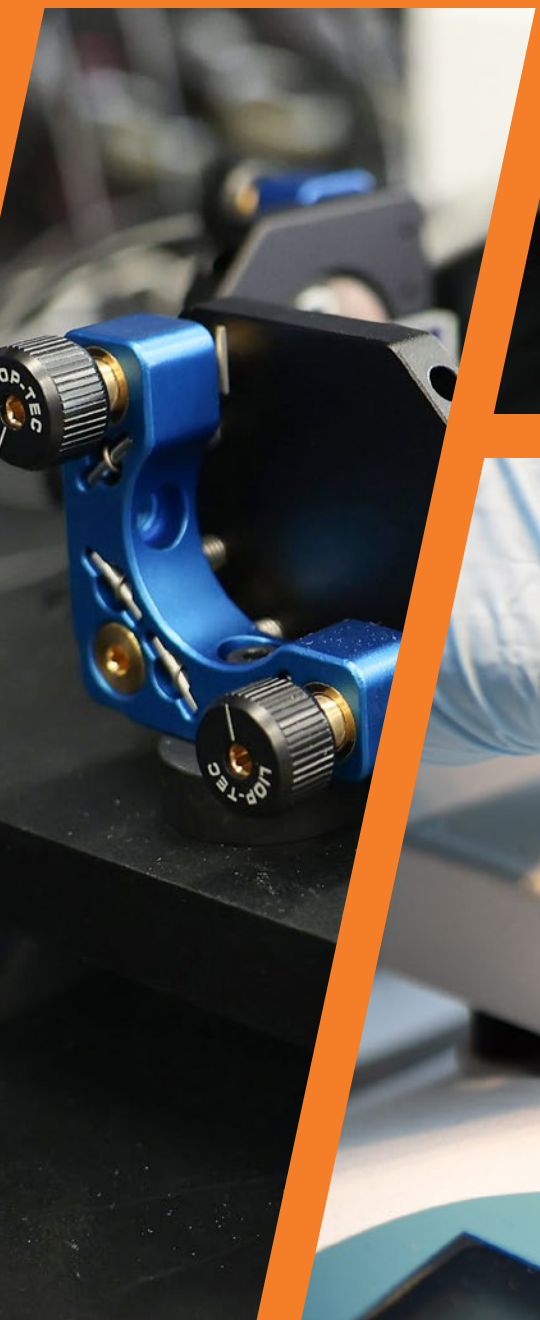
ECE

THE BRADLEY DEPARTMENT OF
ELECTRICAL & COMPUTER
ENGINEERING

2022



COLLEGE OF ENGINEERING
BRADLEY DEPARTMENT OF ELECTRICAL
AND COMPUTER ENGINEERING
VIRGINIA TECH

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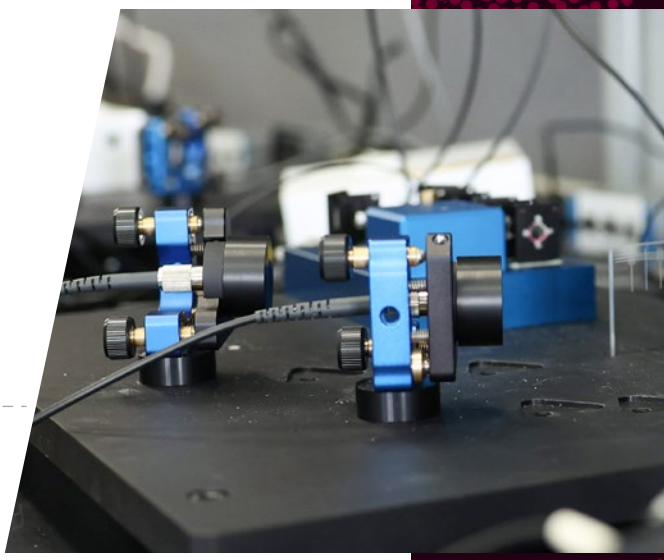
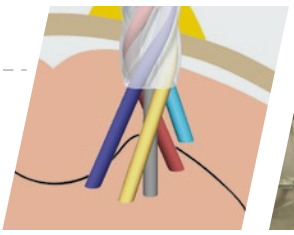
What's Inside





ABOVE: Equipment in the new quantum engineering lab.
BELOW: Xiaoting Jia and her team of researchers have devised a way to use a helical structure to implant sensors into different regions of the brain using only one incision.

PETER MEANS

HARPREET DHILLON, Michael Buehrer, and their team are working on better ways to locate wireless devices using mmWave technology.

From the ECE **DEPARTMENT HEAD**

Emerging out of the pandemic, I am pleased to report that the Bradley Department of Electrical and Computer Engineering (ECE) at Virginia Tech continues to excel on many levels.

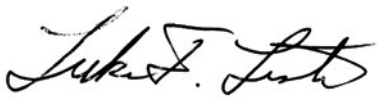
From a mere eight people just five years ago, our Northern Virginia faculty cohort has grown to an impressive 24 members conducting pre-eminent research and instruction that focuses on bioinformatics, quantum engineering, wireless & cybersecurity, and power systems/electronics. In a major milestone for the department, one of those Northern Virginia faculty members, Saifur Rahman, has been elected the President of the IEEE for the Year 2023. Let's all congratulate Saifur on his extensive service to our technical profession and to society in general!

Working closely with our ECE Advisory Board with the goal of recognizing and engaging our alumni in the future pathways of the department, I am proud to announce that we are reviving the ECE Academy of Distinguished Alumni after a 23-year hiatus. This year's induction ceremony which will take place during the annual Bradley Banquet and will honor seven outstanding alumni for meritorious service, exemplary giving, extraordinary impact, or career achievement. The additions to this select group of alumni are Ken Schulz, Daniel Talbert, Dan Sable, Sean Kelley, Noel Schulz, Greg Bottomley, and David Roop.

In this, the sesquicentennial year of Virginia Tech and culminating year of the department's NSF RED grant, we graduate our first student cohort who have experienced our revolutionized undergraduate curriculum. As part of this vast curriculum revision, we now attract computer and electrical engineers who choose a secondary focus in areas as broad as Real Estate, Sociology, Green Engineering, Leadership, Mathematics, and Computer Science. This new approach to our undergraduate degree program is a welcome change from the recent, nation-wide impression that ECE is just electricity, electronics and electromagnetics. As I have said before in these annual reports, this approach has been the main objective of the NSF RED grant strategy: take advantage of the wide number of technical areas available in ECE (the "ECE Majors") and then let the students expand their academic horizons beyond just our department into the comprehensive offerings of the entire university. In this final year of the NSF RED grant, I want to thank the faculty leaders, Tom Martin, Arthur Ball, Lisa McNair, Matt Wisnioski, Liesl Baum, and Scott Dunning for a job well done and for inspiring our students to stretch themselves and pursue their academics dreams.

Last year, 323 students earned B.S. degrees in Electrical Engineering and Computer Engineering and 63 percent of them chose one of the new ECE Majors. The 52 Ph.D. students that graduated in the 2021 timeframe represent a substantial effort in the face of the COVID pandemic, which is a testament to the strength of our graduate program and its faculty and career advisors.

At a spending level of $62.3 million per year, the department is ranked 8th in the country in terms of research expenditures by the 2020 NSF Higher Education Research & Development (HERD) survey.



Luke Lester
Roanoke Electric Power Professor
ECE Department Head

From the chair of the ADVISORY BOARD

The ECE Advisory Board has been exceptionally busy over the past two years, despite having to work completely virtually due to the COVID-19 pandemic. We have undertaken several multi-month explorations to provide the department with external insights and recommendations to aide in longer-term strategy.

The department has been evolving in response to two key events: the NSF RED grant to lead the development of a 21st century undergraduate curriculum, and the the state's agreement with Amazon regarding HQ2 under development in Northern Virginia. These have provided us with an unprecedented opportunity to shape the future of the department, and we are planning to strategically leverage the opportunites.

While no one can fully predict the future, we can look at trends from the world of basic research and the federal government's Critical and Emerging Technologies List to generally understand upcoming needs and opportunities. We see from these analyses that electrical and computer engineering will have a significant role in the majority of our nation's most-critical science and technology (S&T) endeavors over the next 20 years, but this will not be an independent role. ECEs will need to work collaboratively with other engineers, other scientists, and nonscientists to drive the innovations required for our nation's security and prosperity. While ECE fundamentals will remain our bedrock and primary focus, we will need to extend efforts in interdisciplinary team building and leadership. At the same time, project management and communications skills will rise in importance; tackling ethical issues upfront will become the norm; and scientific integrity will be paramount throughout all our efforts. This means the way the department works, collaborates, and teaches must evolve if we are to enhance our future impact and reputation.

The Advisory Board first tackled this realization by evolving itself. We actively changed our membership to now include individuals that have served in a variety of federal agencies (and multiple members with experience leading White House-level S&T initiatives), those with industry experience ranging from small startups to executives at worldwide titans, and academics from other universities. We've also further diversified the membership by years of experience, race, gender, and geography. This range of experiences and insights has proven to be exceptionally valuable as the board analyzed and developed recommendations for the future of the department.

Here is a peek at how our major constituencies will be impacted:

- **Alumni** will continue to be critical partners in future ECE activities. At more than 10,000 strong, our alumni can provide both a vast depth and incredible breadth of insights, experiences, and connections that can help the department succeed. We've already taken initial steps by beginning to highlight alumni stories and by reinvigorating our alumni awards program. Watch for future changes as we continue to engage and collaborate with alumni.
- **External entities** will continue to be important sponsors of the department's cutting-edge research, but the department will need to significantly grow collaboration with other groups, ,to be a major player on topics of national priority.
- **The ECE Faculty** will continue to grow quickly, in both Blacksburg and Northern Virginia—and with the future in mind. New hires will not only be selected on research acumen and teaching abilities, but also on how well they will be able to lead the department into this new environment.
- **Graduate students** will need to perform their research in a less isolated, stovepiped manner, working more collaboratively with external experts on complex and critical issues to enable new capabilities with national impact. Upon graduation they'll have not only deep ECE knowledge, but also the skills and experiences that will enable them to quickly become recognized community leaders on topics of national priority (and funding!).
- We must continue to provide our **undergraduate students** with a solid foundation on core ECE fundamentals, but also continue to grow their knowledge, experience, and appreciation for working in interdisciplinary teams, enhancing and leveraging their communication skills, the basics of project management, and the criticality of ethics and scientific integrity.

Virginia Tech's ECE department has been given a rare opportunity for significant growth, while the nation's S&T enterprise is simultaneously evolving. The Advisory Board has been helping the department view these opportunities through the same lens, recognizing that the decisions we make now will set up how the department is perceived in the future, and more importantly, how we positively impact our country and society. Ut Prosim!

There has never been a more exciting time to be involved in ECE. Please join us on the journey!

Duane Blackburn *(BSEE 1996, MSEE 2001)*
Chair, ECE Advisory Board
S&T Policy Lead, Center for Data-Driven Policy
The MITRE Corporation

Seven members inducted into

ECE's Academy of Distinguished Alumni

Whether in research and development, leadership, or service, ECE alumni are changing the world. To recognize their contributions, ECE has inducted seven of these alumni into the department's Academy of Distinguished Alumni.

"We have many incredible alumni, who are making significant impacts to their fields—either in their career or by giving back to the department," says Department Head Luke Lester. "We want to honor their achievements and inspire our students."

The department has four award categories to recognize different forms of alumni excellence:

- **A Career Achievement Award** in recognition of significant contributions to the field over the course of a career.
- **Two Extraordinary Impact Awards** in recognition of extraordinary accomplishments that improve people's lives.
- **Three Exemplary Giving Awards** for outstanding philanthropic service to ECE.
- **Two Meritorious Service Awards** for outstanding volunteer service to ECE.

Each award recipient receives a trophy, and will be recognized in hallway displays on the Virginia Tech campus for members of the Academy of Distinguished Alumni.

2022 Inductees

Meritorious Service Award

For sustained, outstanding volunteer service to ECE

Kenneth R. Schulz

(MSEE '94)

A PROGRAM LEADER at Lockheed Martin, Schulz was one of the primary creators of the ECE Major Design Experience, when he served on the Industry Advisory Board as a member and chair. He later transitioned to an adjunct faculty role supporting the program.

Exemplary Giving Award

Recognizing up to three individuals or groups annually who champion ECE's mission through outstanding philanthropic service.

Dan Sable (Ph.D. '91)

FOR GENEROUS CONTRIBUTIONS supporting the ECE AMP Lab, Space@VT, and the ECE student laboratories.

Dan Talbert (BSEE '65)

FOR ESTABLISHING a scholarship for electrical engineering students.

Sean M. Kelley (BSEE '90, MSEE '94)

(Not pictured)

FOR ESTABLISHING the ECE Sean M. Kelley Scholarship for U.S. Armed Forces dependents/Virginia residents.

Extraordinary Impact Award

Recognizing up to two alumni per year who have demonstrated an extraordinary and impactful accomplishment that improves people's lives, especially when their life's work represents intellectual integrity, informed ethical values, a focus on public service, and demonstrated leadership.

Noel N. Nunnally Schulz

(BSEE '88, MSEE '90)

A NATIONALLY RECOGNIZED EXPERT in power systems engineering, she is dedicated to recruiting and retaining women in engineering and to mentoring female engineering faculty. She serves as the Chair in Power Apparatus and Systems in the Washington State University School of Electrical Engineering and Computer Science.

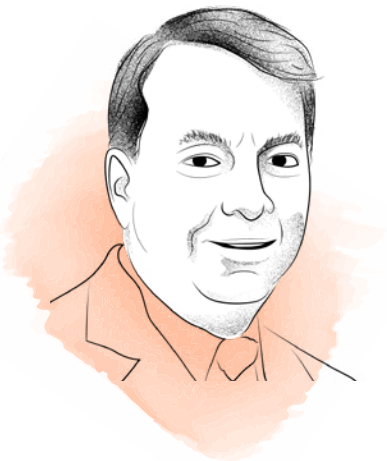
Gregory E. Bottomley

(BSEE '83, MSEE '88)

AN EXPERT on sonar and wireless communications, he recently retired after a career that spanned industry and academia. He worked at AT&T Bell Laboratories and Ericsson, as well as at North Carolina State University. He is a Fellow of the IEEE and has served as Editor in Chief for the IEEE Transactions on Vehicular Technology.

Career Achievement Award

Recognizing an individual who has demonstrated service to the electrical and computer engineering profession, extraordinary accomplishment or stature, and longevity, consistency, and quality of professional contributions.



David W. Roop

(BSEE '76)

ROOP ENJOYED a 43-year career in the electric utility industry focused on electric transmission and substation operation and management. He was elected to the National Academy of Engineering and the Virginia Academy of Science, Engineering and Medicine. He received the 2014 Leadership in Power Award for industry-wide leadership for "changing the landscape of utility human performance and safety; reliability driven asset strategy development; novel catastrophe recovery planning; and the renaissance of power engineering research and education."

Nominations

The new awardees join 12 previous alumni who were inducted in 1998 and 1999. The Honorifics Committee recently revamped the nominations and selection process for ECE's Academy of Distinguished Alumni awards. "We want more alumni to know about these awards, to nominate each other, and to participate," said Paul Ampadu, who chairs the committee.

Alumni must be nominated by another person. Nominations may be submitted year-round through the ECE website (**ece.vt.edu/people/nominations**) and should include basic information on the individual's achievements, such as a bio or CV. Submissions are then verified before going to a selection committee made up of faculty, staff, Industrial Advisory Board members, alumni, and past award recipients.

In addition to the alumni awards, the Honorifics Committee supports ECE students and faculty through the application process for departmental, university, and national awards. "We're here to make the process of applying to awards simpler and more transparent," said Ampadu. "We help ensure the outstanding achievements that come out of the department and its alumni get the acclaim they deserve."

1998 Inductees

Gilbert L. Faison (BSEE '47)
Former president and chairman of Roache Mercer & Faison

Robert B. Fetter (BSEE '47)
Former Professor of Health Care Management at Yale University

Horace G. Fralin (BSEE '48)
Former president of Fralin & Waldron

James K. George (BSEE '64)
Retired corporate vice president of Motorola

Thomas L. Leivesley, Jr. (BSEE '49)
Former vice president and director of Davis H. Elliott, Co.

Harold L. Martin (Ph.D. EE '80)
Chancellor at North Carolina A&T

C. Hyde Tucker (BSEE '56)
Retired president and CEO of Bell Atlantic International

William B. Webber (BSEE '34)
Former vice president of Tektronix

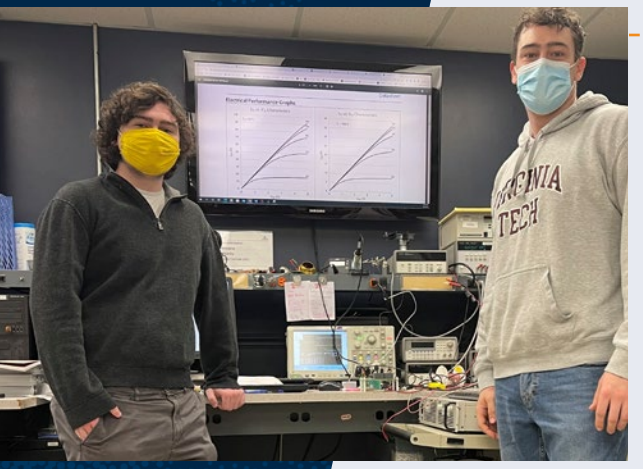
1999 Inductees

Joseph R. Loring (BSEE '47)
Former Chairman & CEO of Joseph R. Loring & Associates

Joe T. May (BSEE '62)
Founder of Electronic Instrumentation Technology, Inc, and former member of the Virginia House of Delegates

Thomas L. Phillips (BSEE '47, MSEE '47)
Former chairman, CEO, and director of Raytheon

ABOVE: An undergraduate student works on a lab assignment in March 2022. Students used the same equipment and parts at home when classes moved online.
BELOW: Researchers had to get creative with lab resources and staffing to maintain safety and distancing requirements during the pandemic.



Pandemic problem-solving

COVID-19 disrupted every part of society, but the ECE department met these changes head on, embracing the advantages of remote research and instruction while tackling the challenges.

Classes, including labs, moved online. Researchers learned to work with limited physical support. And vital resources like the ECE clean room found ways to schedule creatively to manage distancing requirements.

"I'm impressed with how well every member of ECE, from students to faculty and staff, handled the challenges of the past two years," says department head Luke Lester. "Everyone switched to new ways of working, and figured out how to make it work—like the problem solvers they are."

ECE professor Scott Bailey agrees that the department worked together well to meet the changing demands of the pandemic. "Leadership on all levels—starting with our department head down—really stepped up to make sure everything ran smoothly. The department staff was also crucial. I'm proud of how well and quickly our department pivoted to meet the needs of the pandemic."

EXPERIENTIAL LEARNING—VIRTUALLY

Although students and professors faced usual difficulties of online classes—connectivity, engagement, and isolation, some professors found silver linings.

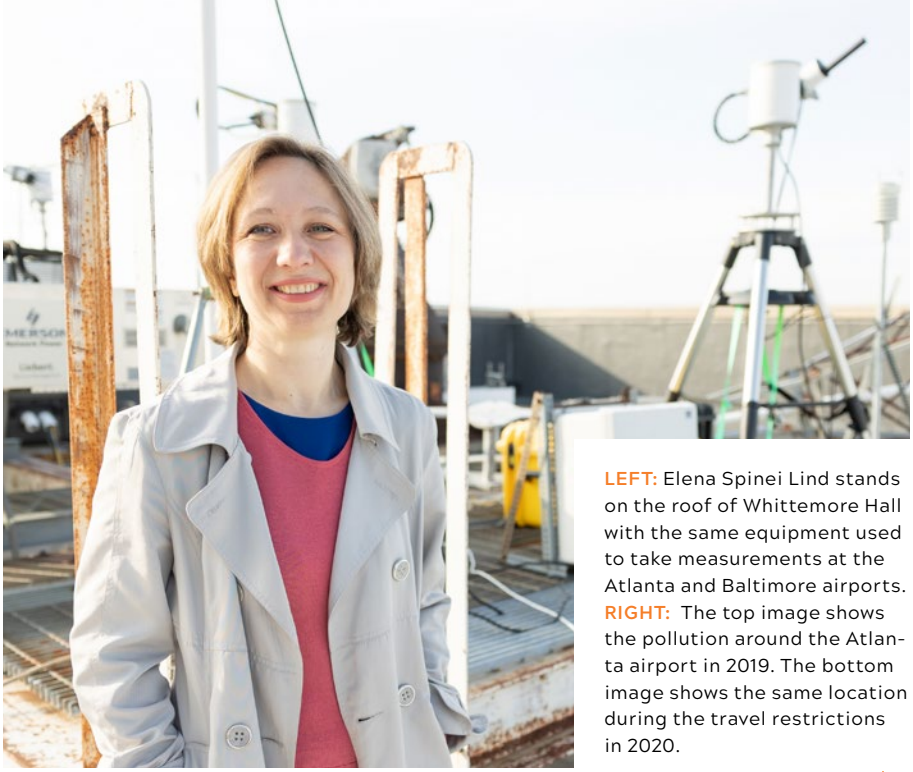
"I kept the chat window open at all times so that I could see student comments and questions in real-time," writes Arthur Ball, ECE collegiate assistant professor. "It turns out that a lot of students who would have been reluctant to speak up in class were perfectly willing to type up a comment in the chat window. The amount of interaction turned out to be more than in in-person instruction!"

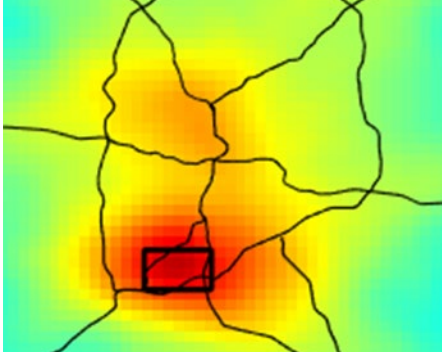
LABS FROM ANYWHERE

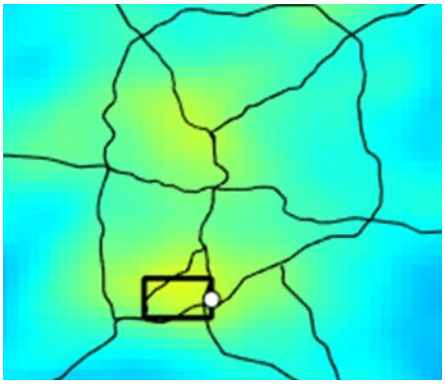
How do you give students a full laboratory experience when they can't use on-campus lab equipment? You send them their own.

ECE students have purchased basic test equipment (including a USB combination oscilloscope, function generator, and network analyzer; a multimeter, and a breadboard) and parts kits for years. This equipment is used throughout the curriculum, and also gives students an opportunity to easily explore and create their own projects. The lab instructors transitioned their courses to use this equipment, and shipped parts kits nationally and internationally to give students what they needed.

Students performed the labs remotely, and received help during synchronous online classes and office hours, as well as through the Piazza question-and-answer app. Not only did this give students a similar experience to what they would have had in non-pandemic conditions, the experience was better in some respects, notes William Baumann, associate professor and Director of Instructional Labs. As students seeking help took pictures and shared their screens over Zoom, "the student was involved in every measurement of the debugging process."







LEFT: Elena Spinei Lind stands on the roof of Whittemore Hall with the same equipment used to take measurements at the Atlanta and Baltimore airports. **RIGHT:** The top image shows the pollution around the Atlanta airport in 2019. The bottom image shows the same location during the travel restrictions in 2020.

Understanding air quality around airports—in a pandemic

Space scientists take advantage of pandemic travel drop

Although the COVID-19 pandemic caused new challenges for both students and researchers, it also triggered some unique research opportunities.

When most travel ceased early in the pandemic, Elena Spinei Lind, an assistant professor of ECE, went to the airport. In a project funded by NASA, Lind and her collaborators at Georgia Tech studied how pollution near airports changed when travel restrictions limited air traffic.

Machines that use a combustion engine, including airplanes and vehicles, leave nitrogen dioxide (NO_2) emissions in their wake. NO_2 is a highly reactive gas that can cause respiratory diseases, participates in ozone formation, and as a result contribute to air pollution. "As electric vehicles become more common," says Lind, "airports might become the biggest source of pollution in a city."

Taking measurements around the Atlanta and Baltimore airports—both from space and at ground level—Lind hopes to understand how these emissions are generated and spread through the atmosphere.

Satellite measurements, taken once daily from a satellite in asynchronous orbit, can measure the total NO_2 in a column above the airport, but can't indicate how high the pollution is at the ground. Most NO_2 is emitted at ground level, explains Lind, then spreads both horizontally and vertically. But airports might show something different, she notes, since so much of their pollution is generated above ground level.

Lind's team took similar measurements from the ground to get a more complete picture. "The ground measurements tell us how the NO_2 is spreading out," she says. Their instruments included ultraviolet-visible spectrometer systems and sky camera, measuring both NO_2, formaldehyde and sky cloud cover.

Although the limited travel of the pandemic showed significant changes in the NO_2 near airports and gave Lind a lot of useful data, she notes that it's still difficult to tell what actually causes the pollution she's seeing. "The hardest part is decoupling where the emissions are really coming from," she says. "On-road traffic bounced back much faster than airplanes. Untangling all this is very complex."

Lind and her team continue to process the huge amounts of data they collected. The instruments measure the gas absorption by solar photons traveling through the earth atmosphere, and radiative transfer models describe the path those photons traveled, Lind explains. "We have to understand the effects of aerosols and clouds on photon scattering to fully interpret the measurements." Only then can they derive the NO_2 vertical distribution and determine where the NO_2 really is at the airports and how the pandemic changed its distribution.

New faculty members

2019-2020

Almuatazbellah Boker

Collegiate Assistant Professor

Ph.D., Electrical Engineering, Michigan State University, 2013
M.S., Control Systems Engineering, the University of Sheffield, UK, 2003
B.Eng., Mechatronics Engineering, the University of Leeds, UK, 2002

AREAS OF INTEREST: Estimation and control of dynamic systems, Multi-time scale systems, Singular perturbation methods

Creed F. Jones

Collegiate Professor & M.Eng. Program Director (Blacksburg)

Ph.D., Computer Engineering, Virginia Tech, 2005
M.S., Electrical Engineering, Oakland University, 1982
B.S., Electrical Engineering, Oakland University, 1980

AREAS OF INTEREST: Image processing, Machine learning, Image-based biometric identification, Imaging for detection of eye diseases

Vassilios Kovanis

Collegiate Professor & M.Eng. Program Director (Northern Virginia)

Ph.D., Theoretical Physics, the University of New Mexico, 1992

B.S., Physics, University of Athens

AREAS OF INTEREST: Photonics, Tunable photonic oscillators, Photonic synthetic matter

Ali Mehrizi-Sani

Associate Professor

Ph.D., Electrical Engineering, University of Toronto, Ontario, Canada, 2011

M.S., Electrical Engineering, University of Manitoba, Manitoba, Canada, 2007

B.S., Electrical Engineering, Sharif University of Technology, Tehran, Iran, 2005

B.S., Petroleum Engineering, Sharif University of Technology and Petroleum University of Technology, Tehran, Iran, 2005

AREAS OF INTEREST: Grid/microgrid integration of inverter-based renewables, High-performance controls, Cybersecurity of communication-based control and protection methods

J. Scot Ransbottom

Collegiate Associate Professor

Ph.D., Computer Engineering, Virginia Tech, 2004

M.S., Computer Science, Duke University, 1997

B.S.E.E., Electrical Engineering, Ohio University, 1988

AREAS OF INTEREST: Cybersecurity, Networking, Computer engineering

Adnan Sarker

Instructor

M.S., Electrical and Computer Engineering, New Mexico State University, 2017

B.S., Electrical and Electronics Engineering, Khulna University of Engineering and Technology, 2009

Leonard (Lenny) Smith

Professor

Ph.D., Physics, Columbia University, 1987

M.Phil., Physics, Columbia University, 1983

M.A., Physics, Columbia University, 1982

B.S., Physics, Mathematics & Computer Science, University of Florida, 1980

AREAS OF INTEREST: Modeling and predictions

Tim Talty

Collegiate Professor & M.Eng. Director of Admissions (Blacksburg)

Ph.D., Electrical Engineering, University of Toledo, 1996

B.S., Electrical Engineering, Trine University, 1987

Areas of interest: Mobile communications, Intra-vehicle wireless sensor networks, Physical layer privacy and security

Haining Wang

Professor

Ph.D. Computer Science and Engineering, University of Michigan, 2003

AREAS OF INTEREST: Cybersecurity, Networking systems, Cloud computing, Cyberphysical systems

Shuxiang Yu

Instructor

M.Eng., Electrical Engineering, Virginia Tech, 2019

B.A., Economics, Virginia Tech, 2019

B.S., Electrical Engineering, Virginia Tech, 2017

NEW FACULTY MEMBERS

2020-2021

Thinh Doan

Assistant Professor

Ph.D., Electrical and Computer Engineering, University of Illinois, Urbana-Champaign, 2018
M.S., Electrical and Computer Engineering, University of Oklahoma, 2013
B.S., Automatic Control, Hanoi University of Science and Technology, 2008

AREAS OF INTEREST: Control theory, Optimization, Reinforcement learning, Cooperative control and decision making in multi-agent systems

Scott Dunning

Collegiate Professor & Director of ECE Undergraduate Program

Ph.D., Electrical Engineering, University of Maine, 1999
M.S., Electrical and Electronics Engineering, University of Maine
B.S., Electrical and Electronics Engineering, University of Maine, 1988

AREAS OF INTEREST: Energy Efficiency, Energy Systems, Engineering Pedagogy

Sook Shin Ha

Collegiate Assistant Professor

Ph.D., Computer Engineering, Virginia Tech, 2012
M.S., Information Technology, Virginia Tech, 2015
B.S., Computer Science, Virginia Tech, 1994

AREAS OF INTEREST: Biological data analysis, Machine learning, Drug-drug interactions, Scientific web tools

Ruoxi Jia

Assistant Professor

Ph.D., Electrical and Electronics Engineering, University of California, Berkley, 2018
B.S., Microelectronics, Peking University, 2013

AREAS OF INTEREST: Machine learning, Privacy, Security, Cyber-physical systems

Ming Jin

Assistant Professor

Ph.D., Electrical Engineering, University of California at Berkeley, 2017
B.Eng., Electrical and Computer Engineering, Hong Kong University of Science and Technology, 2012

AREAS OF INTEREST: Optimization, Control, Machine learning, Cyber-physical systems

Mary Lanzerotti

Collegiate Assistant Professor

A.B., Physics, Harvard University, 1989
M. Phil., Physics, University of Cambridge 1991
M.S., Experimental Physics, Cornell University, 1994
Ph.D., Physics, Cornell University, 1997

AREAS OF INTEREST: Integrated circuits for high-performance server chips and aerospace applications, Data science, Signal processing

Alan Michaels

Professor and Director of NSI Spectrum Dominance Division

Ph.D., Electrical and Computer Engineering, Georgia Tech, 2009
M.B.A., Georgia Tech, 2008
M.S., Operations Research, Georgia Tech, 2005
B.S. & M.S., Applied Mathematics, Georgia Tech, 2003
M.S., Electrical and Computer Engineering, Georgia Tech, 2001
B.S., Electrical Engineering, Georgia Tech, 2000

AREAS OF INTEREST: RF spectrum dominance, Applied mathematics and cryptography

Angelos Stavrou

Professor

Ph.D., Computer Science, Columbia University, 2007
M.S., Electrical Engineering, Columbia University, 2002
M.S., Algorithms, Computability and Logic, National University of Athens, 2001
B.S, Physics, University of Patras, 1997

AREAS OF INTEREST: Large systems security & survivability, Intrusion detection systems, Privacy preserving technologies, Security for MANETs and mobile devices

2021-2022

Ravi Raghunathan

Collegiate Assistant Professor

Ph.D., Optical Science and Engineering, University of New Mexico, 2013
M.S., Optical Science and Engineering, University of New Mexico, 2010
M.S., Electrical Engineering, University of Southern California, 2006
B.AS., Electrical Engineering, University of Windsor, 2003

AREAS OF INTEREST: Quantum photonics, Optical phenomena, Nanophotonics, Quantum optoelectronics

Linbo Shao

Assistant Professor

Ph.D., Engineering Sciences, Harvard University, 2019
M.S., Applied Physics, Harvard University, 2016
B.S., Microelectronics, Peking University, 2014

AREAS OF INTEREST: Integrated photonics, Electro-optics, Quantum photonics, Phononics, Surface acoustic waves, Lithium niobate, Diamond color centers, Nanofabrication

Nektaria Tryfona

Collegiate Associate Professor

Ph.D., Computer Engineering and Informatics, University of Patras, 1995
Computer Engineering and Informatics Degree, University of Patras, 1991

AREAS OF INTEREST: Data science and machine learning, Data management, Data valuation and AI, Spaciotemporal databases, Educational informatics

Jeff Walling

Associate Professor

Ph.D., Electrical Engineering, University of Washington, 2008
M.S., Electrical Engineering, University of Washington, 2005
B.S., Electrical Engineering, University of South Florida, 2000

AREAS OF INTEREST: RF, analog, and mixed-signal systems, 6G communications

Wenjie Xiong

Assistant Professor

Ph.D., Electrical Engineering, Yale University, 2020
M.S., Electrical Engineering, Yale University
B.S., Microelectronics, Peking University, 2014
B.S., Psychology, Peking University, 2014

AREAS OF INTEREST: Computer architecture and security, New physically unclonable functions (PUFs) in DRAM, Cover channel attacks in processor caches

Richard Zhang

Hugh P. and Ethel C. Kelly Professor

Ph.D., Virginia Tech, 1998
M.S., Tsinghua University, 1993
B.S., Tsinghua University, 1989

AREAS OF INTEREST: Electrified green infrastructure power conversion including grid integration of renewables, High power EV charging, Energy storage, Clean hydrogen production

First cohort to graduate with the new ECE curriculum

This spring, the first cohort students will graduate from ECE's new undergraduate curriculum. Over the past few years, the ECE department has overhauled its undergraduate curriculum—introducing new majors and core classes. The goal is to prepare students for diverse careers, and give them the tools they need to thrive in today's world. The curriculum emphasizes foundational knowledge, hands-on learning, and open-ended design projects at every level.

The new base courses include Introduction to ECE Concepts, taken in students' first-year spring semester, six courses covering fundamental topics in the sophomore year, and the Integrated Design Project, also taken in the sophomore year, in which students use skills from those first seven courses to solve an open-ended design challenge.

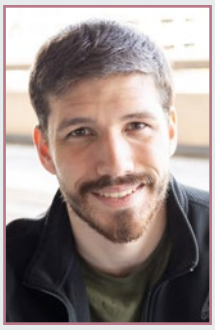
Once students have completed these courses, they can pick focus areas to emphasize in their junior and senior years.

Here's what our students have to say as they've moved through the curriculum:

Danny Flynn

THEN: As a sophomore, Flynn said "Getting into the meat of the courses has been really fun. There are a lot of hands-on assignments now. Every course has a hands-on lab, or out-of-class experience designing something. In 1004, we got to experiment with solar panels and all that stuff you wouldn't normally see until later on." Flynn joined the RockSat-X design team as a sophomore to further apply his knowledge.

NOW: Now a senior, Flynn says that his last two years of courses have helped him find his passion and given him the background to be a leader on design projects: "I've radically changed my interests (now I am much more interested in communications and RF) and chose Communications & Networking as my concentration based on that. I am also in charge of the RockSat-X team now, and getting a strong foundation in all of ECE (rather than just EE) has really helped me lead the team."

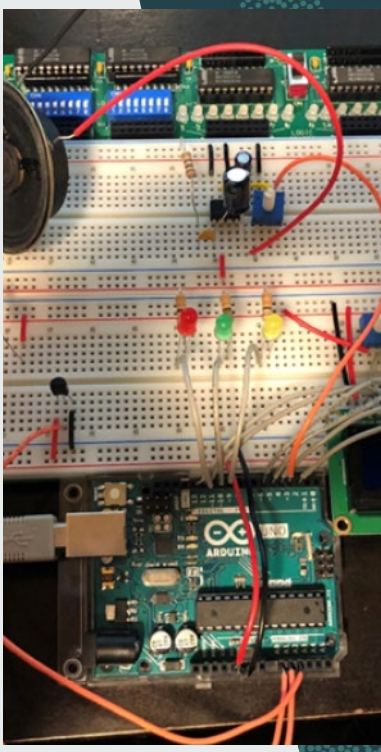


Eli Socash

THEN: As a sophomore, Eli Socash found the curriculum helpful for choosing his major. "Getting the EE side and the CPE side helps you decide how to specialize in one of those fields...I found I wasn't a fan of wiring circuits, but loved microcontrollers."

He also found that the projects were good talking points during interviews: "One thing I enjoyed talking about in interviews was that I got to simulate a 16-bit computer. I'm not just sitting in a desk in a classroom, it's more like I'm applying the classroom knowledge to projects."

NOW: As a senior, Socash appreciates the same aspects of his education: "With this new curriculum, we are challenged to create solutions for applications we could see after college with a mix of both electrical and computer engineering knowledge. My experience of working with a classmate (even during COVID) to design and build a project for the new sophomore Design class is what helped me land all my internships and my job with Textron that I will be starting after graduation."



THE SMART HOME SYSTEM designed by Eli Socash in his sophomore design class.

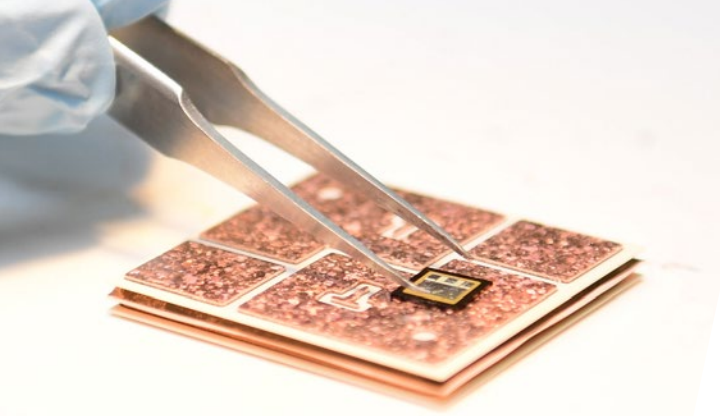
PHOTO SUBMITTED BY TAYLER ANDERSEN

Tayler Andersen

Tayler Andersen, a Controls, Robotics, and Automation major graduating this spring, found the problem-solving aspects of her classes particularly valuable: "I feel as though I have enough tools to encounter a problem and come up with some solutions to solve it." Andersen will be starting a full-time position as a verification engineer with Volvo Trucks after graduation.

Meghana Mudunuri

Meghana Mudunuri says she enjoyed the sense of community that came with being the first class going through the new curriculum. She also found the projects particularly good learning experiences: "Most of the classes are heavily project based, which I have come to genuinely enjoy because that is always where I am able to learn the most, forcing me to actualize concepts and apply them." Mudunuri will be staying at Virginia Tech for another year in ECE's accelerated master's program.



JOY ASICO

ABOVE: A power semiconductor device on a multi-layer ceramic substrate.
RIGHT: Christina DiMarino uses a multi-purpose die and flip-chip bonder.

Packaging for power

CPES Power Electronics Integrated Packaging Lab

The promise of power electronics to improve the efficiency and reliability of our nation's electrical grid depends in large part on packaging the components to maximize performance and minimize cost. New materials, new algorithms, and innovative architectures cannot succeed if they are too expensive and cumbersome to implement.

The solution, according to Christina DiMarino, assistant director of the Center for Power Electronics Systems (CPES), requires not only packaging innovations, but also engineers and scientists who are skilled in the highly niched specialty of power electronics packaging. CPES, the leading research center of its kind, is answering that need with a new innovative power electronics packaging lab in Northern Virginia.

MEETING THE PACKAGING CHALLENGE

The CPES integrated packaging lab provides students and researchers with the resources, support, and the inspiration they need to find new ways to improve power electronics packaging.

Integrated into the grid, power electronics can actively control the power flow and add new functionalities like bidirectional power flow and islanding, a technique for isolating a fault. Reducing the size of power electronics can cut back on the amount of material used as well as installation and maintenance costs. But then the challenge is packaging.

Bad packaging can cause a fault in the system. If the package fails, the semiconductor device could overheat, resulting in a short-circuit or open-circuit failure.

"When you have high voltage over a small distance and high electric fields, you need to develop strategies for grading those fields and selecting appropriate materials," explained DiMarino, who is an ECE assistant professor. "That's what we're doing here in the packaging lab."

AT THE CUTTING EDGE

Along with materials, algorithms, and innovative architectures, packaging and integration is a critical component that CPES targets on its mission to advance technology and prepare the workforce of the future.

Located in the National Capital Region at the Virginia Tech Research Center-Arlington, the new lab was built thanks to $143,000 in donations from 33 donors to the ECE General Fund. The lab strengthens relationships with industry partners and government agencies. Students forge career opportunities and working professionals in the greater Washington D.C. area have access to graduate studies in power electronics systems.

The lab is equipped to process materials, evaluate electrical characteristics and performance, analyze thermal performance and thermo-mechanical reliability, laser cut, etch, and 3D print, among other capabilities, said DiMarino.

"We work really hard to design and prototype these packages, only to destroy them," said DiMarino. "And then of course, we can build them better."

Mastering the machines

Normally, the manufacturers install and calibrate new equipment, but during the COVID-19 pandemic, those tasks have fallen to lab faculty members and students.

"It's been time consuming and challenging, but I think we all better understand the equipment—especially that new thermal analyzer," said DiMarino. "Now all my students are itching to use it to test their packages."

JOY ASICO

CPES GRADUATE STUDENT
He Song uses a stereolithography 3D printer.

A snapshot of the integrated packaging lab's new equipment

Programmable hot plates set the appropriate temperature profiles and can be used for solder reflow processes or silver centering, which is an alternative to solder that enables higher thermal conductivity, improved reliability, and better high temperature operation.

The hydraulic hot press enables pressure-assisted centering for bonding larger areas.

The wire bonder is fairly traditional for power electronics packaging, but the CPES lab will soon be receiving a die bonder for more advanced interconnect bonding for power electronics packaging like flip-chip packaging—where you flip the chip upside-down to achieve a shorter interconnect—and the ability to bond discrete interconnects onto the die directly. The latter yields greater current capability and double-sided cooling for more power output than traditional wire bonding.

A bond tester tests the quality of the bonds, measuring how much force it takes to shear or pull off a bonded component.

Thermal cycling chambers subject assembled packages to thermo-mechanical stress, and accelerates failure. Then the researchers can perform detailed failure analysis to understand exactly how the packaging failed.

A thermal analyzer allows researchers to gauge thermal resistance and heat flow. The machine also allows for active power cycling, which uses the semiconductor as the heat-generating component, as it would be in the actual application, creating different failure mechanisms. It also allows researchers to measure individual thermal resistances for each the package components.

JOY ASICO

CPES GRADUATE STUDENT
Narayanan Rajagopal uses a multi-purpose bond tester.

Empowering student entrepreneurship

As an ECE professor at Virginia Tech and a founder of Kryptowire, a leader in cloud-based mobile security and privacy solutions, Angelos Stavrou works at the intersection of engineering and entrepreneurship. And at this stage in his career, Stavrou has been asking: how do I give back?

"To me," he answers, "if we really care about diversity in engineering, then we need to enable students to succeed—beyond a siloed role on an engineering team."

For Stavrou, this means empowering students with the education and opportunity to incubate new companies. He points to Virginia Tech's Link License Launch as part of a greater emphasis on entrepreneurship at the university and possibly for Virginia to be a new start-up hub.

"Why not Virginia?" he asks. Citing the growth of tech hubs in Colorado and Texas, Stavrou argues that Northern Virginia and the new innovation center ramping up in Alexandria have their own advantages—including the potential for a mix of innovation tied to government as well as for innovative products used by everyone. His own company, Kryptowire, he explains, started with technological innovation tied directly to government contracts before broadening their market.

STARTUP SUCCESS

Kryptowire just raised $21 million of venture capital in February 2022, so Stavrou is well-versed in the finance side of the start-up equation.

He describes his own learning process regarding how to navigate the ecosystem of angel investing and venture capital, and he sees now that Kryptowire could have done better by taking VC funds and growing faster.

Until a couple of years ago, Kryptowire didn't even have a salesperson, he says. Anyone can raise money, he adds, but it's important to raise it from a competitive VC network that will help you grow. He is currently helping friends, professors primarily, avoid some of his mistakes. "Failing fast instead of languishing is better," he quips, "is something I need to instill in others."

NECESSARY RISK

To further explain, Stavrou compares the United States to Europe, where there are no possibilities for bankruptcy. Here in the U.S., however, VCs expect some or most ventures to fail, and that is part of the system. Failure in some sense is the model. This is very different from what our engineering students think about failure, he jokes.

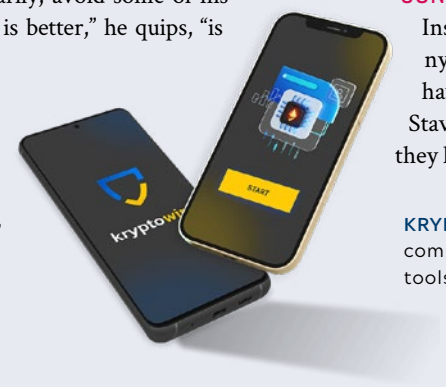
The trick, he says, is to teach what it means to take the necessary, calculated risks. Many successful entrepreneurs have failures under their belt and have learned from them. In that way, failure is valuable feedback that can lead to future success. Just like in a lab, Stavrou explains. "Some of your experiments will fail, but they will potentially teach you a lot. Our students need to learn and be comfortable with failing as part of the learning process," he says, and have the experience in a controlled setting like the incubation center.

Learning from the overall process, Stavrou emphasizes, is the main point. "We are doing a disservice to our students when we train them to be highly skilled but don't give them all the options," he says. And one big option is entrepreneurship itself.

> **"We are doing a disservice to our students when we train them to be highly skilled but don't give them all the options."**
>
> **—Angelos Stavrou**

CONSIDERING ALL THE OPTIONS

Instead of graduating and joining a big company, students can create their own. They might not have security and stock options and a medical plan, Stavrou says, but at the end of the 2–3 year process, they have a shot at making something of their own and



KRYPTOWIRE, Angelos Stavrou's company, provides developers with tools to make sure their code is secure.

JOY ASICO

growing it. There are many responsibilities, but also many benefits, he points out. The experience of being CEO, salesman and head of marketing is invaluable, Stavrou believes, even if they later join a big company. In fact, he notes, many large companies hire people with startup experience at leadership roles instead of entry-level positions.

Not paying attention to the stages of innovation, intellectual property and business plans because we are technologists or engineers, Stavrou cautions, can be detrimental, even though it requires a bit more work.

While Stavrou involves students in his company through internships and co-ops, he also encourages them to join other start-ups. Most importantly, he wants them to look at their ideas from a business standpoint. "I do not want them to be fearless but less conservative—allow for a little more calculated risk-taking," he explains.

He is trying to empower them to believe they can actually be the next Elon Musk or Jeff Bezos. "Why not see how they do?" he asks. Some will start their own companies, and others will not, he says. But they will all learn valuable lessons from the process.

"You don't have to be the person who comes up with the idea, which is something I learned personally. You can be the person who recognizes the value of the idea and has the team to build it up."

"Maybe a Virginia Tech student will found the next big tech company. We'll never know unless we try."

Seeking safety among interconnected devices

At Kryptowire and in his university research, Angelos Stavrou explores how to balance privacy and security with the proliferation of interconnected devices and systems. This area, he believes, is ripe for innovation and full of entrepreneurial opportunity.

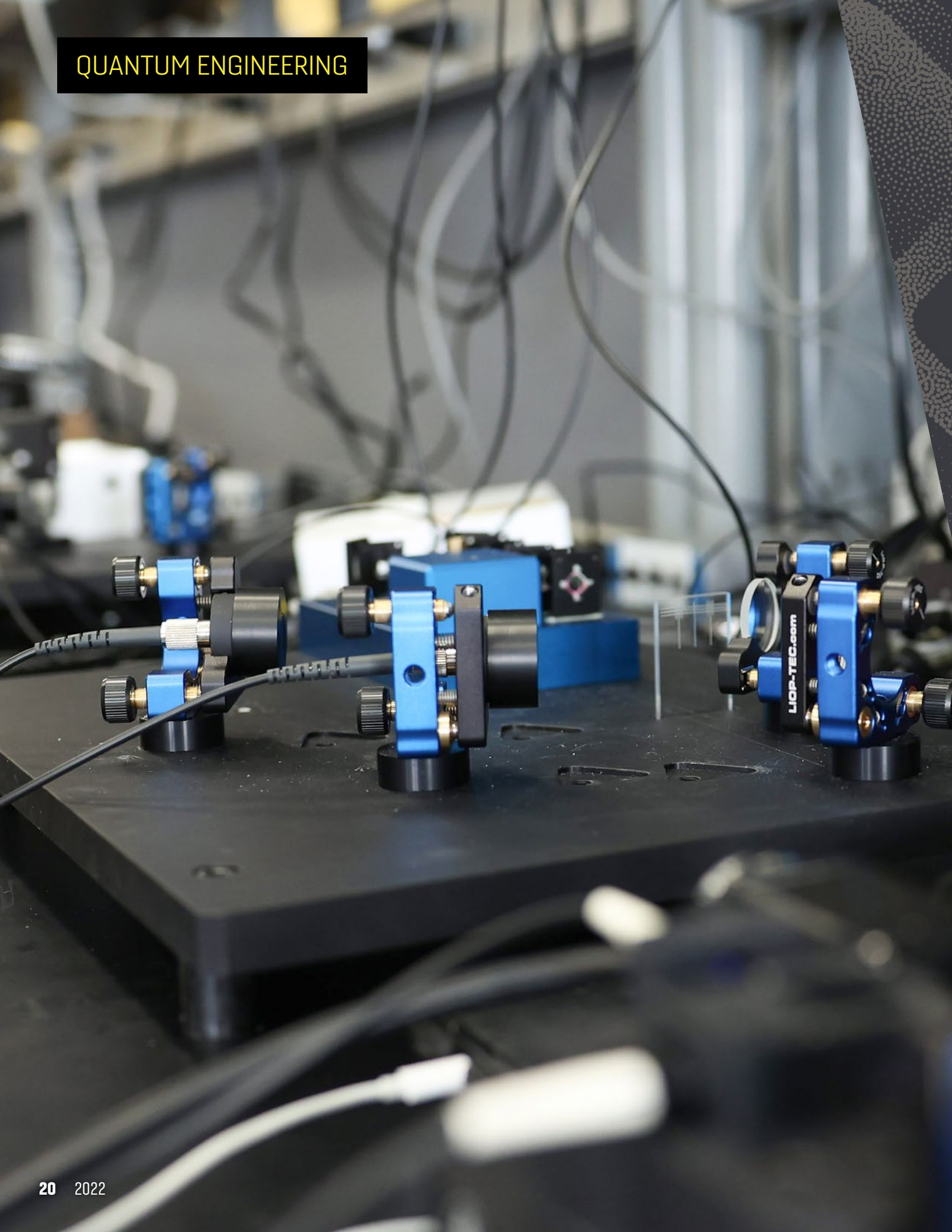
With 5G internet connections, he explains, we are a lot more exposed, so one important question is about how we can protect the end user. Can someone access your television and record what you are up to? What happens to your voice when it is recorded by Alexa or Google Assistant? What if someone gains access to the medical data on your FitBit? On a larger scale, Stavrou explains, 5G security issues include infrastructure access. Can you break into a water plant and shut systems off while disguising what you are doing? And now that we have Wi-Fi systems in our homes and cars, how vulnerable are they, and what are the risks to our privacy?

Designing an entrepreneurial building data platform

Angelos Stavrou is collaborating with the civil engineering and construction departments to establish an Internet of Things (IoT)-enabled building data platform that will allow for the research and development of innovative approaches to sustainable, smart, and connected communities.

Focused on under-represented communities, the project will design and develop buildings for connected communities that meet the smart building/community/city paradigm that envisions the effective integration of physical, digital, and human systems working together. The goal is to work toward sustainability, prosperity, and inclusivity, he says. This includes systems and technologies geared toward Virginia's 2045 carbon-free goal, as well as the related socioeconomic and technology elements.

The plan, Stavrou explains, calls for Virginia Tech to supply 5G internet service to these communities in Arlington and in the Blacksburg area and collect environmental data (temperature, barometric pressure, noise, etc.) as well as energy consumption data to optimize energy efficiency while promoting social integration and educational opportunities through high-speed internet access.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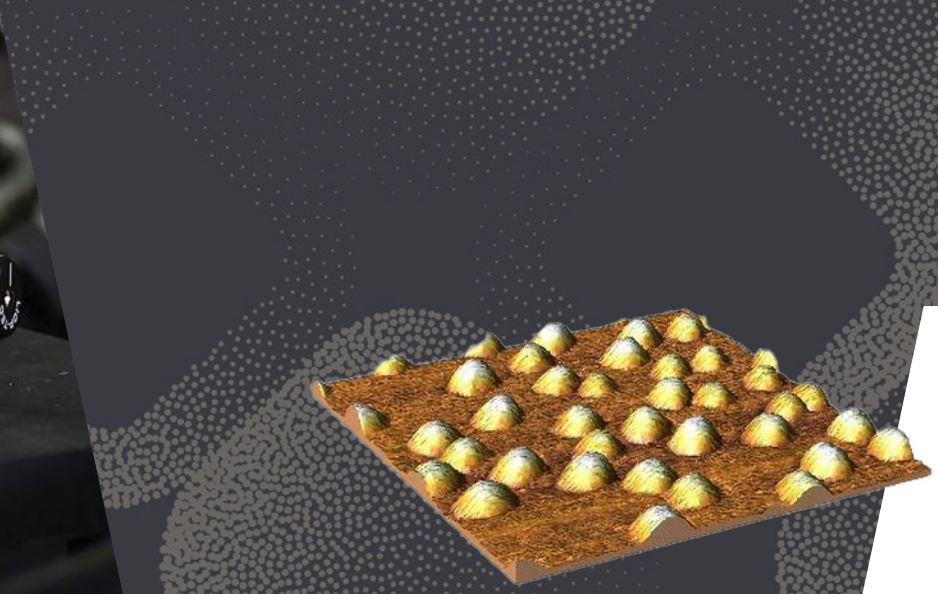
Big plans for really, really small engineering



ABOVE: Quantum dots grown on an InGaAs thin film on a GaAs substrate.
LEFT: Equipment in the new quantum engineering lab.

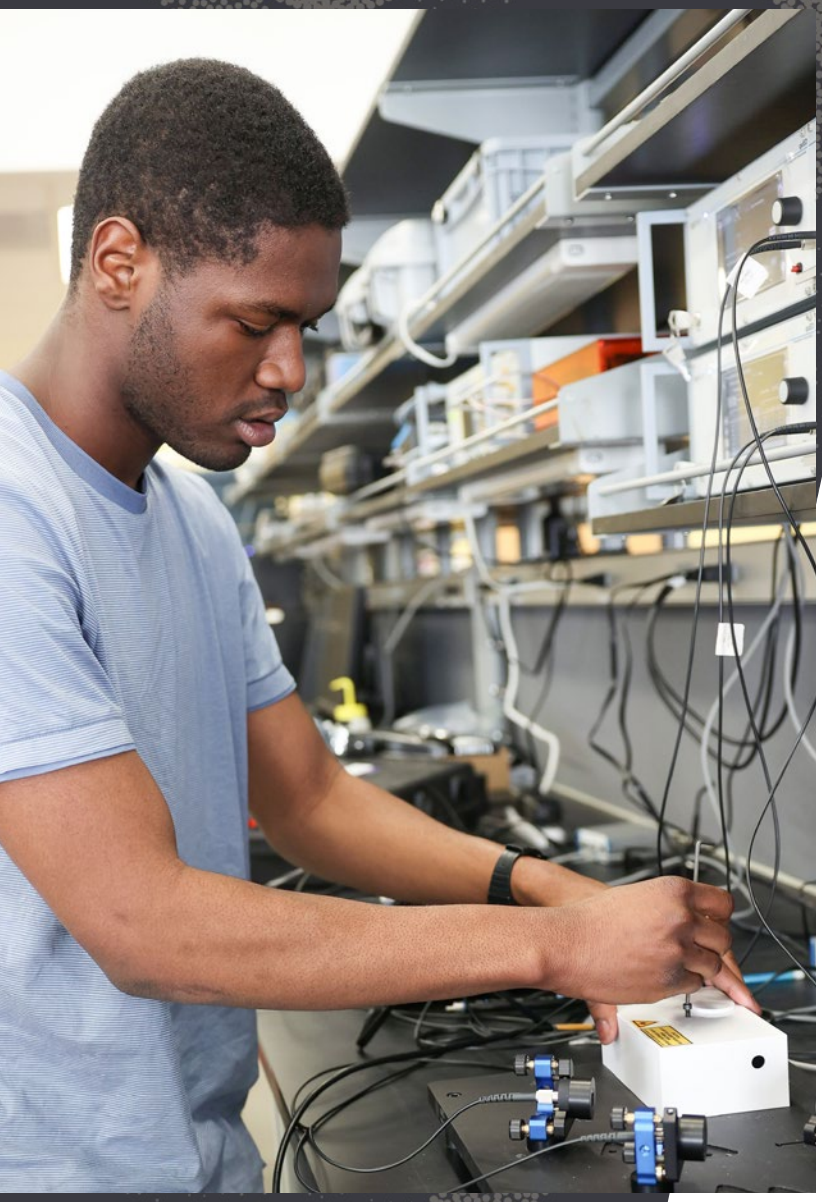
Smaller isn't always better, but when it comes to quantum engineering, quantum-scale developments are ready to change the world. "ECE research is critical to a global effort to advance quantum engineering research and train the new generation of quantum engineers," says Department Head Luke Lester, "And our department is well positioned to be part of the quantum revolution."

Quantum engineering is poised to revolutionize society, notes Lester. It could improve our communications systems, bring us new methods for securing data, make our devices more energy efficient, and, of course, make computers smaller.

According to ECE Professor Wayne Scales, who is working on the curriculum side of ECE's efforts, quantum is the natural next step in computing, following mechanical switches and transistors, and the impact could be just as huge.

Quantum engineering isn't just our usual engineering on a smaller scale, however. At quantum levels, different physical laws and phenomena apply than

QUANTUM ENGINEERING



GRADUATE STUDENT Sefunmi (Shef) Ashiru in the quantum engineering lab—he is one of the first to experiment with the new equipment.

what we're used to at a larger scale. Quantum engineering requires interdisciplinary expertise, including electrical and computer engineering, materials science, computer science, physics, chemistry, and math.

TWO NEW CENTERS FOR QUANTUM RESEARCH

To overcome this interdisciplinary hurdle, Virginia Tech is forming two centers for quantum engineering—one in Blacksburg, and one in Alexandria. These centers will bring together researchers from multiple fields to tackle quantum challenges.

The Center of Quantum Architecture and Software Development will be part of the Innovation Campus in Alexandria, and is partially funded by a $12.5 million gift from Northrup Grumman.

The Virginia Tech Center for Quantum Information Science and Engineering will be the Blacksburg-based complement of the Alexandria center, and will tackle broad research topics from cryptography to atomic clocks.

ECE QUANTUM RESEARCH

Several ECE faculty members already have active quantum engineering research projects.

Lester, along with Mantu Hudait, associate professor of ECE, are researching quantum dot devices—and the materials needed to create them. Their team is crafting devices like ultrafast lasers, single photon sources, and high efficiency solar cells.

New assistant professor Linbo Shao is investigating quantum information processing on silicon substrates. These high-performance devices use microwave, acoustic, and optical devices.

Vassilios Kovanis, collegiate professor & MEng program director for Northern Virginia, is working on non-hermitian quantum mechanics, that uses a combination of dissipation and unitarity in contrast to traditional quantum mechanics. Within this context, he is developing tunable photonic oscillators and photonic clocks, as well as a variety of ultra-sensitive sensors.

Collegiate Assistant Professor Ravi Ragunathan is working on a quantum key distribution testbed that can integrate with cyber and RF modalities.

QUANTUM EDUCATION

In addition to quantum research programs, ECE is developing a new curriculum and new courses to train the next generation of quantum engineers.

"It's a big debate on how to train students in quantum engineering, because it's so interdisciplinary," says Scales.

GRADUATE STUDENT Sefunmi (Shef) Ashiru, Director of Cardinal Education & Associate Director of Engineering Online Natasha Watts, and Wayne Scales talk in the new quantum engineering lab. This new class allows students to get hands on experience on the quantum scale.

Because this curriculum has potential to impact so many technology communities, both the Commonwealth Cyber Initiative (CCI) and the Institute for Critical Technology and Applied Science (ICTAS) have helped fund the laboratory development.

One thing that is a certainty for training quantum engineers: the need for a quantum laboratory course for hands-on learning. The course—taught for the first time during Spring 2022—is intended for students in both engineering and science fields.

Currently, such experiential learning laboratory infrastructure is not common in the United States. The course is quantum photonics based and covers fundamental quantum science concepts, quantum communication, quantum cryptography, and quantum sensing. Although the course is initially taught at the graduate level, Scales plans to offer it to undergraduates—possibly even to those in their sophomore year.

Ultimately, Scales plans to offer a virtual laboratory as well as the in-person experience, enabling more students to gain access to this training. "You can log in remotely to the control panel, and run the experiments," he explains. Therefore, students on other campuses or other universities, as well as working professionals, could then benefit from the Virginia Tech lab.

Scales is also building partnerships with other universities who could then offer the laboratory as part of their programs—particularly universities that could help underrepresented minorities gain access to the tools. "It's an enormous educational opportunity," notes Scales.

"We need to train students from multiple departments, including ECE, materials science, computer science, physics, chemistry, and math in the same core knowledge."

—Wayne Scales

The course development doesn't stop with universities, however. "Ultimately everything will have quantum devices, and we'll need to train people at trade schools and community colleges in quantum concepts," says Scales, "and even K-12 students. It's a completely new way of thinking for the average person."

The field is shifting, notes Scales, from being purely basic science. "It's evolving to be it's own engineering discipline, with critical new applications including cybersecurity, quantum communications, quantum sensing, and quantum materials."

Micro tech, macro effect

Shrinking a 30-pound gas analyzer to a wearable badge

Each of us is exposed to thousands of chemicals daily. Most are harmless. Some are not. Knowing when we're exposed to harmful chemicals is vital for workplace safety, but monitoring efforts are hampered by the large size of the technologies typically needed to detect these chemicals.

The gold standard for detecting what's in the air we breathe is gas chromatography (GC)—an analytical method for determining the chemical composition of a gas using a device that runs gases through several meters of a capillary tubing known as a separation column. The size and expense of conventional GC equipment, however, present a challenge when trying to analyze in real-time, as does the time-consuming process of sending samples to a lab.

The solution, according to ECE Professor Masoud Agah, is a portable and/or wearable micro-GC, which combines a variety of different technologies. Over the last 17 years, his teams have made numerous advances to miniaturize GC technology and to develop new GC architectures. GC suitcase-sized equipment typically weighs 30 pounds or more. "We want to make something you can wear, without noticing the weight," he says.

Today, Agah and co-investigators from across the university are collaborating on a $2.3 million grant from the National Institute for Occupational Safety & Health (NIOSH) to create mobile tools to monitor workplace chemical exposure—in particular for truck drivers who risk exposure to hazardous chemicals from exhaust fumes, cargo, and gases released during fueling.

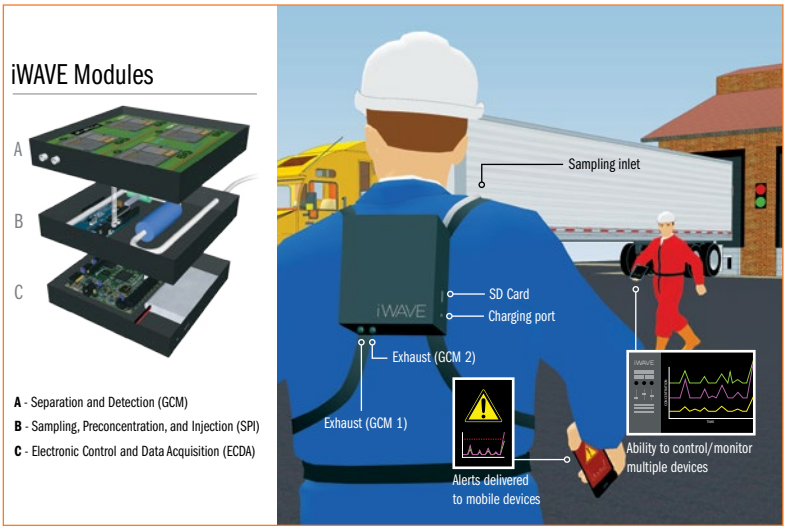
The interdisciplinary team is using micro-GC technology to create a completely new form of personal protective equipment. "For some occupations where people may be exposed to dangerous chemicals, we don't have real-time analysis," says Agah. "This project tries to tackle that."

Using conventional methods, exposure is measured by capturing data over periods of 6 to 12 hours, offering only a broad overview. The Virginia Tech researchers plan to change that, collecting near-term data that can be used to identify when and where the drivers are exposed, and what additional safety practices can help protect them.

The researchers are employing multiple technologies to optimize a micro-GC device they call the iWAVE (intelligent Wearable Analyzer for Vapor Exposure).

The iWAVE combines a number of technologies, including micro-electromechanical systems (MEMS) and semiconductor fabrication, embedded computing, microfluidics, machine learning, and 3D printing. The device provides near-real-time analysis of the environment surrounding the wearer—monitoring chemical

THE IWAVE is a micro gas chromatography device that can be worn as a small backpack. It flags hazardous chemicals that workers might be exposed to.



COINVESTIGATORS on the NIOSH project include: Professor Linsey Marr of Civil and Environmental Engineering, Professor Leyla Nazhandali of ECE, Andrew Miller and Andrew Alden of the Virginia Tech Transportation Institute, Associate Professor Julia Gohlke, of the Virginia-Maryland College of Veterinary Medicine; and Associate Professor Inyoung Kim, of Statistics.

exposure levels on the fly and flagging any dangers. "If you are exposed to acetone, it's probably fine," Agah notes. "If it's benzene, that's a different story."

CRAFTING THE IWAVE

Miniaturizing GC technology is not simple. iWAVE devices will perform the functions of an entire benchtop apparatus, process the data, and wirelessly communicate with cloud-based analytics. From microchips to electrical and fluidic connectors, pressure regulators to electronic and computing circuits, every step needs unique solutions to perfect the balance between efficiency, power, and size.

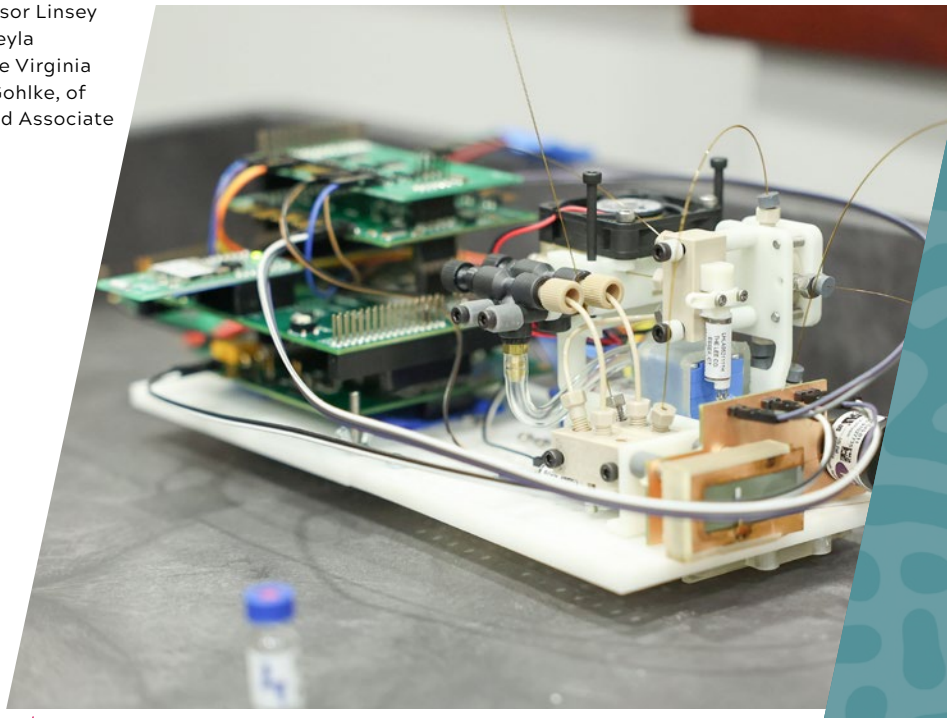
The current iteration of the device is built on student innovation, Agah explains. "A lot of what we have done in the lab are things the students bring to the table. They don't give up. For some of the students it took two years to get past the first barrier, but eventually they succeeded."

With the new iWAVE devices, the researchers will train cloud-based machine learning algorithms to detect dangerous compounds, and inform safety policies of the future.

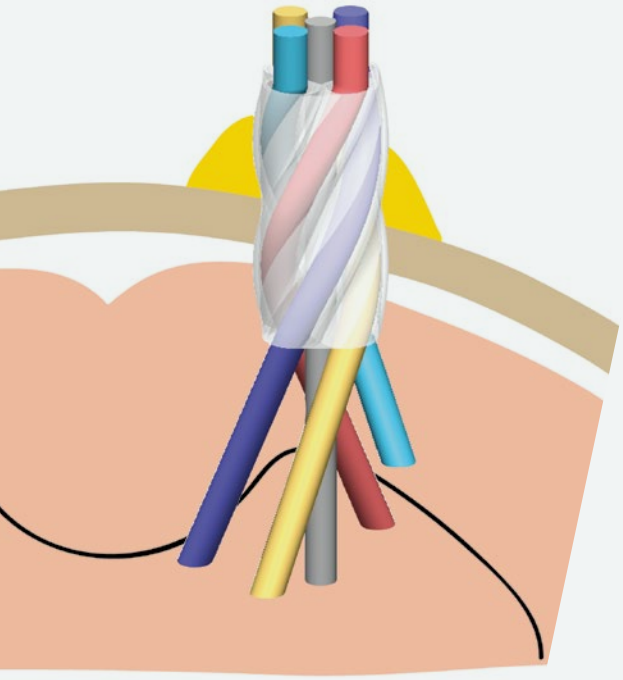
BEYOND THE WORKPLACE

But the applications do not stop there. This technology can translate chemical compounds in the air into a digital signature—expanding our understanding of our environment and surroundings. The iWAVE and micro-GC could open new avenues to evaluate personal health through breath and skin odor analysis, check food safety, search for signs of life during natural disasters, detect diseased plants, and maybe even take a "scent snapshot," capturing the chemical signals of a fragrance you love, Agah suggests.

For now, the iWAVE is focused on monitoring high risk environments to ensure the safety of otherwise hazardous occupations. But Agah has high hopes for this technology moving forward, saying that this is a platform that can revolutionize many different industries. He, and his students and colleagues are ready to tackle the challenges.



A PROTOTYPE of one of the micro GC devices.



XIAOTING JIA and her team of researchers have devised a way to use a helical structure to implant sensors into different regions of the brain using only one incision.

A bouquet for the brain

"Okay, I'm going to implant this device in your brain." No, it's not dystopian science fiction, but a cutting edge treatment for certain medical conditions. Brain implants can be life changing—in a good way—for people suffering from diseases like medication-resistant seizures.

Xiaoting Jia, assistant professor of ECE, and her students are crafting minimally invasive fiber optic devices that can detect and treat seizures and other diseases.

Xia has received two recent grants from the National Institutes of Health for her research, totaling more than $600,000.

Although surprisingly robust in many ways, brains don't always react well to being probed. Jia and her team are making multifunctional devices that are minimally invasive and biocompatible.

MINIMALLY INVASIVE BRAIN IMPLANTS

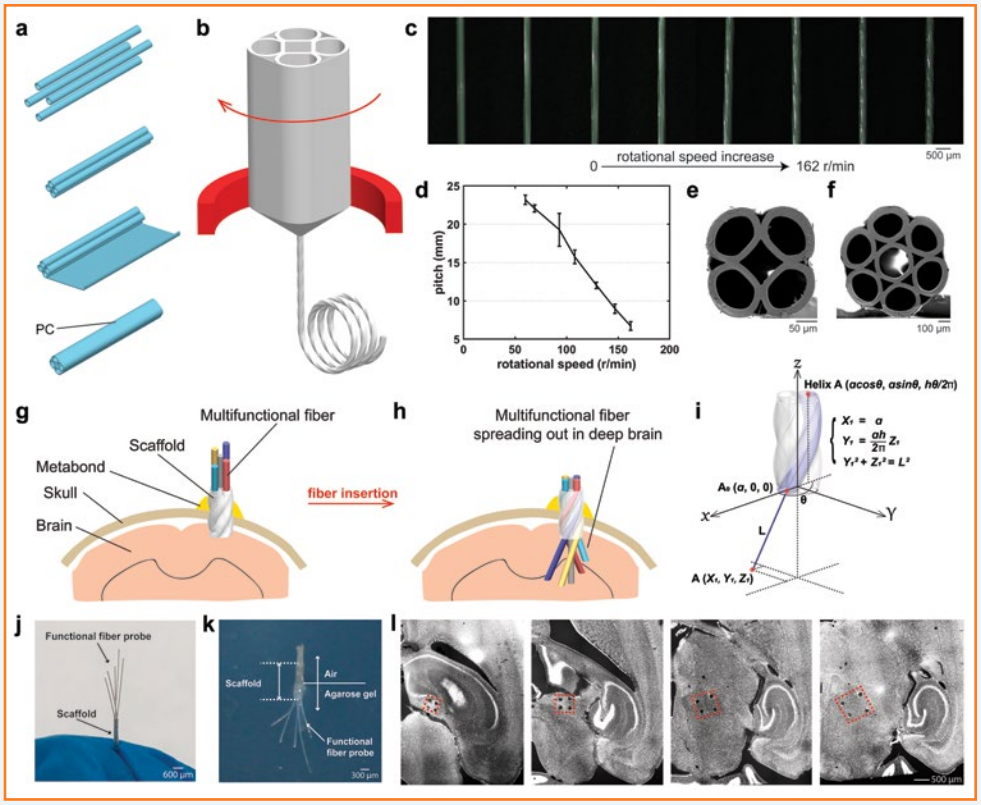
If you want to disturb the brain as little as possible, you typically want fewer holes and smaller devices, and Jia's team is tackling both goals.

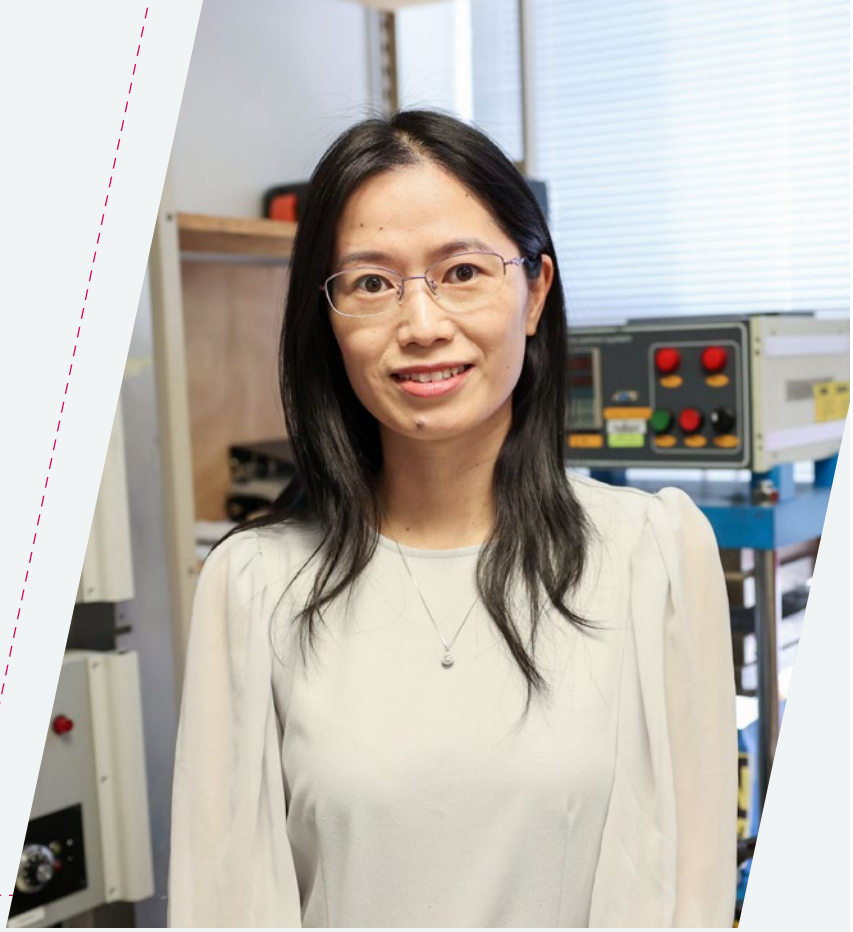
Using "bouquet-like" devices, Jia's team can deliver fibers to multiple regions in the brain through a single, tiny surgical hole. "Because our fibers are so flexible, they can go through a very small surgical hole, then spread out in the brain," Jia explains.

Guiding the fibers through a helical scaffold, they can deliver fibers to many locations with a single incision. "We can precisely predict where each fiber is going by controlling the angle and length of each fiber," notes Jia. "We're talking micron scale, just a few times thicker than hair."

Jia's fibers are also bidirectional and multifunctional, leading to greater utility per micron. Each fiber is both a sensor and a delivery mechanism for either medication or electrical stimulation. "We can see what goes wrong, and intervene in the events and treat the disease," she says.

For her seizure research, Jia plans to use deep brain multielectrode fibers to detect where the seizure starts, then treat it





"THE WORK WE DO can potentially have a very large impact on people who are suffering from certain diseases," says Xiaoting Jia, who is developing devices that can monitor and treat brain diseases like epilepsy.

with either medication or an electrical signal before clinical onset.

Not only could these devices treat medication-resistant seizures, but they could also treat seizures with minimal side effects from medication—when medication is delivered directly to the brain, less is needed.

MATERIAL CHALLENGES

Biocompatibility is a concern for anything that needs to exist in the brain over time. "A major challenge is that existing devices are pretty rigid," notes Jia. "These kinds of biomedical compatibility issues can damage the brain, and are not good for long term implants."

Another concern is that brains sometimes dissolve certain materials, like silicon. To address this, Jia and her team use multimaterial fiber optics, combining metal, polymer, and sometimes semiconductor materials in one fiber.

Using a fiber drawing tower, Jia's team can precisely combine multiple materials to make the fibers they need. Starting from a preform of the material, they stretch the fibers out controlling for temperature, drawing speed, feeding speed, rotation, diameter, tension, and more.

FROM BRAIN SURGERY TO DEVICE MANUFACTURING

This kind of research is truly multidisciplinary, says Jia, whose students do everything from brain surgery (on mice) to manufacturing the devices they implant.

Jia notes how important it is to speak the language and understand the struggles of the neuroscientists they work with: "Engineers can make a very large impact in treating diseases by creating advanced tools, but if we don't know where the problems are we can't make a big impact. We need to get hands on and get into the field."

Although there are many challenges to overcome in many fields, these devices are going to improve people's daily lives in reality—not just science fiction.

Modeling and analyzing astrocytes

Astrocytes are cells in the human brain which, when their function is impaired, may be associated with brain diseases like Alzheimer's, stroke, epilepsy, and schizophrenia.

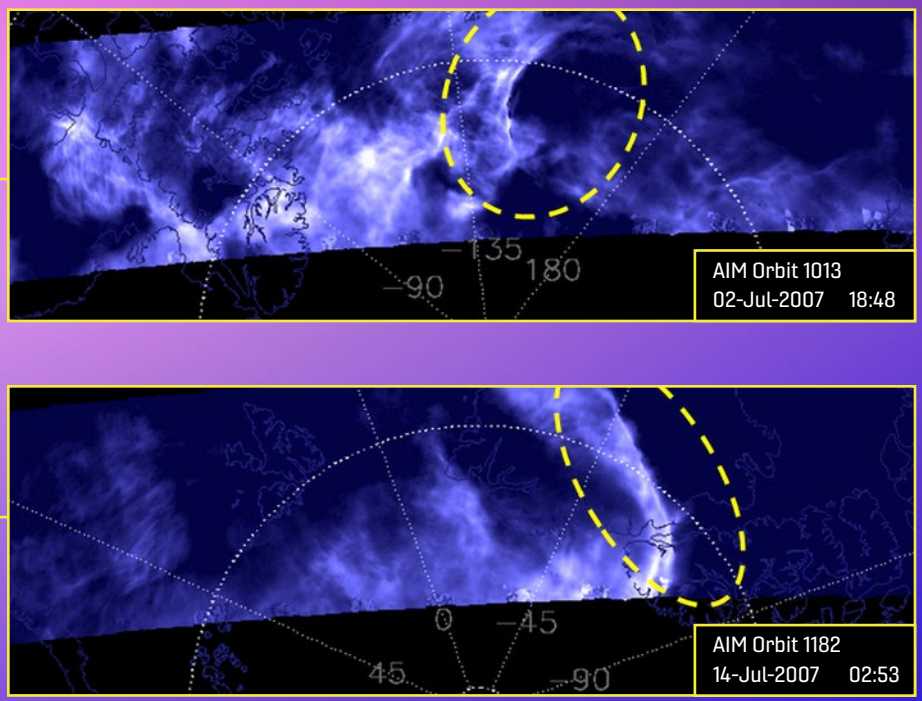
ECE's Guoqiang Yu recently received a grant from the National Institutes of Health to continue his work modeling and analyzing these vitally important cells. Yu and his team are developing computational tools for interpreting calcium dynamics data, using machine learning and systems theories.

The team's previous work has laid a strong foundation for this effort, and includes the discovery that astrocytes in people with Down's syndrome are hyperactive compared to the astrocytes in people without.

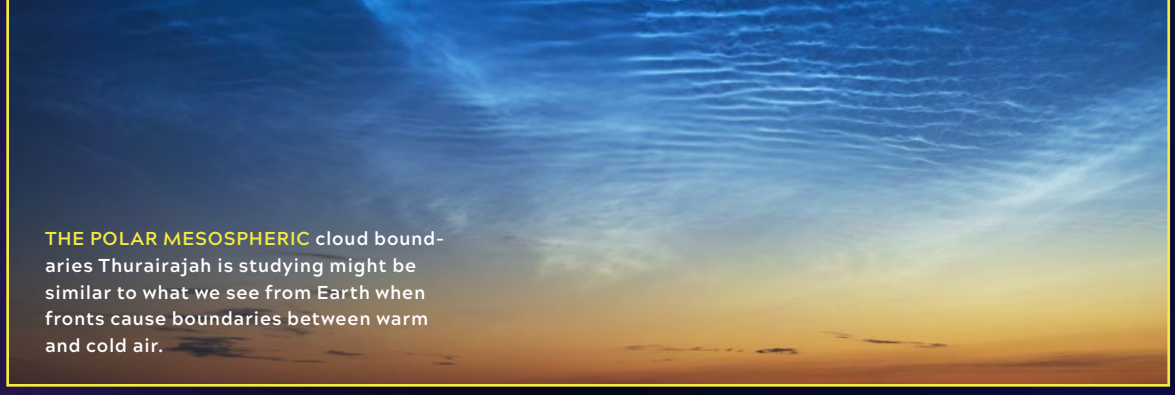
YU AND HIS TEAM. Front row, left to right: Boyu Lyu, Saurabh Bhardwaj, Joseph Wang, Guoqiang Yu. Back row, left to right: Yingzhou Lu, Wei Zheng, Yizhi Wang, Chiung-Ting Wu, Zuolin Cheng, Xuelong Mi.

At the edge of the clouds

Learning from the boundaries of polar mesospheric clouds



NOTE THE SHARP EDGES of these polar mesospheric clouds. Understanding cloud structures like these will add to our understanding of space weather and how it relates to weather on Earth's surface.



THE POLAR MESOSPHERIC cloud boundaries Thurairajah is studying might be similar to what we see from Earth when fronts cause boundaries between warm and cold air.

Space weather can affect the weather we see on Earth's surface, disrupt communications, and provide valuable insight into issues like climate change. There are many variables and much to learn, according to Brentha Thurairajah, an ECE research scientist who is studying the atmospheric dynamics surrounding polar mesospheric clouds–clouds that form about 84 km (52 miles) above Earth's surface, usually at high latitudes.

Specifically, Thurairajah is looking at the sharp boundaries that sometimes separate these clouds from cloud free regions. Understanding these cloud structures will help answer the question of how energy is transported from the troposphere (the part of the atmosphere from Earth's surface to about 14 km off the ground) to the mesosphere (about 50-85 km off the ground).

Looking at the data, the cloud areas are colder than the surrounding areas. "We think this phenomenon is similar to what we see on Earth, where fronts cause a boundary between warm and cold air, and influence the weather," Thurairajah says.

One possible explanation is the presence of an inversion layer: an area where temperature increases with altitude instead of decreasing like it usually does in this part of the atmosphere. "We think this is caused by atmospheric gravity waves," she says. We're exploring whether these waves can propagate upward from the troposphere and influence the mesosphere.

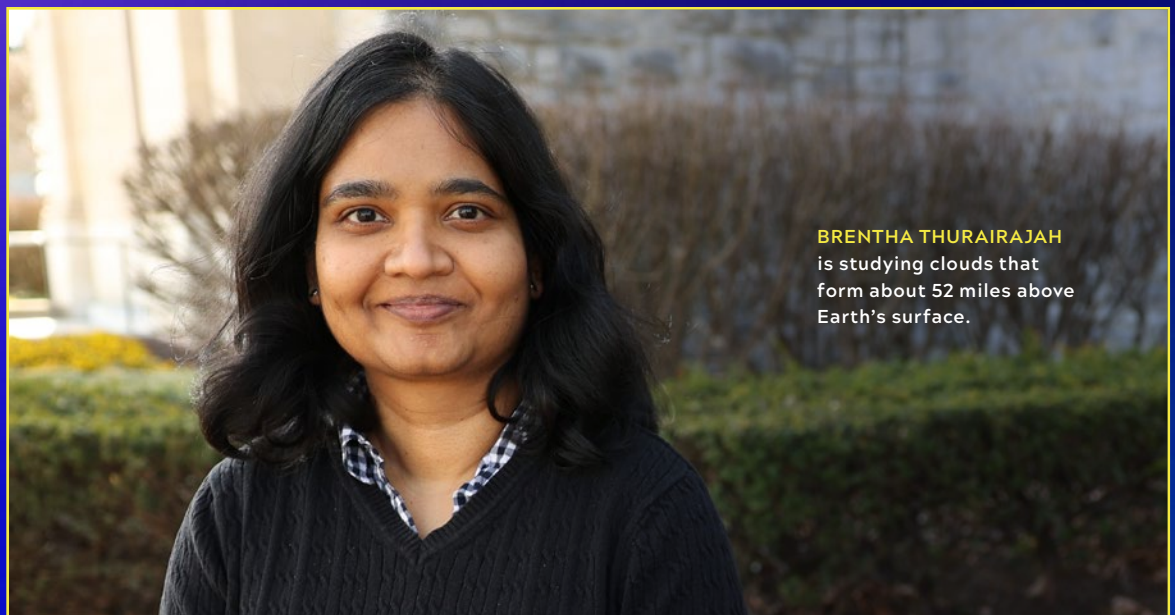
The mesosphere is a gateway region between the atmosphere on the ground and geospace, she notes, "but our models have a missing piece about atmospheric gravity waves. They're so small you can't simulate them." Thurairajah's goal? To analyze data from different satellites to fit this missing piece into the puzzle.

Thurairajah is using data from two different satellites that have taken measurements of the same clouds and their environment: one from NASA's Aeronomy of Ice in the Mesosphere (AIM) mission and one from the Thermosphere Ionosphere Mesosphere Energetics and Dynamics (TIMED) mission.

Although Thurairajah notes that it's challenging to get the right data from two separate satellites, she needs the different kinds of measurements each satellite can provide. She will characterize these front-like structures using images, coincident meteorological data, and gravity wave ray-tracing simulations.

Thurairajah hopes to show that the data and models agree, adding to our understanding of this part of the atmosphere, and of the atmosphere as a system.

Thurairajah has previously investigated other aspects of polar mesospheric clouds, including looking into how one hemisphere can influence the clouds in the opposite hemisphere. Her research continues adding pieces to the puzzle, helping us understand the world around us–and how it is impacted by the world above us.



BRENTHA THURAIRAJAH is studying clouds that form about 52 miles above Earth's surface.

YUHAO ZHANG works in the clean room, where he and his students fabricate devices for their research.

SHAWN SPROUSE

Cybermanufacturing wide bandgap semiconductor devices

You can design the highest performance, smallest form factor semiconductor device in the world—but if it can't be reliably manufactured, its impact will be limited. Reliable, high-quality manufacturing is particularly important as the industry moves to newer materials that can surpass the physical limits of silicon. ECE's Yuhao Zhang is collaborating with Hiu Yung Wong and his team at San Jose State University to help wide bandgap semiconductors achieve their promise with a new manufacturing process—aided by machine learning.

Typically, semiconductor devices, like computer chips, are manufactured on 6–8-inch wafers, which house thousands of devices that are later separated. Fabrication involves many steps, each of which must be nearly perfect to attain the high yield necessary for efficient manufacturing. This works very well for traditional semiconductor devices, like those based on silicon, explains Zhang, who is an assistant professor at the Center for Power Electronics Systems (CPES). However, newer materials like gallium nitride (GaN) and silicon carbide (SiC) can introduce more deformities and variability during manufacturing.

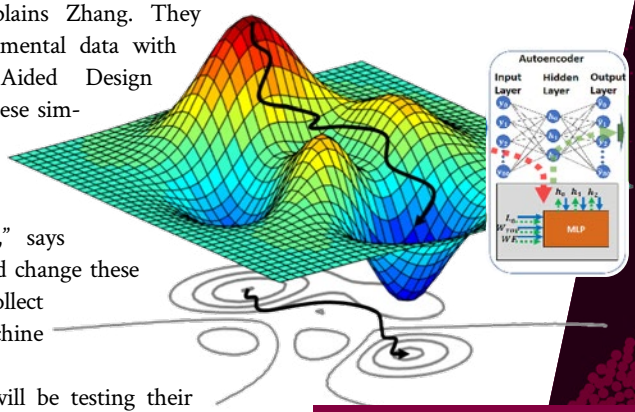
MACHINE LEARNING FOR HIGHER YIELD

Zhang and Wong's solution uses machine learning to compensate for the variability introduced in each step for each device, leading to a high yield even for the newest semiconductor devices.

Because there could be hundreds of parameters that affect these devices during manufacturing, the machine-learning algorithms can help determine the correlations and what changes to make at each manufacturing step to compensate for any variability.

For example, one area of a wafer might have slightly higher resistivity, Zhang explains. "An algorithm would automatically enlarge the area of the devices fabricated on that area so they can meet the specification."

To train the algorithm, the team is collecting data from both experiments and simulations. The experimental data requires the team to fabricate devices and characterize the wafer at every step. However, "this data alone is not enough to train a highly accurate machine learning algorithm," explains Zhang. They will augment the experimental data with Technology Computer-Aided Design (TCAD) simulations. "These simulations might take into account a thousand parameters that can impact the device performance," says Zhang. "As we iterate and change these parameters, we will collect more data for the machine learning algorithm."



A VISUALIZATION of the inverse process, which uses machine learning to find the optimal parameters for wafer manufacturing.
Image credit: Hiu Yong Wong, San Jose State University.

Initially, the team will be testing their ideas using GaN power rectifiers, which require only six fabrication steps. "We want to identify any knowledge gaps," notes Zhang, before moving to more complicated devices.

In addition to the manufacturing challenges, the team is employing broad knowledge to prove that this new process is feasible—including microelectronics, physics, materials science, statistics, and machine learning.

"We are exploring a completely new way of manufacturing semiconductor devices," says Zhang. "If successful, this will have a very high impact."

The result if Zhang and Wong's team is successful? Billions of dollars in savings, reduced waste, and faster research and development of new devices.

Recent Research Breakthrough

Another of Zhang's projects—a medium-voltage Gallium nitride high-electron mobility transistor (HEMT) that operates in enhancement mode above 10 kV—was recently highlighted by Nature Electronics as a research breakthrough from the 2021 IEEE International Electron Devices Meeting, which took place in December 2021.

RUOXI JIA

SHAWN SPROUSE

Enabling responsible data science

Machine learning and AI make life easier, but do they make life safer? ECE assistant professor Ruoxi Jia doesn't think so, but she's working to change that.

When she was a Ph.D. student, Jia analyzed sensor data from buildings to more efficiently control features like lighting and air conditioning. But this line of research made Jia feel uneasy.

"I realized that requiring sensing and data analytics in smart infrastructures could represent a significant privacy threat," explained Jia. "If you monitor the occupancy of the building, it's easy to infer more personal information, like an occupant's habits, interests, and relationships."

Her discomfort led to interest, which set Jia on a new path—enabling responsible data science—which is her research focus as a new ECE assistant professor.

PRESERVING PRIVACY

Jia's research on privacy includes understanding what privacy means in different social and application contexts, using rigorous mathematical tools to characterize privacy, and developing techniques for managing the trade-off between privacy and data.

In her recent work, she has been exploring ways to defend machine learning systems from model inversion attacks, where an attacker aims at reconstructing training data from machine learning model parameters. Mounting such attacks on face recognition models, for instance, can expose private face images used for training the models.

While the vulnerabilities to model inversion attacks are well-understood for simple models, Jia's group is the first to demonstrate that deep neural networks are also susceptible to such attacks. To make machine learning systems more robust to inversion attacks, her group is using information theory to assess the amount of private information memorized by models, and designing new algorithms to limit the unwanted memorization.

MACHINE LEARNING SYSTEMS AT RISK

Privacy isn't the only threat associated with machine learning in the real world. In traditional computer systems, you can build an explicit boundary between the system and the outside world, explained Jia, but that's not possible in a machine learning system whose most crucial ingredient—data—directly comes from the outside world. "This means there are many potential attack surfaces, and it can be hard to deal with the security problem," said Jia.

For instance, a malicious attacker can inject bad data into the training dataset to manipulate the behavior of the machine learning model. Imagine the machine learning model is used in an autonomous car to recognize objects on the road. Through such attacks, the attacker can mislead the model to recognize a stop sign as a speed limit sign, which leads to disastrous consequences.

Jia and her team are developing defenses that can help mitigate attacks. They are building new machine learning algorithms that are robust to bad changes in the training data.

Jia's interest in securing deep neural networks extends to issues of intellectual property. Her team is investigating methods to insert watermarks into deep neural networks to secure the model and prevent plagiarism.

THE VALUE OF DATA

Data is the foundation of machine learning. Jia is also interested in improving the quality and robustness of machine learning models by designing incentives for people to contribute good data, and for companies to collaborate and share good data. But this presents a fundamental quandary—how should we value data?

"Data is very different from any other commodity," explained Jia. "Unlike a physical object, the same piece of data can be copied, shared, and utilized by different entities at the same time. The value of data really depends on how and when it is used."

Jia and her team are investigating principled methods to value data, and using the data value scores to inform data markets, improve data quality, and enable strategic economic data collection.

In Jia's ideal future, we're recompensed for our data, which is secured from attack and used to constantly improve the quality of our lives.

Empowering algorithms to help solve societal-scale challenges


MING JIN

SHAWN SPROUSE

The future is cyberphysical, according to Ming Jin, an ECE assistant professor. Cities will be smart; the electric grid will be highly adaptive, secure, and efficient; and we will use data and algorithms to solve our greatest challenges—including how to improve living conditions and combat climate change. Jin wants to empower algorithms to help solve these problems.

"Unlike traditional machine learning tasks, these problems involve complex physical systems with a significant cyber core that are safety-critical and need to have humans in the loop," said Jin. "Systems like these require a new paradigm of artificial intelligence that can be trusted to do critical work."

To be considered trustworthy, a system must make decisions that are reliable, safe, and understandable, explained Jin. To move this vision closer to reality, he is developing fundamental theories to improve optimization, control, and machine learning.

ASSURED REINFORCEMENT LEARNING

Reinforcement learning is a branch of machine learning that deals with sequential decision making, and Jin is applying it to vital infrastructures like power grids. "As you push data through the complex learning and control pipeline, things may not turn out the way you expected," Jin explained. "And that becomes a real issue for power grids, where a bad decision can cost millions of dollars, or even human lives."

Establishing theoretical and computational foundations for assurance is key to protecting us from the potential harm of artificial intelligence, explained Jin.

To resolve this challenge, Jin and his group are using tools from multiple disciplines, most prominently, dynamical systems theory and statistical learning theory. "Assurance is integral to trust. Without trust, AI cannot go far. To get there, we must reimagine the field," said Jin.

WEAKLY SUPERVISED LEARNING

Machine learning problems are often categorized as supervised or unsupervised learning depending on whether there is a label attached to each item in a training dataset, explained Jin. But the lack of "hand-labeled" data—data that has been manually categorized for training purposes—has been a huge bottleneck in scaling up data analytics from the power grid and other applications.

One of Jin's research projects focuses on employing "weakly supervised learning," which leverages domain knowledge to collect lots of datapoints and assign them lower quality annotations, explained Jin. For example, they might only be 80% certain that the data are labeled correctly, but they compensate for this lower quality data by having access to more of it.

UNTRUSTWORTHY DATA

Decision-making algorithms are built on data from the real world, and researchers don't control the quality of that data. Jin and his team are developing theoretical and computational techniques for robust optimization, including an algorithm based on penalized semidefinite programming, a subfield of convex optimization. With this tool, Jin's team generated the first vulnerability map of the entire U.S. power grid to assess the security of data-driven decision-making algorithms against cyberattacks.

Winning the CityLearn Challenge 2021

Jin led two teams with distinct solutions (ROLEVT & ZoRL) to victory in the 2021 CityLearn Challenge. The teams significantly outperformed all the other competitors, ranking 1st among 24 international teams.

Driven by the pressing needs to combat the advancing climate change, the CityLearn Challenge is an international competition for multi-agent reinforcement learning (RL) solutions to address challenges in urban energy systems.

The competition was designed to stress test any algorithms the same way as they will be deployed in the wild, Jin explained. "To achieve a decent result, your algorithm needs to tackle a variety of challenges faced by contemporary AI." The list of challenges could be long, but key aspects include learning on live systems from limited samples, dealing with system constraints that should never or rarely be violated, interacting with systems that are partially observable, and providing system operators with explainable policies.

Where are you—exactly?

mmWave signals and reconfigurable intelligent surfaces may solve the issues of indoor wireless connection and localization

HARPREET DHILLON and his team are working to achieve centimeter accuracy for locating devices in difficult areas like inside buildings.

PETER MEANS

Have you ever tried to order pizza on your cellphone from the basement of a large building? If so, it was probably a frustrating experience. If you then tried to find the nearest pizzeria from the Google Maps app, your frustration probably increased.

Although wireless connectivity and localization are improving, most of us have had the experience of going into a large building and having our cellphone signal deteriorate—or even disappear. Not only is this annoying when we want to order pizza, but it can also be dangerous if, for example, rescue workers can't locate you in a disaster.

And large buildings aren't the only culprits of poor wireless signals. Depending on the device and location, mountains, trees, clouds, and other blockages can cause similar disruptions. And indoors or outdoors, when signals decrease, so does our ability to locate the devices we care about—from cellphones to refrigerators to self-driving cars.

An ECE team led by Harpreet Dhillon and Michael Buehrer is working to bring reliable wireless connectivity and localization to these low-signal areas.

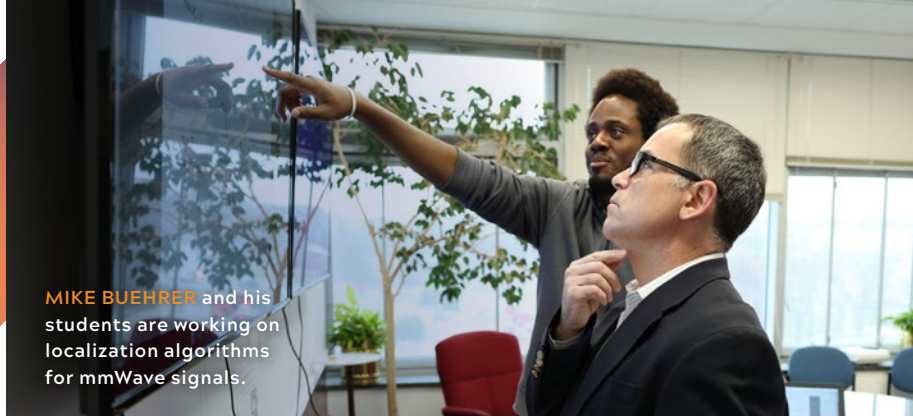
The team is exploring two new technologies: the millimeter wave (mmWave) wireless signals that are becoming more common with 5G, and reconfigurable intelligent surfaces that can help direct signals wherever we need them.

MILLIMETER WAVE

As their name suggests, mmWave signals have a wavelength an order of magnitude smaller than traditional wireless signals and travel at a much higher frequency—10+ GHz instead of the more common 2 GHz. This higher frequency means more information can be transmitted faster, which is spurring its adoption.

The higher frequency also makes these waves better for localization since they can more accurately measure the time it takes signals to travel from a base station, explains Buehrer. "Millimeter waves can also create very narrow beams, which can accurately estimate the angle from the base station," he continues. Both are important for locating a device.

The standard way to locate a wireless device is to measure how long signals take to reach it from base stations with known locations, like cell towers. Using signals from three known locations, you can pinpoint the device's location. In the messy world of reality, however, these signals can take multiple paths and reflect off



MIKE BUEHRER and his students are working on localization algorithms for mmWave signals.

surfaces, notes Dhillon—and you might not always have three signals to work with, making the angle the signal travels from the base station critical information.

RECONFIGURABLE INTELLIGENT SURFACES

A downside of mmWave is that it is easily blocked by physical objects—like trees or walls. To mitigate this, especially inside buildings, the team is investigating the use of reconfigurable intelligent surfaces to redirect signals around corners. According to Dhillon, "mmWave signals have excellent reflection properties, giving mmWave devices a way to receive strong non-line-of-sight signals and allowing us to locate a device using a single anchor node. This becomes even more useful when we can control these reflections with intelligent surfaces."

These surfaces might be about two meters tall and wide, very thin, and can be placed on almost any surface. Each pixel is about 1cm^2, and can be individually controlled. "We can control the angle a signal takes when it leaves that pixel and steer around corners," says Buehrer. "This lets us steer signals around corners and overcome the limits of non-line-of-sight propagation."

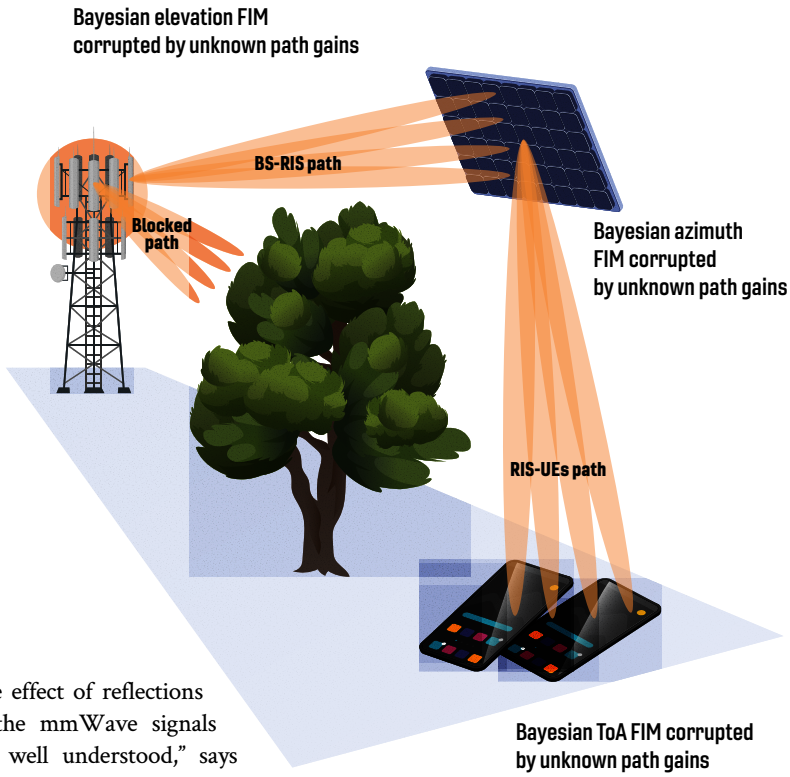
"One of the primary challenges of geolocation," says Buehrer, "is that the signal doesn't take a direct path from transmitter to receiver. But if we can use these surfaces to direct signals, we can use that information to get a better estimate of where the receiver is located."

These surfaces might also allow the team to accurately locate a device vertically—not just horizontally like current systems. This is extremely important for applications in buildings, for example. "One of the hardest open problems in localization is reliable localization in the vertical dimension," says Dhillon. And these new technologies might hold the answer.

ALGORITHMS AND MODELING

The team is developing these location algorithms, starting by modeling the perfect scenario involving reconfigurable surfaces. "There is a fundamental limit to how accurately we can measure these signals," Buehrer explains. "We have to start by knowing what that limit is, what is the best we can possibly do." After determining this, the team will move on to crafting the practical location algorithms.

Building on this, the team will use stochastic geometry to capture randomness in the placement of surfaces and characterize the reflections from them.



mmWAVE SIGNALS can be easily blocked–but intelligent surfaces can reflect these signals and improve non-line-of-sight communications.

"The effect of reflections on the mmWave signals isn't well understood," says Dhillon. "We need to develop fundamentally new stochastic geometry tools for the system-level analysis of mmWave localization."

The team will be developing stochastic models for all key network elements, so their analysis is not limited to a specific network topology, explains Dhillon. "Point elements like base stations can be visualized as collections of points and modeled as point processes. The intelligent surfaces can be modeled using germ grain models." One advantage to this approach, he notes, is that it can determine the network-wide feasibility of the localization algorithms.

Ultimately, the team hopes to achieve centimeter-level accuracy for locating wireless devices. If you've ever looked at your cellphone's location on a map, you might notice that it's accurate within a few meters, at best, when indoors. Dhillon and Buehrer also plan to use their findings to create an open source mmWave localization simulator so anyone can explore and test algorithms.

Please deliver my pizza to the basement conference room—you'll see where my phone is.

6G: It's all about networks—human and machine

It's 2030, and you're networking with colleagues in a crowded banquet hall, where you hear parts of hundreds of conversations. Everyone in the room has a connected device (or two, or three, or 10), which are also communicating with each other and with their base stations. And even with all this noise, people and devices are communicating seamlessly.

Whether it's people or machines shaking hands (or bumping elbows), networks are critical to Lingjia Liu's research.

Liu, ECE professor and Associate Director of Wireless@VT, is working on the technologies needed for the next iteration of wireless communications—6G. Critical to his success are not just communications networks, but also his network of relationships with industry partners, government research labs, former students, and colleagues.

THE PATH TO 6G

Although we talk about wireless communications in terms of 4G, 5G, and now 6G, Liu explains that these are iterative steps rather than huge leaps. There are intermediate steps between each large release, he notes. Between 4G and 5G, for example, we saw LTE-Advanced Pro. Before it's time for 6G, we'll see 5G-Advanced.

Still, researchers like Liu, who contributed to the 4G LTE-Advanced specification, are looking two—or more—steps ahead.

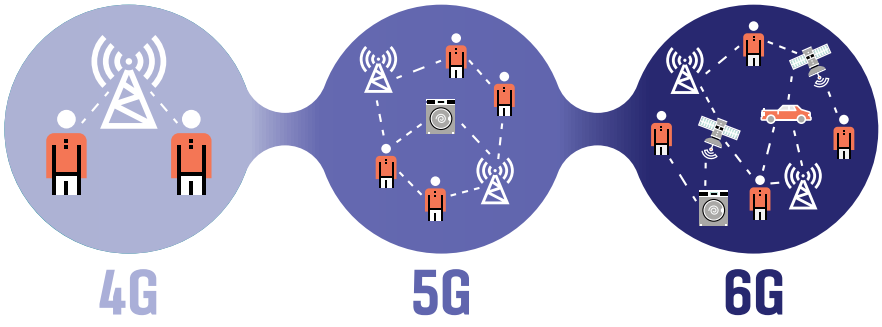
According to Liu, 6G will bring us "higher data rates, higher reliability, higher density, and higher intelligence." The big push, he notes, is for ubiquitous, efficient, and intelligent connectivity—for all devices everywhere. Connectivity no longer just means our cellphones need to stay connected to a cell tower as we drive down the highway—in 10 years, we'll be dealing with cellphones, self-driving cars, smart cities, CubeSats and the innumerable connected devices that make up the Internet of Things.

"5G is starting to pave the way for smart cities and autonomous vehicles, but 6G will capitalize on those initial ideas," says Liu. "At the end of the day, we should be able to connect any device, wherever we are in a smart and efficient way."

MIMO POTENTIAL

One enabling technology for connecting all these devices is the massive multiple input multiple output (MIMO) technology, where each device incorporates a massive number of antennas. Unlike humans, these devices can then communicate different messages to different places at the same time. According to Liu "it's easy in theory, but in reality the hardware and complexity is difficult to scale to hundreds or thousands of simultaneous communications."

Liu is tackling the algorithms behind massive MIMO devices. Similar to when people all converse at once in a crowded room, "when you need simultaneous



OUR DEMAND for wireless connectivity increases as we add new kinds of devices to our networks, and the networks must keep up. The 4G standard was focused on individual users with one or two cellphones each. The 5G standard accounts for more devices in the Internet of Things. The 6G standard must achieve reliable and intelligent communications for phones, devices, and critical infrastructure.


LINGJIA LIU

communications on the same frequency, those signals will interfere with each other," he explains. Liu and his team are developing algorithms for transmitters to minimize this interference.

Another challenge is scaling these algorithms to hundreds or thousands of users—when you can only communicate with a fraction of those users at once. "You have to determine which users to choose to maximize both throughput and fairness, which can present conflicting objectives," says Liu. Traditionally, these problems are solved by modeling, but as we connect more and more devices, the complexity becomes too great for traditional models to be sufficient.

MACHINE LEARNING JOINS THE TEAM

This is where machine learning comes in. Machine learning requires a lot of training, overhead, and computational power, explains Liu. But when the models become this complex, and must adapt to a rapidly changing environment, machine learning rises to the challenge.

Even for 4G and 5G systems, there are tens of thousands of variables to account for. "Even with the perfect equation, there are thousands of parameters. It's too complicated. This is where machine learning can provide benefits."

Liu also uses machine learning to optimize high frequency communications—millimeter wave, or even Terahertz. For such high frequencies, Liu explains that "the devices are far from being ready. When you move to those high frequencies, there are a lot of imperfections in the devices. Machine learning can help you learn and compensate for these imperfections."

INFRASTRUCTURE ENHANCEMENTS

To handle all these communications, our communications infrastructure will also become far more diverse. We already have communications satellites that can deliver high speed internet to areas that are not well served by cell towers and other methods. As we see more of these, as well as communications from high altitude balloons and aircraft, one challenge becomes how to integrate them together.

"A key feature of cellular communication is mobility—you don't feel interrupted when you move from one tower to another. This is called mobility control," explains Liu. But when you need to move not just from cell tower to cell tower, but from cell tower to high altitude balloon, to satellite, to airplane, and back to a cell tower, it becomes more complicated.

In addition to moving between different types of nodes, there are additional challenges for these new nodes: higher velocities, Doppler spread, and environmental factors that can interfere with communications.

Nothing is off limits for finding a solution, including changing the waveform itself. "The current waveform may not be enough for these different nodes to work together," says Liu. "We're looking at how the fundamental waveform could be redefined."

BEYOND THEORIES

Although his designs might be preparing for our future communications needs, Liu is looking beyond theoretical models. "Our work is not only in theory. We do a lot of prototyping, and it's one of the most important features of our research," he says. When you show that your ideas are working in hardware, he continues, "you don't have to argue for your ideas or assumptions." It just works.

In early stages of new technologies, researchers traditionally simplify their models with various assumptions, working on crafting theoretical frameworks and solutions. These complex communications challenges, even in the not-yet-realized 6G, can't afford simplification, notes Liu.

These technologies must work with all the messiness that is the real world. "In industry, you cannot make too many idealized assumptions, you have to make things work," notes Liu. "We work very closely with our industry partners to make sure our ideas and innovations will solve the challenges of reality, not just address theoretical models."

HUMAN NETWORKING

As with so many challenges, Liu notes that the hardest part is defining the problem appropriately. And to do that, he relies on his industry contacts. "Industry knows 5G and 6G systems best. To really make an impact, you need to collaborate with industry leaders and become a trusted partner so you can identify the problems."

Core to Liu's group's success is his ties to the telecommunication industry, both from his own network and close ties to his former students. "I want my students to feed back into my group," says Liu. "I want them to work with us, provide internships, and network—with current and past students."

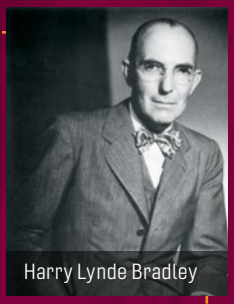
And there are plenty of former students for the group to connect with. Even during the pandemic, Liu's team graduated six Ph.D. students. "It's very rewarding to see how hot those students were in the job market, even during the pandemic," says Liu.

All these connections are vital, according to Liu. "If you know the problems, and have the industry connections, you know what is coming, and you know what challenges to solve."

When Liu and his team find themselves in that crowded room, they are part of all those conversations, solving the challenges that will take us to the next level of connectivity.

2021 | 2022

Bradley & Webber Honors



Harry Lynde Bradley

The late Mrs. Marion Bradley Via established an endowment for ECE in honor of her late father, **Harry Lynde Bradley,** who was a pioneer in the electric motor control industry and cofounder of the Allen-Bradley Company of Milwaukee, which is now part of Rockwell Automation. In recognition, the department is called The Bradley Department of Electrical and Computer Engineering. The endowment funds scholarships, fellowships, and professorships in an ongoing effort to improve our ECE programs.

William B. Webber

William B. Webber (EE '34) established a fund to encourage women engineers. Webber's career took him to Westinghouse, the U.S. Signal Corps, then to a booming company co-founded by an army buddy–Tektronix Inc. Today, the William B. Webber Fellowship is awarded to high achieving women pursuing a graduate degree in ECE.

2021 | 2022

Bradley & Webber Fellows

Benjamin Biggs

BSEE '18 Brigham Young University
MSEE '20 Virginia Tech
Advisor: Daniel Stilwell

RESEARCH: Biggs is developing algorithms to maximize the effectiveness of search paths in a large search space where finding optimal paths is currently infeasible and communication is unreliable.

Mark A. Caimie, Jr.

BSEE '19 Pennsylvania State University
MSEE '21 Virginia Tech
Advisor: Christina DiMarino

RESEARCH: Caimie is developing semiconductor materials and technologies targeted at high voltage applications in renewable energy power grids and electric ships.

Rebecca DeSipio

BSEE '21 Pennsylvania State University
Advisor: A. Lynn Abbott

RESEARCH: DeSipio is developing machine and deep learning algorithms classifying 2D images. A possible application is detecting Parkinson's disease from hand drawn spirals.

Davis Earley

BSEE '20 Auburn University
Advisor: Elena Spinei Lind

RESEARCH: Earley is developing an observational method to improve validation for satellite air quality measurements using Multi-Axis Differential Optical Absorption Spectroscopy.

Sengal Ghidewon-Abay

BSEE '21 Virginia Tech
Advisor: Ali Mehrizi-Sani

RESEARCH: Ghidewon-Abay is developing machine learning based controllers for electronics-based energy resources, which will allow a higher penetration of renewable energy sources within the power grid.
HONORS: *New Horizon Graduate Scholar, Virginia Tech Stamps Scholar*

Richard F. Gibbons III

BSEE '21 Virginia Tech
Advisor: Jonathan Black

RESEARCH: Gibbons is working on Hardware-in-the-Loop simulations for 5G internet satellite constellations, developing a CubeSat payload control module, and qualifying and testing hardware for space.

Alyse Jones

BSEE '20 Louisiana Tech University
MSEE '22 Virginia Tech
Advisor: William C. Headley

RESEARCH: Jones is developing a radio framework to avoid interference by intelligently selecting the best frequency based on current conditions as determined by reinforcement learning. One goal is to better understand the limitations of hardware, and potential solutions.
HONORS: *Collins Aerospace Scholarship, New Horizons Graduate Scholar*

Justin Kleiber

BSCE '20 University of Oklahoma
Advisor: Daniel Stilwell

RESEARCH: Kleiber is designing robust control systems for autonomous underwater vehicles, and analyzing the impact that uncertainty can have on the the vehicles.

Bradley & Webber Fellows

Danielle Lester

BSEE '21 Virginia Tech
Advisor: Christina DiMarino

RESEARCH: Lester is developing and characterizing novel electronic devices to allow higher voltage switching than was previously possible. These devices will help streamline renewable energy integration into power grids.

Lauren O. Lusk

BSEE '19 University of Oklahoma
MSEE '22 Virginia Tech
Advisor: Joseph Gaeddert

RESEARCH: Lusk is working on multi-sensor processing for blind signal recovery in the presence of multiple interferers, using adaptive multi-sensor devices.
HONORS: *New Horizons Scholar*

Sarah Maxseiner

BSCPE '20 Virginia Tech
Advisor: A. Lynn Abbott

RESEARCH: Maxseiner is developing a convolutional neural network to identify objects in sketches using a training set of well drawn and poorly drawn examples.

Megan O'Neal Moore

BSEE '19 Virginia Tech
MSEE '21 Virginia Tech
Advisor: William C. Headley

RESEARCH: Moore is developing neural networks to enhance the detection of signals and interference in instances where noise uncertainty or inaccurate assumptions would otherwise make this difficult.
HONORS: *New Horizon Graduate Scholar, Collins Aerospace Fellow, AOC Electronic Warfare Scholarship Recipient*

Sam Shebert

BSEE/CE '20 State University of New York, Oswego
Advisor: Michael Buehrer

RESEARCH: Shebert is researching the automatic classification of wireless signals such as 4G, 5G, WiFi 6, and Bluetooth, using convolutional neural network deep learning models and other methodologies.

Cathlyn Stone

BSCS '14 University of Colorado, Colorado Springs
MSCS '18 University of Colorado, Boulder
Advisor: Binoy Ravindran

RESEARCH: Stone is optimizing concurrency protocols for heterogeneous distributed memory systems, and writing systems-level software for shared memory management across CPUs, GPUs, and SmartNICs.

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Bradley Scholars

Joshua Sutton

BSEE '21 Virginia Tech
Advisor: Almuatazbellah Boker

RESEARCH: Sutton is developing new control methods for non-contact imaging on the micro scale using novel 3D modeling to design near-optimal control of atomic force microscopes.

Joseph G. Thomas

BSEE '18 Virginia Tech
MSEE '20 Virginia Tech
Advisor: Yizheng Zhu

RESEARCH: Thomas is working on optical imaging systems for applications in light microscopy, soft-tissue mechanics, and in situ corrosion monitoring, using quantitative phase imaging, optical coherence tomography, and spectral interferometry.

Minh Vu

BSCE '20 Virginia Tech
Advisor: William C. Headley

RESEARCH: Vu is investigating countermeasures against automotive frequency-modulated continuous-wave radar spoofing for distance-decreasing attacks.

Andrew Merdes

Computer Engineering

Merdes is finishing his first year in ECE. He enjoys various clubs on campus, including Board Game Club, Tennis, and Pickleball. His most memorable experience at Virginia Tech so far was visiting the FRITH lab and seeing all the tools and machines students can use.

James Mislay

Computer Engineering

Mislay has been passionate about ECE from a young age, starting with robotics and circuits kits and solidifying in his high school programming class. He designed a Pulse Oximeter as part of his Integrated Design Project, which calculates the user's blood oxygen saturation.

Nathan Moeliono

Computer Engineering

Moeliono has a passion for math and problem solving, and a drive to delve into various fields of innovation. He has developed a fully autonomous robot for his senior design project, and is researching geolocation-based augmented reality for phones.

Bradley Alumni

S = SCHOLAR
F = FELLOW

NAME	TITLE	COMPANY	LOCATION
JoAnn Adams S BSEE '94	Co-Owner	Big Fish Design	Centreville, Va.
Robert Adams F MSEE '95, Ph.D. '98	Professor, ECE	University of Kentucky	Lexington, Ky.
Shawn Addington F BSEE '90, MSEE '92, Ph.D. '96	Professor and Head, Department of Electrical and Computer Engineering	Virginia Military Institute	Lexington, Va.
Sarah S. Airey S BSCPE '01	Speech Scientist	Recordsure	Cambridge, U.K.
Christopher R. Anderson S/F BSEE '99, MSEE '02, Ph.D. '06	Associate Professor	United States Naval Academy	Annapolis, Md.
Matthew R. Anderson S BSCPE '04	Engineer	Arrcus	Washington, D.C.
Nathaniel August F BSCPE '98, MSEE '01, Ph.D. '05	Principal Engineer	Intel Corporation	Portland, Ore.
Stephen P. Bachhuber F BSEE	Principal Engineer	Qorvo	Raleigh, N.C.
Mark Baldwin F BSEE '93, MSEE '05, Ph.D. '08	Engineer	Dominion Power	Midlothian, Va.
William D. Barnhart S/F BSEE '00, MSEE '02	Electronics Engineer	Northrop Grumman	Redondo Beach, Calif.
Benjamin Alan Beasley S BSEE '09	Homemaker	---	Raleigh, N.C.
Brian Berg F BSEE '90, MSEE '91, Ph.D. '01	President and Founder	Dimmersion, LLC	Agoura Hills, Calif.
Ray Bittner F BSCPE '91, MSEE '93, Ph.D. '97	Principal Hardware Engineer	Microsoft Azure	Redmond, Wash.
Aric Blumer F Ph.D. '07	Staff Hardware Engineer	Luna Innovations Incorporated	Pearisburg, Va.
Bryan Browe F BSEE '97, MSEE '00	Senior IT Specialist (InfoSec)	Office of Financial Research	Fredericksburg, Va.
Kirsten Ann Rasmussen Brown S BSEE '94	Senior Vice President, Office of the Chairman	MicroStrategy Inc.	Tyson's Corner, Va.
Steven Edward Bucca F BSEE '87, MSEE '89	Senior RF Engineer	ATK	Lafayette, Colo.
Mark B. Bucciero F BSCPE '01, MSCPE '04	Component and Systems Engineer, Principal Investigator	Logos Technologies	Raleigh, N.C.
R. Michael Buehrer F Ph.D. '96	ECE Professor	Virginia Tech	Blacksburg, Va.
Charles Bunting F MSEE '92, Ph.D. '94	Associate Dean of Research and Sponsored Programs	Oklahoma State University	Stillwater, Okla.
Jonathan Bunting F MSCPE '19	Staff Solutions Engineer	Mythic	San Francisco, Ca.
Colin Burgin F BSEE '16	Student	Virginia Tech	Blacksburg, Va.
Carey Buxton F Ph.D. '01	Electrical Engineer	US Government	Spotsylvania, Va.
Scott Cappiello S BSCPE '94	VP, Data Programs	Verato	San Marcos, Calif.
Matthew Carson S BSEE '98	Technical Account Manager	Pexip	Concord, N.C.
Matthew Carter F BSEE '09	Technical Lead - Card Processing	Braintree	San Mateo, Calif.
Ricky Castles S BSCPE '03, MSCPE '06, Ph.D. '10	Associate Professor	East Carolina University	Greenville, N.C.
Eric D. Caswell F Ph.D. '01	Director, Small Antenna Engineering	L-3 Randtron Antenna Systems	Linthicum Heights, Md.
Daniel Dae Cho S BSEE '06	Associate	Esplin & Associates, P.C.	San Diego, Calif.
Jeffrey R. Clark F MSEE '03, Ph.D. '06	Proprietor	Black Dog Writing & Editing	Meadows of Dan, Va.
Ross Clay S BSCPE '09	Software Developer	Twitter	Raleigh, N.C.
Brittany Clore S BSCPE '10, MSCPE '12	Lead Cyber Security Engineer	The MITRE Corporation	McLean, Va.
Michael Cogswell F BSMATH '13, BSCS '13, and MSCPE '16	Student	Georgia Institute of Technology	Atlanta, Ga.
Kevin B. Cooley S BSEE '02	Electrical Engineer	Automation Controls, Inc.	Newport News, Va.
Thomas Alan Cooper S BSEE '10, MSEE '12	Software Design Engineer	Jacobs Engineering Group	Severn, Md.

NAME	TITLE	COMPANY	LOCATION
Carrie Aust Cox F MSEE '00	High-Speed I/O Design	IBM	Apex, N.C.
Shane Coyle F	Space Science and Electromagnetic Ph.D. Candidate	Virginia Tech	Blacksburg, Va.
David Casteel Craven S BSCPE '08	Member Technical Staff	Semi-Custom Platform Debug, AMD	Austin, Texas
Stephen Douglas Craven F Ph.D. '08	Electrical Engineer	Tennessee Valley Authority	Chattanooga, Tenn.
Cass Dalton S BSCPE '03	Software Engineer	Expedition Technology Inc	Chantilly, Va.
Phillip A. Danner S BSCPE '91	Founder, Investor, and Trader	Self Employed	Glen Allen, Va.
Paul U. David F MSEE '15	Research Engineer	Georgia Tech Research Institute	Atlanta, Ga.
Bradley A. Davis F BSEE '86, MSEE '88, Ph.D. '00	Research Associate Professor	Virginia Tech	Blacksburg, Va.
Scott Davis S BSCPE '00	Engineer Manager	Kollmorgen	Blacksburg, Va.
Lucy Del Barga (née Fanelli) F MSEE '14	Computer Engineer	Sandia National Laboratories	Albuquerque, N.M.
Jacques Delport F	---	---	---
Thurman Shaver Deyerle IV F BSEE '10, MSEE '13	Senior Wireless Hardware Engineer	Qualcomm	San Diego, Calif.
Brian M. Donlan F MSEE '05	---	---	---
Sean Douglass F	M.S. Student	Virginia Tech	Centreville, Va.
Thomas H. Drayer F BSEE '87, MSEE '91, Ph.D. '97	Technical Director	Department of Defense	Silver Spring, Md.
Bradley Duncan F Ph.D. '91	Executive Director, Graduate Academic Affairs	University of Dayton	Dayton, Ohio
Gregory D. Durgin F BSEE '96, MSEE '98, Ph.D. '00	Professor, ECE	Georgia Tech	Atlanta, Ga.
William Ashley Eanes S BSEE '95	Business Relations Manager	Duke Energy Corporation	Greensboro, N.C.
Michael Emanuel F BSEE '18, MSEE '19	Application Engineer	Texas Instruments	Arlington, Va.
Richard Ertel F Ph.D. '99	Senior Staff Engineer	L-3 Technologies	
Brian Flanagan S/F BSEE '97, MSEE '98	Senior Design Engineer	Intel	Coronado, Calif.
Kevin Flanagan S BSCPE '00, MSCPE '01	ASIC Design Engineer	Intel	Folsom, Calif.
Todd B. Fleming F BSCPE '94, MSEE '96	Software Engineer	block.one	Blacksburg, Va.
Bryse Flowers F BSEE '14, MS '19	Ph.D. Student	University of California, San Diego	San Diego, Calif.
Ryan Fong S/F BSCPE '01, MSCPE '04	Senior Engineer	Fourth Dimension Engineering	Columbia, Md.
Michael Fraser F MSEE '12, Ph.D. '16	---	---	Blacksburg, Va.
Janay Frazier F	---	---	---
Jayda Blair Freibert S BSEE '98	Market Manager - Industrial Refrigeration	Kelvion	Richmond, Va.
Daniel Friend F Ph.D. '09	Senior Engineer	InPhase Research	Fairfax, Va.
Bradley H. Gale S BSEE '97	Computer Software Professional		Mentor, Ohio
R. Matthew Gardner, Sr. F BSEE '03, MSEE '05, Ph.D. '08	Director, System Protection	Dominion Energy	Richmond, Va.
Daniel J. Gillespie S BSCPE '95	Director, SaaS Upgrades	Huron Consulting Group	Portland, Ore.
Brian Gold S BSEE '01, MSCPE '03	Engineering Director	Pure Storage	Mountain View, Calif.
Christopher Goodkind S BSCS '19	Software Engineer	Capital One	Arlington, Va.
Jonathan Graf S BSCPE '02, MSCPE '04, Ph.D. '19	Founder and CEO	Graf Research	Blacksburg, Va.
Timothy Gredler S BSCPE '03	Controls Engineering Manager	Daikin Applied Americas	Staunton, Va.
Christopher Griger S BSCPE '02	Senior Principal FPGA Engineer	Atom Computing	Austin, Texas
Daniel Hager S BSCPE '08, MSCPE '09	Lead Software Engineer	Chick-fil-A	Smyrna, Ga.
Adam P. Hahn S BSCPE '03	Senior Software Engineer	Bloomberg LP	New York, N.Y.
Alexander Hanisch S BSCPE '03, BS MATH '03	Modeling and Simulation Scientist	Joint Warfare Analysis Center	Fredericksburg, Va.

Bradley Alumni

NAME	TITLE	COMPANY	LOCATION
Nathan Harter F MSEE '07	Senior Systems Engineer	G3 Technologies, Inc.	Frederick, Md.
Dwayne Allen Hawbaker F BSEE '89, MSEE '91	Engineering Supervisor	Johns Hopkins APL	Baltimore, Md.
William C. Headley F BSEE '06, MSEE '09, Ph.D. '15	Associate Director, Electronic Systems Laboratory	Hume Center for National Security and Technology	Blacksburg, Va.
Matt Helton S BSEE '01	Principal Control Systems Engineer	Eastman Chemical Co.	Kingsport, Tenn.
Ben Henty F MSEE '01	Senior Research Engineer	Johns Hopkins APL	Laurel, Md.
Jason Hess F BSEE '97, MSEE '99	Manager for HW Engineering, Internet of Things Group	Cisco Systems	Austin, Texas
Erik Hia F BSCPE '99, MSCPE '01	Retired	Retired	Glade Hill, Va.
Daniel J. Hibbard F BSEE '02, MSEE '04	Vice President, Electronic Systems	Trident Systems Inc.	Washington, D.C.
James E. Hicks F MSEE '00, Ph.D. '03	Senior Engineering Specialist	The Aerospace Corporation	Chantilly, Va.
Kristen Hines F MSCPE '16	---	---	---
Hugh E. Hockett S BSCPE '03	Staff Software Engineer	Google	Raleigh-Durham, N.C.
Spencer Hoke S BSCPE '03	Software Engineer	Apple	San Diego, Calif.
Andrew S. Hollingsworth S BSCPE '03	Lead Software Engineer	Charon Technologies	Burke, Va.
Michael Hopkins F Ph.D. '14	Senior R&D Imagineer	Walt Disney Imagineering	Los Angeles, Calif.
Ellery L. Horton S BSCPE '04	Software Development Engineer in Test	LexisNexis	Selma, N.C.
Keith Cristopher Huie F MSEE '02	Program Area Engineer	Raytheon	Dallas/Fort Worth, Texas
Ryan Hurrell S BSEE '03	Staff Engineer	Siemens Healthineers - Molecular Imaging	Knoxville, Tenn.
John Todd Hutson S BSEE '93	Manager, Internet Engineering	Sprint Corp.	Reston, Va.
Elizabeth Hutz S BSCPE '18	Co-Owner	Cash Home Buyers NC	Alexandria, Va.
Ryan Irwin F Ph.D. '12	Engineering Manager	Yelp	Boston, Mass.
Christopher Jelesnianski F MSCPE '15	Graduate research student	Virginia Tech	Blacksburg, Va.
Daniel A. Johnson F BSEE '98, MSEE '01	VP/MD Retail Strategy and Analytics	OneMain Financial	Richmond, Va.
Callie Johnston S BSCPE '14	Associate Professional Staff II	Johns Hopkins APL	Columbus, Ohio
Edward Andrew Jones S BSEE '07	Principal Engineer	Infineon Technologies Austria AG	Villach, Austria
Kevin D. Jones F BSEE '09, MSEE '11, Ph.D. '13	Manager - ET Operations Engineering Support	Dominion Energy	Richmond, Va.
Basil Thomas Kalb S BSEE '98, MSEE '02	Owner	Bootstrap Software Solutions	Fairfax, Va.
Nicholas Kaminski F BSEE/CPE'10, MSEE '12, Ph.D. '14	Research Staff Member	Institute for Defense Analysis	Washington, D.C.
Adam Steven Kania S BSEE '01	Service Portfolio Manager	Caterpillar Inc.	Houston, Texas
David Kapp F MSEE '93, Ph.D. '95	Principal Engineer at Resilient and Agile Avionics Branch	Air Force Research Laboratory	Miamisburg, Ohio
Dimosthenis Katsis F BSEE '95, MSEE '97, Ph.D. '03	Principal Engineer, Advanced Development Programs	Blue Origin, LLC	Kent, Wash.
Nathan Kees F BSEE '08, MSEE '14	Senior Design Engineer	VPT Inc.	Blacksburg, Va.
Paul Kennedy F BSEE '17, MSEE '19	Associate Professional Staff	Johns Hopkins APL	Laurel, Md.
David L. Kleppinger, Jr. S BSCPE '04, MSCPE '08, Ph.D. '10	Software Development	Electrical Distribution Design	Williamsburg, Va.
Paul A. Kline F Ph.D. '97	Principal Research Scientist	Aster Labs	Shore View, Minn.
William Kuhn F BSEE '79, Ph.D. '96	Professor Emeritus	Kansas State University	Manhattan, Kan.
Zachary La Celle S BSCPE '09	Engineer	Robotic Research, LLC	Gaithersburg, Md.
Evan Lally F BSEE '03, MSEE '06, Ph.D. '10	Co-Founder	Dogwood Logic, Inc.	Blacksburg, Va.
Jeff Laster F BSEE '91, MSEE '94, Ph.D. '97	Technical Account Manager	Mentor: a Siemens Business	Dallas, Texas
Mark Alan Lehne F Ph.D. '08	Research Scientist	Intel Corporation	Hillsboro, Ore.

NAME	TITLE	COMPANY	LOCATION
Charles Lepple F BSEE '00, MSEE '04	Senior Research Engineer	Johns Hopkins APL	Columbia, Md.
Jason E. Lewis S/F BSEE '99, MSEE '00	System Engineer	ABB	Lewisburg, W.Va.
Virginia Li F BSEE '13, Ph.D. '21	Application Engineer	ADI	Santa Clara, Calif.
Joseph C. Liberti F BSEE '89, MSEE '91, Ph.D. '95	Chief Scientist	Perspecta Labs	Red Bank, N.J.
Zion Lo S BSEE '94	Manager, DevOps	Beeline	Centennial, Colo.
Janie A. Hodges Longfellow S BSCPE '01	CPO	Nicus Software	Fairfax, Va.
Daniel L. Lough F BSCPE '94, MSEE '97, Ph.D. '01	Deputy Director, Advanced Cyber Effects Office	National Reconnaissance Office	Chantilly, Va.
Amy Malady F BSEE '09	DSP Engineer	BCubed Engineering Corp	Ashburn, Va.
Annie Martin F BSEE '04	Software Engineer	Panorama Education	Watertown, Mass.
Cheryl Duty Martin S BSEE '95	Chief Research and Development Officer	Alegion	Austin, Texas
Stephanie Martin S BSEE '04	Electrical Engineer	Johns Hopkins APL	Laurel, Md.
Michael F. Mattern S BSEE '02	Electronics Engineer - Technical Advisor	Cummins Inc.	Columbus, Ind.
Christopher A. Maxey S BSCPE '02, MSEE '04	Principal Program Manager	Microsoft	Arlington, Va.
Eric J. Mayfield S BSEE '97, MSEE '98	Technical Director	Department of Defense	Sykesville, Md.
David Mazur S/F BSEE '11	Manager: UI and Enterprise Integration	Rockwell Automation	Milwaukee, Wis.
Patrick McDougle S BSEE '03	RF Systems Engineer	Leidos	Goose Creek, S.C.
Brian Joseph McGiverin S BSCPE '96, MSIT '07	Senior Software Engineer	Tanium	Durham, N.C.
John McHenry F BSEE '88, MSEE '90, Ph.D. '93	Senior Electrical Engineer	Department of Defense	Fort Meade, Md.
David R. McKinstry F MSEE '03	Principal Systems Engineer	Ultra Electronics 3 Phoenix Inc.	Chantilly, Va.
James W. McLamara F BSEE '02	Professional Engineer	James W McLamara P.E.	Walton Beach, Fla.
Garrett Mears S BSCPE '00	Startup CTO and Technical Advisor	---	London, U.K.
Vin Menon S BSCPE '02, BSISE '02	Social Sector Consultant	---	Washington, D.C.
Michael Mera S BSEE '03	Lead Electrical Engineer	Picatinny Arsenal	Morris County, N.J.
Carl E. Minton F BSEE '97, MSEE '02	---	---	McLean, Va.
Hannah Mohr F MSEE '19	Electrical Engineer	---	Los Alamos, N.M.
John Morton F MSEE '98	Senior Systems Engineer	Syntonics LLC	Columbia, Md.
Stephen Nash S BSCPE '03	Software Engineer	Allied Associates International	Washington, D.C.
Troy Nergaard F MSEE '02	Head of Controls and Embedded Systems	Lightship RV	Seattle, Wash.
Michael Newkirk F BSEE '88, MSEE '90, Ph.D. '94	Principal Professional Staff	Johns Hopkins APL	Laurel, Md.
Paul Nguyen S/F BSEE '98	Vehicle Operations Officer	US Air Force	
J. Eric Nuckols F BSEE '97, MSEE '99	Co-Founder	InPhase Research Corporation	Fairfax, Va.
Nicole Ogden F	Student	Virginia Tech	Blacksburg, Va.
Abigail Harrison Osborne S BSCPE '04	Home School Teacher	---	---
Neal Patwari S BSEE '97, MSEE '99	Professor, ESE and CSE	Washington University	St. Louis, Mo.
Joseph Allen Payne, Jr. S BSEE '00	Advisory System Architect	Northrop Grumman	Linthicum, Md.
My Linh Pham S BSCPE '07, BSPHYS '07	Technical Staff	MIT Lincoln Laboratory	Cambridge, Mass.
William B. Puckett F MSEE '00	---	---	---
Yaron Rachlin S BSEE '00	Senior Staff	MIT Lincoln Laboratory	Cambridge, Mass.
Parrish Ralston F BSEE '06, MSEE '08, Ph.D. '13	Program Manager, Electronic Hardware Development	Northrop Grumman	Baltimore, Md.
David Reusch F BSEE '04, MSEE '06, Ph.D. '12	Principal Scientist	VPT Inc.	Blacksburg, Va.
Richard Steven Richmond F MSEE '01	Senior Staff Design Engineer	Silicon Labs	Austin, Texas
Amy M. Ridenour F	Senior Power Conversion Engineer	GE Renewable Energy	Salem, Va.

Bradley Alumni

NAME	TITLE	COMPANY	LOCATION
Christian Rieser F BSEE, MSEE '01, Ph.D. '04	Capabilities & Innovation Leader	The MITRE Corporation	Charlottesville, Va.
Jamie N. Riggins S/F BSEE '04, MSEE '06	Electrical Engineer	Department of Defense	Washington, D.C.
Gray Roberson F Ph.D. '07	Senior Technical Staff Engineer	Kollmorgen	Blacksburg, Va.
Pablo Max Robert F MSEE '98, Ph.D. '03	---	---	---
Ian Roessle F Ph.D.	Researcher	Virginia Tech	Blacksburg, Va.
Thomas Rondeau S/F BSEE '03, MSEE '06, Ph.D. '07	Program Manager	DARPA	Arlington, Va.
Amy Rose S BSCPE '03	Senior Program Manager, Product Security Incident Response Team	NVIDIA	Raleigh-Durham, N.C.
Thomas Rose S BSEE '94	Chief Engineer, Agile Integration Lab and Flying Test Bed	Boeing	St. Louis, Mo.
Jonathan Scalera F MSCPE '01	Director of Ultrasound Imaging, Assistant Professor of Radiology	Boston University School of Medicine	Cambridge, Mass.
Javier Schloemann F Ph.D. '15	Senior Staff Scientist	SAS	Cary, N.C.
David Craig Schroder S BSEE '05	Vice President	Piedmont Composites & Tooling	Davidson, N.C.
Steven Schulz F MSEE '91	Director, Electrical Design for Electric Power Conversion	Rivian	Los Angeles, Calif.
Ian Schworer F BSCPE '03, MSEE '05	Director	TriplePoint Capital	Menlo Park, Calif.
Jeffrey T. Scruggs F BSEE '97, MSEE '99	---	---	---
Walker Sensabaugh F BSCPE '16	Principal Associate Senior Software Engineer	Capital One	Richmond, Va.
Kashan Ali Shaikh S BSCPE '02	Systems Engineering Lead, Cell & Gene Therapy	Cytiva	Boston, Ma.
Adam Keith Shank S BSCPE '07	Software Engineer	IBM	Raleigh, N.C.
Raymond Ashley Sharp S BSEE '02	Director of Programs	Northrop Grumman	Baltimore, Md.
Rebecca Kay Shelton F MSEE '08	Electronics Engineer	US Army Primary Standards Laboratory	Blacksburg, Va.
Jacob R. Simmons S BSCPE '08, MSEE '10	Software Engineer	CommScope	Forest, Va.
Roger Skidmore F BSCPE '95, MSEE '97, Ph.D. '03	CEO	EDX Wireless	Austin, Texas
Jeff Smidler S BSEE '99	Area Sales Manager	Automated Logic Corporation	Richmond, Va.
Amanda Martin Staley S/F BSEE '99, MSEE '01	Traffic Flow Management Integration and Evolution Mission Area Group Manager	The MITRE Corporation	McLean, Va.
Graham David Stead S BSCPE '93	Chief Technology Officer	WaveMetrix & Acta Wireless	San Diego, Calif.
Jennifer Hastings Steele S BSEE '96	Electrical Engineer	Department of Defense	
Neil Steiner F MSEE '02, Ph.D. '08	Founder	Information Dynamics Research	Arlington, Va.
Douglas Sterk F BSEE '00, MSEE '03	Principal Design Engineer	VPT Inc.	Blacksburg, Va.
Scott Stern S BSEE '93	Owner/General Manager	Deer Valley Golf Course	Hershey, Pa.
Samuel S. Stone S BSCPE '03	Associate	Goodwin Procter	North Foxborough, Mass.
Anne Palmore Stublen S BSEE '91	Accreditation Manager	Elijah House Academy	Richmond, Va.
Seema Sud F Ph.D. '02	Distinguished Scientist and Engineer	The Aerospace Corporation	Reston, Va.
Juan Suris F Ph.D. '07	Head of Quantitative Modeling and Strategies	PGIM Fixed Income	Westfield, N.J.
Ethan Swint F Ph.D. '12	---	Tau Motors	San Francisco, Calif.
David L. Tarnoff F BSEE '87, MSEE '91	Associate Professor, Department of Computing, College of Business and Technology	East Tennessee State University	Johnson City, Tenn.
Alexander James Taylor F BSEE '02, MSEE '04	Senior Software Engineer	The MathWorks	Boston, Mass.
Daniel J. Tebben F Ph.D. '06	Scientist	Johns Hopkins APL	Laurel, Md.

NAME	TITLE	COMPANY	LOCATION
Benton Thompson F MSEE '11	Software Engineer	G3 Technologies Inc.	Ashburn, Va.
Richard Tillman F BSEE '12, MSEE '14, Ph.D. '16	Senior Professional Staff	Johns Hopkins APL	Laurel, Md.
Maymoonah Toubeh F MSCPE '18, Ph.D. '22	Graduate Research Assistant	Virginia Tech	College Park, Md.
Jerry Towler S BSEE '08, MSEE '11	Engineering Manager for Autonomous Systems Research	Southwest Research Institute	San Antonio, Texas
Rose Trepkowski F MSEE '04	---	---	---
Christian Twaddle S BSCPE '01	Senior Engineer	Visionist	Woodstock, Md.
David Uliana F BSCPE '11, MSCPE '13	Director of Engineering	Caddo Minerals	Austin, Texas
Matthew C. Valenti F BSEE '92, Ph.D. '99	Professor	West Virginia University	Morgantown, W.Va.
Michael Gordon Vondrak S BSCPE '05	Frontend Developer	Charter Communications	Denver, Colo.
Wesley T. Wade S BSEE '93	Senior Systems Engineer	Oracle Financial Services Software	Leesburg, Va.
Kristin Weary S BSEE '03	Electrical Engineer	Fluor Marine Propulsion - Naval Nuclear Laboratory	Niskayuna, N.Y.
Michael Lee Webber F BSEE '02, MSEE '04	Program Manager	United States Air Force	Fort Belvoir, Va.
Paul C. Weinwurm F BSEE '03	Engineering Supervisor	American Electric Power	Roanoke, Va.
Matt Welch S BSEE '09	Test Engineer	General Electric	Greenville, S.C.
Jason S.K. Wienke S BSEE '02	Technical Analyst	Systems Engineering Group	Blacksburg, Va.
William Worek S BSCPE '99, MSCPE '02	Senior Engineer	SAIC	Arlington, Va.
Kai Xu S BSEE '95	Vice President of Product Management	Houzz	Palo Alto, Calif.
Matthew A. Yaconis S BSEE '97	Senior Software Engineer	Rockwell Collins	Albany, N.Y.
Jason Yoho F MSEE '98, Ph.D. '01	VP of Engineering	HYPERLABS	Louisville, Colo.
Ben York F MSEE '10, Ph.D. '13	Principal Project Manager	Electric Power Research Institute	Dallas, Texas
Phillip Andrew Zellner F BSEE '07, MSEE '12, Ph.D. '13	---	---	---
Jason Ziglar F Ph.D. '18	Senior Software Engineering Manager	Argo AI	Pittsburgh, Pa.
Richard Zimmermann S BSCPE '07	Applications Programmer	Virginia Tech Transportation Institute	Blacksburg, Va.
Gregory A. Zvonar S/F BSEE '90, MSEE '91	Distinguished Member of Technical Staff / Interceptor Knowledge Center Technical Director	The Charles Stark Draper Laboratory / Missile Defense Agency	Huntsville, Ala.

Patents issued

2019 | 2020 | 2021

Patents issued **2021**

Three-phase, three-level inverters and methods for performing soft switching with phase synchronization
Patent 10,886,860, Issued January 5, 2021
Inventors: N. Haryani, S. Ohn, R. Burgos, D. Boroyevich

Time-variant antenna module for wireless communication devices
Patent 10,886,599, Issued January 5, 2021
Inventors: S. Suh, H.G. Skinner, W.D. Kesling, M. Manteghi

Matrix transformer and winding structure
Patent 10,910,140, Issued February 2, 2021
Inventors: C. Fei, F.C. Lee, Q. Li

High electron mobility transistors with charge compensation
Patent 11,171,203, Issued November 11, 2021
Inventors: Y. Zhang

Method and system for energy aware scheduling for sensors
Patent US2021/0191495 A1, Issued June 24, 2021
Inventors: L. DaSilva, J. Hribar

Systems, methods, and apparatuses for intrusion detection and analytics using power characteristics such as side-channel information collection
Patent 10,970,387, Issued April 6, 2021
Inventors: C.R.A. Gonzalez, J.H. Reed, S.C. Chen

Patents issued **2020**

Estimating the location of a wireless terminal based on cooperative measurements
Patent 10,527,708, Issued January 7, 2020
Inventors: S.D. Gordon, S. R. M. Vaghefi, R. M. Buehrer

System and method for heterogenous spectrum sharing between commercial cellular operators and legacy incumbent users in wireless networks
Patent 10,568,104, Issued February 18, 2020
Inventors: A. Amanna, J. Mitola, III, T.C. Clancy, J.H. Reed, R. Mcgwier, A. Sengupta, A. Kumar

Switched capacitor converters with multi resonant frequencies
Patent 10,658,928, Issued May 19, 2020
Inventors: O. Jong, Q.Li, F.C. Lee

Inverse charge current mode (IQCM) control for power converter
Patent 10,673,328, Issued June 2, 2020
Inventors: S. Bari, F.C. Lee, Q. Li

Non-linear droop control
Patent 10,770,988, Issued September 8, 2020
Inventors: F. Chen, R. Burgos, D. Boroyevich

Interleaved converters with integrated magnetics
Patent 10,790,081, Issued September 29, 2020
Inventors: C. Fei, B. Li, F. C. Lee, Q. Li, H. Wu

Automated program synthesis from natural language for domain specific computing applications
Patent 10,843,080, Issued November 24, 2020
Inventors: M.S. Hsiao

Functionalized metal oxides as a stationary phase and a surface template for micro gas chromatography separation columns
Patent 10,852,278, Issued December 1, 2020
Inventors: M. Agah, M. Akbar, A. Garg, L. Nazhandali, H. Shakeel

Bidirectional three-phase direct current (DC)/DC converters
Patent 10,873,265, Issued December 22, 2020
Inventors: H. Xue, B. Li, Q. Li, F.C. Lee

System and method for real-time optimized scheduling for network data transmission
Patent 10,873,412, Issued December 22, 2020
Inventors: Y. Huang, Y. T. Hou, Y.Chen

System and methods for monitoring eye health
Patent 10,806,341, Issued October 20, 2020
Inventors: M. Rickard, C. Jones

Patents issued **2019**

Method and apparatus for balancing current and power
Patent 10,187,050, Issued January 22, 2019
Inventors: Y. Mao, C. Wang, K. Ngo

Method for jointly adapting an OFDM waveform and the demodulator for interference mitigation and harsh channels
Patent 10200138, Issued February 5, 2019
Inventors: M. Carrick, J. H. Reed, V. Marojevic

Transmitter for transmitting a high-rate data transmission through direct excitation
Patent 10218540, Issued February 26, 2019
Inventors: M. Salehi, M. Manteghi

Multiphase coupled and integrated inductors with printed circuit board (PBC) windings for power factor correction (PFC) converters
Patent 10217559, Issued February 26, 2019
Inventors: Y. Yang, M. Mu, F. C. Lee, Q. Li

Process and system for establishing a moving target connection for secure communications in client/server systems
Patent 10243733, Issued March 26, 2019
Inventors: C. F. Morrell, R. A. Moore, J. G. Tront, R. C. Marchany

Optimal battery current waveform for bidirectional PHEV battery charger
Patent 10250053, Issued April 2, 2019
Inventors: L. Xue, P. Mattavelli, D. Boroyevich

Cooler with emi-limiting inductor
Patent 10290587, Issued May 14, 2019
Inventors: K. Ngo, C. Wang, H. Cui

Critical-mode-based soft-switching techniques for three-phase bi-directional AC/DC converters
Patent 10291109, Issued May 14, 2019
Inventors: Z. Huang, Z. Liu, F. C. Lee, Q. Li, F. Xiao

Current mode control DC-DC converter with single step load transient response
Patent 10312805, Issued June 4, 2019
Inventors: V. Li, P. Liu, Q. Li, F. C. Lee

Omnidirectional wireless power transfer system
Patent 10333353, Issued June 25, 2019
Inventors: J. Feng, Q. Li, F. C. Lee, M. Fu

Soft-switching triangular current mode control for three phase two-level converters with power factor control
Patent 10381921, Issued August 13, 2019
Inventors: N. Haryani, R. Burgos

Coupled inductor for interleaved multi-phase three-level DC-DC converters
Patent 10396684, Issued August 27, 2019
Inventors: M.Mu, S.Lu, Y. Jiao, F. C. Lee

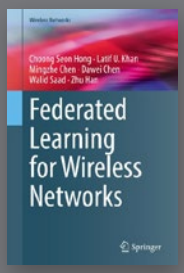
Modular multilevel converter capacitor voltage ripple reduction
Patent 10404064, Issued September 3, 2019
Inventors: Y. Lyu, Y. Hsieh, F. C. Lee, Q.Li

Using power fingerprinting (PFP) to monitor the integrity and enhance security of computer based systems
Patent 10423207, Issued September 24, 2019
Inventors: J. H. Reed, C. R. A. Gonzalez

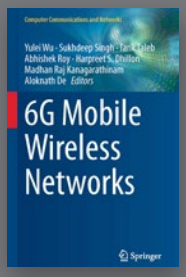
Microprocessor fault detection and response system
Patent 10452493, Issued October 22, 2019
Inventors: B. Yuce, N. F. Ghalaty, P.R. Schaumont

Variable DC link converter and transformer for wide output voltage range applications
Patent 10454381, Issued October 22, 2019
Inventors: B. Li, Z. Liu, F. C. Lee, Q. Li

Books published



Federated Learning for Wireless Networks
C. S. Hong, L. U. Khan, M. Chen, D. Chen, W. Saad, Z. Han
Springer 2021



6G Mobile Wireless Networks
Y. Wu, S. Singh, T. Taleb, H. S. Dhillon, A. Roy, M. R. Kanagarathinam, A. Springer
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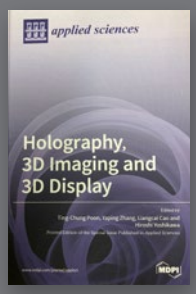

Holography, 3D Imaging and 3D Display
T.-C. Poon, Y. Zhang, L. Cao, H. Yoshikawa ed.
MDPI 2021

Ph.D. degrees awarded

2020 | 2021

An, Hongyu
Powering Next-Generation Artificial Intelligence by Designing Three-Dimensional High-Performance Neuromorphic Computing System with Memristors
Committee Chair: Yi, Y.

Arun, Balaji
Scalable Byzantine State Machine Replication: Designs, Techniques, and Implementations
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Moving Toward Intelligence: A Hybrid Neural Computing Architecture for Machine Intelligence Applications
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Barik, Tapas Kumar
Modern Adaptive Protection and Control Techniques for Enhancing Distribution Grid Resiliency
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Optimization Methods for Distribution Systems: Market Design and Resiliency Enhancement
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The Analysis and Design of Phase-Tunable Low-Power Low-Phase-Noise I/Q Signal Sources for Analog Phase Calibrated Transceivers
Committee Chair: Riad, S.

Chatterjee, Shubhajeet
On Enabling Virtualization and Millimeter Wave Technologies in Cellular Networks
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High-Dimensional Generative Models for 3D Perception
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Chetlur Ravi, Vishnu Vardhan
Stochastic Geometry for Vehicular Networks
Committee Chair: Dhillon, H.S.

Choi, Jin-Woo
Action Recognition with Knowledge Transfer
Committee Chair: Huang, J.-B.

Drikas, Zachary
New Techniques for Time-Reversal-Based Microwave Pulse Compression
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Elouni, Maha
Regulating Traffic Flow and Speed on Large Scale Networks: Control and Geographical Self Organizing Map (Geo-SOM) Clustering
Committee Chair: Rakha, H.A.

Feng, Junjie
6.78MHz Omnidirectional Wireless Power Transfer System for Portable Devices Application
Committee Chair: Li, Q.

Feng, Ziang
Wearable Power Sources and Self-Powered Sensors Based on the Triboelectric Nanogenerators
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Using Workload Characterization to Guide High Performance Graph Processing
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Real-Time Resource Optimization for Wireless networks
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Huang, Zhengrong
SiC-Based High-Frequency Soft-Switching Three-Phase Rectifiers/Inverters
Committee Chair: Li, Q.

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Multimaterial Multifunctional Fibers for Biomedical Applications
Committee Chair: Jia, X.

Krothapalli, Ujwal
Regularization, Uncertainty Estimation and Out of Distribution Detection in Convolutional Neural Networks
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Lee, Moonhyun
Digital-Based Zero-Current Switching (ZCS) Control Schemes for Three-Level Boost Power-Factor Correction (PFC) Converter
Committee Chair: Lai, J.S.

Li, He
Privacy and Authentication in Emerging Network Applications
Committee Chair: Park, J.-M.

Li, Virginia
Control and Modeling of High-Frequency Voltage Regulator for Microprocessor Application
Committee Chair: Li, Q.

Liu, Jinshan
Secure and Reliable Deep Learning in Signal Processing
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Loghmannia, Pedram
Time-Variant Components to Improve Bandwidth and Noise Performance of Antennas
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Mesgarpour Tousi, Maryam
Electric Field Grading and Electrical Insulation Design for High Voltage, High Power Density Wide Bandgap Power Modules
Committee Chair: Ghassemi, M.

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Distributed, Stable Topology Control of Multi-Robot Systems with Asymmetric Interactions
Committee Chair: Williams, R.K.

Naik, Gaurang Ramesh
Coexistence of Vehicular Communication Technologies and Wi-Fi in the 5 and 6 GHz Bands
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Statistical Analysis of Geolocation Fundamentals Using Stochastic Geometry
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Ramdaspalli, Sneha Raj
An Expert-Based Approach for Grid Peak Demand Curtailment using HVAC Thermostat Setpoint Interventions in Commercial Buildings
Committee Chair: Rahman, S.

Ramezanpour, Keyvan
A Deep Learning Approach to Side-Channel Analysis of Cryptogprahic Hardware
Committee Chair: Ampadu, P.K.

Rao, Raghunandan
Enhancing Performance of Next-Generation Vehicular and Spectrum Sharing Wireless Networks: Practical Algorithms and Fundamental Limits
Committee Chair: Reed, J.H.

Saha, Chiranjib
Advances in Stochastic Geometry for Cellular Networks
Committee Chair: Dhillon, H.S.

Song, Hao
Swarm Unmanned Aerial Vehicle Networks in Wireless Communications: Routing Protocol, Multicast, and Data Exchange
Committee Chair: Liu, L.

Sun, Keyao
Protection, Control, and Auxiliary Power of Medium-Voltage High-Frequency SiC Devices
Committee Chair: Boroyevich, D.

Tang, Ye
D-Q Frame Impedance Based Small-Signal Stability Analysis of PV Inverters in Distribution Grids
Committee Chair: Burgos, R.

Wang, Congchao
Automated Tracking of Mouse Embryogenesis from Large-Scale Fluorescence Microscopy Data
Committee Chair: Yu, G.

Wang, Yinxue
Automated Identification and Tracking of Motile Oligodendrocyte Precursor Cells (OPCs) from Time-Lapse 3D Microscopic Imaging Data of Mixed-Motion-Model High-Density Touching Cell Clusters in vivo
Committee Chair: Yu, G.

White, Natalie
Dynamic Electrical Responses of Biological Cells and Tissue to Low- and High-Frequency Irreversible Electroporation Waveforms
Committee Chair: Jia, X.

Wu, Ziling
Data-Driven X-ray Tomographic Imaging and Applications to 4D Material Characterization
Committee Chair: Zhu, Y.

Wu, Chiung Ting
Machine Learning Approaches for Modeling and Correction of Confounding Effects in Complex Biological Data
Committee Chair: Wang, Y.J.

Xu, Yue
Insulation Design, Assessment and Monitoring Methods to Eliminate Partial Discharge in SiC-Based Medium Voltage Converters
Committee Chair: Boroyevich, D.

Yang, Shuo
Femtosecond-Laser-Enabled Fiber-Optic Interferometric Devices
Committee Chair: Wang, A.

Yeh, Chih-Shen
Fully Soft-Switching Modulation Methods for SRC-Unfolding Inverter
Committee Chair: Lai, J.S.

Yellu, Augustine
Second Harmonic Generation Stimulated Electromagnetic Emissions during High Power High Frequency Radio Wave Interaction with the Ionosphere
Committee Chair: Scales, W.A.

Yu, Kevin
Coverage Planning for Unmanned Aerial Vehicles
Committee Chair: Williams, R.K.

Yu, Oscar
High Voltage Synchronous Rectifier Design Considerations
Committee Chair: Lai, J.S.

Zhang, Qianqian
Machine Learning for Millimeter Wave Wireless Systems: Network Design and Optimization
Committee Chair: Saad, W.

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Sam Yakulis
BSEE '91
Chief Operating Officer
Forever Oceans

Honors & achievements

Keynote addresses

Walid Saad gave keynote speeches at the 10th International Conference on Computational Data and Social Networks, Nov. 2021, Montreal; the IEEE ICC Workshop on Edge Learning for 5G Mobile Networks and Beyond, June 2021, Montreal; the 2021 International Symposium on Ubiquitous Networking (UNet 2021), May 2021, virtual; IEEE ComSoc NFV and SDN Technologies Subgroup, Dec. 2021, virtual; Wireless World Research Forum (WWRF), Dec. 2021, Paris.

Ali Mehrizi-Sani presented a keynote address at the IEEE International Conference on Control, Instrumentation, and Automation, March 2022, Tehran/ virtual.

Conference chairs

Y. Thomas Hou served as Executive Chair of IEEE INFOCOM 2021, May 2021, virtual.

Harpreet Dhillon served as co-chair of DroneCom: 4th International Workshop on Drone Assisted Wireless Communications for 5G and Beyond, ACM MobiCom, New Orleans, Oct. 2021.

T.-C. Poon served as chair of the 2021 Optica Frontiers in Optics (FiO) conference, Washington, D.C., Nov. 2021.

Honors & awards

Saifur Rahman was elected the President of IEEE in the fall of 2021. He is serving as the 2022 IEEE President and will be the President and CEO of IEEE in 2023. He is the first ever Virginia Tech faculty member to be elected as the IEEE President.

Scott Midkiff was honored with the ORBIE Award as the 2021 Capital CIO of the Year. ORBIE awards recognize CIOs with outstanding professional achievements who inspire the next generation of technology leaders.

Harpreet Dhillon received the 2021 IEEE WTC Outstanding Young Researcher Award, given to an individual within 10 years of their Ph.D., who has achieved exceptional early career visibility. He was also placed 15th on the AI2000 100 most cited scholars in IoT.

Yuhao Zhang and Ryan Williams received NSF CAREER Awards in 2021 and Dong Dong received the honor in 2022. CAREER awards are designated for faculty members early in their career who are expected to become leaders in their field.

Mona Ghassemi has won a DoE Early Career Research Award—one of only 83 awarded in 2021. The DoE Early Career Research Program is designed to provide support to exceptional researchers during the crucial early career years.

Walid Saad was named a Clarivate Highly Cited Researcher by Web of Science for 2021.

Ming Jin and a team of two graduate students, **Vanshaj Khattar** and **Mingy Kim,** along with undergraduate student **Qasim Wan**i won 1st place in the 2021 CityLearn Challenge. The international competition addresses grand challenges in power and energy systems.

T.-C. Poon was named a Life IEEE Fellow for contributions to optical image processing and digital holography.

Exceptional national & international service

Wayne Scales serves on the Trustee Board of the University Space Research Association.

Mona Ghassemi serves as a Member-at-Large of the Administrative Committee of the IEEE Dielectrics and Electrical Insulation Society (DEIS).

Lingjia Liu serves on the National Spectrum Consortium (NSC) Executive Committee.

Scott Midkiff serves as an ABET Program Evaluator.

Cameron Patterson serves as an ABET Evaluator.

Editorships

ACM Transactions on Sensor Networks	**Y. Thomas Hou**	Associate editor
Frontiers in Photonics	**T.-C. Poon**	Specialty chief editor
IEEE Journal on Selected Areas in Communications	**Walid Saad**	Associate editor-in-chief, special issue
IEEE Transactions on Energy Conversion	**Ali Mehrizi-Sani**	Associate editor
IEEE Transactions on Green Communications and Networking	**Harpreet S. Dhillon**	Editor
IEEE Transactions on Network Science and Engineering	**Walid Saad**	Area editor
IEEE Transactions on Wireless Communications	**Harpreet S. Dhillon**	Editor
IEEE Transactions on Wireless Communications	**R. Michael Buhrer**	Editor
IEEE Transactions on Wireless Communications	**Luiz DaSilva**	Associate editor
IEEE Wireless Communications Letters	**Harpreet S. Dhillon**	Senior editor
Optical Engineering	**Yizheng Zhu**	Associate editor
Radiation Effects and Defects in Solids	**Wayne Scales**	Associate editor
Transactions on Network Science and Engineering	**Y. Thomas Hou**	Editor-at-large

Best paper awards

Y. Tom Hou, students **Yongce Chen** and **Yubo Wu,** with **Wenjing Lou** of CS won the IEEE INFOCOM 2021 Best Paper Award for "A Deep-Learning-based Link Adaptation Design for eMBB/URLLC Multiplexing in 5G NR."

Charles E. Thornton, R. Michael Buehrer, and **Anthony F. Martone** won the Vanu Bose Best Paper Award at the IEEE Military Communications Conference (MILCOM) 2021, Oct. 2021, San Diego for "Waveform Selection for Radar Tracking in Target Channels With Memory via Universal Learning."

Yibin Dong, Seong K. Mun of physics, and **Joseph Wang** (ECE) won a "Best Application Paper" Award at the 3rd International Congress on Blockchain and Applications, March 2020, Slamanca, Spain, for their paper, "Blockchain-Enabled Next Generation Access Control."

Student best paper awards

Joseph Kozak, won the Ph. D. Thesis Talk Award of the IEEE Power Electronics Society.

M. A. Abd-Elmagid, H. S. Dhillon, 2021 WiOpt Student Best Paper Award for "Distributional Properties of Age of Information in Energy Harvesting Status Update Systems," Oct 2021, Philadelphia.

Qihao Song won the Best Presentation Award of the 2021 Applied Power Electronics Conference (APEC), June 2021, Virtual.

Short courses

Harpreet Dhillon presented a short course on Machine Learning in Communications at the JTG/IEEE Information Theory Society Summer School in Information Theory, Signal Processing, Telecommunication, and Networking, June-July 2021, Kanpur and at IIT Bhubaneswar, Jan, 2022 Bhubaneswar. He also presented a workshop on Poisson Line Cox Process: Distributional Properties and Applications to Vehicular Networks at Laboratory for Information, Networking and Communication Sciences (LINCS), March 2022, Paris.

ECE faculty

A. Lynn Abbott
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