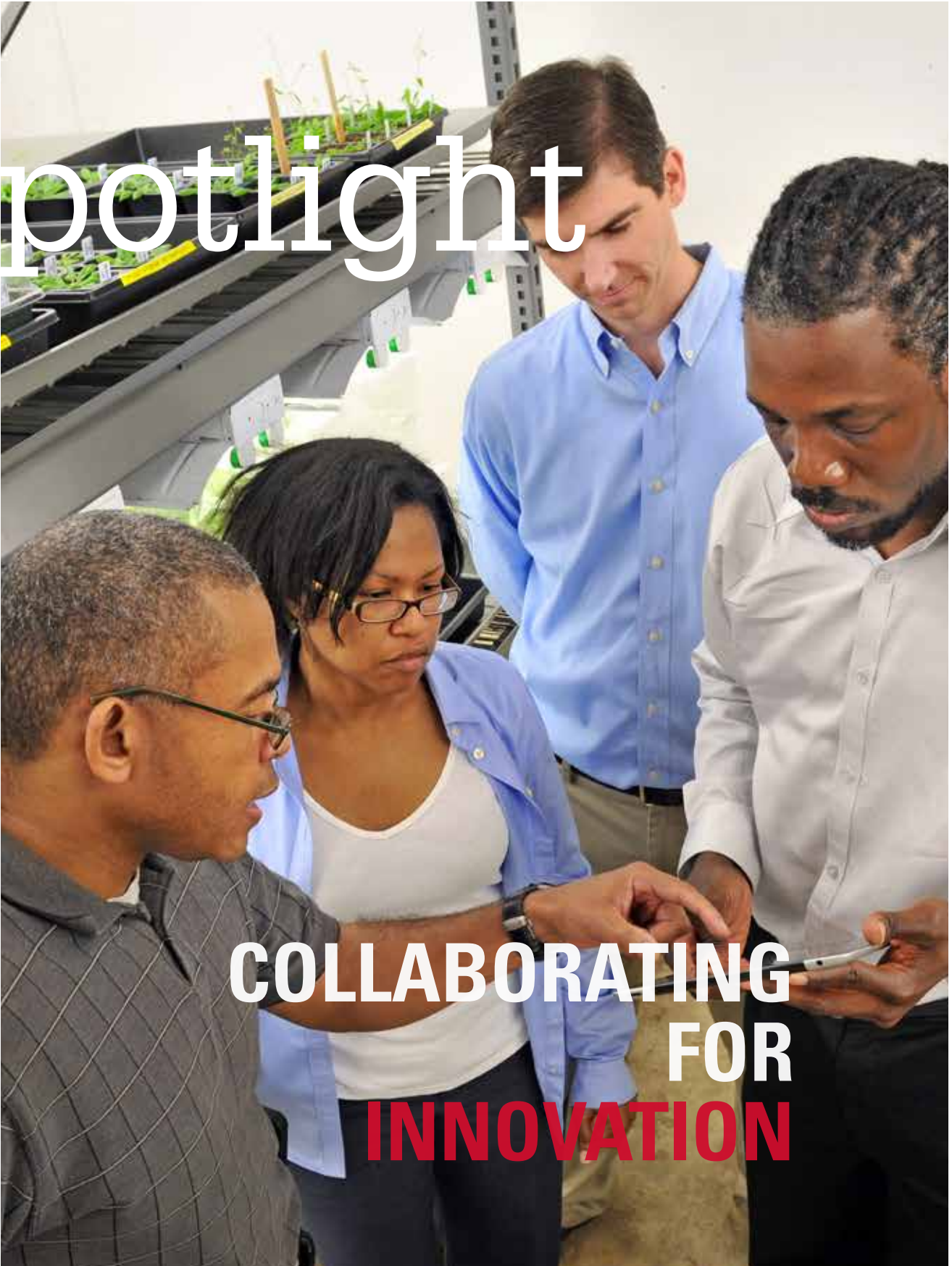


Spotlight



**COLLABORATING
FOR
INNOVATION**

NC STATE

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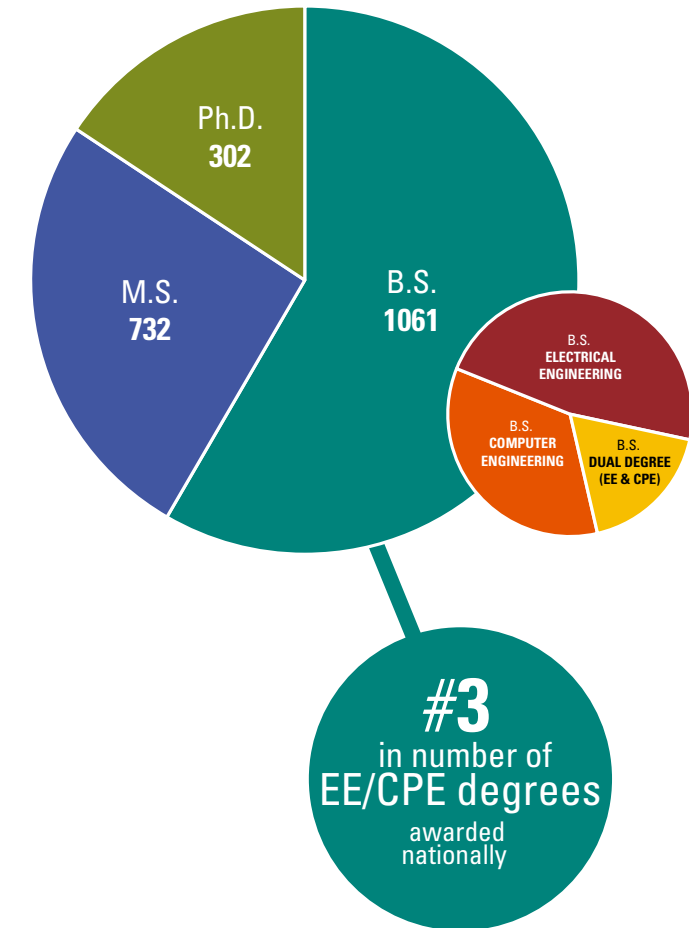
63 Tenured/Tenure-Track

\$37M Research Expenditures

22 NSF CAREER Awards

24 IEEE Fellows

2 National Academy of Engineering Members



According to ASEE 2020



#6

Best value among public universities nationally

according to U.S. News & World Report



#9

University in the U.S. to study Electrical Engineering

according to ShanghaiRanking's Global Ranking 2022

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FROM THE DEPARTMENT HEAD

FROM THE ADVISORY BOARD



the North Carolina legislature has provided seed funding to jump-start significant growth of the College of Engineering and the university. To meet the projected workforce needs, the College of Engineering may need to grow by as much as 40%. This will also require significant growth in many other parts of the university to support the new engineering students. The growth in demand of ECE and Computer Science graduates is anticipated to be particularly strong. As a result, initial discussions suggest that ECE may grow by as many as 575 undergraduate students, 300 graduate students, more than 30 faculty, and 4-5 supporting staff. Such growth would make us among the largest departments in the nation (according to the American Society of Engineering Education data, we are already one of the top 10 suppliers of electrical engineering and computer engineering degrees in the U.S.).

Of course, significant growth like this must be done carefully and strategically. Our curriculum as well as the expertise of the new faculty that we hire must enable us to prepare students for the needs of the innovative companies growing in North Carolina and position us to contribute to national challenges identified by the CHIPS and Science Act. Significantly, this growth also provides an opportunity for us to increase the diversity of both our students and faculty.

I hope the excitement of what the students, staff, and faculty in ECE have accomplished in the past year will be apparent in the stories covered in this Spotlight. However, the excitement has just begun!

Dr. Daniel D. Stancil
ECE Department Head

This is an exciting time for Electrical and Computer Engineering in general, and particularly for our ECE Department at NC State. One evidence of the broader opportunity is the passing of the bipartisan CHIPS and Science Act. This act provides funding for growing our domestic semiconductor manufacturing capacity, as well as research in cutting-edge technologies such as quantum computing, artificial intelligence, clean energy, and nanotechnology—all critical areas where electrical and computer engineers will play leadership roles. The act also provides significant funding to promote diverse workforce development in STEM fields.

Closer to home, an increasing number of top-tier technology companies are announcing new facilities or growth in North Carolina. Beyond the highly visible companies that are usually associated with ECE, in today's sophisticated economy, virtually all companies need ECEs. Recognizing the strong connection between the availability of an educated workforce and the attractiveness of North Carolina for business expansion and growth,



It is a great pleasure to write to you on behalf of the ECE Strategic Advisory Board (SAB). North Carolina continues to attract technology companies as they build and expand operations in our state. It is a testament to our state's innovative research ecosystem which develops a well-educated talented workforce. Corporate academic relationships with their creative training programs are key in developing this workforce. There is a growing demand for talent with education in areas of semiconductors, electric vehicles, clean energy, cloud computing, machine learning, artificial intelligence and wearable devices.

Keeping this trend in mind the ECE SAB has expanded and evolved. Despite the challenges of the COVID-19 pandemic the SAB stayed committed to provide the department with insights and advice to leverage these opportunities for long term impact. The SAB membership now comprises experience in academics and industry, software and hardware technology, manufacturing, healthcare, energy,

life sciences, sales and consulting. Their diverse backgrounds and perspectives further enhance the value of our recommendations to the department.

The SAB advises the department primarily in 3 areas: thought leadership, course topic recommendations and external perspectives / alumni relationships to meet the demands of industry. For example, the SAB has been supportive of adding coursework in the areas of machine learning, semiconductor design, engineering leadership and data science to teach skills which make our students highly employable. Additionally, the board is instrumental in identifying challenges in both academic and research settings and urging the department to adjust and adapt curriculum and corporate relationships accordingly. Most importantly, the SAB serves to guide the department in ensuring the focus on recruiting under-represented students and faculty remains a top priority. Finally, in the area of alumni engagement, the SAB guides the department in impactful outreach methods including the active support of the ECE Hall of Fame ceremony which recognizes alumni with extensive contributions to the electrical and computer engineering profession. As we continue to recognize more of our community this year, we have introduced the Outstanding Young Alumni Award and Distinguished Service Award.

The SAB is looking forward to participating in the engineering expansion discussions in the next few years. This is our opportunity to make decisions to develop a workforce that will have a positive impact on our state's innovative research ecosystem.

Dr. Sonali Luniya
Chair, ECE Strategic Advisory Board
Vice President of Corporate Development, Holmusk

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SOLARPACK

RACES INTO HISTORY

NC State's solar vehicle team, SolarPack, competed in the Formula Sun Grand Prix in July and drove the fastest lap in the history of the competition, finishing in three minutes and one second on a 2 1/2-mile track. The SolarPack car completed a total of 75 laps.

SolarPack is NC State's first solar vehicle team. The team is tasked with building a car that is powered by solar energy. This year, SolarPack is engineering things no other team has done before.

Their car is a converted 2001 Volkswagen Golf GTI that weighs over 2,800 pounds, by far the heaviest car at the FSGP.

SolarPack purchased the original Volkswagen Golf body during the height of the COVID-19 pandemic for just \$1,000. Ben Nichols, SolarPack's technical director and a graduate student in electrical and computer engineering, said the team wanted to show that solar energy could be practically applied to existing car models, but they also needed to conserve money during that difficult time.

"The few sponsors we had that would have been able to [fund SolarPack] had to focus on their companies and make sure that they would survive through the pandemic," Nichols said. "Buying the Golf cut about \$30,000 in car body fabrication costs."

"We tried everything from solar cell donations to percent of purchase nights at local restaurants and yet we were still struggling to get the money we needed to make one of the more important components of a solar car: the solar array," Nichols said. "This meant that we needed to get

creative and ended up purchasing the solar cells unassembled. Our solar team then constructed the array by hand and ended up doing hundreds of solder connections."

The team spent a total of just \$1,300 on the array.

COVID-19 presented challenges to SolarPack's efforts in other ways as well. To be safe, only five people were allowed to work on the car at a time in a team member's garage.

"We worked tirelessly getting the battery pack assembled and into the car but we never had the time to test the pack before we were off to the race," Nichols said. "This was a huge risk for us, but we had no other choice than to trust our capabilities and head to the competition."

Later, the team discovered two of the cells in the 1,352-cell battery pack had come loose and had to stay up for an entire night so they could fix this issue. Strag said he believes this was the most difficult ordeal SolarPack had to overcome at the event.

"It involved redoing a lot of what we'd already done: reassembling the battery enclosure, reassembling the battery pack, bringing individual cell modules up to charge — which takes time," Strag said.

Theodore Holshouser, a fourth-year student studying computer engineering, said seeing the car get on the road as onlookers cheered was a euphoric experience.

"It was actually more moving for me to hear the reception from the people," Holshouser said. "Hearing that ovation ... I almost broke into tears."



DETECTING COUNTERFEITS WITH A SMARTPHONE

As counterfeit merchandise and documents become more difficult to detect, methods for checking authentication need to become more sophisticated. A new authentication system that gets down to the microscopic level to detect counterfeits is a promising solution — especially since it can all be done using a smartphone.

Chau-Wai Wong, an assistant professor in the Department of Electrical and Computer Engineering, received a patent for this new method, which is cheaper than traditional systems like holograms and ultraviolet ink. It's also more accurate, as traditional methods rely on human judgment for the final decision.

Common items at risk for counterfeiting include tickets, IDs, medicine, military devices and merchandise packaging.

In developing countries, medicine counterfeiting has become a significant problem. The high prices of medicines have made counterfeiting them an attractive opportunity to unsuspecting victims. Because of the long supply chains involved from pharmaceutical companies to consumers, there are ample ways to interfere with product security.

In smaller countries, the resources to detect counterfeit products are severely lacking. There is currently no accessible tool that exists for consumers to verify the quality of their products themselves.

The National Science Foundation has awarded Wong and his collaborator's research a \$450K grant over the next three years to weaken the physical side of counterfeiting capabilities. "We proposed to combine this authentication technology with blockchain to safeguard commercial products," said Wong.

Wong's detection method is dependent on the existence of physically unclonable features (PUFs), or the unique, microscopic structures on a surface that are almost impossible to replicate.

Given the advancement and availability of smartphones, Wong saw benefits to making the authentication method available through an app versus traditional technologies.

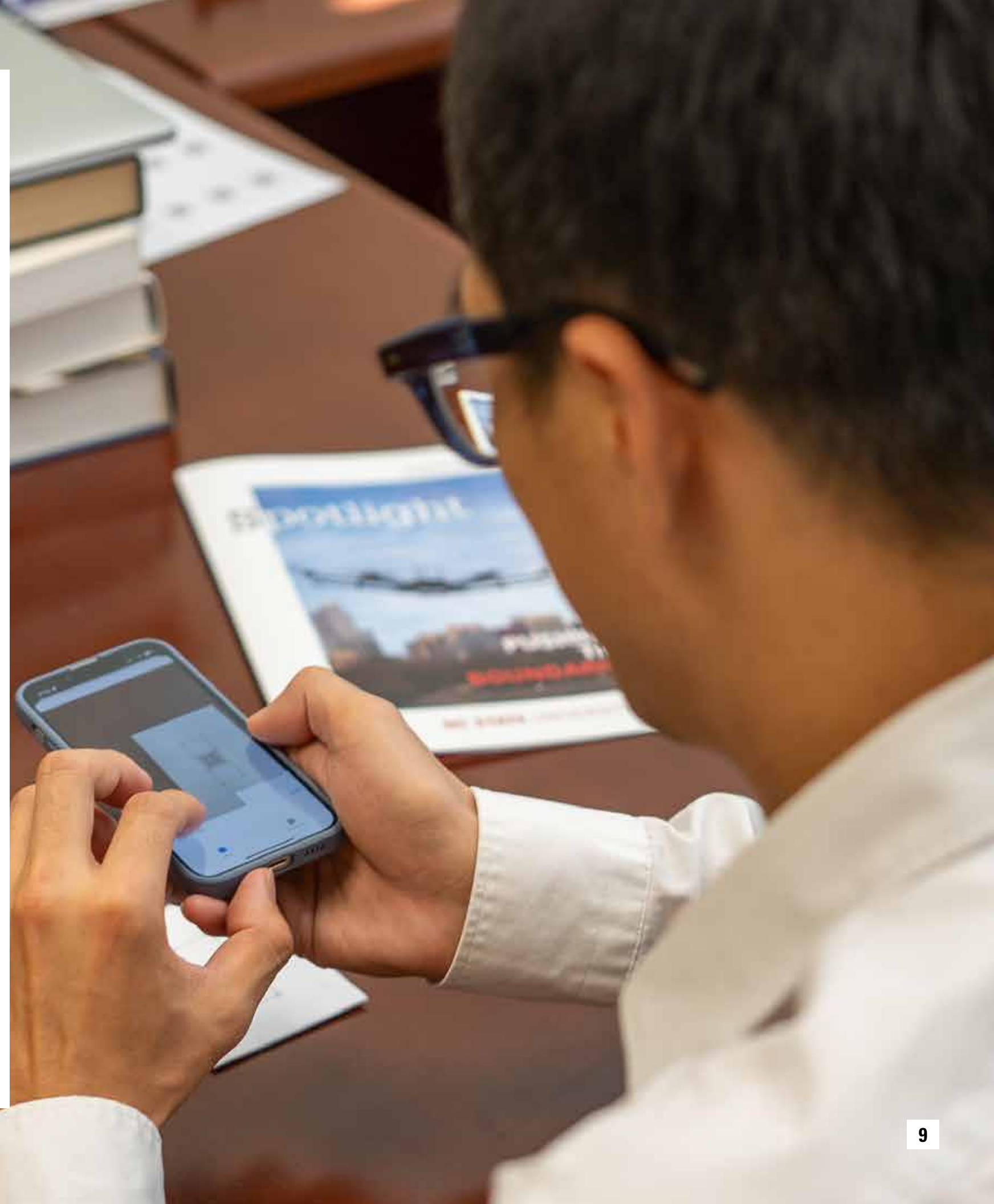
"With the increased imaging capability of modern smartphones, they make it easier for the technology to be widely used," Wong said.

The item's surface is illuminated as the user takes multiple photos. These photos are used to calculate the normal vector field, a verification feature that assesses the unique directions along the surface of a product. These series of directions are then verified against the reference directions in the backend database and authenticity is verified or denied within seconds.

"Because we have a 'fingerprint' in the database, no matter who's trying to verify the product and as long as the software 'pipeline' is not hacked, we can be confident whether something is or is not authentic," Wong said.

The NSF grant significantly boosts the opportunity for commercialization. The verification process has a potentially promising future in the areas of supply chain management as companies have begun expressing interest.

For his work, Wong was recently awarded the Jimmy H. C. Lin Innovation Award from the University of Maryland (UMD), where he received his Ph.D. The award offers financial assistance to faculty and staff members and students throughout the expensive patenting process to support the spirit of the invention.





NEW ENERGY-EFFICIENT GaN DEVICES

An interdisciplinary team of NC State electrical engineering and materials science researchers have created new high-power rectifiers that are more energy efficient than previous technologies. The low-loss performance reported by the team is made possible by a unique technique for doping gallium nitride (GaN) in a controlled way.

“Many technologies require power conversion – where power is switched from one format to another,” said Dolar Khachariya, the first author of the paper and a recent electrical and computer engineering Ph.D. graduate from NC State University. “For example, the technology might need to convert AC to DC, or convert electricity into work – like an electric motor.” In modern power conversion systems, semiconductor-based components, such as switches and rectifiers, represent key building blocks that drive the resulting conversion efficiency.

“Developing more efficient power electronics like power switches reduces the amount of power lost during the conversion process,” said Khachariya, who is now a researcher at Adroit Materials Inc. “This is particularly important for developing technologies to support a more sustainable power infrastructure, such as smart grids.”

The team reported the highest performing GaN-based Junction Barrier Schottky (JBS) diode to date. “JBS diodes are useful because they provide an attractive combination of on-state and off-state performance,” said Shane Stein, second author of the paper and current electrical and computer engineering Ph.D. student. “They have the same low ON-state voltage drop and high switching speeds as Schottky Barrier Diodes, as well as the low leakage current and high blocking voltage capability of PN diodes in the OFF-state. This means Junction Barrier Schottky diodes have both lower energy losses and higher robustness than other devices.”

To manufacture JBS diodes, the ability to strategically introduce dopants or impurities in certain areas of the device is paramount. “Ion implantation is the preferred approach for selective area doping, and it is readily available in other semiconductor technologies, such as silicon and silicon carbide,” said **Spyridon “Spyros” Pavlidis**, a co-author of the paper and an assistant professor in electrical and computer engineering. “While GaN possesses material properties that inherently allow for the design of more efficient high-voltage devices compared to other technologies, manufacturing challenges, such as how to implant and subsequently activate magnesium (Mg) to create the regions of p-type GaN, have limited the ability of vertical GaN devices to compete.”

“We’ve demonstrated that you can selectively dope GaN to create functional JBS diodes and that these diodes are not only functional but enable more power efficient conversion than JBS diodes that use conventional semiconductors. For example, in technical terms, our GaN JBS diode, fabricated on a native GaN substrate, has record high breakdown voltage (915 V) and record low on-resistance,” said Ramón Collazo, co-author of the paper and an associate professor of materials science and engineering at NC State. “We’re currently working with industry partners to scale up production of selectively doped GaN, and are looking for additional partnerships to work on issues related to more widespread manufacturing and adoption of power devices that make use of this material.”

“We are continuing to refine this technology in order to further improve efficiency and increase the power rating of the devices,” said Pavlidis.



NEW APPROACH ALLOWS FOR **FASTER RANSOMWARE DETECTION**

Engineering researchers have developed a new approach for implementing ransomware detection techniques, allowing them to detect a broad range of ransomware far more quickly than previous systems.

Ransomware is a type of malware. When a system is infiltrated, the ransomware encrypts that system's data – making the data inaccessible to users. The people responsible for the ransomware then extort the affected system's operators, demanding money from the users in exchange for granting them access to their own data.

Ransomware extortion is hugely expensive, and instances of ransomware extortion are on the rise. The FBI reports receiving 3,729 ransomware complaints in 2021, with costs of more than \$49 million. What's more, 649 of those complaints were from organizations classified as critical infrastructure.

"Computing systems already make use of a variety of security tools that monitor incoming traffic to detect potential malware and prevent it from compromising the system," says **Paul Franzon**, co-author of a paper on the new ransomware detection approach. "However, the big challenge here is detecting ransomware quickly enough to prevent it from getting a foothold in the system. Because as soon as ransomware enters the system, it begins encrypting files." Franzon is the Cirrus Logic Distinguished Professor of Electrical and Computer Engineering at NC State University.

"There's a machine-learning algorithm called XGBoost that is very good at detecting ransomware," says Archit Gajjar, first author of the paper and a Ph.D. student at NC State. "However,

when systems run XGBoost as software through a CPU or GPU, it's very slow. And attempts to incorporate XGBoost into hardware systems have been hampered by a lack of flexibility – they focus on very specific challenges, and that specificity makes it difficult or impossible for them to monitor for the full array of ransomware attacks.

"We've developed a hardware-based approach that allows XGBoost to monitor for a wide range of ransomware attacks, but is much faster than any of the software approaches," Gajjar says.

The new approach is called FAXID, and in proof-of-concept testing, the researchers found it was just as accurate as software-based approaches at detecting ransomware. The big difference was speed. FAXID was up to 65.8 times faster than software running XGBoost on a CPU and up to 5.3 times faster than software running XGBoost on a GPU.

"Another advantage of FAXID is that it allows us to run problems in parallel," Gajjar says. "You could devote all of the dedicated security hardware's resources to ransomware detection, and detect ransomware more quickly. But you could also allocate the security hardware's computing power to separate problems. For example, you could devote a certain percentage of the hardware to ransomware detection and another percentage of the hardware to another challenge – such as fraud detection."

"Our work on FAXID was funded by the Center for Advanced Electronics through Machine Learning (CAEML), which is a public-private partnership," Franzon says. "The technology is already being made available to members of the center, and we know of at least one company that is making plans to implement it in their systems."



PAVING THE WAY

JUNTOS

As an eighth grader in Wake County, Michael Nuñez, now a junior in computer engineering, had yet to consider where he would go to college, let alone how he would make it happen. Joining his local Juntos 4-H Program gave him the support he needed to become a student worker and Juntos mentor as a senior at NC State, eight years later.

Juntos, which means “together” in Spanish, is aptly named because the program unites community partners to better support local Hispanic and Latino K-12 students through high school graduation and into their college careers.

NC State’s Juntos 4-H Program was founded in 2007. Today Juntos is a national movement led by land-grant universities and extension professionals in 14 states — with a vision to grow.

In 2014, Nuñez was introduced to Juntos through his school. After he attended the Juntos Summer Academy at NC State, his perspective and goals began to shift.

“After attending the academy, we said, ‘If college is like this, we’re going to pay attention,’” Nuñez says, referring to himself and his peers in the program. During the Summer Academy, advisors and admissions staff from the College of Engineering connected with students to discuss the college’s majors and show them key resources, like the James B. Hunt Jr. Library and the ECE MakerSpace. The experience sparked Nuñez’s passion for computer engineering.

“I chose computer engineering because I was really fascinated with the hardware... what was inside the devices is what really captivated me,” Nuñez said.

Despite not getting accepted as a first-year student, Nuñez followed his mentors’ advice and found a pathway to NC State through Wake Technical Community College (WTCC) and the Community College Collaboration(C3) partnership.

The community college environment allowed Nuñez to learn how to connect with his professors. After two years at WTCC with the support of C3,

Nuñez applied and was accepted to NC State, and he was named a Goodnight Transfer Scholar.

In 2022, Juntos established its own unique partnership with WTCC to support first-generation and Latino students on their path to higher education. “This is a model NC State Juntos is ready to replicate,” says Diana Urieta, senior director and co-developer of Juntos. “Over 80% of our graduating seniors [in 2021] are choosing their local community college to start their postsecondary education,” she says.

Transitioning from a community college to a large university campus can be difficult, and it’s crucial for students to find a sense of belonging in order to have a successful college career. When Nuñez arrived at NC State in the fall of 2021, the Juntos office quickly became his space for community and connection.

Juntos “helps with the transition from high school or community college to our larger NC State community. This prevents students from getting lost in the crowd and helps them get a stronger sense of belonging,” said **Edgar Lobaton**, associate professor and active mentor in the Juntos program.

Through Juntos, Nuñez mentors eighth through twelfth graders to help them better understand how to achieve their goals, whether it’s to join the workforce or to enroll in a trade-school program, a community college or a four-year institution. He also spends time with the families of students, sharing his educational experiences and providing important scholarship information. Nuñez knows from personal experience how valuable family involvement is for students to stay motivated and succeed.

Even when thinking about future career options, Nuñez operates from a perspective of service and community building.

“If you don’t go back to your roots or give back to where you came from, you’re not really showing appreciation to the things that made you who you are,” Nuñez explains.

VIRAL VECTOR INITIATIVE

A new engineering lab on Centennial Campus will refine the manufacturing and production technologies of viral vectors, or viral delivery mechanisms, used in biomedical research. The Viral Vector Initiative in Research and Learning (NC-VVIRAL) lab will develop innovative purification and sensing processes that are affordable and highly scalable for commercial applications.

Viral vectors are viruses that have been modified to deliver genetic material into cells for treatment or research. Because viruses already naturally know how to deliver their genomes into cells they want to infect, scientists can use non-pathogenic viruses as a vehicle to introduce what they need directly into a cell.

Michael Daniele, associate professor in electrical and computer engineering and biomedical engineering and Stefano Menegatti, associate professor in chemical and biomolecular engineering, will oversee a multi-disciplinary group of engineering students and scientists who will investigate chromatography, microelectronics, data analytics and more.

The lab space is based on the concept of semiconductor foundries. It provides the resources for students and researchers to come with their viral vector design and learn how to manufacture it.

The NC-VVIRAL Lab will help solve the industry need to have cohesive technology, equipment and knowledge around the viral vectors. Their mission is to make viral vectors affordable and available at scale.

“The first immediate need that this fulfills in the industry is the ability to learn and develop technologies to transition new biotherapeutics, like viral vectors, into a commercially viable product,” said Daniele.

Due to the interdisciplinary nature of the research at NC-VVIRAL, the students working at the lab will bring in a wealth of knowledge. As these students enter the workforce in North Carolina, they are able to contribute multiple engineering perspectives from their experience.

The exciting new aspects of this research will allow participants to be at the cutting edge of viral vector development by exploring new manufacturing capabilities. Students will gain training in bioprocessing technologies and biomolecular analytic tools “all at the same place, all at the same time,” said Daniele.

“We are open for business. We are open to consulting and collaborating with the industries.” Menegatti said. “We have accumulated here the critical mass of instruments and cross-disciplinary expertise” to get better products into the market, faster.

 [Learn more at go.ncsu.edu/vviral](https://go.ncsu.edu/vviral)

FROM THE LAB TO THE FARM

The Benchbot research project is a collaborative effort at NC State between the Department of Electrical and Computer Engineering and the Department of Crop and Soil Sciences.

The idea of the project is to build a robot with machine learning that can automate the process of plant imaging. This monitoring of plant phenotyping helps researchers collect data regarding how big they grow, leaf shapes and sizes, and other physical characteristics of the plants.

From this collection of data, scientists can learn more about plant health and structure. This knowledge helps streamline the growing process to make it faster and more efficient.

The current way of tracking plant phenotypes is through manual images and annotations. Researchers have to study and observe the plants and note their characteristics themselves. This way of tracking data is much more time-consuming, and less efficient due to the innate human error of categorizing data.

The Benchbot will replace human efforts of imaging and categorizing plants by making the process fully automated. "The basic reason that we develop machines is to make human work easier, especially repetitive tasks," said Priya Jakhar, an electrical and computer engineering Master's student working on the Benchbot.

The robotic system is equipped with a high-resolution camera that takes multiple images of

the crop. These images are sent to computer-based machine learning algorithms that are programmed to recognize and sort plant phenotypes.

The Benchbot provides an interdisciplinary research experience for students who are involved. Not only do they get exposure to the agricultural world, but electrical and computer engineering students can practice many different practical skills.

Students can work on the hardware side of the project which includes sensor integrations or incorporating embedded systems. On the software side, students can learn more about computer programming or machine learning algorithms. Additionally, the Benchbot project employs mechanical engineering students to help build the seven-foot frame and help with its automated mobilization.

"Ideally we want to be able to scale up with the benchbot... we want to be able to take it to a more realistic setting where we try to understand what are the factors that are impacting the responses in the different plants?" said **Edgar Lobaton**, an associate professor in the Department of Electrical and Computer Engineering.

There are a few Benchbots that have been built and deployed across the country to farmland. Here, the robot can practice real-world applications of monitoring plant phenotypes and weed species.

"For agriculture, right now, the primary revolution going on is the use of computer vision... we all see a future where robots are going to be doing more and more of the farming and computer vision systems are a key part of making that operate," said Chris Reberg-Horton, professor of crop and soil science.





ENGINEERING NORTH CAROLINA'S **FUTURE**

A funding initiative from the state legislature titled Engineering North Carolina's Future will help grow the enrollment of engineering and computer science students at NC State and other engineering programs in the University of North Carolina System.

The initiative recognizes the significant growth of science, technology, engineering and mathematics (STEM) workforce-dependent industries in North Carolina and was spurred, in part, by several significant hiring announcements in the state by leading technology companies in 2021.

NC State plans to add about 4,000 engineering and computer science students over the next few years and hire more than 100 new faculty members. This growth would bring the enrollment in the College of Engineering to more than 14,000 students and the University's total student population to more than 40,000.

Engineering North Carolina's Future will provide NC State with \$20 million over two years to catalyze the hiring of additional faculty members and support staff including academic advisors and laboratory personnel to support the larger student body.

"NC State is providing the workforce, research and partnerships that are fueling the Triangle's flourishing tech industry that is driving huge economic impact benefits across the state of North Carolina," said Chancellor Randy Woodson. "We greatly appreciate the General Assembly's support and recognition of NC State's critical role in Engineering North Carolina's Future."

Recent economic development announcements by Apple, Google, FUJIFILM Diosynth and many others show the rapid growth of the tech industry in North Carolina. The demand for NC State's well-prepared STEM graduates — as well as

partnerships with NC State's world-leading faculty members and their research — has never been greater. As just one example, Google's new unit in Durham, NC, will be led by Kamala Subramaniam, an NC State electrical and computer engineering alumna who received her M.S. in 2001 and Ph.D. in 2006.

As the workforce needs of the state grow, however, NC State has not kept pace with demand; last year alone, the University turned down undergraduate admissions to 1,400 engineering applicants who had a 3.75 or higher unweighted GPA due to a lack of faculty members and space.

"These new funds will enable NC State to keep our best and brightest students in the state, and will allow us to meet the needs of North Carolina's

growing technical workforce," Woodson said.

Engineering North Carolina's Future will also help the College of Engineering take the next step toward its goal of becoming the leading public college of engineering in the United States.

Heavy state investment in the College helped spur a period of significant enrollment growth and research expansion between 2006 and 2018. The College reached \$200 million in annual research expenditures and climbed as high as eighth nationally in annual expenditures among all engineering colleges. Along with that growth came national recognition; the College was ranked as high as 11th among all public colleges of engineering in U.S. News & World Report rankings of the best graduate engineering programs in the country.

THE FUTURE OF 6G IN NORTH CAROLINA

Cellular systems are always evolving. The desire to communicate and what to communicate is increasing every day. Each cellular system has expanded on its predecessor and added new capabilities that make us think about how we ever lived without it before.

What's exciting about 6G is that researchers are still determining what's to come. People have yet to discover what the next generation of technology and innovation is going to be, but the 6GNC collaborative effort in the Department of Electrical and Computer Engineering is right at the forefront of it all.

"This is the chance to develop new ideas that will eventually make it into the standard and make it into products," said **Robert Heath**, ECE Lampe Distinguished Professor.

"The research teams at NC State cover an incredible number of areas and technologies that will play a key role in 6G," explained **Nuria Gonzalez-Prelcic**, associate professor of electrical and computer engineering, "this effort includes aspects of antenna and circuit design, integrated circuit optimization, or algorithms for the physical and upper layers of the cellular network, including artificial intelligence solutions."

Some of the potential capabilities of 6G range from live-streaming from outer space to communicating instantly with deep-sea divers to enhancing the virtual reality experience and even remote surgery. All of these examples require an advanced cellular network that can efficiently and flawlessly communicate over wireless connections.

To create these cellular communication networks, researchers must co-design the necessary components. As design systems grow more complex with new ideas, the components become more particular. 6GNC is providing the necessary collaborative communication space that understands how to interact with each other to create technology that functions in the real world.

Overcoming blockage is one key challenge to be solved to deploy future mmWave/sub-THz networks. Funded by NSF through the RINGS program, Gonzalez-Prelcic and Heath are working on the design of creative solutions to reduce the time that the cellular network needs to reestablish the link once a blockage event appears. In particular, they have pioneered the idea of using sensor data, advanced signal processing, and learning tools to provide information that can be used to significantly reduce this configuration time.

Additionally, professor of electrical and computer engineering, **Alexandra Duel-Hallen**, has received NSF funding to develop machine learning methods to provide reliable early warning of mobile millimeter wave signal blockage hundreds of milliseconds ahead, thus facilitating a proactive response of the network to mitigate blockage.

The **integration of space or aerial segments into the cellular network** is another innovation that will change the way we think about cellular infrastructure. Conventional terrestrial base stations will be supplemented by space/aerial nodes, including UAVs, HAPS, LEO and GEO satellites. Partnerships through the AERPAW project, led by **Ismail Guvenc**, professor of electrical and computer engineering, are helping to develop the technology that supports the next generation of UAVs. The introduction of LEO constellations into the cellular network is interesting for automakers like Toyota who are helping fund 6GNC to develop solutions which will provide coverage to underserved areas or disaster zones, enabling continuous support of automated vehicles even in emergencies or remote locations.

6G networks will likely also **incorporate new bands into the cellular spectrum**. In the context of a system operating at frequencies below 6 GHz, mid-band, millimeter wave bands and even sub-THz bands, it is important to develop circuits that can be used at different carrier frequencies.



Funded by MaXentric Technologies, **Brian Floyd**, Alton and Mildred Lancaster Professor of electrical and computer engineering, and his team is studying new architectures for broadband and reusable transceiver cores. These can be used for many different frequency bands and architectures, and then investigating novel beamformer integrated circuits to be used in a satellite communication system.

Associate professor of electrical and computer engineering, **Jacob Adams**, and his team are investigating the application of 3D printed ceramics to beamforming lenses for low-cost steerable arrays.

With funding from NSF, **Wenye Wang**, professor of electrical and computer engineering, is working on the implications of multiband operation in higher layers of future networks. Wang's work on multiband systems also covers aspects related to efficient monitoring and spectrum utilization.

The **integration of sensing and communication** will be another key novelty in 6G networks. This means that the wireless signal used for communication will also be used to provide location and mapping information about the objects in the environment.

Samsung is providing funding to Gonzalez-Prelcic's team to understand the benefits of using reconfigurable intelligent surfaces in indoor environments to achieve localization accuracies under 10 cm, which would enable applications such as immersive reality or automated operation of robots in factories. In tandem, research by Floyd's team is developing full-duplex circuits that enable this functionality.

NC State is undoubtedly creating a high-value-added hub for research in the wireless space. The team in 6GNC continues to grow. Assistant professor **Suresh Venkatesh**, new to the NC State faculty, is creating hardware for joint sensing and communication that operates in millimeter wave and THz bands. His approach based on electromagnetic-circuit co-design, will provide resilient, secure, multi-functional, and scalable components for future ISAC systems in 6G.

ERICSSON AND AERPAW COLLABORATE ON 5G DRONE FOR SMART AGRICULTURE

Ericsson and the Aerial Experimentation and Research Platform for Advanced Wireless (AERPAW) have announced a collaboration on advancing the use of 5G for drone operations in support of smart agriculture.

Based at NC State, AERPAW is the first wireless research platform to study the convergence of 5G technology and autonomous drones.

AERPAW is funded by a \$24 million grant, awarded by the PAWR Project Office on behalf of the National Science Foundation, to develop an advanced wireless research platform in partnership with Wireless Research Center of North Carolina, Mississippi State University, Renaissance Computing Institute (RENCI) and additional partners.

Ericsson enables communications service providers and enterprises to capture the full value of connectivity. Partnerships with cutting edge research initiatives help their customers go digital, increase efficiency and find opportunities.

In a demonstration hosted at NC State, the AERPAW team equipped a custom drone with a connected camera and local compute capacity to monitor a field of cattle for information on grazing patterns. Footage from the field was streamed over a 5G connection enabled by an Ericsson base station and Ericsson Cloud Packet Core network. The demonstration took place on the mid-band spectrum (3.4 gigahertz) applying 100 megahertz of spectrum under AERPAW's experimental program license. Network performance was measured at speeds exceeding 100 Megabits per

second in the uplink and more than 450 Megabits per second in the downlink.

The advanced connectivity of a 5G network provides the capabilities needed to sustain high-quality video streaming, support remote interaction, and enable analytics at the edge through communication with a local compute-enabled network node. Use cases include agriculture solutions such as animal monitoring and tracking, but also delivery of supplies and objects for commercial use, improved air traffic control under Federal Aviation Administration regulations, and command and control of unmanned aerial vehicles (UAVs) over cellular links.

"Smart agriculture will likely represent a very large growth segment for UAVs in the next decade," said **Mihail L. Sichertiu**, professor of electrical and computer engineering and Co-PI of AERPAW. "And field testing at sites like AERPAW is critical both for exploring what's possible and for ensuring operational safety. Only a drone under constant monitoring and control is a safe drone."

"It's great to see Ericsson and AERPAW showcasing how collaboration can bring together research and 5G networks to support critical operations supporting public safety and agriculture monitoring," said Per Wahlen, Vice President and Head of Business Development at Ericsson North America. "Wide-area network coverage is needed to safely expand drone operations beyond visual line-of-sight missions."

[Learn more at aerpaw.org](https://aerpaw.org)



AERPAW

Aerial Experimentation and Research
Platform for Advanced Wireless



Smart
Agriculture



Autonomous
Vehicles



Disaster
Relief



Aerial Traffic
Control

ASSIST: THE FUTURE OF HEALTH

Since 2012, the NSF-funded Center for Advanced Self-Powered Systems of Integrated Sensors and Technologies (ASSIST) has led the way in developing flexible, self-powered wearable devices that enable continuous monitoring of personal health and personal environment. These devices monitor a variety of chronic health conditions and generate data to support physicians and patients.

The ASSIST Center is led by NC State and includes Florida International University, Penn State University and the University of Virginia, University of Michigan, University of Utah and University of North Carolina as partners.

The Center maintains its technical leadership in five theme areas: energy harvesting and storage, low power sensors, low power electronics, electronic textiles, and systems integration and data analysis.

Its health and environment monitoring systems provide unique capabilities including monitoring of asthma and metabolism, self-powered vigilant ECG monitoring, and ultra-light flexible wound monitoring patches.

Multimodal energy harvesting technologies enable wearables to be powered directly by the human body's heat and motion. Biochemical sensing portfolio includes several biomarkers and the ability to collect sweat and other fluids passively and at zero power.

The Center's researchers are increasing their emphasis on implantable devices which will provide additional continuous monitoring capabilities.

A multidisciplinary research team is building new partnerships in the medical field to validate our systems. The Center has a thriving innovation ecosystem that includes 10 start-up companies, 82 inventions, 32 full patents filed, and over 15 industry member companies. Over 10 years the Center's faculty graduated 91 Ph.D. students.

Over the past ten years, the Center has published 650 papers and our faculty and students have received numerous awards and recognitions. Among many highlights, ASSIST has:

- Been featured in AICHE.org's publication: Catalyzing Commercialization, June 2022 for its research in osmotic pumps for sweat collection and liquid metals,
- Presented at the National Academy of Engineering event, Extraordinary Engineering: Impact of NSF initiatives,
- Presented at numerous Department of Defense events, connecting its wearable technologies with the needs of soldiers.

The team is focused on a self-sufficiency path that includes new research avenues, additional funding opportunities, and an expanded industry membership portfolio. They are building industry engagement by holding member company seminars, introducing member companies' products to students and faculty, and providing access to student recruiting opportunities. Collaborations with the industry recently yielded an SBIR award as well as a Partnerships for Innovation grant to explore market opportunities for ASSIST's flexible thermoelectric generators (TEGs) technology.

Key accomplishments of the past year include:

- Novel, liquid metal-based materials for TEGs are now more flexible than ever with record high power levels, while piezoelectric-on-foil sensing arrays enable self-powered gait/fall monitoring.
- In the multimodal biosensing platform, researchers can simultaneously measure pH and temperature for real-time enzymatic sensing of glucose, lactate, and urea. They can also measure local tissue or arterial oxygenation using electrochemical and photonic sensing combined with zero-power sweat collection systems.
- Advancements in e-nose technologies including metal oxide gas sensors and capacitive micromachined ultrasonic transducers allow for selective sensing of volatile organic compounds at ultra-low power levels.
- The Center's Health and Environmental Tracking platform, which boasts a technology readiness level (TRL) of 5 or 6 as well as sub-milliwatt power consumption, is part of various clinical experiments for asthma exacerbation prediction, sweat analysis, and wound monitoring.
- Researchers demonstrated an ECG-monitoring shirt with continuous operation, powered by body heat. With ASSIST's low-power electronics and radio, and ASSIST's body-optimized wearable antenna, the shirt consumes only 65 μ W of average power.

 [Learn more at assistcenter.org](https://assistcenter.org)



Energy Harvesting
and Storage



Low Power
Sensing



Health
Wearables



Low Power
Systems-on-Chip

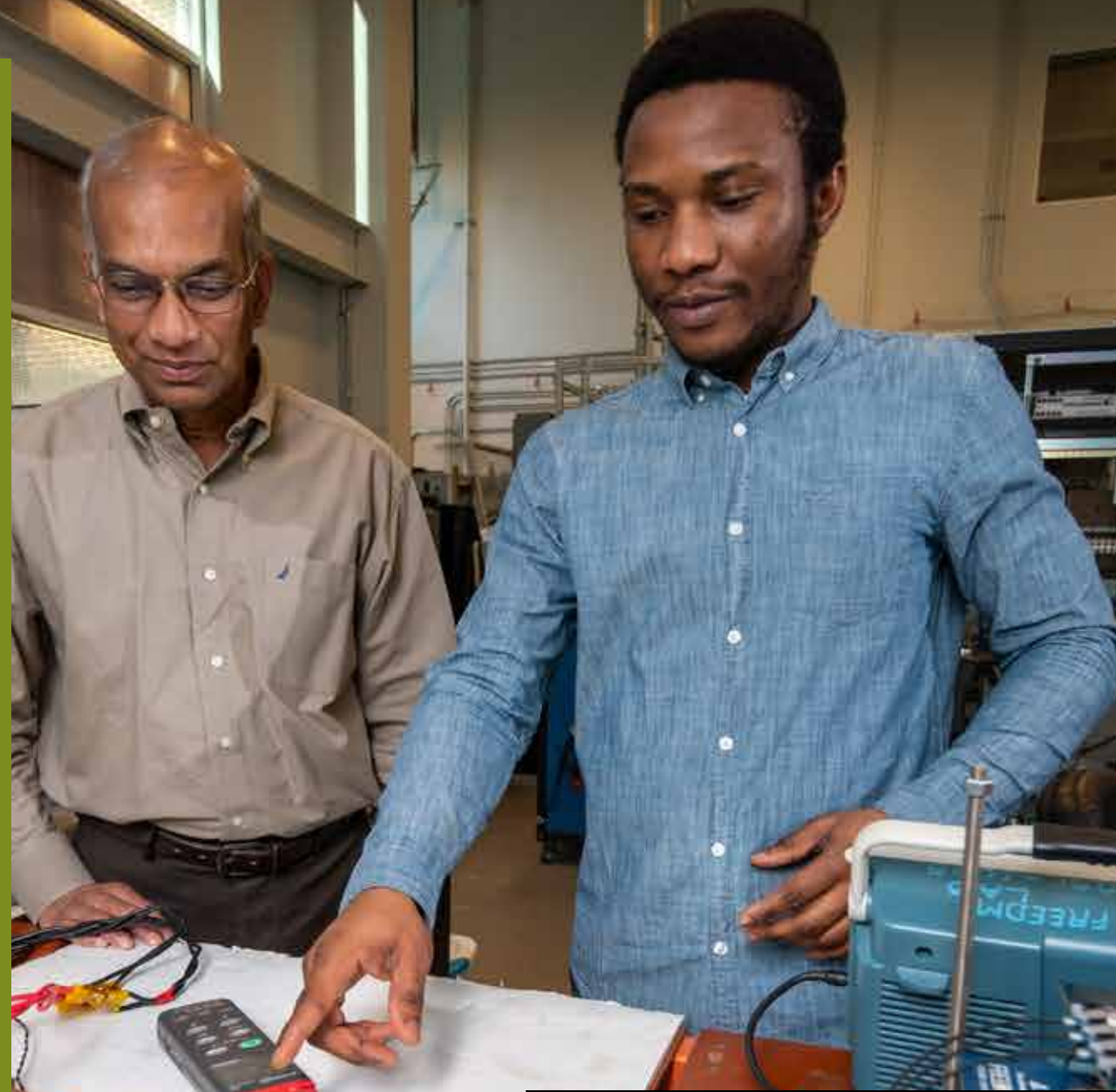
FREEDM: SPARKING INNOVATION

The Future Renewable Electric Energy Delivery and Management (FREEDM) Systems Engineering Research Center is built on collaboration between university researchers and industry leaders. This past year, almost all of their projects included another organization, many of whom are industry partners. FREEDM's Extreme Fast Charger project included ABB, New York Power Authority, and Danfoss. The UNIFI award includes Danfoss, Hitachi Energy, Eaton, NYPA, and Typhoon HIL. The PV Analysis and Response Support (PARS) Platform will provide real-time situational awareness for electric utilities including NYPA, other NC-based utilities and Pacific Northwest National Lab. FREEDM is working with Henkel to characterize new materials for their application to power electronic systems and working closely with Eaton's Power Electronics Center of Excellence.

FREEDM members are part of US DOE research consortia including the US DRIVE Partnership (Duke Energy) and the 21st Century Truck Partnership (Eaton) to advance electric vehicle technology and charging infrastructure. In addition, industry members leverage their partnership with FREEDM to conduct confidential equipment testing in their labs. These research collaborations allow members to accelerate their research timelines.

FREEDM also works in concert with other universities both for research and education. The Center for Advanced Power Engineering Research is a partnership between power engineering programs at NC State University, UNC Charlotte and Clemson University. CAPER provides research opportunities specifically for undergraduates and requires faculty from different universities to work together.

FREEDM is active with the North Carolina Renewable Ocean Energy Program led by the Coastal Studies Institute at East Carolina University and is building hardware components for the new Atlantic



Marine Energy Center demonstration site at Nags Head, NC. FREEDM also has a strong partnership in cybersecurity and grid control software with Vanderbilt University. On a broader scale, FREEDM is active in the University Energy Institute Collaborative, a coalition of over 150 university-based energy institutes formed to address the critical challenges facing America's energy systems.

FREEDM is a connector for local and regional partnerships. They actively support the Research Triangle Cleantech Cluster and the Triangle Clean Cities Coalition. They regularly provide tours of facilities to energy companies considering locating near Centennial Campus. In the past couple of years, FREEDM included dozens of local utilities and regional companies in research proposals and they look forward to expanding these partnerships because innovation requires collaboration to solve our greatest challenges.

[Learn more at freedm.ncsu.edu](http://freedm.ncsu.edu)



Wide Bandgap
Power Electronics



Electric
Transportation



Modern Power
Systems



Renewable Energy
Systems

POWERAMERICA: ACCELERATING SiC AND GaN MANUFACTURING

PowerAmerica is a member-driven consortium of more than 70 companies, universities, and national labs accelerating the adoption of energy-efficient silicon carbide (SiC) and gallium nitride (GaN) power semiconductor technologies. Its membership network spans the wide-bandgap technology ecosystem, from materials to device developers and fabs to module manufacturers to end users, as well as universities that educate and provide the future workforce. As the institute continues to grow, so does the diversity of its membership.

PowerAmerica serves its members by collaborating to improve technical capabilities, supporting semiconductor manufacturing, and strengthening the SiC and GaN power electronics supply chain. The member companies, in turn, produce new and improved products and services that reduce costs and provide energy savings, while enabling the development of new technologies and businesses, creating high-tech jobs, and strengthening manufacturing in the United States.

Member dues, government agency grants, and North Carolina State University, which serves as the consortium's headquarters, support PowerAmerica financially. The overall objectives of the organization are established in Bylaws and directed by members through a Member Advisory Committee (MAC) in which all members have a right to be heard and vote, with votes weighted according to membership level. PowerAmerica staff implements the services and activities

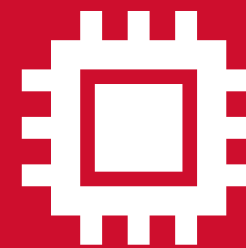
determined by the members.

Since its inception in early 2015, and based on the ideas and suggestions of PowerAmerica's members, the organization has developed a value proposition consisting of four ongoing initiatives to support the success of its members.

"Membership in PowerAmerica provides Texas Instruments (TI) the opportunity to influence the important research being done in wide bandgap technology by the organization," notes Stephanie Watts Butler, GaN Technology Innovation Architect with Texas Instruments.

"We look forward to further opportunities enabled by the research and workforce people development happening at PowerAmerica."

 [Learn more at poweramericainstitute.org](http://poweramericainstitute.org)



Advanced Chip
Manufacturing



Resilient Energy
Grid



Higher Efficiency
Power Conversion



Rugged Power
Electronics

EXPANDING FACULTY

We are very pleased to announce four new additions to our faculty for the upcoming semesters. As the college continues to expand, it is imperative to meet these demands with more professors who can aid the growth of our department and the development of our students.

The NC State Electrical and Computer Engineering Department offers its congratulations to each new faculty member and is excited to welcome them as a valuable addition to our faculty!



Samira Mirbagher Ajorpaz joined ECE as an assistant professor in August. Ajorpaz received her Ph.D. in Computer Science from Texas A&M University in 2019, and was a postdoctoral scholar at the Department of Computer Science and Engineering at University of California San Diego. Her research is at the intersection of computer architecture, security and machine learning with a focus on designing predictive microarchitectural units with small-scale and tight-timing margins.



Aritra Mitra will be joining ECE as an assistant professor in January 2023. Mitra received his Ph.D. from Purdue in 2020, and is currently a postdoctoral researcher in the Department of Electrical and Systems Engineering at the University of Pennsylvania. His research interests include control and optimization, machine learning, statistical signal processing, distributed algorithms, multi-agent systems, sequential decision-making under uncertainty, and resilience and security.



Abraham Vázquez-Guardado will be joining us in January 2023 as an assistant professor. Vázquez-Guardado received his Ph.D. in Optics and Photonics from the College of Optics and Photonics (CREOL) at the University of Central Florida in 2018. He comes to us from Northwestern University, where he has been a postdoctoral Fellow. His research interests include implantable battery-free devices for biomedical and neuroscience applications.



Suresh Venkatesh will be joining ECE as an assistant professor in January 2023. Venkatesh received his Ph.D. in Electrical Engineering from the University of Utah in 2017, advised by David Schurig, previously an assistant professor at NC State. Since 2018, he has been a postdoctoral research associate at Princeton University. His research interests include metamaterials and surfaces at GHz-THz frequencies, massive mm-wave phased arrays, 5G Communication, physical layer security, antenna and waveguide theory and design, and advanced electromagnetic simulations.

We look forward to welcoming more outstanding faculty—if you are interested, visit ece.ncsu.edu/hiring to see new faculty positions.

GROWING THE FUTURE

At NC State, it matters that all students are seen and enabled to achieve their fullest potential.

Winsor Alexander is a perfect embodiment of this principle. During his time as a professor and director of graduate programs in the Department of Electrical and Computer Engineering, Alexander helped graduate some of the most African-American Ph.D. students at the university. To show gratitude for his mentorship and continued guidance, the students of Alexander have created the Winsor Alexander Endowment in his honor.

Elebeoba May, now an associate professor at the University of Wisconsin at Madison Department of Medical Microbiology and Immunology, credits much for her success to the guidance she received from Alexander while a student at NC State.

May recounted a rocky start at NC State as an undergraduate in the Caldwell Fellows program. Lost in the monotony of day-to-day classes, she needed something to reinvigorate her love for engineering. As one of her professors, Alexander noticed and did exactly that. His persistent invitations convinced May to join his research group and become an undergraduate researcher under his guidance.

“It was really pivotal for me... it kind of reset my focus and got me engaged in school again,” May explained.

From joining his lab, May and Alexander’s relationship grew into what she now describes him as an “academic father.” Whenever she applied for grants or jobs, she knew Alexander would provide invaluable advice that would help her achieve her goals, and she did.

Cranos Williams, a joint faculty member of the Department of Electrical and Computer Engineering and the Department of Plant and Microbiology at NC State, shares a very similar experience with Alexander.

Williams met Alexander while he was an undergraduate student at North Carolina Agricultural and Technical State University. At the time, Alexander was a visiting professor who guided Williams into pursuing graduate school at NC State University.

After finishing his Ph.D. under Alexander’s advisement, Williams took on an assistant professor role at NC State. During the first few years of this role, William explained that Alexander “was extremely pivotal” in making him believe in his success.

Being an underrepresented faculty member in the department presented challenges and self-doubt for Williams. But Alexander taught him that “success breeds acceptance” and that kept Williams hopeful. His success in academia continues to grow. Today, Williams is the NC State Plant Sciences Platform Director for Data Driven Plant Sciences and Goodnight Distinguished Professor in Agricultural Analytics.

Many of Alexander’s students have the same advice and mentorship embedded in their minds. Alexander believed in his students and taught them how to believe in themselves.

“Dr. A saw me when it felt like no one else saw me,” May described. Since leaving NC State, May recognizes that her academic connection with Alexander made NC State “mean something even more.”

To honor the importance of the relationship Alexander built with his students, the WEA Endowment Committee was formed.

Upon his retirement from NC State, the students who were impacted the most by Alexander wanted to honor his legacy by creating the Winsor Alexander Endowment. “We want NC State, we want our department to know that it mattered that he was there,” said May. When creating the endowment, the committee members wanted to answer the question “who’s going to continue being that person who sees the people who sometimes are not seen?”

[Learn more at ece.ncsu.edu/wea](https://ece.ncsu.edu/wea)

2022 INDUCTEES OF THE ECE ALUMNI HALL OF FAME



Bob Kepley
Senior Vice President of Engineering
Hughes Network Systems
BS EE 1979; MS EE 1981



Varun Nagaraj
Dean
SPJIMR, Mumbai
MS CPE 1988



Ranbir Singh
President
GeneSiC Semiconductor Inc.
MS EE 1992; Ph.D. EE 1997



Aubrey T. Smith
President & CEO
ATS Solutions, Inc.
BS EE 1962



Carl Wilkins
Vice President, Distribution
Quanta Technologies
BS EE 1986

OUTSTANDING EARLY CAREER AWARD



Ioannis Papapanagiotou
Director of Engineering
Gemini
MS CPE 2009; Ph.D. CPE 2012

DISTINGUISHED SERVICE AWARD



William Easter
Professor Emeritus
NC State University

The Department of Electrical and Computer Engineering at NC State University is proud to honor accomplishments of our outstanding graduates and community with our 2022 awards.

We have inducted 86 exemplary alumni into our Alumni Hall of Fame since its inception in 2015, celebrating the accomplishments of our outstanding graduates who use their education to excel in a profession, career, or service.

The Outstanding Early Career Award is presented to one alum each year who has attained significant achievement early in their career and who shows promise of further contributions to the field.

Finally the Distinguished Service Award recognizes and honors the lasting service and impact that members of the NC State ECE community have had on the department, its students, and mission.

We hope these meaningful accolades will inspire current and future students to follow in these inductees' footsteps.

Learn more at ece.ncsu.edu/engagement/awards

HONORS AND ACHIEVEMENTS

FACULTY AWARDS

Wenyuan Tang and **Spyros Pavlidis** received CAREER Faculty Early Career Development awards from the National Science Foundation (NSF). The CAREER program offers the NSF's most prestigious awards in support of early-career faculty.

Iqbal Husain was the recipient of the 2022 ALCOA Foundation Distinguished Engineering Research Award, and **Michael Kudenov** was the recipient of the 2022 ALCOA Foundation Engineering Research Achievement Award. The awards are intended to recognize senior and young faculty members respectively who have accomplished outstanding research achievements.

Ömer Oralkan received the IEEE Sensors Council Advanced Career Technical Achievement Award in Sensor Systems or Networks 2022 and **Amay Bandodkar** received the IEEE Sensors Council Early Career Technical Achievement Award in Sensors 2022.

Amay Bandodkar was the recipient of the Biosensors 2021 Young Investigator Award which recognizes one researcher for their outstanding work in the field of sensors or sensor-related topics

Veena Misra received the Holladay Medal for Excellence which recognizes members of the NC State faculty whose careers have demonstrated outstanding achievement and sustained impact in research, teaching, or extension and engagement. This award is the highest honor bestowed by NC State and the university's Board of Trustees.

Fred Kish received the IEEE Photonics Society Quantum Electronics Award 2022 that honors an individual for outstanding technical contributions to quantum electronics, either in fundamentals or applications.

Jacob Adams was the recipient of the 2022 William F. Lane Outstanding Teaching Award which recognizes excellence in teaching or educational leadership in the Department of Electrical and Computer Engineering.

Spyros Pavlidis received the 2022 R. Ray Bennett Faculty Fellow Award that provides support for high-achieving young faculty in the department in pursuing their academic and cutting-edge research initiatives.

OUTSTANDING NATIONAL AND INTERNATIONAL SERVICE

The Defense Advanced Research Projects Agency (DARPA) has named **Veena Misra** to the Microsystems Exploratory Council (MEC) for a three-year term beginning this summer

Virginia Tech's Bradley Department of Electrical and Computer Engineering inducted **Greg Bottomley** to their Academy of Distinguished Alumni.

Subhashish Bhattacharya was named an IEEE Fellow in 2021 in recognition of his outstanding contributions to the field and for contributions to power conversion systems and active power filters.

Fred Kish became a Fellow by the National Academy of Inventors 2021—the highest professional distinction accorded solely to academic inventors.

STUDENT AWARDS

Ajit Kanale received the 2021-22 Outstanding Ph.D. Student of the Year Award from the College of Engineering, recognizing achievements within teaching, leadership, research, citizenship and recruiting. His work was guided by co-advisors professors **B. Jayant Baliga** and **Subhashish Bhattacharya**.

Shubham Nema was named ECE Master Scholar of the Year 2021-22 because of his major driving force for our research in reliability analysis and fault injection with Sandia National Labs.

Chethan Anjinappa received the ECE Distinguished Dissertation award for excelling in his research, teaching, and service activities during his Ph.D. journey at NC State. He has authored/co-authored 8 journal papers and 12 conference papers, contributed to a book chapter, and won 2 best-poster awards.

DOCTORAL DEGREES AWARDED

Aditi Agarwal

Electrical Engineering

Enhancing Performance of SiC Planar-gate Power MOSFETs with 650 V, 1.2 kV, and 2.3 kV Blocking Voltages with Structural Modifications.

B. Baliga (Chair)

Parvez Ahmmed

Electrical Engineering

Low-power Bioelectrophotonic Systems for Physiological Monitoring in Humans and Animals.

Alper Bozkurt (Chair)

Mohammad Abdalla Moh'd Hadi Alshboul

Computer Engineering

Addressing Challenges of Non-Volatile Main Memory Integration.

Yan Solihin (Chair)

Chethan Kumar Anjinappa

Electrical Engineering

Millimeter-Wave Wireless Networks: Coverage Characterization, Deployment Optimization, and Channel Estimation.

Dror Baron (Co-Chair) & Ismail Guvenc (Co-Chair)

Anup Anurag

Electrical Engineering

HV SiC MOSFET Enabled Solid State Transformers for Mobile Utility Support Equipment-based Applications.

Subhashish Bhattacharya (Chair)

Kevin Chen

Electrical Engineering

Robust Controller Design for Stability Improvement of a Single-phase Community Microgrid in Islanded Mode.

Mesut Baran (Chair)

Siyuan Chen

Electrical Engineering

AC-DC Solid State Transformer Based on SiC MOSFETs 98.

Wensong Yu (Chair)

Mazharul Huq Chowdhury

Electrical Engineering

Rare-Earth Free Electric Machine for High Performance Applications.

Iqbal Husain (Chair)

Alireza Dayerizadeh

Electrical Engineering

Isolated Gate Driver Power Supply for Medium Voltage Applications.

Srdjan Lukic and Zeljko Pantic (Co-Chairs)

Martins Ezuma

Electrical Engineering

UAV Detection and Classification Using Radar, Radio Frequency and Machine Learning Techniques.

Ismail Guvenc (Chair)

Marc David Foster

Electrical Engineering

On Developing Behavioral, Environmental, and Physiological Monitoring Systems for Dogs.

Alper Bozkurt (Chair)

Luis Sandry Francisco Fernandez

Electrical Engineering

Machine Learning for Design Rule Checking, Multilayer CMP Hotspot Detection, and PPA Modeling, with Transfer Learning and Synthetic Training.

Paul Franzon and William Davis (Co-Chairs)

Danyang Huang

Electrical Engineering

Theory and Design of Practical Direct Antenna Modulation Transmitters.

Jacob Adams (Chair)

Billy Huggins III

Computer Engineering

An Evolutionary Approach to Producing Optimal Electronic Design Automation Tool Settings.

Paul Franzon and William Davis (Co-Chair)

Danyang Huang

Electrical Engineering

Theory and Design of Practical Direct Antenna Modulation Transmitters.

Jacob Adams (Chair)

Dolar Khachariya

Electrical Engineering

A Path Towards GaN-based Vertical Superjunction Devices.

Spyridon Pavlidis (Chair)

Ashish Kumar

Electrical Engineering

Ruggedness, Protection, Performance Evaluation and Demonstration of High Voltage SiC Power Devices in Medium Voltage Power Applications.

B. Baliga and Subhashish Bhattacharya (Co-Chairs)

Junkai Liang

Electrical Engineering

Addressing Challenges of Uncertainty and Non-convexity toward Future Power Systems with High Renewable Penetration.

Wenyuan Tang (Chair)

Ji Liu

Computer Engineering

Leveraging Quantum State Information for Dynamic Assertions and Static Compiler Optimizations.

Huiyang Zhou (Chair)

Runze Liu

Electrical Engineering

Micro Signal Extraction for Surface-based Authentication and Deepfake Detection.

Chau-Wai Wong (Chair)

Yukun Luo

Electrical Engineering

FPGA Based High Bandwidth Motor Emulator for Interior Permanent Magnet Machine Utilizing SiC Power Converter.

Iqbal Husain (Chair)

Landon Mackey

Electrical Engineering

Ultrafast Direct current Protection Systems for Faster Fault Isolation in Multi-terminal LVDC and MVDC Distribution.

Iqbal Husain (Chair)

Utkarsh Mehrotra

Electrical Engineering

Methodologies of Cascading and Scaling to Realize High Voltage Cascaded SuperCascode Power Switch.

Douglas Hopkins (Chair)

Siddharth Mehta

Electrical Engineering

Design, Modeling, and Control of Doubly Salient Reluctance Machines.

Iqbal Husain (Chair)

Abdullah Tahsin Mughrabi

Computer Engineering

Fast and Efficient End-to-End Graph Processing with Shared Memory Accelerators.

Gregory Byrd (Chair)

Nandini Negi

Electrical Engineering

Optimal Co-Designs of Communication and Control in Bandwidth Constrained Cyber-Physical Systems.

Aranya Chakraborty (Chair)

Md Mobarak Hossain Polash

Electrical Engineering and Materials Science and Engineering

Understanding and Engineering Spin and Quantum Driven Thermoelectric Materials.

Daniel Stancil and Veena Misra (Co-Chairs)

Dhrubo Rahman

Electrical Engineering

WBG-based EV Traction Drive using Variable DC-link and Soft-switching Technique.

Iqbal Husain (Chair)

Ali Rahmati

Electrical Engineering

On Applications of Optimization Techniques in UAV Communication, Resource Allocation, and Adversarial Attacks.

Huaiyu Dai and Ismail Guvenc (Co-Chairs)

James Lee Reynolds

Electrical Engineering

Electrical Techniques and Systems for Precision Agriculture and Rapid Phenotyping.

Alper Bozkurt (Chair)

Pratishtha Shukla

Electrical Engineering

Game-Theoretic Investment Planning for Cyber-Security of Networked Control Systems.

Alexandra Duel-Hallen and Aranya Chakraborty (Co-Chairs)

Rafael Luiz da Silva

Electrical Engineering

Enabling Machine Learning Tasks in Wearable Cyber-Physical Systems through Uncertainty Quantification and Signal Processing.

Edgar Lobaton (Chair)

Haonan Tong

Electrical Engineering

Computational Solutions for Unraveling Gene Regulatory Mechanisms Underlying Stress Response in Living Organisms.

Cranos Williams (Chair)

Xiaochu Wang

Electrical Engineering

Analysis and Design of Demand Response Programs in Electricity Markets.

Wenyuan Tang (Chair)

Hancheng Wu

Computer Engineering

Facilitating the Deployment of Irregular Applications on Parallel Manycore Architecture by Identifying Irregular Patterns.

Michela Becchi (Chair)

ECE COLLOQUIA SPEAKERS

Frequency Support in Modern Grids Facing Low Inertia Challenge

Nilanjan Ray Chaudhuri

Associate Professor
Pennsylvania State University

Unconventional biochemical sensors and energy devices for applications in wearables and neuro-engineering

Amay Bandodkar

Assistant Professor
NC State University

The Digital Biomarker Discovery Project: An Open-Source Toolbox for Biosignal Analysis

Jessilyn Dunn

Assistant Professor
Duke University

Heterogeneous integration of bioelectronic materials for smart health

Wubin Bai

Assistant Professor
University of North Carolina, Chapel Hill

Bridging the Gap between Algorithm and Architecture: A Machine learning-based Approach

Biresh Kumar Joardar

NSF Computation Innovation Post-Doctoral Fellow
Duke University

Anti-virus hardware: Applications in Embedded, Automotive and Power Systems security

Kanad Basu

Assistant Professor
University of Texas, Dallas

Perception-based Biometric Recognition: Challenges Demanding Unconventional Solutions

Benjamin Riggan

Assistant Professor
University of Nebraska, Lincoln

Precision Technologies for Physical and Visual Sensing in Agricultural Systems

Sierra Young

Assistant Professor
NC State University

Accelerating Optimization and Reinforcement Learning with Quasi-Stochastic Approximation

Sean Meyn

Robert C. Pittman Eminent Scholar Chair
University of Florida

Cyberattack Detection Through Dynamic Watermarking

Abhishek Gupta

Assistant Professor
The Ohio State University

Cars, Games, Phones, and Drones

Samarjit Chakraborty

William R. Kenan, Jr. Distinguished Professor
University of North Carolina, Chapel Hill

Performance and Reliability Trade-offs for Integrated Circuits

Elyse Rosenbaum

Melvin and Anne Louise Hassebrock Professor
University of Illinois Urbana-Champaign

Benefit of Grid Edge Synchronized Measurements

Yilu Liu

Governor's Chair Professor
University of Tennessee Knoxville

Developing Reliable Power Electronics

F. Patrick McCluskey

Professor
University of Maryland, College Park

Recent Trends in Microwave Remote Sensing of Water Resources

Mahta Moghaddam

Ming Hsieh Chair
University of Southern California

Efficient III-nitride long wavelength emitters

Jonathan Wierer

Professor
NC State University

Developing sensors and systems for functional interventional ultrasound imaging

Brooks Lindsey

Assistant Professor
Georgia Tech

Challenges of IoT Security within the context of Smart Grid, 5G and Cryptocurrencies

Kemal Akkaya

Professor
Florida International University

The Next 1000X in High Performance Computing – why the next decade has the potential to bring radical change

Simon Hammond

Sandia National Laboratories

Ultra-Low-Latency Millimeter Wave Networking using True-Time-Delay Array Architecture

Danijela Cabric

Professor
University of California, Los Angeles

Advanced Packaging, Heterogeneous Integration, and the Future of Semiconductor Systems

Madhavan Swaminathan

John Pippin Chair in Electromagnetics
Georgia Institute of Technology

Ultra-WBG Semiconductors III-Nitrides and Diamond – Integration technologies for harsh environmental applications

Erhard Kohn

Professor (ret)
Ulm University

The COSMOS Testbed – a Platform for Advanced Wireless, mmWave, and Optical Experimentation

Tingjun Chen

Assistant Professor
Duke University

Learn more at ece.ncsu.edu/colloquia

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