at its core is a remote-controlled vehicle that detects metal underneath it. Previous enhancements to the project include centralized power distribution, user-friendly controls, improved physical appearance, and video streaming from an onboard camera. The primary goal of this project was to adapt the current iteration of the Metal Detecting Vehicle to use modules built to a set of specifications. These specifications have been created by this team so that future senior design teams might continue to build other implements to increase the utility of the vehicle.



Tesseract Tubes

Team Members: Drew Prevost, Nate Drinkard, Andrew Horton
Faculty Advisor: Mr. Dennis Hite

This project included the design and development of a high-fidelity combination USB / DAC vacuum tube personal audio system for use with high-end headphones. Any headphone can be connected to a computer and they will work for the playback of music. However, a typical computer will not have the capability to fully utilize the range of high-end headphones. These headphones require much more power than a computer can provide and are almost wasted without an external source to drive them. This personal audio system consisted of three individual subsystems. A USB DAC computer interface, a power supply, and a headphone amplifier.



RFID Tag Parking Assistance Program (TPAP)

Team Members: Brittany Rasche, Zachery Stagg, Paul Propes
Faculty Advisor: Mr. Dennis Hite

This project included the design and construction of a working prototype for an RFID Tag Parking Assistance Program (TPAP). TPAP is designed to autonomously track the number of parking spots that are available in a parking lot at one time. This system was designed to benefit not only the students on campus but also faculty, staff, and visitors. The TPAP system aims to decrease traffic and congestion on campus, decrease accidents, help students and faculty arrive on time for classes, and prevent anxiety and stress for all.



ECE Thanks COLSA for the Renaming of Eng 107!

COLSA CORPORATION ENGINEERING CYBERSECURITY LAB (ENG 107)

PH.D. & MASTERS GRADUATES

THE ECE DEPARTMENT 2020

PH.D. GRADUATES

GRANT BERGSTUE

Field: Electrical Engineering

Dissertation: Motion Tracking Through Moire Images of Fork Gratings

Advisor: Dr. Patrick Reardon

MICHAEL CROSS

Field: Electrical Engineering

Dissertation: Missile Interceptor Integrated Guidance and Control: Single Loop Higher-Order Sliding Node Approach

Advisor: Dr. Yuri Shtessel

RISHABH DAS

Field: Computer Engineering

Dissertation: An Embedded Defense-In-Depth Module for Detecting Cyberattacks on Interdependent Scada Controllers

Advisor: Dr. Tommy Morris

ELBASHER O. ELSAMI ELMAHDI

Field: Computer Engineering

Dissertation: Secure Integrity in Wireless Ad Hoc Networks

Advisor: Dr. Seong-Moo Yoo

SUEANNE NICHOLE GRIFFITH

Field: Computer Engineering

Dissertation: A Virtual Cyber-Physical System Testbed for Use in Network Intrusion Detection and Prevention System Verification

Advisor: Dr. Tommy Morris

MITCHELL HUNT

Field: Electrical Engineering

Dissertation: Design, Testing, and Modeling of Radio-Frequency and Digital Circuits Using Metal-Ferroelectric-Semiconductor Field-Effect Transistors

Advisor: Dr. Ho

ZHUOCHENG JIANG

Field: Electrical Engineering

Dissertation: Efficient Predictive Lossless Hyperspectral Image Compression

Advisor: Dr. David Pan

MEGHANA RAMESH

Field: Electrical Engineering

Dissertation: Condition Assessment of Composite Insulators

Advisor: Dr. Ravi Gorur

KUMAR SHARSEMBIEV

Field: Computer Engineering

Dissertation: Protocol Misbehavior Mitigation Framework for Broadcast Communications in Vehicular Ad Hoc Networks

Advisor: Dr. Seong-Moo Yoo

MICHAEL T. SHROVE

Field: Computer Engineering

Dissertation: Predicting Software-Based Project Outcomes Using Machine Learning

Advisor: Dr. Emil Jovanov

AARON WERTH

Field: Computer Engineering

Dissertation: Evaluation of an Embedded Process Prediction Intrusion Prevention System for Industrial Control Systems

Advisor: Dr. Tommy Morris

MASTERS GRADUATES

MD KAWSER BEPARY

Field: Computer Engineering

Thesis: Aging Characterization and Detection of Recycled Dram Chips

Advisor: Dr. Tauhidur Rahman

HARSHA GANEGODA

Field: Computer Engineering

Thesis: An Implementation of the Wireless Body Area Network of Synchronized Inertial Sensors for Balance Testing

Advisor: Dr. Emil Jovanov

MD MEHEDI HASAN

Field: Electrical Engineering

Thesis: Security and Privacy Threat of Nand Flash Memory and Countermeasure

Advisor: Dr. Biswajit Ray

MD IMTIAZ RASHID

Field: Computer Engineering

Thesis: Security Primitives With Emerging Memory Chips and Its Application in Wireless Communication

Advisor: Dr. Tauhidur Rahman

SOPAN SARKAR

Field: Computer Engineering

Thesis: Radio-Layer Vulnerabilities of Bluetooth Low Energy: Exploitation and Attacks

Advisor: Dr. Jianqing Liu

IGOR SEMENOV

Field: Computer Engineering

Thesis: An Implementation of Chacha20 Stream Cypher in All-Programmable SoCs

Advisor: Dr. Aleksandar Milenkovic

CONGRATULATIONS TO ALL!

FACULTY PROJECTS

Hardware Reliability and Security Research Project

Dr. Biswajit Ray

The laboratory is developed by Dr. Biswajit Ray. He works closely with his graduate students Mr. Sadman Sakib, Ms. Preeti Kumari, Mr. Sijay Huang, Mr. Md Raquibuzzaman, Mr. Umeshwarnath Surendranathan, and Ms. Matchima Buddhanoy on various projects.

The research spans the boundaries of electron devices and systems for addressing the challenges in hardware security and reliability, IoT-enabled sensing and energy-efficient computing. Presently the projects are funded by the National Science Foundation (NSF), and the Department of Energy (DOE).

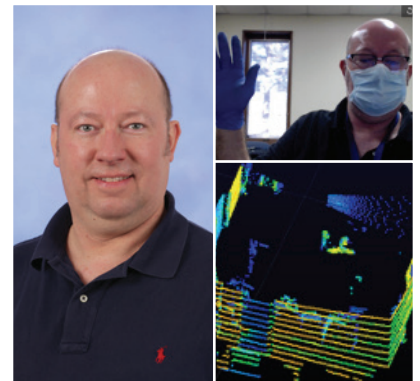
We are looking forward to attracting new students to work on these exciting projects. For more information about these projects, visit our research laboratory website: (https://sites.google.com/a/uah.edu/ray_biswajit)



16-Channel Velodyne Lidar

Dr. David Coe

The ECE Department acquired a 16-channel Velodyne LIDAR to support autonomous car research. LIDARs use invisible infrared laser light to precisely measure the range and bearing of obstacles surrounding the vehicle. The first image is a photograph of Dr. David Coe waving to the web camera, and the second image shows the point cloud generated by the LIDAR of a similar scene. Note that the LIDAR has imaged Dr. Coe and his waving hand in the center as well as the walls, windows, and doors of the office itself.



ECE Research in Non-Volatile Memories

Dr. Aleksandar Milenkovic & Dr. Biswajit Ray

Non-volatile memory (NVM) is a semiconductor technology allowing computing devices to retain the data and program stored without a continuous power supply. NVMs are the fastest growing portion of semiconductor industry driven by ever-increasing amounts of generated data - the amount of data created daily is forecast to reach 466 ZettaBytes (10^{18} bytes) in 2025, an almost tenfold increase over 59 ZettaBytes created daily in 2020.

The ECE Department research groups led by Dr. Ray and Dr. Milenkovic pursue several projects focusing on state-of-the-art and emerging non-volatile memories. A broad theme of these projects is finding new approaches to leverage physical properties of NVM chips to enrich their functionality or improve their operation.

ECE graduate students Mr. Prawar Poudel, Mr. Sadman Sakib, Ms. Preeti Kumari currently work on these projects. For more information about these projects, visit the web sites of the LaCASA Laboratory (lacasa.uah.edu) and the Hardware Reliability and Security Lab.



FACULTY PROJECTS

Can mHealth Technology Help Mitigate the Effects of the Covid-19 Pandemic?

Dr. Emil Jovanov

Support for telehealth and mobile health monitoring has risen among healthcare workers and consumers since the rise of the COVID-19 pandemic, according to a new study. Dr. Emil Jovanov, a pioneer in the wearable health monitoring field from The University of Alabama in Huntsville (UAH), participated and was a coauthor of the study conducted by a task force of experts organized by the Mass General Brigham (MGB) Center for COVID Innovation.

"According to our interviews with healthcare professionals, we found out that the support for telemedicine and tele-rehabilitation increased from about 10% before the pandemic to almost 60% now," says Dr. Jovanov, an associate professor of electrical and computer engineering who was selected as an Institute of Electrical and Electronics Engineers (IEEE) fellow in 2020 for his contributions to the field of wearable health monitoring.

According to the study, mobile health technologies (mHealth) create tremendous opportunities for monitoring, mitigation and testing in the COVID-19 pandemic and future pandemics.

Dr. Jovanov says the nation's COVID battle could be assisted by an integrated mHealth system that can help assess who needs to be tested by providing relevant information through contact tracing, tracing of shared space and infrastructure, and monitoring of physiological changes.

"All this information can be used to inform decisions and optimize the use of resources," he says. "An integrated system can also characterize disease spread by tracking spatio-temporal patterns of new cases."

Dr. Jovanov joined experts from top bioengineering institutions across the globe for the three-month effort organized by lead author Dr. Paolo Bonato, an associate professor in the Department of Physical Medicine and Rehabilitation at Harvard Medical School, and Dr. Bonato's team at the Motion Analysis Laboratory, which he directs. The laboratory is located at Spaulding Rehabilitation Hospital in Boston, a member of the Mass General Brigham Integrated Health System.

Link to PDF of Study: <https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=9162431>



FACULTY AWARDS



Biswajit Ray

COE Outstanding Research Award

Dr. Biswajit Ray would like to thank the College of Engineering (COE) award committee for recognizing him with the 2020 COE Outstanding Research Award. Ray states that he would also like to thank Dr. Milenkovic for nominating him for this award. "This award recognizes the hard work of my graduate students: Mr. Sadman Sakib, Ms. Preeti Kumari, Mr. Sijay Huang, Mr. Md Raquibuzzaman, Mr. Umeshwarnath Surendranathan, and Ms. Matchima Buddhanoy. I am very fortunate to work with all my students who are highly enthusiastic and motivated to their research work. I would also like to thank our sponsors - the National Science Foundation (NSF), and the Department of Energy (DOE) for funding our research activity."



Maria Pour

COE Outstanding Teaching Award

Dr. Maria Pour received the COE Outstanding Teaching Award in 2020. Pour is honored to receive this award and gives her thanks to the nominators and selection committee.



Ron Bowman

COE Outstanding Service Award



Jennifer English

University Distinguished Teaching Award

SERVICE AWARDS

Dennis Hite

SENIOR LECTURER

20 Years of Service



Jacqueline Siniard

SENIOR STAFF ASSISTANT

30 Years of Service



NEW HIRES



David Foreman

LEAD COMPUTER SYSTEMS ENGINEER

Dave Foreman joined the ECE staff in November 2020, after working with the UAH SMAP Center for 19 years. Mr. Foreman has worked with Unix and Linux operating systems since 1986 and has spent his entire career in Huntsville in support of various U.S. Government organizations on Redstone Arsenal. Mr. Foreman is a graduate of Jacksonville State University with a Bachelor of Science degree in Computer Science. He is supporting our CPE and cybersecurity programs.

WE WELCOME OUR NEWEST CHARGERS!

Timothy Carver

LECTURER

Timothy A. Carver holds a Bachelor of Science in Computer Science and Electronics Engineering, a Master of Science in Computer Science. Over the years he has designed and programmed video games, consulted at General Electric Aircraft Engines and run his own business. He fell in love with teaching and has served in several faculty positions at The University of Cincinnati and other colleges. As a practicing Forensic Computer Examiner, Timothy Carver has developed and taught courses in digital forensic science and cybersecurity. He is a member of the International Society of Forensic Computer Examiners and a member of the Board of Directors for the High Tech Crime Consortium. Because of his research on Bitcoin Forensics, Timothy Carver has been asked to consult on several cases and provide training to quite a few law enforcement organizations. He has also been referenced by the National Security Agency for his knowledge of Bitcoin.



ECE RETIREMENTS

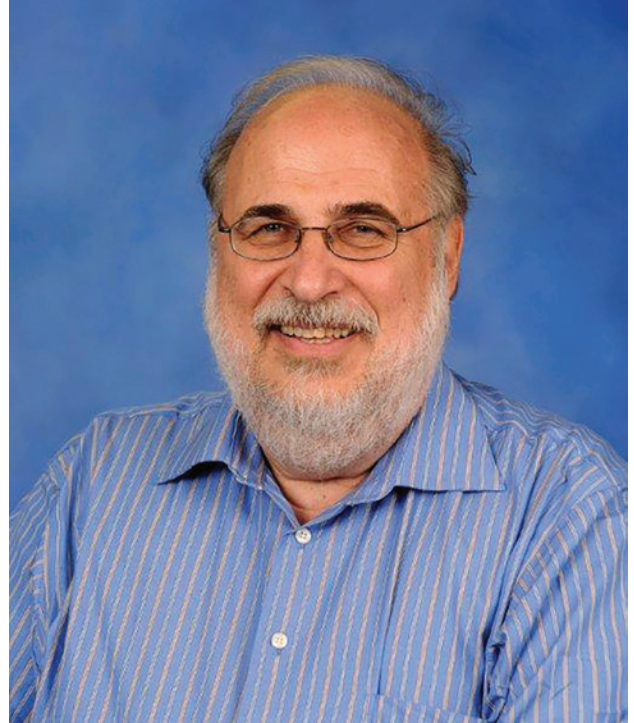
Jeffrey Kulick

PROFESSOR

Professor Kulick received an Engineering Physics degree at New York University's College of Engineering, and his MSc and PhD at The University of Pennsylvania in Electrical Engineering. 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.

He joined UAH in 1990 where he worked to develop a holographic television system. The work received two patents. Following this, Professor Kulick worked on an optical interconnect for parallel computers called the Some-Bus. More recently, Professors Kulick and Coe have developed a laboratory for safety critical software engineering. Several cyber-physical systems have been created including research implementation of the Positive Train Control System following the DO-178c safety process model.

Professors Kulick and Coe are currently developing an autonomous car laboratory featured elsewhere in this brochure. Students can study machine learning algorithms for autonomous vehicle operation and their response while undergoing security attacks.



Jacqueline Siniard

SENIOR STAFF ASSISTANT

Jacqueline Siniard, Senior Staff Assistant, will be retiring on January 1st, 2021, after 32 years of honorable service in the ECE department and at UAH. Jacqueline moved to Huntsville, AL, in 1987. When asked about her time at UAH, she said, she's "forever thankful to Dr. Auden for hiring me on to UAH and those many years at Graduate Studies". Then, Jacqueline had the opportunity to move to ECE in 1999, which she did. Jacqueline worked for many years under 4 department chairs and has seen many students graduate with Masters and Doctoral degrees. "It's these students that she will miss the most", says Jacqueline. After her retirement, she plans to fill her days with volunteer work with the homeless dog shelters, her own pets, and sometime in the future hopefully traveling the US to see more places. Jacqueline has been instrumental in the development of the ECE graduate degree programs and an invaluable resource to our graduate students.



THANK YOU FOR YOUR SERVICE!

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 the industry, governments, and academia.

For more information about our department or to learn more about our degree programs, please visit www.uah.edu/eng/departments/ece

DEGREES OFFERED:

Bachelor of Science in Computer Engineering (BSCPE)

Bachelor of Science in Electrical Engineering (BSEE)

Bachelor of Science in Cybersecurity Engineering (BSCBS)

Master of Science in Computer Engineering (MSCPE)

Master of Science in Cybersecurity Engineering (MSCBS)
(jointly with Computer Science & the College of Business)

Master of Science in Software Engineering (MSSE)
(jointly with Computer Science)

Master of Science in Electrical Engineering (MSEE)

Doctor of Philosophy in Computer Engineering
(jointly with UAB)

Doctor of Philosophy in Electrical Engineering

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