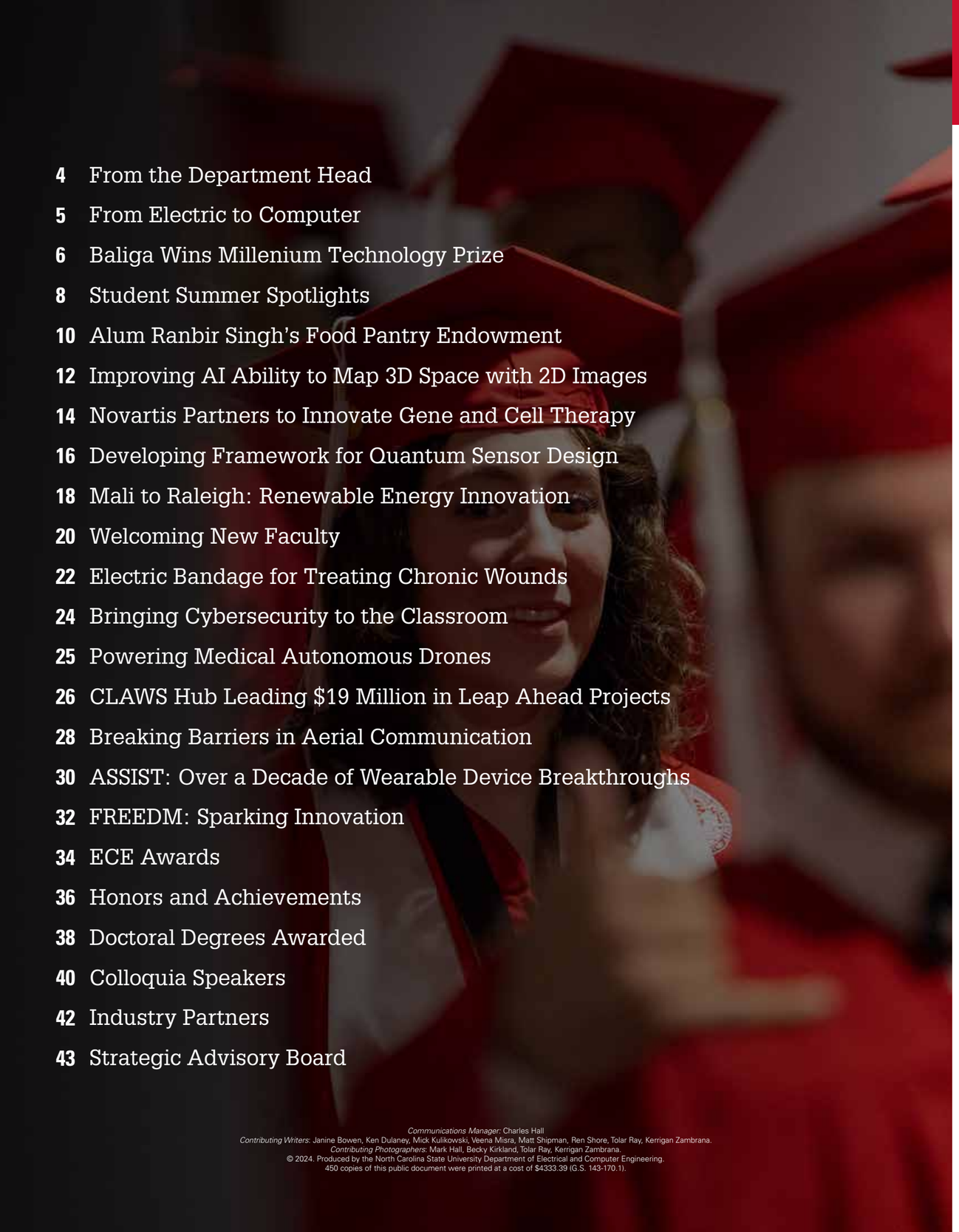
Spotlight

TRAILBLAZING TECH.
TRANSFORMATIVE HEALING.

NC STATE



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2024 NUMBERS **AT A GLANCE**

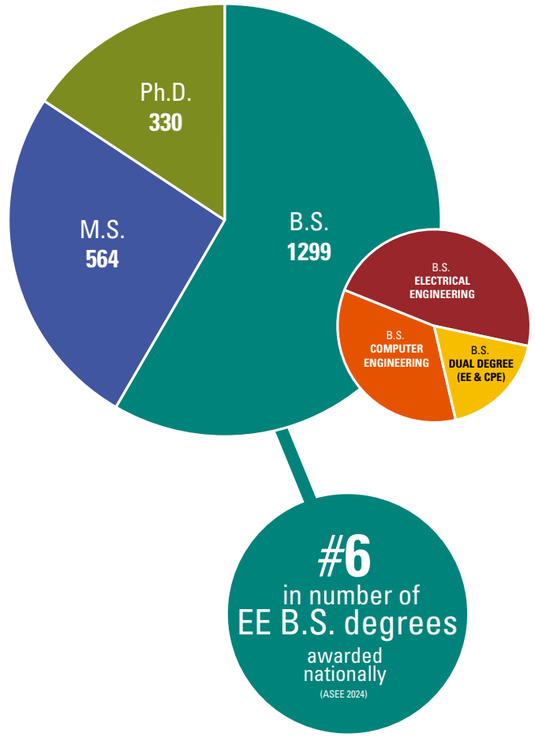
64 Tenured/Tenure-Track

$33M Research Expenditures

21 NSF CAREER Awards

24 IEEE Fellows

2 National Academy of Engineering Members



#2

for research commercialization among public universities

according to Heartland Forward

#3

in the nation for share of research sponsored by industry

according to the Association of University Technology Managers

FROM THE **DEPARTMENT HEAD**

Welcome to the 2024 edition of *Spotlight*, the annual glance at the incredible strides made by the Department of Electrical and Computer Engineering at NC State University. As we navigate a rapidly growing technological landscape, the success of our students, faculty and alumni continues to demonstrate our unwavering commitment to innovation, excellence and community.

Over the past year, ECE has experienced a period of great transformation, characterized by innovative research, new partnerships and notable successes from our students and faculty. Our faculty's pioneering work in quantum computing, wide bandgap semiconductors, renewable energy, biosystems, and AI is driving the future of technology, while our NSF ERCs continue to produce impactful solutions in wearable health monitoring and renewable energy systems.

This culture of innovation places NC State ECE at the forefront of solving global challenges, whether it's advancing gene therapy, leading semiconductor research, or leading the next generation of cybersecurity experts.

We're also excited to welcome several new faculty members who will strengthen our department's areas of expertise, including signal processing, machine learning, and quantum computing. Their arrival further solidifies our department as a powerhouse of research and education.

Our student body continues to make us proud, with many embarking on internships with industry leaders and excelling in international competitions. These hands-on experiences ensure our graduates are prepared to tackle real-world problems and lead in their respective fields. This year's *Spotlight* features students who have worked on everything from autonomous drones to cutting-edge chip design, all while pursuing their academic goals with passion and determination.

We take great pride in celebrating the achievements of our alumni and faculty this year. From significant donations like Ranbir Singh's endowment for the Feed the Pack food pantry to a growing list of ECE alums that lead in their industries across the country, our alumni continue to make a lasting impact both within and beyond the university. Their generosity and leadership not only enrich our community but also inspire current and future students to strive for excellence and service in their careers. We also celebrated the retirement of Prof. Jay Baliga, a power semiconductor powerhouse who has elevated our department to international recognition.

As we reflect on our achievements, I also want to express my deepest gratitude to our alumni, donors, and industry partners. Your support has been instrumental in helping us provide scholarships, fund innovative research, and create new opportunities for our students. Together, we are shaping the future of engineering and technology, not just at NC State but on a global scale.

I hope you enjoy this publication, which showcases just a glimpse of the remarkable work happening in our department. We look forward to continuing this journey of innovation with you.

Sincerely,

Dr. Veena Misra
ECE Department Head

STAY CONNECTED WITH @NCStateECE

1893 — Electrical Engineering Begins

The first electrical engineering course—Electricity and Magnetism—is offered at the North Carolina College of Agriculture and Mechanic Arts, taught by Lt. Richard Henderson, U.S. Navy.

1917 — EE Becomes a Department

Due to the growth of the two programs and diverging needs, Physics is separated from Electrical Engineering, marking the beginning of the Department of Electrical Engineering.

1921 — First Woman at NC State

Lucille Thomson became the first woman ever to enroll at NC State. She enrolled in electrical engineering.

1923 — School of Engineering

The School of Engineering was formed, consisting of the Electrical Engineering Department, Civil Engineering Department, Physics Department, Textile Engineering, and Mechanical Engineering.

1953 — First African-American Student

The first African-American graduate students enrolled at NC State, including Robert Clemons in EE. He would become the first African-American to receive a degree from NC State in 1957.

1979 — First Woman on Faculty

Dr. Sarah A. Rajala joined the Electrical Engineering faculty and became the first female Ph.D. faculty member to join the College of Engineering.

1981 — Electrical and Computer

With the growth and influence of the modern computer, the department is renamed the Department of Electrical and Computer Engineering.

1982 — First NSF Center

Benjamin O'Neal established the first NSF research center in the department: The Center for Communications and Signal Processing, establishing a persisting pattern of cutting edge research.

2012 — ASSIST & FREEDM

The ASSIST Center opens, joining the FREEDM Center, which started in 2008, marking the department as the country's only with two concurrent NSF centers.

2014 — PowerAmerica

President Obama and the U.S. Department of Energy tap NC State to lead a $140 million advanced manufacturing institute to unite academic, government and industry partners to revolutionize energy efficiency across a wide range of applications.

2018 — IBM Quantum Hub

NC State became the first university in North America to establish an IBM Quantum Hub to advance quantum computing.

2019 — AERPAW

AERPAW is the nation's first aerial wireless experimentation platform spanning 5G technologies and beyond, which will enable cutting-edge research.

2023 — CLAWS Hub

NC State leads the Commercial Leap Ahead for Wide Bandgap Semiconductors Hub as part of the CHIPS-Act-funded Microelectronics Commons.

BALIGA WINS

MILLENIUM TECHNOLOGY PRIZE

North Carolina State University Professor **B. Jayant Baliga** has been awarded the 2024 Millennium Technology Prize for his work on the invention, development and commercialization of insulated gate bipolar transistors (IGBTs), which play a critical role in energy efficiency for technologies worldwide. The Millennium Technology Prize, which comes with a €1 million award, is the most prestigious international award focused on recognizing technological innovation.

The IGBT is an energy-saving semiconductor switch that controls the flow of power from an electrical energy source to any application that needs energy. The IGBT improves energy efficiency by more than 40 percent in an array of products, from cars and refrigerators to light bulbs, and is a critical component enabling modern compact cardiac defibrillators.

> The IGBT has reduced global carbon dioxide emissions by over 82 gigatons (180 trillion pounds) over the past 30 years. This is equivalent to offsetting carbon dioxide emissions from all human activity for three years, based on average emissions of the past 30 years.

"The IGBT has already had and continues to have a major impact on supporting sustainability with improved living standards worldwide, while mitigating environmental impact," says Minna Palmroth, chair of the Board of Technology Academy Finland, the foundation which awards the Millennium Technology Prize. "The main solution to tackle global warming is electrification and moving to renewable energy. The IGBT is the key enabling technology in addressing these issues."

"It is very exciting to have been selected for this great honor," says Baliga, who is the Progress Energy Distinguished University Emeritus Professor of Electrical and Computer Engineering at NC State.

"I am particularly happy that the Millennium Technology Prize will bring attention to my innovation, as the IGBT is an embedded technology that is hidden from the eyes of society. It has enabled a vast array of products that have improved the comfort, convenience and health of billions of people around the world while reducing carbon dioxide emissions to mitigate global warming. Informing the public of this impactful innovation will illustrate the betterment of humanity by modern technology."

Baliga's portfolio of 123 U.S. patents includes many other inventions that have also been commercialized. The split-gate power MOSFET is widely manufactured for use in laptops, PCs and servers. And his silicon carbide inventions – including the JBS rectifier and shielded channel power MOSFET – are used in a variety of state-of-the-art electrical power management technologies.

> Baliga – who Forbes has called "the man with the world's largest negative carbon footprint" – continues to work on technological challenges related to energy efficiency. He and his collaborators are currently working on new inventions to improve efficiencies related to solar power generation, electric vehicles and power delivery for AI servers.

The Millennium Technology Prize will be presented to Professor Bantval Jayant Baliga in Finland on Oct. 30 in an award ceremony that also celebrates the 20th anniversary of the prize. The prize will be presented by its patron, the president of Finland.

The €1 million Millennium Technology Prize is the preeminent award focused on technological innovations for a better life. This includes work that improves human well-being, biodiversity, and wider sustainability. Overseen by the Technology Academy Finland, it was first awarded in 2004, and its patron is the President of Finland. Winners are selected by a distinguished international panel of experts from academia and industry. Innovations must be backed up by rigorous academic and scientific research and fulfill several criteria, including promoting sustainable development and biodiversity, having generated applications with commercial viability, and creating accessible socio-economic value.

STUDENT SUMMER SPOTLIGHTS

EXPLORING NEW FRONTIERS AT NASA JPL

This summer, **Zander Selleseth** '25, a dedicated Electrical Engineering student at NC State set his sights on the stars and beyond during an incredible internship at NASA's Jet Propulsion Laboratory (JPL) in Pasadena, CA. As a visiting researcher in the Radar Concepts and Formulation Group, Selleseth immersed himself in groundbreaking projects and gained invaluable experience that has profoundly shaped his career aspirations.

Pioneering Projects at JPL

At JPL, Selleseth contributed to the development of circuits essential for novel atomic radar sensors and low-power/long-range RFID systems. These technologies have the potential to revolutionize remote sensing and communication, showcasing the cutting-edge innovation that JPL is known for. Selleseth's hands-on work with RF/Microwave CAD tools such as HFSS, ADS, and AWR allowed him to delve deep into the technical aspects of these pioneering projects.

Adventures in Quantum Physics

Selleseth's summer was marked by his exploration of the fascinating applications of quantum physics in remote sensing. His research and development efforts gave him a deeper understanding of how quantum principles can be harnessed for practical, real-world technologies. This knowledge not only broadened his technical skillset but also ignited a passion for further exploration in the field.

Selleseth's time at JPL has had a profound impact on his career goals. The dynamic environment and the thrill of working on aerospace technology have solidified his desire to pursue a career in the aerospace industry.

"This experience has shown me that a career in the aerospace industry is a lot of fun and I would love to work at JPL someday," shared Selleseth.

SHINING IN INTERNATIONAL ENERGY LEADERSHIP

Sneha Narasimhan '25, a Ph.D. candidate in Electrical Engineering at NC State, recently participated in the prestigious EPISTIMI-ACG-LUCE Summer Leadership Workshop in Athens, Greece.

Selected as one of 25 graduate students globally, Narasimhan honed her skills in negotiation, mentorship, communication, and ethics.

"I was honored to be part of a cohort focused on developing future leaders in energy," Narasimhan said. "Over the week from July 15-19, we engaged in group discussions designed to enhance our skills in critical areas such as negotiation and communication."

Narasimhan highlighted the public speaking workshop and negotiation training as pivotal experiences, boosting her confidence and teaching effective techniques for mutually beneficial outcomes.

She expressed gratitude for the support from the ECE department and her advisor, Prof. **Subhashish Bhattacharya**.

This program significantly influenced Narasimhan's career goals by emphasizing leadership and ethical decision-making in the energy sector. "I am more determined than ever to become a leader in the energy industry, committed to making a positive impact," she noted.

Her journey exemplifies the dedication fostered within the NC State ECE community.

CHIP DESIGN AT MARVELL SEMICONDUCTOR

Adam Davis '25, a Computer Engineering major at NC State, is interning as a Physical Design Intern at Marvell Semiconductor in Morrisville, NC. At Marvell, he's working on custom ASICs (Application-Specific Integrated Circuits) that help drive the AI revolution. Davis compares his role to urban planning, using EDA (Electronic Design Automation) software to transform RTL (Register-Transfer-Level) code into GDS-II photomasks, the blueprints for manufacturing chips.

This summer, Davis had the chance to work with TSMC's cutting-edge N3 process, which boasts transistors just 3nm apart. He's focused on optimizing signal density within chip designs while ensuring functionality, timing, and manufacturability.

One of Davis's standout experiences has been collaborating with engineers across all levels of the company. Learning from entry-level engineers, seasoned experts, and upper management has significantly enriched his internship experience and given him valuable insights into the chip design process.

Reflecting on his time at Marvell, Davis says that building high-performance, competitive chips often requires what he calls "engineering miracles." This realization has only deepened his passion for the field.

Looking to the future, he aims to combine his technical expertise with a solid understanding of business to design the next generation of chips that address global challenges.

★See more at go.ncsu.edu/marvell-video

ALUM RANBIR SINGH'S
FOOD PANTRY ENDOWMENT

Thanks to a generous gift from alumni Ranbir Singh, the Feed the Pack Food Pantry has taken a critical step in ensuring the long-term sustainability of its efforts to combat food insecurity on NC State's campus.

Singh, who earned his Ph.D. in 1997 and a master's degree from NC State in 1992, both in Electrical Engineering, is creating the pantry's first endowment. Student Leadership and Engagement Associate Director Brian Mathis explained that the endowment's annual investment returns will play a key role in sustaining the food pantry's annual operating budget.

"Our food pantry is 100% dependent on donations and gifts," Mathis said. "One of the things that we have to do as members of the Pack Essentials team, in conjunction with university development, is strategize to ensure we are continuing to meet our annual fundraising goals for the operations. The endowment, and growing the endowment, is a way that we can take a little bit of that pressure off because of sustainable money coming in."

When Singh arrived at NC State in the fall of 1990 after earning his bachelor's degree at the Indian Institute of Technology, he was struck by how welcoming the Office of International Students, the engineering department and the entire university community were to him.

> "I do feel that a whole lot of professional success that I've had is because of the training that I received at NC State."

Singh, who is now an executive vice president with Navitas, a leader in semiconductors, said that this gift is "just a small way of expressing my gratitude."

Singh's inspiration to create the Ranbir Singh Food Insecurity Endowment runs much deeper than his gratitude for his student experiences.

Singh practices his faith as a member of the Sikh community. Central to the Sikh belief system is the tradition of giving food and feeding members of a person's community. Singh explained that this is not just about feeding people to solve the problems of hunger and food insecurity but that eating together is a way to combat feelings of inequality.

"The issue that they were originally trying to solve is that everybody, whether they are poor or in a different social strata, is that if they eat together, it fosters community," Singh said.

> "That's why this donation is not just for one community, such as international or engineering students. It has to be for everybody."

Mathis called Singh's endowment a "leadership gift," as he hopes that others will step up to contribute to the endowment going forward.

Singh said he hopes his gift represents his beliefs as a way to combat food insecurity and build community among students from all walks of life.

"Those who are facing food insecurity should find this to be a place where they can go without any hesitation, and hopefully share the food with their roommates, dorm mates, apartment mates like I did," Singh said. "We used to live where many students would come together and eat together. Hopefully this will engender a sharing amongst friends and colleagues and encourage them, when they are able, to also nurture this effort."

IMPROVING AI ABILITY TO MAP

3D SPACE WITH 2D CAMERAS

Researchers have developed a technique that allows artificial intelligence (AI) programs to better map three-dimensional spaces using two-dimensional images captured by multiple cameras. Because the technique works effectively with limited computational resources, it holds promise for improving the navigation of autonomous vehicles.

"Most autonomous vehicles use powerful AI programs called vision transformers to take 2D images from multiple cameras and create a representation of the 3D space around the vehicle," says **Tianfu Wu**, corresponding author of a paper on the work and an associate professor of electrical and computer engineering at North Carolina State University. "However, while each of these AI programs takes a different approach, there is still substantial room for improvement.

> "Our technique, called Multi-View Attentive Contextualization (MvACon), is a plug-and-play supplement that can be used in conjunction with these existing vision transformer AIs to improve their ability to map 3D spaces," Wu says. "The vision transformers aren't getting any additional data from their cameras, they're just able to make better use of the data."

MvACon effectively works by modifying an approach called Patch-to-Cluster attention (PaCa), which Wu and his collaborators released last year. PaCa allows transformer AIs to more efficiently and effectively identify objects in an image.

> "The key advance here is applying what we demonstrated with PaCa to the challenge of mapping 3D space using multiple cameras," Wu says.

To test the performance of MvACon, the researchers used it in conjunction with three leading vision transformers – BEVFormer, the BEVFormer DFA3D variant, and PETR. In each case, the vision transformers were collecting 2D images from six different cameras. In all three instances, MvACon significantly improved the performance of each vision transformer.

"Performance was particularly improved when it came to locating objects, as well as the speed and orientation of those objects," says Wu. "And the increase in computational demand of adding MvACon to the vision transformers was almost negligible.

"Our next steps include testing MvACon against additional benchmark datasets, as well as testing it against actual video input from autonomous vehicles. If MvACon continues to outperform the existing vision transformers, we're optimistic that it will be adopted for widespread use."

The paper, "Multi-View Attentive Contextualization for Multi-View 3D Object Detection," was presented at the IEEE/CVF Conference on Computer Vision and Pattern Recognition.

NOVARTIS PARTNERS TO INNOVATE GENE AND CELL THERAPY

NC State University and Novartis Gene Therapies have finalized a pioneering partnership to revolutionize the manufacturing processes for gene and cell therapies. This initiative centers on Lentivirus, a crucial gene delivery vector increasingly utilized in engineering therapeutic cells to combat aggressive forms of cancer.

> "This collaboration symbolizes the synergism between basic science, tech transfer and process innovation to improve the quality and accessibility of life-saving drugs," commented Kultaran Chohan, associate vice chancellor for research commercialization.

The project will be led by principal investigators **Michael Daniele** from the Departments of Biomedical Engineering (BME) and Electrical and Computer Engineering (ECE) and Stefano Menegatti from the Department of Chemical and Biomolecular Engineering (CBE). They will work alongside Tarl Vetter, associate director of gene therapy processing at Novartis, who will oversee downstream Lentivirus processing.

"We are excited to start this project! Lentivirus is a difficult product to make and one for which an improved manufacturing pipeline is greatly needed," said Menegatti.

This project is a significant addition to the NC-VVIRAL pipeline, an academic-industrial initiative to innovate viral vector manufacturing. "The regional connection between two innovation powerhouses such as Novartis and NC-VVIRAL is the way of the future for bioprocessing and workforce training," said Vetter.

A critical component of this project will be the Lentivirus purification adsorbent developed by NC-VVIRAL, with sponsorship from Merck Life Science KGaA and Ligatrap Technologies. "We are proud to see our investments in technology innovation move the needle in modern bioprocessing," said Oliver Rammo, director of novel modalities R&D at Merck. Crapanzano, Ligatrap CEO and pediatric cardiologist, added, "It is our duty to the patients to accelerate the transition of this technology to the market."

Daniele expressed his enthusiasm for the collaboration, stating, "We look forward to this project. It is very exciting to bring so many great people and technologies together on this endeavor."

This partnership represents a significant achievement by fully supporting the Ph.D. journey of Taylor Pleines, an incoming graduate student.

> Furthermore, it exemplifies NC State's "Think and Do" philosophy, showcasing how innovative partnerships can propel scientific research and education forward.

Michael Daniele, co-director of NC-VVIRAL, plays a key role in driving the initiative's mission. NC-VVIRAL focuses on developing cutting-edge technologies and training the next generation of bioprocessing professionals, fostering innovation and enhancing the effectiveness of viral vector production.

DEVELOPING FRAMEWORK
FOR QUANTUM SENSOR DESIGN

Researchers from NC State and the Massachusetts Institute of Technology have designed a protocol for harnessing the power of quantum sensors. The protocol could give sensor designers the ability to fine-tune quantum systems to sense signals of interest, creating sensors that are vastly more sensitive than traditional sensors.

"Quantum sensing shows promise for more powerful sensing capability that can approach the fundamental limit set by the law of quantum mechanics, but the challenge lies in being able to direct these sensors to find the signals we want," says **Yuan Liu**, assistant professor of electrical and computer engineering and computer science at NC State and corresponding author of the research. Liu was formerly a postdoctoral researcher at MIT.

> "Our idea was inspired by classical signal processing filter design principles that are routinely used by electrical engineers," Liu says. "We generalized these filter designs to quantum sensing systems, which allows us to 'fine-tune' what is essentially an infinite dimensional quantum system by coupling it to a simple two-level quantum system."

Specifically, the researchers designed an algorithmic framework that couples a qubit to a bosonic oscillator. Qubits, or quantum bits, are quantum computing's counterpart to classical computing's bits – they store quantum information and can only be in a superposition of two basis states: $|0\rangle$, $|1\rangle$. Bosonic oscillators are the quantum analog of classical oscillators (think of a pendulum's motion), and they share features similar to classical oscillators, but their states are not limited to a linear combination of only two basis states – they are infinite-dimensional systems.

"Manipulating the quantum state of an infinite-dimensional sensor is complicated, so we begin by simplifying the question," Liu says. "Instead of trying to figure out amounts of our targets, we just ask a decision question: whether the target has property X. Then we can design the manipulation of the oscillator to reflect that question."

By coupling the infinite-dimensional sensor to the two-dimensional qubit and manipulating that coupling, the sensor could be tuned to a signal of interest. Interferometry is used to encode the results into the qubit state which is then measured for readout.

"This coupling gives us a handle on the bosonic oscillator, so we could use a polynomial function – math that describes waveforms – to engineer the oscillator's wave function to take a particular shape, thus attuning the sensor to the target of interest," Liu says.

"Once the signal happens, we undo the shaping, which creates interference in the infinite-dimensional system that comes back as a readable result – a polynomial function determined by the original polynomial transformation of the oscillator and the underlying signal – in the qubit's two-level system. In other words, we end up with a 'yes' or 'no' answer to the question of whether the thing we're looking for is there. And the best part is that we only need to measure the qubit once to extract an answer – it's a 'single-shot' measurement."

The researchers see the work as providing a general framework for designing quantum sensing protocols for a variety of quantum sensors.

> "Our work is useful because it utilizes readily available quantum resources in leading quantum hardware (including trapped ions, superconducting platform, and neutral atoms) in a fairly simple way," Liu says. "This approach serves as an alarm or indicator that a signal is there, without requiring costly repeated measurements. It's a powerful way to extract useful information efficiently from an infinite dimensional system."

MALI TO RALEIGH

RENEWABLE ENERGY INNOVATION

Meet **Alex Diallo**, a senior in Electrical Engineering at NC State University, whose journey from West Africa to Raleigh, North Carolina, is fueled by a passion for renewable energy and a desire to give back to his homeland. Originally from Mali, Alex's story exemplifies perseverance, community and the power of education.

Growing up in Mali, Alex experienced a unique blend of cultural richness and natural beauty. "Mali is special because of the people, culture and nature. People are very welcoming — families and neighbors are close-knit. Everyone helps each other. It feels good to belong to such a caring community," Alex reflects. The ancient history, vibrant festivals and iconic Malian music are integral parts of life there, creating a warm and supportive environment that Alex still cherishes.

> However, life in Mali also presented certain challenges, such as frequent power outages. These blackouts, sometimes lasting hours, sparked Alex's interest in renewable energy. "I started having an interest in photovoltaic (PV) systems because they offer a solution to the recurrent power cuts. Mali's flat land and high solar irradiance make it ideal for solar energy," Alex explains.

His vision? To return home one day and help his community by designing and installing solar and battery storage systems.

Alex's educational journey began in Mali, where the French language dominates the classroom. After finishing high school, he moved to the U.S. to pursue his dreams, starting at Wake Tech. There, he not only learned English but also found a supportive community of classmates and professors who encouraged him to transfer to NC State. "The ECE department at NC State is well known, and many people recommended it as the perfect fit for my goals," he says.

Choosing to major in Electrical Engineering (ECE) was a natural step for Alex, fueled by his childhood experiences. Today, his passion for sustainability shines through his senior capstone project: designing a photovoltaic and battery system that powers an EV charging station and a building on campus. "It's a lot of work, but I'm enjoying it because this is what I want to do in the future," he shares. Through this hands-on project, Alex is acquiring the skills he will need to achieve his dream of opening a PV and battery system company in Mali.

Though Alex has embraced life in Raleigh, he admits there are things about home he misses. "I love nature — Raleigh has so many parks and lakes to visit, which I enjoy. But I miss my family and the traditional dishes from Mali like riz au gras and wudjila, a meat stew with soft bread on the side," he says with a smile.

As he approaches graduation, Alex's goals remain clear and his determination remains unwavering. His journey from Mali to NC State exemplifies the transformative power of education and the profound impact it can have not only on individuals but entire communities.

★Hear more at go.ncsu.edu/diallo-video

EXPANDING **FACULTY**

The Department of Electrical and Computer Engineering is very pleased to announce six new additions to our faculty for the upcoming semesters. As the College of Engineering 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.

Sabre Kais

Kais joined NC State ECE as a professor in August, bringing over 30 years of experience from Purdue University where he led groundbreaking research in quantum computing and quantum information science. An internationally recognized expert in chemical quantum computing, Kais has made significant strides in quantum algorithms, particularly in quantum phase transitions and quantum entanglement, which have advanced the understanding of molecular systems and quantum technologies. His collaborations with IBM on pioneering quantum perturbation methods have set a new standard in the field.

In addition to his role at Purdue, Kais served as the Research Director of the Theory Group at the Qatar Environment and Energy Research Institute, where he focused on energy sustainability and quantum applications in environmental research. Kais has published over 250 peer-reviewed articles and received numerous accolades, including fellowship in the American Physical Society and the Guggenheim Fellowship for his contributions to theoretical chemistry and quantum science.

Kais holds a B.S., M.S., and Ph.D. from the Hebrew University of Jerusalem. Reflecting on his new role, Kais says,

> "I eagerly anticipate this new chapter at NC State and look forward to contributing to the cutting-edge research in quantum computing."

His work promises to strengthen NC State's leadership in quantum technologies and inspire the next generation of engineers and scientists.

Stanley Cheung

Cheung, a leading expert in semiconductor photonics, will be joining NC State ECE as an associate professor in January 2025. Currently a principal scientist at HP Labs, Cheung's research spans optical interconnects, neuromorphic computing, non-volatile photonic memories, and more. His work in semiconductor and photonic technologies aligns perfectly with the department's growth in these fields. Cheung earned his B.S. in Electrical Engineering from the University of Southern California, his M.S. from Columbia University, and his Ph.D. in Electrical Engineering from the University of California, Davis. His expertise will help drive innovation at NC State.

Sevgi Zubeyde Gurbuz

Joining NC State ECE in January 2025, Gurbuz will bring her expertise as an associate professor from the University of Alabama. Her research spans machine learning, signal processing, and cognitive radar, with a focus on healthcare applications. She has secured nearly $3 million in funding and earned the prestigious 2023 NSF CAREER award. Gurbuz holds a Ph.D. from Georgia Tech and both her M.S. and B.S. degrees in Electrical Engineering from MIT.

Ali Gurbuz

Gurbuz will join NC State ECE as an associate professor in January 2025 from Mississippi State University. His research focuses on signal processing, wireless communication, and radar applications in fields like agriculture. With over $11 million in funding and multiple awards, including the 2023 NSF CAREER award, Gurbuz's work has earned recognition across industries. He holds a Ph.D. and M.S. from Georgia Tech and a B.S. in Electrical Engineering from Bilkent University in Turkey.

Jennifer Marley

Marley will join NC State as an associate teaching professor in the Spring of 2025, bringing a wealth of experience from both electrical engineering and applied mathematics. Marley is currently an associate professor at the University of Virginia, having previously served as a tenured associate professor in Electrical and Computer Engineering at Valparaiso University. She holds a Ph.D. and M.S. from the University of Michigan and a B.S. in Electrical Engineering from NC State University. Returning to her alma mater, Marley is poised to inspire the next generation of engineers with her rich academic background and passion for teaching.

Vijay Shah

Shah is joins us an Assistant Professor in the Electrical and Computer Engineering Department at North Carolina State University. He heads the NextG Wireless Lab@NC State, dedicated to advancing the forefront of wireless communication and network technologies beyond current generations. Prior to joining NC State, he was an Assistant Professor in the Cybersecurity Engineering Department at George Mason University and Research Assistant Professor in the Bradley Department of ECE at Virginia Tech from 2021 - 2024 and 2019 - 2021, respectively.

Paschalis Gkoupidenis

Gkoupidenis, an associate professor at NC State starting this fall, earned his PhD in materials science from NCSR "Demokritos", Athens, Greece, in 2014. During his Ph.D., his research focused on ionic transport mechanisms of organic electrolytes, physics of ionic-based devices, and of non-volatile memories. Following his PhD, in 2015 he joined the group of George Malliaras at the Department of Bioelectronics (EMSE, France) as a postdoctoral researcher where his research focused on the design and development of organic neuromorphic devices based on electrochemical concepts. In 2017, Paschalis Gkoupidenis joined the Max Planck Institute for Polymer Research, and became a Group Leader at the Department of Molecular Electronics.

Visit **ece.ncsu.edu/hiring** to see new faculty positions.

ELECTRIC BANDAGE

FOR TREATING CHRONIC WOUNDS

Researchers have developed an inexpensive bandage that uses an electric field to promote healing in chronic wounds. In animal testing, wounds that were treated with these electric bandages healed 30% faster than wounds treated with conventional bandages.

Chronic wounds are open wounds that heal slowly, if they heal at all. For example, sores that occur in some patients with diabetes are chronic wounds. These wounds are particularly problematic because they often recur after treatment and significantly increase the risk of amputation and death.

One of the challenges associated with chronic wounds is that existing treatment options are extremely expensive, which can create additional problems for patients.

"Our goal here was to develop a far less expensive technology that accelerates healing in patients with chronic wounds," says Amay Bandodkar, co-corresponding author of the work and an assistant professor of electrical and computer engineering at North Carolina State University. "We also wanted to make sure that the technology is easy enough for people to use at home, rather than something that patients can only receive in clinical settings."

"This project is part of a bigger DARPA project to accelerate wound healing with personalized wound dressings," says Sam Sia, co-corresponding author of the work and professor of biomedical engineering at Columbia University. "This collaborative project shows that these lightweight bandages, which can provide electrical stimulation simply by adding water, healed wounds faster than the control, at a similar rate as bulkier and more expensive wound treatment."

Specifically, the research team developed water-powered, electronics-free dressings (WPEDs), which are disposable wound dressings that have electrodes on one side and a small, biocompatible battery on the other. The dressing is applied to a patient so that the electrodes come into contact with the wound. A drop of water is then applied to the battery, activating it. Once activated, the bandage produces an electric field for several hours.

"That electric field is critical, because it's well established that electric fields accelerate healing in chronic wounds," says Rajaram Kaveti, co-first author of the study and a post-doctoral researcher at NC State.

> The electrodes are designed in a way that allows them to bend with the bandage and conform to the surface of the chronic wounds, which are often deep and irregularly shaped.

"This ability to conform is critical, because we want the electric field to be directed from the periphery of the wound toward the wound's center," says Kaveti. "In order to focus the electric field effectively, you want electrodes to be in contact with the patient at both the periphery and center of the wound itself. And since these wounds can be asymmetrical and deep, you need to have electrodes that can conform to a wide variety of surface features."

"We tested the wound dressings in diabetic mice, which are a commonly used model for human wound healing," says Maggie Jakus, co-first author of the study and a graduate student at Columbia. "We found that the electrical stimulation from the device sped up the rate of wound closure, promoted new blood vessel formation, and reduced inflammation, all of which point to overall improved wound healing."

> Specifically, the researchers found that mice who received treatment with WPEDs healed about 30% faster than mice who received conventional bandages.

"But it is equally important that these bandages can be produced at relatively low cost – we're talking about a couple of dollars per dressing in overhead costs." says Bandodkar.

"Diabetic foot ulceration is a serious problem that can lead to lower extremity amputations," says Aristidis Veves, a co-author of the study and professor of surgery at Beth Israel Deaconess Center. "There is urgent need for new therapeutic approaches, as the last one that was approved by the Food and Drug Administration was developed more than 25 years ago. My team is very lucky to participate in this project that investigates innovative and efficient new techniques that have the potential to revolutionize the management of diabetic foot ulcers."

In addition, the WPEDs can be applied quickly and easily. And once applied, patients can move around and take part in daily activities. This functionality means that patients can receive treatment at home and are more likely to comply with treatment. In other words, patients are less likely to skip treatment sessions or take shortcuts, since they aren't required to come to a clinic or remain immobile for hours.

"Next steps for us include additional work to fine-tune our ability to reduce fluctuations in the electric field and extend the duration of the field. We are also moving forward with additional testing that will get us closer to clinical trials and – ultimately – practical use that can help people," says Bandodkar.

The paper, "Water-powered, electronics-free dressings that electrically stimulate wounds for rapid wound closure," is published in the open-access journal Science Advances. The paper's co-authors include Henry Chen, an undergraduate in the joint biomedical engineering department at NC State and UNC; Bhavya Jain, Navya Mishra, Nivesh Sharma and Baha Erim Uzunoğlu, Ph.D. students at NC State; Darragh Kennedy and Elizabeth Caso of Columbia; Georgios Theocharidis and Brandon Sumpio of Beth Israel Deaconess Medical Center; Won Bae Han of Korea University and the Georgia Institute of Technology; Tae-Min Jang of Korea University; and Suk-Won Hwang of Korea University and the Korea Institute of Science and Technology.

BRINGING CYBERSECURITY

TO THE CLASSROOM

North Carolina middle and high school teachers are learning how to incorporate cybersecurity content into their classrooms through the GenCyber Teacher Camp, led by NC State College of Education Professor of Learning, Design, and Technology Florence Martin.

Sponsored by a grant from the National Security Agency (NSA), the camp introduced educators from more than a dozen North Carolina counties to cybersecurity topics and skills that will enable them to increase students' access to cybersecurity careers.

Prior to attending the in-person camp on July 15 and 16, teachers participated in six online modules related to cybersecurity concepts, cyber ethics and safety, cryptography, real-world cybersecurity, cyber policies and cybersecurity careers. They then designed three cybersecurity lessons to implement in their classrooms during the upcoming school year.

"Only a few schools in North Carolina offer courses on cybersecurity at the middle or high school level. The GenCyber teacher camp provided NC teachers with the conceptual, technical, and pedagogical knowledge and skills needed to teach cybersecurity," Martin said. "It was rewarding to see teachers actively participate in both the online modules and the in-person camp empowering them to teach cybersecurity."

The GenCyber professional development was designed by Martin and ECE Assistant Professor **Aydin Aysu** in collaboration with NC State doctoral students, a mentor teacher and researchers from the College of Education and Friday Institute for Educational Innovation, including Research Scholar Rebekah Davis.

> In feedback to the project team, participating teachers said they particularly enjoyed the blend of theory, resources and practical activities offered in the professional development as well as learning coding programs from experts. One participant described the in-person session as "the most engaging, informational and interactive [professional development] I have participated in."

Educators who participated in the GenCyber camp will continue to engage with NC State researchers as well as cybersecurity professionals online throughout the fall and will attend a future learning convening where they will have an opportunity to share about the implementation of the lessons they created and hear from speakers in various cybersecurity careers.

POWERING MEDICAL

AUTONOMOUS DRONES

Researchers from NC State, in collaboration with Utah State and Navajo Tech, are pioneering drone technology designed to safely transport medical supplies over long distances. This project, funded by the National Institute of Standards and Technology (NIST) through the PowerAmerica program at NC State, aims to improve pandemic preparedness by overcoming critical challenges in drone range, charging efficiency and supply safety.

At the heart of the project is a wireless charging system developed by NC State, which enables drones to recharge quickly without manual intervention. "Our focus was to design a system that can autonomously charge the drone without the need for exposed contacts, which are vulnerable to the elements," said **Zeljko Pantic**, who leads NC State's effort. "We created a platform that aligns the coils of the charging pad and the drone with precision, down to one-eighth of an inch. This level of accuracy is crucial for efficient wireless power transfer."

The drones used in the project are classified as category two, weighing under 55 pounds. They can fly approximately 100 miles before needing to recharge.

> The goal is to charge the drone in less than 30 minutes, a feat made possible by the precise wireless system developed at NC State.

Utah State's team worked on the drone's autonomy, ensuring it can land and take off from charging pads without human intervention. They utilized advanced technologies such as lidar, GPS, and cameras for precise navigation. "Our tests show a perfect landing rate," said Pantic. "Each attempt landed the drone accurately on the pad, which is essential for smooth operation in real-world scenarios."

Navajo Tech developed a thermally regulated container to keep medical supplies safe, ensuring the temperature remains at two to seven degrees Celsius during transport.

This project also addressed a significant challenge in drone design: balancing weight and efficiency. "We had to make some trade-offs between having a lightweight system and maintaining efficiency," Pantic explained. "If you improve efficiency, you add bulk. By optimizing the system's power density, we were able to find the sweet spot. Our current design delivers three watts per gram of added mass, which allows us to maximize both power and flight range."

Looking forward, the team aims to further enhance this technology. One future step is developing a "Drone-in-a-Box" solution that automates drone deployment, making it as simple as programming a flight route and pressing a button. "The solution exists but is extremely expensive, with costs often exceeding $100,000," Pantic said. "We're exploring ways to make it more affordable and accessible."

This project is part of a larger NIST initiative focused on advancing drone technology for disaster preparedness. NC State, Utah State and Navajo Tech's work on this groundbreaking system promises to reshape the future of medical logistics, offering faster and safer delivery methods in emergencies.

★ **See more at go.ncsu.edu/medidrone-video**

CLAWS HUB LEADING

$19 MILLION IN LEAP AHEAD PROJECTS

The White House and U.S. Department of Defense announced in September the first year of funding, totaling $19 million, for four additional projects for the Commercial Leap Ahead for Wide Bandgap Semiconductors (CLAWS) Microelectronics Commons Hub, headed by North Carolina State University.

The projects were selected from more than 100 proposals and aim to improve the performance of transistors and switches used in important civilian and military technologies, as well as to increase U.S. economic competitiveness and national security with translational pathways to commercialization.

"Under the leadership of President Biden and Vice President Harris, we're creating a new chapter in semiconductor research and development here in America," said Arati Prabhakar, the President's Chief Advisor for Science and Technology and Director of the White House Office of Science and Technology Policy. "Here in North Carolina, these CHIPS and Science Act investments through the Microelectronics Commons will advance innovation for components that enable the most sophisticated defense systems, strengthening our national security. [These] awards are the next step forward in making sure that we win the future."

Wide bandgap "leap ahead" technologies are highly innovative technologies associated with "war-winning" capabilities against potential near-peer adversaries. "Commercial Leap Ahead" technologies are those that leapfrog the current state of the art and are important for the economic competitiveness of the nation. Key civilian infrastructures like the power grid, data centers, telecommunication and transportation systems often have similar needs as the military to operate with higher performance, higher efficiency and more reliability. There is also great economic potential in emerging critical technologies like artificial intelligence, quantum computing and autonomous vehicles in which wide bandgap semiconductors will play an important enabling role.

The higher voltages, temperatures and frequencies that wide bandgap semiconductors provide over silicon devices crosscut across all domains of military operations from undersea to land, air and space enabling lighter, faster, and more capable ships, submarines, aircraft and satellites. On the civilian side they enable electric vehicles to go further, factories and data centers to save energy, and a more resilient power grid.

The project teams connect industry leaders, national labs and the best in academia to develop prototype manufacturing line capability to transition the technologies from "lab to fab" to demonstrate the ability to scale these technologies to production. The teams span the supply chain from materials experts supplying epitaxy and wafers to state-of-the-art fabrication, test and packaging; as well as Defense Industrial Base partners to streamline insertion into programs with Department of Defense technology needs.

CLAWS
Commercial Leap Ahead for Wide Bandgap Semiconductors

High Permittivity Dielectrics to Increase the Performance of III-Nitride Transistors

Led by NC State, this $3.83 million in first year award (total estimated value of $11.54 million) will increase the efficiency and radiation hardness of advanced transistors used in avionics and satellite applications. Partners include MACOM, EPC Space, Lockheed Martin, University of Florida, NASA and Sandia National Laboratories.

Transition Readiness for NITride Rf Overmatch (T/R NITRO)

Led by MACOM, this $3.68 million in first year award (total estimated value of $12.65 million) will deliver advance prototypes of high frequency transistors and circuits for use in electronic warfare, radars, and 5G/6G telecommunications. The partners include NC State, Adroit Materials and the Naval Research Laboratory.

Advanced High Voltage Silicon Carbide Switches

Led by GE Aerospace, this $7.82 million in first year award (total estimated value of $27.02 million) will push the development of 6.5 to 10 kV planar field-effect transistors (FETs) into a low-volume production environment and develop 6.5 to 10 kV Superjunction (SJ) devices, in which the U.S. is at the forefront of competition with Asia. The partners include Coherent, NC State, Stony Brook University, University of Albany, Naval Research Laboratory, DEVCOM and N.C. A&T State University.

Advanced Power Switches Using UWBG Gallium Oxide

Led by Kyma Technologies, this $3.52 million in first year award (total estimated value of $11.40 million) will advance the state-of-the-art in gallium oxide high voltage switching devices by producing power diodes and power transistors capable of blocking up to 10kV, and make available the epilayers, devices, and composite substrates to the DoD and community at large through the CLAWS hub. The partners include NC State, University of California at Santa Barbara, Modern Microsystems, the Air Force Research Laboratory, Naval Research Laboratory and GE Aerospace.

BREAKING BARRIERS
IN AERIAL COMMUNICATION

The Aerial Experimentation and Research Platform for Advanced Wireless (AERPAW) program at NC State has been at the forefront of advancing wireless communication technologies and supporting the development of next-generation wireless networks. AERPAW, located on Centennial Campus, is a collaborative initiative involving academic, industry, and government partners. Its primary goal is to provide a testing and experimentation environment for aerial communication networks, including drones and unmanned aerial vehicles (UAVs), to facilitate the integration of 5G and beyond technologies into our daily lives.

AERPAW has recently expanded its infrastructure and testing capabilities, solidifying its position as one of the most comprehensive platforms for aerial communication research in the United States. This expansion includes additional equipment, base stations, and extended coverage areas for advanced experiments. The program has also upgraded its digital twin, allowing experimenters to develop wireless and UAV trajectory control solutions remotely. Once fully developed, these experiments are deployed in the real-world testbed, and the resulting data is provided to experimenters.

Furthermore, AERPAW has strengthened its partnerships with industry leaders and government agencies, such as Ericsson, Keysight, and NI. These collaborations not only provide financial support but also offer valuable insights into practical applications, bridging the gap between theory and real-world implementation.

AERPAW's research focus has evolved to accommodate the demands of the wireless communication industry, with a particular emphasis on urban air mobility (UAM). The program explores how aerial networks can support UAM services, addressing issues related to low-altitude airspace management, communication between autonomous aerial vehicles, and integration with existing ground-based infrastructure.

AERPAW remains committed to nurturing the next generation of engineers and scientists in the field of aerial communication networks. Educational and training initiatives prepare students and researchers to work on cutting-edge technologies. In March 2025, AERPAW will host the third ACW community workshop, with participants from academia, industry, and government. The event features panel discussions, hands-on training sessions for students, and a drone demonstration at Lake Wheeler.

Its second UAV competition, AERPAW Autonomous Data Mule (AADM) launched this year. As part of the challenge, student teams will use AERPAW's digital twin to program an autonomous drone and a software-defined radio equipment carried by the drone to download data from a number of towers as quickly as possible.

In another major milestone, AERPAW formally announced Phase-2 General Availability, with eight fixed nodes in February 2024. Summer 2025 marks the target completion for Phase-3.

This year also saw AERPAW become an Open Testing and Integration Center (OTIC) under the O-RAN Alliance, supporting conformance, interoperability, and testing services for O-RAN hardware and software AERPAW also became an Open Testing and Integration Center (OTIC) under the O-RAN Alliance, supporting conformance, interoperability, and testing services for O-RAN hardware and software

With expanded infrastructure, enhanced partnerships, a refined research focus, and active involvement in standardization efforts, AERPAW continues to lead in aerial communication research. Through its experiments and collaborative efforts, it significantly contributes to the development of advanced wireless communication technologies and the seamless integration of aerial networks into daily life. AERPAW's ongoing efforts are poised to shape the future of wireless communication.

★Learn more at aerpaw.org

AERPAW
Aerial Experimentation and Research Platform for Advanced Wireless

ASSIST: OVER A DECADE OF WEARABLE DEVICE BREAKTHROUGHS

More than ten years since its founding, the Advanced Self-Powered Systems of Integrated Sensors and Technologies (ASSIST) Center led by NC State has made groundbreaking advances in wearable health monitoring devices.

The center, established in 2012 with the goal of advancing fundamental science in energy harvesting and storage, low-power sensing and low-power electronics, is now increasing its focus on implantable devices as it moves toward a self-sufficient future while building on current initiatives.

"It took us a while to get the systems together, and it took even more time to make them robust and solid," said **Veena Misra**, co-director of ASSIST, Department Head and MC Dean Distinguished Professor in the Department of Electrical and Computer Engineering (ECE). "Now we have a prototyping lab, a systems integration team and a thriving education program. … One of the most exciting things I think we can do is take our systems we've built and help patients."

Moving forward, ASSIST will be funded through large grant proposals, support from existing and new industry partners and non-research sources of revenue.

From wearable to implantable

ASSIST has developed several implantable devices, with funding from NSF. Researchers are using ultrasound to power implantable devices made of ASSIST's novel material and sensing technologies that can be used to monitor cardiac health. ASSIST faculty members aim to demonstrate and evaluate ultrasonic, biomaterial and bioelectronic components of cardiac implantable systems through benchtop and in-vivo experiments, and will eventually assemble the components and continue in-vivo and in-vitro experiments with the complete device.

Through industry funding, researchers have also developed implantable devices to monitor farm, companion and working animals to understand and improve their welfare. Researchers aim to miniaturize versions of wearable health monitoring devices — like health-tracking smart watches — into microchip implants that can be injected under animals' skin.

Ideas for and from everyone

Throughout its 10 years, ASSIST has prioritized professional development opportunities, as well as outreach for students from kindergarten through college, offering summer camps, undergraduate research positions and programs for middle and high school students. Education goes hand-in-hand with ASSIST's research.

Elena Veety, education director for ASSIST and teaching assistant professor in ECE, said these initiatives will continue and expand.

One of its most successful pre-college programs is the Wearable Device Challenge. "They do some really unique things," Veety said. These unique things include a glove that helps alleviate arthritis, a posture detection device and a gait rehabilitation device worn on a sock.

These are all ideas in the same vein as what ASSIST faculty members are developing and researching — and the students devising them might be among the people continuing ASSIST's foundational research as the center looks to the next decade and beyond.

★ **Learn more at assistcenter.org**

FREEDM:
SPARKING INNOVATION

The Future Renewable Electric Energy Delivery and Management (FREEDM) Systems Center started as an NSF Engineering Research Center in 2008 with a vision to redesign the electric distribution grid to allow more distributed energy resources through plug and play functionality and distributed control algorithms. With a dozen affiliated faculty and over 100 graduate students, their research today is focused on four pillars: Wide Bandgap (WBG) Semiconductors, Electric Transportation, Modern Power Systems, and Renewable Energy. Their lab capabilities include power device packaging design and testing, Hardware-in the-Loop (HIL) simulation, and a high bay space rated for 1 Megawatt and 15 kV voltage.

Much of the research in WBG is in partnership with PowerAmerica to develop new applications for higher voltage devices or new topologies to achieve higher performance at lower cost. Recent projects include the development of a 2.2-level silicon carbide inverter topology that uses an active filter in parallel with the standard 2-level topology. It achieves zero voltage switching and reduces dV/dt by 10X through unique adaptive gating control while reducing device costs by 40%.

In Electric Transportation, FREEDM is leading the way with novel motor drive designs, new motor topologies with increased power density, and very high power fast chargers. Their research teams deployed a 1 MW Extreme Fast Charger in partnership with the New York Power Authority and ABB, developed a 250 kW traction drive with Ricardo Engineering for evaluation on electric trucks at shipping ports, built a 100kW heavy rare-earth free traction electric motor, and designed a charging network for electric wheelchairs.

FREEDM's power systems research includes software development and highly accurate grid simulations. They develop monitoring systems for grid cybersecurity, algorithms for managing wide area networks of distributed wind resources, and applications of machine learning to forecast loads and generation. One of the FREEDM-affiliated associate professors, **Wenyuan Tang** was awarded two prizes this year for forecasting: one for solar generation potential in multiple US cities and another for hydropower operations optimization.

FREEDM SYSTEMS CENTER

Renewable energy covers the center's research in improving renewable system efficiency, power electronics specifically for renewable resources, and microgrids. In partnership with the Atlantic Marine Energy Center, FREEDM researchers are developing a multi-port converter and control system to manage wave power, solar power, and energy storage for a demonstration microgrid at Jennette's Pier on the Outer Banks of North Carolina. They are building an open source microgrid co-design platform that generates an optimal design and the associated control algorithms.

FREEDM provides a talent pipeline for tomorrow's workforce. The professional science masters degree in Electric Power Systems Engineering has a 100% placement rate for graduates. Its students are leaders in the Graduate Student Association, advocates for gender diversity in power electronics, and nationally recognized through awards and scholarships. One third of FREEDM students find employment with a member company upon graduation with the balance moving to positions in academia, national research labs, and other corporations.

★Learn more at freedm.ncsu.edu

Wide Bandgap Power Electronics

Electric Transportation

Modern Power Systems

Renewable Energy Systems

The Department of Electrical and Computer Engineering at NC State University is proud to honor accomplishments of our outstanding graduates and community with our 2024 awards.

We have inducted 91 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.

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**

2024 INDUCTEES OF THE ECE
ALUMNI HALL OF FAME

Dilip Bhatia
VP, Chief Experience Officer
Lenovo
BS EE 1993; BS CPE 1993

Joe Britt, Jr.
CEO
Afero
BE CPE 1991

Arshed Javaid
Co-Founder and Managing Partner
Parraid
1989 BS EE; 1989 BS CPE

Steven Whisenant
Principal Engineer
Duke Energy
1974 BS EE

Wilson White
VP, Government Affairs & Public Policy,
Google
2003 BS CPE

OUTSTANDING
EARLY CAREER AWARD

Xu She
Senior Director of Engineering, Lunar Energy
2013 Ph.D EE

HONORS AND **ACHIEVEMENTS**

FACULTY AWARDS

Alper Bozkurt – Secured a $4.3 million grant for research in wearable technology aimed at advancing human health and performance through biosensing systems.

Brian Floyd – Awarded Innovator of the Year for his contributions to wireless communication technology, especially in radio frequency (RF) systems design.

Qing Gu – Received the 2023-24 R. Ray Bennett Faculty Fellow Award for her excellence in research on optoelectronics and next-generation laser systems.

Michael Daniele – Honored with the 2024 William F. Lane Outstanding Teaching Award for his exceptional dedication to student learning in biomedical engineering and nanotechnology.

Aydin Aysu and **Edgar Lobaton** – Both were named University Faculty Scholars for their research excellence and contributions to Electrical and Computer Engineering.

Omer Oralkan - Elected to the College of Fellows of the American Institute for Medical and Biological Engineering for pioneering contributions in capacitative micromachined ultrasonic transducers.

Aranya Chakrabortty – Awarded the NSF Director's Award for Superior Accomplishment for his exceptional work in managing NSF programs on power systems, control systems and Midscale Research Infrastructure, as a program director in the Electrical, Communications, and Cyber Systems (ECCS) division of NSF.

COMPETITIONS AND PAPERS

Ismail Guvenc and **Cole Dickerson** – Electrical Engineering Ph.D. student Dickerson advised by Guvenc, professor of Electrical and Computer Engineering, has been awarded a prestigious Graduate Research Fellowship from the National Science Foundation.

Danny Krafft – Electrical Engineering Ph.D. candidate, earned third place in a national competition for designing a bench that fosters social connections. This innovative bench design was recognized for its ability to bring people together, making it stand out on a national stage.

Krishna Namburi and **Iqbal Husain** – Ph.D. candidate Namburi and Iqbal Husain, ABB Distinguished Professor won the Best Paper Award at ITEC 2024 for their research on electric vehicle systems.

ALUMNI AWARDS

Five NC State ECE alumni were recognized on the 'Power 100' list for their significant impact and leadership in the energy and power engineering sectors.

Tim Humphrey (BS EE '96) is the Chief Analytics Officer and NC Senior State Executive for IBM. As a member of NC State's Board of Trustees, Humphrey remains highly involved with the university, especially within engineering programs where he has given generously to support diversity initiatives. In 2019, he established the Timothy L. Humphrey Women and Minority Engineering Initiatives Award and the Timothy L. Humphrey Inclusion, Equity and Diversity Award. He was also inducted into the NC State ECE Hall of Fame in 2018.

Ryan Pratt (BS EE '00) is the CEO and founder of Guerrilla RF, headquartered in Greensboro, which provides high-performance MMICs for the wireless infrastructure market. Pratt also currently serves on the NC State ECE Strategic Advisory Board.

Scot Wingo (MS CPE '91) is the CEO of Spiffy, a mobile vehicle maintenance company that raised $30 million in February to expand into six more states. Wingo also leads the Tweener Fund which supports promising new triangle start-ups, and serves on the Board of Advisors for NC State Innovation and Entrepreneurship. He was inducted into the NC State ECE Hall of Fame in 2015.

Amit Sharma (MS CN '02) is the CEO of Chapel Hill-based CData Software, a data connectivity business that received $140 million in funding in 2022, earning it a spot on the Deloitte Technology Fast 500 list of rapidly growing companies.

Kamala Subramaniam (MS CN '01; Ph.D. CPE '06) is the Director of Software Engineering and Site Lead for Google's Durham campus. Kamala is also the Diversity & Inclusion leader for Google Networking, passionate about hiring and growing underrepresented talent in her organizations. She serves on both the NC State Computer Science Strategic Advisory Board as well as the NC State Board of Visitors.

DOCTORAL DEGREES AWARDED

Mostafa Abdelhamid
Electrical Engineering
InGaN/GaN Light Emitting Diodes on Relaxed InGaN Templates.
Salah M. Bedair (Chair)

Sodiq Agoro
Electrical Engineering
Design Modeling and Predictive Control of Dual Three Phase Permanent Magnet Synchronous Motors for Traction Applications.
Iqbal Husain (Chair)

Muhammet Annayev
Electrical Engineering
Design and fabrication of glass-based capacitive micromachined ultrasonic transducers (CMUTs) for imaging, neuro-stimulation, and power transfer.
Omer Oralkan (Chair)

Emran Ashik
Electrical Engineering
The Mobility and Gate Oxide Reliability Improvement of SiC CMOS for High-Temperature Applications.
Bongmook Lee (Co-Chair), Veena Misra (Co-Chair)

Divyakumar Mahiman Badheka
Electrical Engineering
Information Contained in Electromagnetic Fields in MU-MIMO Communication System.
Brian Hughes (Chair)

Ritvik Chattopadhyay
Electrical Engineering
Design of High-Performance Electric Motors with Reduced Magnet Utilization for Electrified Transportation.
Iqbal Husain (Chair)

Mrugen Deshmukh
Electrical Engineering
Feedback Overhead Reduction and Interference Mitigation for Next Generation Wireless Systems.
Ismail Guvenc (Chair)

Ryan Dreifuerst
Electrical Engineering
Machine Learning-Assisted Beam Management and Codebook Design.
Robert Heath (Chair)

Kelvin Dsouza
Electrical Engineering
The Effect of Electromagnetic Fields on Materials and the Mechanism of Field-Induced Phase Retention.
Daryoosh Vashaee (Chair)

Anuj Dubey
Computer Engineering
A Full-Stack Solution for Side-Channel Security of Machine Learning Hardware.
Aydin Aysu (Chair)

Cody Ellington
Electrical Engineering
Enhanced Frequency-Selective N-Path Filters and Receivers.
Brian Floyd (Chair)

Archit Gajjar
Computer Engineering
Ransomware Detection with XGBoost Hardware Acceleration for Data Centers using High-Level Synthesis.
Paul Franzon (Chair)

Sandeep Hari
Electrical Engineering
N-path Receivers and Filters: From RF to mmWave.
Brian Floyd, (Chair)

Zhangjie Hong
Electrical Engineering
Phased Array Characterization and Calibration using Code-Modulated Embedded Test.
Brian Floyd (Chair)

Rongxing Hu
Electrical Engineering
Energy Management System of Renewable-powered Microgrids for Resilience Service in Distribution System.
Ning Lu (Chair)

Jishnudeep Kar
Electrical Engineering
Model-Free Designs for Wide-Area Control of Power Systems with Cyber-Physical Insights.
Aranya Chakrabortty (Chair)

Emre Karabulut
Computer Engineering
Efficient, Flexible and Secure Implementations for Lattice-based Cryptography.
Aydin Aysu (Chair)

Priyank Kashyap
Computer Engineering
Machine Learning to Enable Side-Channel Analysis and Generative Modeling in Electronic Design Automation.
Aydin Aysu (Co-Chair), Paul Franzon (Co-Chair)

Hanpyo Lee
Electrical Engineering
Machine Learning Applications for Smart Meter Data Analysis.
Ning Lu (Chair)

Xianpeng Liu
Electrical Engineering
Towards Robust Camera-based 3D Object Detection by Learning Robust 2D-to-3D and 3D-to-2D Representations.
Tianfu Wu (Chair)

Devon Martin
Electrical Engineering
Multi-Sensor Data Fusion for Agriculture and Animal Welfare Monitoring.
Alper Bozkurt (Chair)

Jake McCall
Electrical Engineering
Development of Experimental and Computational Tools for Volumetric Ultrasound Localization Microscopy and Steps Toward Its Clinical Cancer Diagnostic Translation.
Omer Oralkan (Co-Chair), Paul Dayton (Co-Chair)

Mahita Nagabhiru
Computer Engineering
Hardware Atomic Instructions for Lock-Free Programming.
Gregory Byrd (Chair)

Yongduk Oh
Electrical Engineering
Gradient-Index Lenses for RF Applications Using High Permittivity Ceramic Materials.
Jacob Adams (Chair)

Sanket Parashar
Electrical Engineering
Design and Performance Analysis of Medium Voltage Power Converter Utilizing Series-Connected HV SiC MOSFETs and HV SiC JBS Diodes.
Subhashish Bhattacharya (Chair)

Ferdous Pervej
Electrical Engineering
Collaborative Edge and On-Device Learning in Wireless Networks under Resource Constraints.
Huaiyu Dai (Chair)

Harish Pulakhandam
Electrical Engineering
System-Level Optimization Methods for High-Speed Motor Drives.
Subhashish Bhattacharya (Chair)

Sagar Rastogi
Electrical Engineering
Open-Circuit Fault Analysis for a Three-phase Dual Active Bridge Converter: A Comprehensive Investigation of Mode Analysis, Transformer Behavior, and Fault Diagnosis Techniques.
Subhashish Bhattacharya (Chair)

Tiantong Ren
Electrical Engineering
Toward High Output Power, Wide Bandwidth, Calibrated Phased-Array Transmitters for Millimeter-Wave Communication.
Brian Floyd (Chair)

Rohan Sengupta
Electrical Engineering
GaN-Based Heterogeneous Heterostructure Devices.
Spyridon Pavlidis (Chair)

Shrivatsal Sharma
Electrical Engineering
Control and Operation of DC Microgrids Enabled by Wide-Bandgap Devices Based Power Electronic Converters.
Subhashish Bhattacharya (Chair) **Sourish Sankar Sinha**
Electrical Engineering
Investigation of High-Frequency Electromagnetic and Electrostatic Shielding for WBG Power Module.
Douglas Hopkins (Chair)

Shane Stein
Electrical Engineering
GaN Junction Devices for Microwave and Power Electronics.
Spyridon Pavlidis (Chair)

Dakai Wang
Electrical Engineering
Adaptive Soft-switching High-Power Converters and Inverters for Electric Vehicle Applications.
Wensong Yu (Chair)

Zgiping Wang
Computer Engineering
Fast and Accurate Event Prediction for System-on-Chip Power and Energy Estimation.
Rhett Davis (Chair)

Luowei Wen
Electrical Engineering
Selective Gate Driver Balancing the Reliability and Efficiency of SiC Electric Vehicle Traction Inverters.
Iqbal Husain (Co-Chair), Wensong Yu (Co-Chair)

Mike Wilkins
Electrical Engineering
Wearable Multimodal Maternal-Fetal Monitor for Improving Neonatal Outcomes.
Michael Daniele (Chair)

Bei Xu
Electrical Engineering
Development of Advanced Grid-Support Functionalities Using Battery Energy Storage Systems.
Ning Lu (Chair)

Xinyi Xu
Electrical Engineering
Application and Modeling of Electrically Modulated Magnetic Properties in Anti-ferromagnetic Systems.
Ki Kim (Chair)

Shougang Yuan
Computer Engineering
Bandwidth-Efficient Secure Memory Designs for GPUs.
Huiyang Zhou (Chair)

Joe Zhou
Electrical Engineering
Pixel Diffraction in Passive Millimeter Wave Compressive Imaging and Compressive Sensing Algorithm Development.
David Ricketts (Chair)

Yilu Zhou
Electrical Engineering
A Smart E-Nose System Based on A Novel Monolithic MEMS Array.
Bongmook Lee (Co-Chair), Veena Misra (Co-Chair)

Rui Zou
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Modeling, Prediction, and Multi-RAT Access of High Resolution Spectrum Based on Decoding Enabled Measurement.
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Quantum algorithms for combinatorial optimization

Rebekah Herrman

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The University of Tennessee, Knoxville

Robotic System Performance: Academia to Industry & From Hardware to Software

Daniel J. Sorin

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Engineering and Medicine

Behnaam Aazhang

J.S. Abercrombie Professor
Rice University

Quantum Rydberg Radar

Darmindra Arumugam

Program Manager
NASA Jet Propulsion Laboratory, Caltech

Trustworthy ML: A Computer Architecture Perspective

Khaled N. Khasawneh

Assistant Professor
George Mason University

Circuits and Systems for Next Generation Wireless Communication

Jeffrey Walling

Associate Professor
Virginia Tech

Full-duplex Wireless Integrated Sensing and Communication

Besma Smida

Associate Professor
University of Illinois Chicago

From Soft to Essential: The Skills Needed for Engineers to Face Wicked Problems

Ethan Rivera

Student Programming Lead
The Ohio State University

Balancing Heterogeneity and Programmability Across Computing Scales

Abhishek Bhattacharjee

Professor of Computer Science
Yale University

The Growing Complexity of Transmission System Planning

Samuel Roberts II

General Manager, Transmission Planning and Operations Strategy
Duke Energy

RowHammer, RowPress and Beyond: Can We Be Free of Bitflips (Soon)?

Onur Mutlu

Professor
Computer Science at ETH Zurich

Intel HERACLES: Homomorphic Encryption Revolutionary Accelerator with Correctness for Learning-oriented End-to-End Solutions

Dr. Rosario Cammarota

Senior Principal Engineer
Intel Labs

Design for Reliability: The origin of aging and degradation in advanced power modules and emerging state of health (SOH) estimation techniques

Faisal Khan

Chief Researcher, Power Electronics
National Renewable Energy Laboratory (NREL)

Real-Time Continuous Monitoring of Metabolites: Addressing Artifacts, the Elephant in the Room

Sanjiv Sharma

Senior Lecturer
Swansea University

Mid-Infrared Photonic Integration on InP

Mikhail A. Belkin

Professor of ECE and Chair for Semiconductor Technology
Walter Schottky Institute of the Technical University of Munich

Regularizing the Irregular

Milind Kulkarni

Michael and Katherine Birck Head
Purdue University

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