NC STATE

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Engineering

MAGAZINE SPRING / SUMMER 2023

IUU YEARS of the College of

of the College of Engineering at NC State

100 YEARS OF IMAGINATION AND INNOVATION

The College of Engineering celebrates its 100th anniversary in 2023, and we're looking back on a century of achievements.

The School of Engineering was officially founded on May 28, 1923. It started with the electrical engineering, civil engineering, physics, textile engineering and mechanical engineering departments. Over the ensuing decades, the physics department was moved to a different college, and the departments of materials science and engineering, industrial and systems engineering, chemical and biomolecular engineering, nuclear engineering, paper science and engineering, biological and agricultural engineering, computer science and biomedical engineering were added.

Engineering has been a core part of NC State University since it was founded in 1887 as the North Carolina College of Agriculture and Mechanic Arts.

associated with engineering in the NC State University Special Collections Research Center thought to be taken in 1923. The students are in Park Shops on North Campus. Named after Charles Benjamin Park, who was an expert machinist and superintendent of the shop for almost 50 years, the building was completed in 1914 and is now home to offices, distance learning facilities and a coffee shop. Mechanical engineering students used of white, male students. Lucille it for their shop classes, where they built machines and practiced skills they enroll in 1921, and **Katharine Stinson** were taught in classes.

The College of Engineering has changed and grown over the last



century. Today, the mechanical engineering department also includes Pictured above is one of three photos aerospace engineering. Students build rockets, put together supersonic wind tunnels and construct solar powered cars. Across the College's departments, research looks much different than it did 100 years ago. But just as their counterparts did, students became the first African American are still putting their knowledge into practice.

> Our understanding of who can be an engineer has changed. No longer is the school almost exclusively composed **Thomson** became the first woman to became the first woman to receive an engineering degree from NC State in 1941. In the two most recent incoming

classes, women have made up approximately 33 percent of students. Hardy Liston and Robert L. **Clemons** were the first African American graduate students to enroll in NC State in 1953, and three years later, Walter Holmes, Irwin Holmes, Manuel Crockett and Edward Carson undergraduate students at the University. All studied engineering. Today, organizations like the Women

and Minority Engineering Programs work to ensure a diverse student body by providing community building and engagement, academic support and professional development through several activities to ensure an inclusive environment for students.

Turn to page 20 for more.



To the moon

Christina Koch will be the first woman to fly to and orbit the moon as one of four astronauts selected for NASA's Artemis II mission.

Koch, who has a B.S. in physics and a B.S. and M.S. in electrical engineering from NC State University, spent 328 days in space in 2019-20, the longest continuous time spent in space by a woman. She also was part of the first all-woman spacewalk.

Artemis II will launch from Cape Canaveral in November 2024, with a 10-day mission of checking all systems of the Orion spacecraft and conducting a lunar fly-by to collect the necessary information for a moon landing in 2025. Koch will serve as mission specialist I.

Raised in Jacksonville, North Carolina, Koch has inspired and supported students who also dream of going to space. In 2019, she hosted a Q&A session from space with students from NC State, the North Carolina School of Science and Math. and other area schools. She returned to Raleigh earlier this year for an event at the NC Museum of Natural Sciences

"I'm happy to go to the moon carrying the banner of NC State electrical engineering and physics," she said in an interview with NC State News after NASA announced the crew. "Those two things – theoretical understanding and a hands-on approach to problemsolving – came together for me while I was there.

"I'm proud of that background. I love tinkering, working with tools and taking things apart. I've been told, though, not to mess with the spacecraft — unless asked." ■

As we've reached the end of the 2022-23 academic year, I am very pleased to let you know that your College of Engineering is as strong as it's ever been. Thanks to the outstanding efforts of our dedicated faculty members, students and staff members, we have rebounded extremely well from the many challenges faced during the pandemic. Combined with new commitments from our state legislature, the College is now on the cusp of a significant expansion. As we celebrate a century of achievements as part of our 100th anniversary this year, we can be as excited about where we are going in the years to come as we are proud of all that's been achieved so far.

Minh-Thu Dinh provides a great example of that bright future. An electrical engineering senior, last fall she received NC State's Leader of the Pack Award, which recognizes a student who has made outstanding contributions in leadership, scholarship and service. You can learn more about her in our Q&A. Other stories share how our researchers are working on the serious problem of microplastics and how electrical engineering alumna Christina Koch will be the first woman to travel to the moon as part of the Artemis II mission. The message in these stories is clear: as an NC State engineering or computer science student you will be afforded an opportunity to work on crucial problems faced by humankind, and as a graduate your degree is a platform that can carry you to any career goal that you want to achieve.

This has been the case for over a century. While engineering students were among the first graduates of our University, it was not until May 28, 1923, that a School of Engineering was established. We are celebrating this anniversary throughout this 2023 calendar year, with special events this spring and during Red and White Week this fall, Oct. 22-28.

As the College prepares for its second century, I will wrap up my time as its dean at the end of the summer. Let me just take this moment to reiterate what an immense honor and privilege it has been to serve as your dean for the last 17 years. Your generosity, enthusiasm, support and love for this College of Engineering have never ceased to amaze me. During these years, my wife, Maggie, and I have made so many close friends and have cherished memories of the many occasions and outstanding achievements we have been proud to celebrate with you. Please understand how crucial all of you, our alumni and friends, have been to the success of our College and how special you have made these years for us. For this and so much more we will always be sincerely grateful and in your debt.

Finally, I am very pleased to share with you that the provost has announced that Jim Pfaendtner, currently the chair of the Chemical Engineering Department at the University of Washington, will be starting his appointment as our new Dean of Engineering on Aug. 1, 2023. I leave you confident that with your steadfast support our College will continue to thrive under Jim's leadership and look forward to the heights to where this very special College of Engineering will continue to rise in its second century.

Dean

FROM THE DEAN



Louis A. Martin-Vega, Ph.D., NAE

NC STATE

Engineering

MAGAZINE VOL. XVII, ISSUE I

DEAN Louis A. Martin-Vega

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REDUCE, **REUSE**,

NC State researchers in the

Department of Chemical and

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CULTURE OF CARE

emphasis on wellness and mental

NC State and the College of

Engineering are placing an

studying the fundamental science

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waste.

health

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Dean Louis Martin-Vega leaves a strong legacy for NC State Engineering as he steps down from the dean position this summer.

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The College of Engineering celebrates 100 years since its official founding in May 1923.



ON THE COVER

Winston Hall, the first engineering building on NC State University's campus, opened in 1910. Fitts-Woolard Hall is the newest and opened in 2020.



What drew you to electrical engineering at NC State?

My dad used to be an engineering technician who specialized in fire alarm systems. He worked for my school district when I was younger, and he would always tell me the fun things he got to do at work, whether it was setting up the PA system or figuring out the fire alarm configurations, and it encouraged me to explore a career like that. I really wanted to prioritize a school that would allow me to explore electrical engineering and see which discipline I want to pursue within the major.

Why did you found the CRANE Collective at NC State, and how has it grown?

I co-founded it with a couple of my friends who felt like there wasn't an organization to address more complex issues within the Asian diaspora at NC State. A lot of what we do is geared toward community engagement. Last year, we had a workshop that discussed cultural grief, which is not something that you would commonly find in most organizations. But we also do more community-oriented events, like our headlining one, the Asian Artist Showcase. We always want to prioritize spaces and experiences that allow people to grow and allow our communities to become further engaged and be

comfortable while doing it.

Why is it important to you to explore Asian American historv?

I think there is not a lot of information that is known about Asian American history that I was able to discover. Not everyone needs to be passionate about ethnic studies, but even just finding out more about your own identity and those around you provides insight on how to improve your surrounding spaces and communities.

Why did you decide to apply for Leader of the Pack?

One of my roommates encouraged me to apply. I initially wasn't going to because I felt demotivated since a lot of my conceptions of Leader of the Pack were that you had to do NC State-specific things. But once I got more encouragement from my peers and even from the Goodnight Scholars professional staff, I decided to apply. I also wanted to recognize the Asian American efforts at NC State. I've seen it transform over the past four years into an amazing and evolving community, and I wanted to put that in the spotlight.

What was your most meaningful experience from your time at NC State?

One of my most meaningful experiences was through the

QUESTIONS FOR MINH-THU DINH

Minh-Thu Dinh, electrical engineering '23 and Goodnight Scholar, was elected the 2022 Leader of the Pack during Red and White Week. She co-founded the CRANE (Critical Asian Narratives and Engagement) Collective, which is an umbrella organization for Asian American organizations at NC State University. She will be working at Eaton Corporation after graduation.

Goodnight Scholars Program on the Mountains to Coast trip in March 2022. Students get to explore North Carolina and visit new sites, all while going to middle schools and teaching children about STEM through fun activities. On that trip, I made more meaningful connections with my peers, and I also gained a better sense of myself as a human. rather than someone who was just getting assignments done, because there was a strong emphasis on finding your identity as well as learning how you can help others. 🗖

PACK POINTS

Two NC State alumni head up Columbiaclass submarine program

"These are the most complicated devices ever imagined, engineered and operated by human beings. I'll put them up against the space shuttle any day."

ERIC SNIDER

The Columbia-class by the numbers

43-FOOT DIAMETER. 560 FEET LONG

DISPLACE 20,815 TONS WHEN SUBMERGED

CREWED BY ABOUT 155 PEOPLE

40-YEAR LIFESPAN

\$132 BILLION ROGRAM BUDGE FOR DESIGN AND CONSTRUCTION OF 12 SUBMARINES

84 MONTHS TO COMPLETE CONSTRUCTION OF FIRST SUBMARINI

3,500+ SHIPYARD PERSONNEL



BRANDI SMITH

DESIGNED TO OPERATE

826

undetectably at secret depths within the ocean, fueled by a nuclear reactor and armed with 16 missiles, the next generation of nuclear ballistic missile submarines is among the most critical components in the United States' defense strategy. The Columbia-class is the U.S. Navy's top acquisition priority, and these submarines will take over the role of the nation's sea-based strategic deterrent.

The development and construction of the Columbia-class are overseen by two NC State University College of Engineering alumni: Brandi Smith, mechanical engineering '02, and Eric Snider, nuclear engineering '86. Smith is the vice president for the

Columbia-class program at HII's Newport News Shipbuilding (NNS) division. Snider is the vice president of the Columbia program at General Dynamics Electric Boat (GDEB). Nuclear ballistic missile

RENDERING OF COLUMBIA-CLASS SUBMARINE BELOW THE SURFACE

submarines are the most survivable leg of the United States' nuclear triad, which is comprised of nuclear deterrent weapons and strategies on air, land and sea. The Columbiaclass will replace the aging Ohioclass, which have patrolled the oceans since 1981. These will be the largest submarines built by U.S. shipvards.

"These are the most complicated devices ever imagined, engineered and operated by human beings," Snider said. "I'll put them up against the space shuttle any day."

BRINGING A SHIP TO LIFE

Designing and constructing a new class of nuclear submarines requires intense collaboration and a wide array of expertise.

GDEB is the main contractor and has shipyards in Groton, Connecticut, and Quonset Point, Rhode Island. NNS, in Newport News, Virginia, is the subcontractor and specializes in the construction of the bow and stern. These are the only shipyards in the U.S. with the capabilities to build these submarines.

While the Columbia-class is similar in design to the Ohio-class, there are some key changes. It is the first class of U.S. submarines designed from the beginning to accommodate women crew members. Previous classes were modified after women were allowed to enlist in submarine service starting in 2010.

To make the submarines stealthier, they will be all-electric drive, rather than mechanical drive. Steam produced by the on-ship nuclear reactor will generate electricity that powers the propulsion motor. Each nuclear reactor will last 40 years without requiring a mid-life refueling, meaning submarines can be used for their full lifespans with minimal interruptions.

The Columbia-class was also designed digitally, and robotics and machine learning are making the construction process safer. Forty years ago, a person was tasked with going down 42 feet into a missile tube in high heat to weld the tube to the bottom of the submarine. Today, a robot takes care of it.

"Our shipbuilders look different today," Smith said. "When we talk about being all digital, that's not just about the design."

These shipbuilders include construction workers, engineers, electricians and data scientists. among other positions.

Together, shipbuilders are constructing the submarine in pieces. Six modules will be as near to complete as possible before they are closed up to form the full submarine at GDEB's shipyards. Since these submarines have such a long lifespan, designers also consider needs for updates and potential repairs, making parts that might need to be replaced easily accessible.

Like many industries, the shipyards have faced labor shortages and supply chain problems. But with the Ohio-class nearing the end of its lifespan, the Navy, GDEB and NNS are dedicating resources to meet their deadline. The future USS District of Columbia is slated to be completed in 2027, the year the first of the Ohio-class retires. It will then undergo years of testing before it is deployed in 2031. Work on the next Columbiaclass submarine has started and is expected to take 80 months. The 12 submarines will be in commission

through the 2080s.

A WAY TO GIVE BACK

Working on such an important project is rewarding and humbling to Smith and Snider - and collaborating with fellow NC State engineers is a bonus.

Smith grew up in Fayetteville, North Carolina, near Fort Bragg, and she started at NNS right out of college. She has the unique experience of working on the first ship of the Gerald R. Ford class of nuclear-powered aircraft carriers, and now on

PACK POINTS

the first submarine of the Columbiaclass. She was promoted to her current position in 2022.

"I saw building submarines and aircraft carriers as a way for me to give back to our nation by supporting the men and women who protect our freedom," she said. Snider, who is from Madison, North Carolina, enlisted in a Navy officer commissioning program during his sophomore year at NC State, and spent 35 years of his career in the Naval Nuclear Propulsion Program. He retired from the government in 2020, and he joined GDEB less than a year later.

"I feel very humbled to have been asked to lead this," he said. "In my heart. I believe that it is crucial to our existence as a nation that we all know and love."

Both Smith and Snider see many exciting opportunities in shipbuilding, especially considering the length of the project timeline and the many areas of expertise required to see each submarine to completion.

"Shipbuilding is a really cool industry to work in," Smith said. "The mission we have in support of this great nation can't be found anywhere else."

GENERAL DYNAMICS ELECTRIC BOAT WELDER MARIA BETANCE-PIZARRO WELDS THE INITIALS OF REP. ELEANOR HOLMES NORTON, WHO SPONSORED THE SHIP, ONTO THE PLATE TO BE AFFIXED TO A PLACE OF HONOR IN THE SUBMARINE.





Annual Red and White Week BBO celebrates College's achievements and future

ON THE SUNNY AFTERNOON

of Nov. 4, College of Engineering alumni with graduation years spanning decades drove past the Plant Sciences Building and Fitts-Woolard Hall — the newest additions to Centennial Campus — on their way to the Oval for the annual Homecoming BBQ.

"The word 'Homecoming' describes it. It's coming home to where we got the start of our love for what we do."

WENDY LAING

This was the first regularly scheduled Homecoming event for the College since 2019, after the special celebration to dedicate Fitts-Woolard Hall in 2021. Attendees commemorated the achievements of past graduates and current students while looking toward the future, as the College marks its 100th anniversary in 2023.

"We're celebrating Red and White Week and everything our College has achieved, but also a very bright future going forward," said Dean Louis Martin-Vega.

Many of the alumni in attendance were excited to revisit the campus and connect with graduates from other classes.

"The word 'Homecoming' describes it. It's coming home to where we got the start of our love for what we do," said Wendy Laing, B.S. and M.S. industrial

> engineering '90 and assistant executive director of NC State Industry Expansion Solutions.

The event began with speeches from students Hannah Dickerson, chemical and biomolecular

engineering '24, and Evan Merkel, electrical and computer engineering (ECE) '23

Dickerson expressed how she was able to find a home within the College that has given her the connections, relationships and knowledge necessary to succeed after graduation.

"Being part of the College of Engineering is about much more than being part of another community. It is about being a part of a living, breathing network of people who are able to support you academically, emotionally and

physically," Dickerson said. "It's about finding a home: a place where you feel safe enough to thrive, brave enough to make a mistake or two, and strong enough to rebound from those and persevere."

Merkel spoke about the research and extracurricular opportunities available at NC State that he never thought possible. For him, that includes creating a mentorship program to support ECE students and cultivating a community as vice president of the Embedded Machine Learning Club.

"[Alumni] like yourselves are the reason why the College of Engineering continues to thrive and people like me have the opportunity to do all these types of things," he said.

The BBQ luncheon was part of a series of events hosted during Red and White Week. Along with the Wilson College of Textiles, the College put on the first Pack Appreciation Day on Centennial Campus. Students wrote thank you notes to donors while enjoying ice cream at the Corner, the new outdoor social hub on Centennial. They also signed a large thank you card for Martin-Vega, expressing gratitude for his 17 years as leader of the College.

'A source of pride and motivation': 50 years of the PULSTAR Reactor

FOUR NUCLEAR REACTORS have

been built and operated on NC State University's campus, but none have been able to stand the test of time - except for the PULSTAR Reactor. This academic year, it celebrates 50 years of serving NC State's missions of education, research and outreach.

The PULSTAR Reactor is a 1-MW pool-type nuclear research reactor run by the Nuclear Reactor Program (NRP) and located in Burlington Engineering Laboratory on NC State's north campus. Since its completion in 1972, the reactor has supported NC State's faculty and staff members in education and research activities.

"Having this opens up the possibility of exciting new tools and research, especially with the reactor facilities being available nationally," said Ayman Hawari, Distinguished Professor of Nuclear Engineering (NE) and director of the NRP.

As a partner facility of the Department of Energy Idaho National Laboratory Nuclear Science User Facilities consortium, the reactor is accessible for other institutions across the United States. It is routinely used by the University of North Carolina at Chapel Hill, Duke University, University of Illinois Urbana-Champaign and the Massachusetts Institute of Technology.



THE PULSTAR REACTOR AROUND 1971, SHORTLY BEFORE ITS COMPLETION IN TIME FOR THE 1972-73 ACADEMIC YEAR.

Research and education are conducted using in-pool irradiation fixtures and through four beamport facilities powered by the reactor's core: a neutron imaging facility, a neutron powder diffraction facility, an intense positron beam and an ultra-cold neutron source. To increase the reactor's capabilities, three additional beamport facilities are being constructed. One facility will test the safety and performance of advanced nuclear fuel systems in relation to varying temperature and radiation levels. The other two facilities will test molten salts, or liquid salt, such as mixtures of fluorine, beryllium and lithium, that can directly cool

the core of the nuclear reactor and possibly fuel the reactor.

NC State students also make use of the facilities, in some cases running them. Getting students to the point of conducting research using the reactor or gaining licensure

to run it are a major benefit of the NRP. It provides students the skills necessary to be competitive for jobs and graduate school, and it serves as a huge selling point for prospective students.

"Working within the reactor is a 'cool factor' that inspires students to work within this field and attend our university," said Lisa Marshall extension assistant professor and director of outreach, retention & engagement for NE.

With new facilities under way and new generations of students preparing for exciting careers, Hawari anticipates the PULSTAR Reactor will continue to give students and faculty and staff members unique instruments that might not exist elsewhere, including the national laboratories.

"It is a source of pride and motivation," Hawari said. "And with these facilities, we hope to attract the brightest."

"Having this opens up the possibility of exciting new tools and research. especially with the reactor facilities being available nationally." AYMAN HAWAR

BME Grad

The

Podcast



A lasting resource for BME students and alumni - available wherever you listen to podcasts

NAVIGATING THE END of college

and the start of a career is tricky especially during a pandemic that cut off in-person interactions for months.

Out of these challenging circumstances came The BME Grad Podcast, co-hosted by recent alumni of the UNC/NC State Joint Department of Biomedical Engineering (BME). On the podcast, hosts and guests offer insights and advice on pursuing paths in the medical technology industry.

During the pandemic, it was especially helpful to BME students who missed out on networking opportunities and were struggling to figure out where they fit into the job market.

Allie Mitzak,

BME '19 and product manager at Teleflex, and Brian Kim, BME '19 and associate project manager at Stryker, are the current co-hosts.

"Our goal has been to create a resource for the BME community." Mitzak said. "That's at the front of our minds, to make this resource accessible and ever-growing."

Mitzak started hosting Zoom calls in 2020 with Grace Cronin, BME '19 and former co-host. to help students navigate their post-graduation challenges. After noticing some common themes and questions, the two started The BME Grad Podcast.

Kim was the guest on the first episode released in January 2021. He became a co-host of the podcast for its second season last April.

Episodes cover different early career paths available to BME students, share tips on interview preparation and feature graduate students talking about their master's and Ph.D. programs, among other topics. Some

guests are just a few years out of college. Others are established professionals in their fields.

"A lot of it was rooted in our auestions from when we were in undergrad, or our struggles," Kim said. "It was a way for us to share introspective thoughts to students who are currently living it in this moment, from a couple years down the line."

The podcast is reaching its intended audience: 75 percent of listeners are aged 18-27. While most listenership is in North Carolina, they have listeners across the United States. Biomedical engineering educators have told Mitzak and Kim that they're tuning in to better understand jobs students are starting.

"The things people are thanking us for in the show are exactly what we set out to do," Mitzak said.

BME faculty and staff members are supportive, and they have been featured on episodes and suggested guests for the show. Mitzak, a University of North Carolina at Chapel Hill graduate, and Kim, an NC State University graduate, were both drawn to the department because of the partnership between the two universities. Each was the other's closest friend from the other campus.

The BME Grad Podcast now has 50 episodes, and plans for the third season are in the works. Episodes are available on a variety of platforms, including Spotify, Apple Podcasts, Google Podcasts, Amazon Music and Audible.

Shuffling lab reports and sheet music: How



AFTER A LONG DAY of classes or a tough exam, some students might relax by watching a favorite TV show or going to the gym. For Hrishikesh Ram, chemical engineering and chemistry '25. sitting down at a piano bench for a few hours does the trick. Having this creative outlet is just as important to Ram as his studies.

Ram started piano at 4 years old at the Cary School of Music under the guidance of John Herrmann. As part of a trio with the NC Chamber Music Institute, Ram won an international competition in 2021 that resulted in an invitation to play at Carnegie Hall.

"It was an amazing experience, especially playing on their piano," Ram said. "It's often overlooked how a well-maintained piano can make you sound, and it responded so well to various motions I went through."

While Ram excelled in piano. he wasn't sure about making a career out of it. Coming to NC State University seemed obvious, as he

was interested in engineering and grew up just 15 minutes away in Apex, North Carolina. He selected chemical engineering because of its range of careers.

At NC State, Ram is exploring his interests in physical chemistry, fluid mechanics and thermodynamics, and he is pursuing a music minor to continue his formal piano practice. These studies keep him busy between lab research and recitals. Ram joined the lab of Phil

Westmoreland, professor in the Department of Chemical and Biomolecular Engineering, before his first year. As an undergraduate research intern, he assists Westmoreland in projects with the Environmental Protection Agency focused on the destruction of polyfluoroalkyl substances (PFAS), or "forever chemicals" commonly found in cleaning products, personal care items and other household items that slowly break down and release harmful chemicals into the environment.

"It's been a highlight of my time

here," he said. "I'm lucky to be part of such an impactful project where I can apply what I've learned so far while still having so much more to learn."

Meanwhile, Ram has continued to improve on his piano performance under the guidance of Olga Kleiankina, teaching professor of piano. He received the 2022 Performing Artist Award during the Fall 2022 Bowers Medal of the Arts and Student Award Ceremony held by Arts NC State.

"It's wonderful to see how the arts as a whole have such a thriving community of artists at a technicaloriented college," he said.

Ram plans to pursue a Ph.D. after graduation. Keeping piano in his life is certain, especially since he has role models who have continued to pursue music despite the direction of their careers.

"It's a fascinating journey having kept piano in my life for so long," he said. "It's definitely something I hope to keep alive no matter where l ao." 🗖

"It's often overlooked how a wellmaintained piano can make you sound, and it responded so well to various motions I went through." HRISHIKESH RAM

Technique offers new insight into how materials respond to stresses

RESEARCHERS HAVE DEMONSTRATED techniques

that provide unprecedented detail into how materials behave when exposed to a range of stresses. including shear stress. The work can inform the development of everything from new electronic devices to high-performance textiles.

"Whether you're developing electronic devices or textile applications, it's important to understand how the materials you are using will respond to various stresses," said Bharat Gwalani, an assistant professor in the Department of Materials Science and Engineering.

"We've demonstrated an in situ technique that lets us see how materials respond — at the nano-scale - when it is scratched, indented or experiences shear stress," he said.

Shear stress refers to stress that is applied in a direction parallel to the surface of a material, such as when one object is dragged across the surface of another object.

"We are also able to monitor changes in material structure and mechanical properties during high-strain, cyclical shear stress, which means the shear stress is being applied repeatedly." Gwalani said. "We commonly see cvclical shear stress when surfaces rub against each other.

And for all of these modes of stresses, we're getting site-specific assessments — meaning that we can see what is happening in the areas immediately adjacent to where the stress is being applied in near real-time."

Improving understanding of a material's mechanical characteristics under stress tells

designers precisely how the material will behave when exposed to those stresses. In simple terms, measuring "stress-strain" curves tells how much a material stretches. whether the material stiffens or becomes softer, and so on.

"Because these techniques are done in situ — meaning they can be performed without removing samples from the bulk material; and because we can see what is happening in great detail; and because all of this is happening in near real-time; we can also see how stresses affect the microstructure of the materials," he said. "For example, we can identify 'preferred slip planes,' or areas where the atoms in the material slide against each other when the material is deformed by stress.

"There are two significant advances here," Gwalani said. "First, this is the first time anyone has demonstrated the ability to collect this level of detail into mechanical responses to shear stress. Second, we are now able to see exactly how the microstructure of materials is responding to these forms of stress."

Previously, researchers could see what a material's microstructure looked like before and after these types of stress were applied. The new work means researchers are able to see what is happening to the microstructure of these materials throughout the process of deformation.

"There are obvious applications for this work in the fields of aerospace, automobile and ceramics engineering," Gwalani said, "We think there is also tremendous potential for these techniques to advance work in energy storage, textiles, semiconductors and geochemistry."

Marshall honored for service, teaching and research excellence

LISA MARSHALL has always felt at home in higher education. As the director of outreach, retention & engagement for the Department of Nuclear Engineering (NE), for 21 years she has championed values of service, teaching and research. In 2022, she was appointed the inaugural extension assistant professor in NE and was awarded the Social Responsibility in the Nuclear Community Award from the American Nuclear Society (ANS) — all while working on her Ph.D. in higher education at NC State University. She was also recently named vice president and president-elect of ANS.

Marshall grew up in Trinidad, the larger island of Trinidad and Tobago. Her family valued education and the pathways to success it could open. She took that value with her. and her desire to help generations of students realize their potential and reach their goals has fueled her purpose at NC State.

"I have the best job in the world

because I work with youth and young adults," she said. "There are so many students coming through our program who I'm still in contact with because of my approach to education."

In her new position, the first of its kind within the College, Marshall sees a chance to further develop departmental programming to help students understand how their education and training is valuable to the communities that they will work with.

"Being appointed to this position is a great honor," she said. "Nuclear education to me is an essence of modern society that is often unseen, but has clear implications to how we can live better."

Marshall's dedication to expanding understanding and participation within her field goes beyond NC State. She co-founded the Diversity and Inclusion in ANS Committee. She felt particularly honored to be recognized for that work, which she said is often



treated as an add-on but is a fundamental part of making sure all voices are heard.

"A legacy is being built where we are looking at what are our responsibility and privileges that we have, while considering who's not at the table or if there should even be a table," she said. "These are the types of questions we must ask ourselves for the betterment of nuclear engineering."

Marshall will graduate from her Ph.D. program in 2024-25. She has a concentration in opportunity, equity and justice, and her studies have supported her work to improve engineering students' success and grow the department.

"I've been fortunate to merge profession and education," she said. "The lines of education and engineering are blurred together and to be able to have this interdisciplinary approach to educating our students is a sweet spot for me as I finish my degree and continue my career."



Top recruit balances D1 baseball and engineering

MICHAEL GUPTON, first-year engineering student and outfielder for the NC State baseball team, has always loved to take things apart and put them back together.

Toys he received on Christmas morning were disassembled by the end of the day. He once even took apart his parents' washer and dryer.

"They weren't too happy about that," he said with a laugh. He did put the machines back together, with some help.

Gupton has also always loved baseball. He started playing at 3 vears old with his older brother. By the time he graduated from high school, he was the top-ranked player in North Carolina and had set an unofficial world record in the 60-yard dash, running it in 5.96

seconds at the 2021 Perfect Game National Showcase.

With these two skill sets, NC State seemed like the right fit. Gupton loved the school and had grown up watching Wolfpack basketball, football and baseball. He verbally committed to the baseball team as a freshman at Rolesville High School in Rolesville, North Carolina.

"It was a perfect place for me," he said. "It was close to home and has a great engineering department, which is something I wanted to go into, and of course, has a great baseball program."

Gupton is planning to major in civil engineering. To help balance his workload, he will take his more rigorous classes during the fall



semester, when he has a lighter baseball schedule

Navigating both engineering and collegiate baseball is challenging, but Gupton is already seeing improvement in his time management skills as he adjusts from high school to college. So far, he said, the transition has gone smoothly.

Nationally, Gupton is best known for his speed. Major League Baseball (MLB) uses the 60-yard dash to evaluate speed and acceleration. His time of 5.96 seconds is faster than times posted by current MLB players. In North Carolina, he is known as an all-around player. He had a .380 batting average in high school and was ranked the No. 10 outfielder in the U.S.

With the baseball season under way, Gupton said his goal is to be the best teammate he can be, and that this team has some of the strongest bonds he's ever experienced. His first time putting on the NC State uniform was an emotional moment for him after years of watching games from the stands.

"When we were standing out on the first baseline doing the National Anthem on Opening Day, it was just a really, really special moment for me," he said. "I felt really blessed that I had the opportunity to be here. I'm just really grateful for this whole thing."

Solar and (much) more: NC Clean Energy **Technology Center marks 35 years**

THE NORTH CAROLINA Solar

Center was established in 1987 as an outgrowth of the Solar House, an educational resource and laboratory on the NC State University campus designed to demonstrate how solar energy could power an individual home.

In the ensuing years, the center contributed to making the state a national leader in solar energy by helping to eliminate roadblocks to use. The center's staff trained the workforce needed to install and maintain solar power systems. They helped lawmakers understand the policy fixes needed to clear the way for implementation. And staff members taught local firefighters what they need to know about a new solar farm in their district.

As the solar energy sector has matured, the work has changed to include studying how aging solar panels can be safely disposed of and how to help consumers choose wisely when dealing with companies that want to install solar panels on their home.

Over the years, the center expanded its scope to many other areas of clean energy, including the transition to a smarter power grid, adoption of hybrid and electric DSIRE is the most comprehensive vehicles, green building and increasing electric generation from wind, biomass and other sources. Its name was changed to the NC Clean Energy Technology Center (NCCETC) in 2014.

No matter the technology, the center's role is to help speed up its implementation



through training programs, policy research, outreach and economic development.

"If you want to get something out of the lab and into the real world, odds are we are having a hand in it these days," said Steve Kalland, executive director of NCCETC.

Among the center's major roles is maintaining the Database of State Incentives for Renewables and Efficiency (DSIRE). Funded by the U.S. Department of Energy and run by the center since 1995, source of information on incentives and policies that support renewables and energy efficiency in the United States.

The center also hosts the annual State Energy Conference of North Carolina at the McKimmon Center on campus. Over the last six years, NCCETC has grown the conference said.

from around 400 to more than 900 attendees from a variety of backgrounds. Since 2017, it has also held an annual Sustainable Fleet Technology Conference & Expo to expand education, training and networking on advanced clean transportation technologies.

The center marked 35 years in December 2022, and the worry about possible impacts from climate change has made clean energy transformation a priority for leaders at home and abroad. NCCETC is perfectly positioned to continue driving that change and is adding fuel cells, fusion and hydrogen energy generation and small modular nuclear reactors to its research portfolio.

"A lot of new energy technologies are coming, and the role of the center is to move these new technologies forward," Kalland



TOP, LEFT TO RIGHT: DONALD BITZER, NATHAN CROOK AND AFSANEH RABIEI; BOTTOM, LEFT TO RIGHT: SINDEE SIMON, ZLATKO SITAR AND RICHARD SPONTAK

Two faculty members named **NAI** senior members

Afsaneh Rabiei, professor in the Department of Mechanical and Aerospace Engineering (MAE), and Zlatko Sitar, Kobe Steel Distinguished Professor in the Department of Materials Science and Engineering, were among the 95 emerging academic inventors named senior members of the National Academy of Inventors (NAI)

Rabiei leads research on the processing and characterization of advanced materials, metal foam, coatings and composites within the Advanced Materials Research Laboratory.

Sitar founded the Wide Band Gaps research laboratory that focuses on bulk and thin film growth and characterization and device development in wide bandgap semiconductors.

Established in 2018, this NAI fellowship is awarded to inventors who have made significant contributions within their disciplines. To be considered for election, candidates must be active employees, faculty members,

scientists or administrators with success in patents, licensing and commercialization that have resulted in technologies that have brought or have the potential to trigger real impact.

Crook receives NSF CAREER Award

Nathan Crook, assistant professor in the Department of Chemical and Biomolecular Engineering (CBE), received a National Science Foundation (NSF) CAREER Award for his proposal, "Enhancing Probiotic Yeast Colonization for Stable in Situ Biomanufacturing."

His project focuses on engineering *Saccharomyces boulardii*, a probiotic yeast, to reside for longer periods of time in the gut than it normally does by encouraging it to metabolize and bind to the sugars that line the interior of the human gut wall. This work has the potential to identify how fungi can colonize in the gut while also potentially producing drugs that help fight inflammatory bowel disease and C. difficile infections.

The NSF CAREER Award is one of the most prestigious awards in support of junior faculty members who exemplify the role of teacherscholars through outstanding 200 times. research, excellent education Spontak is considered by and the integration of education many engineering students and research within the and faculty members to be context of the mission of their organizations. They receive their funding over five years from NSF.

Spontak receives 2022 R.J. **Reynolds** Award

Richard Spontak,

Distinguished Professor in CBE, received the 2022 R.J. Reynolds Tobacco Company Award for Excellence in Teaching, Research and Extension in honor of his contributions to his discipline and his dedication to student mentorship.

Widely recognized as a global leader in nanostructured polymer systems, he has published 300 peer-reviewed publications, received six patents, given 350 invited talks and was featured on 21

FACULTY HIGHLIGHTS

international journal covers and one book cover. His impact is further quantified by over 14,000 citations and an h-index of 61, with 11 papers cited over

an outstanding mentor and instructor. This is due to his ability to create a welcoming environment where he exposes students to interdisciplinary research while enhancing their learning through introductions to world-class faculty members

Bitzer named a **Computer History** Museum **Fellow**

Donald Bitzer. Distinguished University Research Professor in the Department of Computer Science, was named a 2022 Fellow by the Computer History Museum (CHM) for his global influence and outstanding contributions in the field of computer science through pioneering online education and communities with PLATO (Programmed Logic for Automated Teaching

Operations) and co-inventing the plasma display.

The CHM Fellow Awards Program recognizes remarkable innovators for their notable contributions to the advancement of computing. This prestigious program exhibits the groundbreaking achievements of each Fellow and denotes their historical significance.

Simon elected **AAAS Fellow**

Sindee Simon, department head of CBE and Distinguished Professor, was elected a Fellow of the American Association for the Advancement of Science (AAAS).

Simon was elected for her transformational contributions to materials physics and chemistry, particularly for novel experiments and modeling of non-equilibrium behavior of glasses and the impact of nanoconfinement on phase transitions and polymerization kinetics

AAAS's Council chooses Fellows on the basis of their contributions toward the advancement of science and its applications, and candidates are nominated by their peers and undergo an extensive review process before selection.

Better than he found it



MARTIN-VEGA LEAVES STRONG LEGACY FOR NC STATE ENGINEERING

NINO MASNARI'S pitch was a compelling one.

NC State University's College of Engineering was one of the largest and most prestigious engineering colleges in the nation. Located in the technology-rich Research Triangle region, it was poised for even more growth. The College was a third of the way into a move to Centennial Campus, which was fast becoming one of the top academic/industry research campuses in the country. As Masnari prepared to step down after 10 years as dean, the College was looking for someone to take it to the next step.

When **Louis Martin-Vega**, who has been dean since 2006, tells the story of his interactions with his friend and predecessor, the punchline is always: "Nino," I asked. "If everything is so great, then why are you stepping down?"

The late Masnari helped bring Martin-Vega to NC State from his role as the engineering dean at the University of South Florida. During his time in Raleigh, Martin-Vega has helped the College take that next step, leading a period of significant growth in student enrollment and faculty size, national reputation, research productivity and diversity among its faculty and student body.

Martin-Vega will step down from the dean position at the end of the summer. With 17 years in office, he will leave nearly tied with **J. Harold Lampe** as the longest-serving dean of engineering at NC State. During his tenure, Martin-Vega served as president of the American Society for Engineering Education and was elected as a member of the National Academy of Engineering. The position he is leaving will continue to bear his name. Alumni **Jim and Ann Goodnight** established the Louis Martin-Vega Dean's Chair Endowment at the College of Engineering in 2022. "We couldn't have had a better dean than Dean Louie, in my opinion," said **Frank Culberson**, chemical engineering '60, a

"We couldn't have had a better dean than Dean Louie, in my opinion," said **Frank Culberson**, chemical engineering '60, a longtime member and former president of the NC State Engineering Foundation Board of Directors. "He did everything right, and the results show."

RESEARCH POWERHOUSE

Martin-Vega encouraged faculty members to compete for leadership of large research centers and emphasized growing the number of Ph.D. students and the College's research infrastructure to help support those efforts.

In 2008, the National Science Foundation (NSF) awarded a team led by NC State engineering faculty members the second Engineering Research Center (ERC) in the College's history. The FREEDM Systems Center is building a smarter power grid that can incorporate renewable sources. Four years later in 2012, NC State was awarded another ERC, called the ASSIST Center, for work building wearable and implantable health care monitoring devices powered by the human body. At that time, NC State became one of only two universities in the country to lead two ERCs at once and one of only two to ever be awarded the lead role in three.

to compete for phasized growing the "We couldn't have had a better dean than Dean Louie, in my opinion. He did everything right, and the results show." "I hope... that I am leaving [the College of Engineering] better than it was when I came here, better for the students, faculty and alumni, and for NC State"



The College has since led several other major research centers and it now routinely ranks in the top 12 colleges of engineering in the country in annual research expenditures.

Veena Misra, ASSIST director and MC Dean Distinguished University Professor in the Department of Electrical and Computer Engineering, recalls when she formed a team to submit an ERC proposal. Even though there were multiple proposals in the works from NC State at the time, Martin-Vega told her to push forward with her dreams and passion and that the best ideas would win out.

Over the more than 10 years of ASSIST, Martin-Vega has been a tireless promoter and advocate for the center but also honest and insightful with his feedback and guidance.

"He has been really behind the scenes, but also in front of the scenes," said Misra. "Louie has been a full partner in ASSIST."

After Engineering Buildings I, II and III were completed, plans for finishing the move to Centennial with a fourth and fifth engineering building were stalled by the 2008 recession. To keep moving forward, Martin-Vega committed the College to raise \$60 million in private philanthropy to help fund construction of the next engineering building. It was a major departure for a campus in the University of North Carolina System, where capital projects had traditionally been funded entirely by the state. Finally, in 2020, Fitts-Woolard Hall opened its doors, and eight of the College's nine academic departments had moved to the new campus.

BROADENING PERSPECTIVES

As dean, Martin-Vega has prioritized increasing the number of women and members of groups historically underrepresented in engineering and computer science among the student body and the faculty. Not doing so would be a detriment to the College, he said.

"You're missing out," Martin-Vega said. "Lack of diversity means that you're missing out on opportunities, you're missing out on perspectives."

When Martin-Vega arrived, the faculty was only 5 percent women, a percentage that has now grown to over 35 percent. Also, a woman had never served as head of any of the College's departments. Three of the College's nine academic departments are now led by women, and the College has had a total of four under his leadership.

Not surprisingly, the enrollment of women students has also grown significantly, with more than a third of the incoming first-year cohort female and with some programs enrolling as many or more women students than men.

This broadening of diversity in the College has also led to improvement of the educational experience for all students. **John Gilligan**, the College's executive associate dean, said that working with the UNC System

and the University to implement premium tuition for some departments and an enhancement fee for undergraduate students were major achievements.

The cumulative effect of these efforts has significantly increased the College's national and international reputation. The College increased its spot in *U.S.*



News & World Report rankings of graduate engineering programs from 35th overall to as high as 24th overall and 12th among all public colleges of engineering.

"Louie has done tremendous work as dean of engineering," said **Randy Woodson**, chancellor at NC State. "He's made this College much stronger in a number of key areas, from research and alumni engagement to diversity and national reputation, all while keeping student success at the forefront of everything that the College does. We are so proud of what he has achieved and wish him the best in what comes next."

ENERGY FOR ENGINEERING

Colleagues describe Martin-Vega as an excellent communicator who is able to ask the right questions and quickly size up a situation. Misra calls him "a strategic genius."

He is especially known for his warmth and gregarious personality. As dean, he has rarely missed an invitation to interact with faculty members, students or alumni, often with his wife, Maggie, at his side.

"He gets energy from other people, and he gives energy back," Gilligan said.

While he didn't initially feel a calling to be a dean, Martin-Vega said, he did know from a young age that he would enjoy a career in academia. What he always knew he really wanted was to make a positive difference, wherever he was, by serving others and helping to facilitate their success and make their important ideas a reality.

"My goal has always been to leave whatever unit I am privileged to lead in a better state than when I arrived. I hope this has been the case for the College of Engineering at NC State; that I am leaving it better than it was when I came here, better for the students, faculty and alumni, and for NC State," Martin-Vega said of his tenure. "It is now time for someone else to keep building on what we have accomplished, and I am confident that this will be the case." A century ago, in 1923, what was then the North Carolina State College of Agriculture and Engineering of the University of North Carolina formally established the School of Engineering.

Over the next 100 years, tens of thousands of students have forged their paths and had their lightbulb moments. Faculty members have mentored the next generations of engineers and computer scientists while making research breakthroughs that would have been unimaginable in 1923.

Alumni have made their marks on the world, through brilliant breakthroughs in their fields, inspiring others to pursue engineering and computer science, and more.

Today, the School of Engineering is known as North Carolina State University's College of Engineering. A lot has changed over the last century, but throughout those years one thing has remained the same: NC State engineers and computer scientists are imaginative and innovative, leading the way to a better future.

IMAGINATION **+INNOVATION**

The College of **Engineering has** accomplished a lot in 100 years. The full timeline is available at ENGR.NCSU. EDU/100-YEARS. Join our College of Engineering (COE) in celebrating this milestone, and help us prepare for the next 100 years. All information will be shared at ENGR.NCSU.EDU/100-YEARS.

- . Oct. 22-28.



FEATURES

 We want to celebrate you, too. Share your story of Imagination and Innovation by filling out the form at GO.NCSU.EDU/ YOURCOESTORY, or share photos and memories on social media using the hashtag #NCStateEngr100.

 Follow along on social media as we share stories of our College's early days, trailblazing women and minority engineers, outstanding alumni, state-of-the-art facilities, research accomplishments and more.

Alumni, faculty and staff members, students and friends gathered on May 3 to mark the 100th anniversary. PBS North Carolina debuted a preview for a video series highlighting the College of Engineering and its century of achievements. Stay tuned for more festivities during Red and White Week this fall,

A HYDRAULICS LAB IN THE 1920s COMPARED TO A HYDRAULICS LAB IN 2022.

IMAGINATION -INNOVATION

100 YEARS The College of Engineering

1920s

1923



The School of Engineering was officially established. Wallace C. Riddick became the first dean. At the time, the school consisted of what are now the **Departments of Electrical** and Computer Engineering; Civil, Construction, and **Environmental Engineering;** Textile Engineering: and **Mechanical and Aerospace** Engineering (MAE), as well

as the Physics Department.

1929

The School of Forestry was established, and in the following years, the Wood Products and Paper and Pulp Department was created. It is now called the Department of Paper Science and Engineering.

1930 What is now the



Industrial and Systems Engineering was established, according to the spring 1930 course catalog.

1945

J. Harold Lampe became the school's fourth dean. He served for 17 years.



NC State became the first university to develop a nuclear engineering curriculum, now the Department of **Nuclear Engineering**

Frances M. "Billie" Richardson became the first woman to be on faculty in the School of Engineering at NC State.

1910s

1910

Winston Hall opened. It was the first building primarily devoted to engineering activities.





1921

Lucille Thomson was the first woman to enroll in engineering. With an interest in radio, she enrolled in electrical engineering. There are conflicting accounts about if she graduated or not in 1923.

1924

The Ceramic Engineering Department was created. Along with Mining Engineering (1925), and Geology (1927), these departments were precursors to the **Department of Materials Science** and Engineering.

1930s

1937

The school established more departments: what are now the **Departments** of Chemical and **Biomolecular Engineering** and Agricultural and **Biological Engineering**, as well as Math, Architectural Engineering and Geological Engineering.

Blake Ragsdale Van Leer

became dean. He served until 1942, when he left on military leave.

1940 The Department

1940s

of Aeronautical Engineering (now MAE) was established

1941

Katharine Stinson became the first woman to receive an engineering degree from NC State (B.S. mechanical engineering with aeronautical option), according

to some records. She was later the first woman engineer hired by the **Civil Aviation** Administration.

1944

The NC State Engineering Foundation, Inc. was created to foster and promote ways of improving and developing engineering in North Carolina.

1953 The first on-campus nuclear reactor, R1, was completed. NC State was the first university to build and use a reactor for educational purposes.

The first African American graduate students enrolled at NC State: Hardy engineering and FEATURES

1956

Walter Holmes. Irwin **Holmes** Manuel Crockett and Edward Carson become the first African American undergraduate students to attend NC State.

Hervasio Guimaroes de Carvolho received his Ph.D. in nuclear engineering. He was arguably the first Hispanic student to receive a Ph.D. from NC State.

1960

Irwin Holmes was the first African American man to receive a bachelor's degree from NC State. He was also the first **African American** athlete at NC State and was captain of the tennis team.



1962 Ralph E. Fadum was

named dean. He served as dean until 1978.

1950s

1957

professional

engineering.

Robert L. Clemons became the first **African American** man to receive a degree from NC State, when he received a

degree in electrical

1967

The Department of **Computer Science** was established.

1960s

Anna Clyde Fraker

became the first woman to receive a Ph.D. in engineering at NC State (ceramic engineering). She was the first woman to receive an advanced engineering degree of any kind at NC State in 1961





Liston in mechanical Robert L. Clemons in electrical engineering

IMAGINATION *HINNOVATION*

100 YEARS The College of Engineering

1978

NC State was running the largest minority engineering summer programs in the nation after only five years of recruiting and fundraising efforts.

Larry K. Monteith became dean until 1989.

1989 **Christine Grant**

1980s

became the first African American woman hired as a faculty member in the College.

1998 The Women in

1997

Engineering

Program was

established.

A 2+2 program was established with the University of North Carolina at Wilmington.

Louis A. Martin-

2006

Vega became the first Hispanic dean at NC State (see page 16).

2000s

2003

The Industrial

Extension Service,

Williamston, North

established.

2004

Craven Community College's Havelock campus became part of the 2+2 program.

2008

NC State was awarded the Future Renewable **Electric Energy Delivery** and Management (FREEDM) Systems Center, a National Science Foundation (NSF) Engineering Research Center (ERC)

2009

was named head of biomedical engineering, becoming the first woman named as a department head in the College.

1970s

1975 **Hubert Winston**

became the first **African American** man to receive a doctoral degree in chemical engineering. He also became the first **African American** faculty member in the College of Engineering



1982

George Bland became the first African American man appointed as an assistant dean (undergraduate student services) and as an associate dean (undergraduate programs, 1985).

1979

Sarah A. Rajala

became the first

woman to be

a Ph.D. faculty

member in the

College.

The first 2+2 program was established with the **University of North Carolina** at Asheville. Students complete their first one or two years in Asheville, then

transfer to NC State.

The College established the Minority Engineering Programs.



1987

The School of Engineering changed its name to the College of Engineering

1988

The Department of **Computer Science**

was transferred to the College of Engineering from the College of Physical and Mathematical Sciences.

1996

1990s

The College offered the state's first online, real-time, distanceeducation class.

Sarah A. Raiala

became the first woman to be named an associate dean in the College.

Nino Masnari was

named dean. He led the start of the College's move to **Centennial Campus** until he stepped down in 2006.

2002

now Industry The formal **Expansion Solutions** groundbreaking (IES), celebrated for Engineering the grand opening **Building I** of its first countytook place on funded extension Centennial office, which is in Campus.



2007

The Golden LEAF **Biomanufacturing Training and Education Center** (BTEC) opened, a unique center offering educational and training opportunities to develop skilled professionals for the biomanufacturing industry. BTEC is a major draw for biomanufacturing companies to come to North Carolina.

FEATURES



Engineering North Carolina's Future, a state legislative initiative, was announced, ushering in an unprecedented period of growth for the College



in response to the state's need for STEM graduates.

Nancy Allbritton

2021

NC State was awarded the **Science and Technologies** for Phosphorus Sustainability (STEPS) Center to improve phosphorus sustainability, funded by the NSF.

2010s

2020s

2012

NC State was awarded the Center for Advanced Self-**Powered Systems** of Integrated Sensors and **Technologies** (ASSIST), making the university at the time the only institution in the nation with two

active NSF ERCs.

2020

The move to Centennial Campus took a major step forward with the opening of Fitts-Woolard Hall. Eight of the nine departments have relocated, with nuclear engineering remaining in Burlington Labs along with the nuclear reactor.



NC State University researchers are studying the fundamental science behind how to address plastic waste

> AN ILLUSTRATION OF THE SELF-SUSTAINING, CIRCULAR SYSTEM OF "MICROCLEANERS." THE SOFT DENDRICOLLOIDS (ORANGE) ARE FUNCTIONALIZED WITH PEPTIDES THAT BIND TO THE COLORED MICROPLASTIC PIECES. THESE MICROPLASTICS ARE THEN CONSUMED BY ENGINEERED MICROBES (GREEN) TO BE USED AS FUEL OR TO BE MADE INTO MORE

MICROCI FANERS

FEATURES

REDUCE, REUSE, RECYCLE

Plastic waste is found almost everywhere on Earth. Public service announcements about how to reduce plastic consumption — skip the straw, the reusable bag and water bottle movements — are also almost everywhere. These are small ways people can use less single-use plastic in their own lives. But big questions remain, like how to collect plastic waste that is creating environmental health problems? What's the most effective way to recycle plastic? And how many different kinds of plastics are out there?

"Worldwide, it's recognized that these are useful materials," said Phil Westmoreland, professor in the Department of Chemical and Biomolecular Engineering (CBE). "We can do things with polymers that we can't do with other materials. The idea of using plastic still makes a lot of sense. The idea of using it once and throwing it away has a naive sort of attitude: 'I don't know where it came from, I don't care.'"

Ideally, each piece of plastic ever produced, even the microplastics contaminating the oceans, can be reprocessed and made into something else that's useful — "the circular economy." But behind this well-known concept, as well as the common solution "reduce, reuse, recycle," is the complicated, fundamental science of studying these materials and their reactions to different collection and recycling methods, and the need to figure out how to scale up solutions to meet this growing problem.

Re-making polymers

Plastics are made of polymers, and there are many different types that require different methods to be broken down. Plastic bags are made of polyethylene, while Styrofoam cups are made of polystyrene. Polypropylene is used for fibers and plastic bottles, and polyester is commonly used in clothing. These, and many others, are used daily. Each polymer has different chemical properties, meaning each requires slightly different recycling methods.

One common plastics recycling method is pyrolysis, the thermal degradation of plastics at temperatures ranging from 250 to 900 degrees Celsius RMD predicts the movements of each in an oxygen-free environment. The plastic is converted to liquid fuel. The gases that come off the thermally decomposed polymers are used to make new polymers. Westmoreland has conducted research in this space for 30 vears.

Mechanical recycling generally leads to products made from recycled plastics methodologies behind pyrolysis, and that are designed to be thrown away or recycled again.

"Re-making the materials that you make polymers from is much more appealing as a circular economy," he said. "You make it, use it, reconstitute it fresh."

Figuring out the best way to do this involves experimental and theoretical work. At NC State University, Westmoreland's lab decomposes different polymers using fast pyrolysis and slower, thermogravimetric analysis, which continuously measures the mass



of the polymer while it is thermally decomposing. They measure the products and the decomposition rates to see which reactions are taking place and at what temperature. In parallel, they have successfully predicted these decomposition rates and mechanisms using computational quantum chemistry and a reactive molecular dynamics (RMD) method they created.

To model reactions in a polymer melt, of the individual atoms within each of the polymer molecules. The key is computing the forces between every atom and molecule at every time step, and then applying Newton's second law of motion to predict their new positions and velocities.

There are other approaches and Westmoreland is looking at induction and microwave heating to break down the materials. These can be powered by greener energy sources, such as solar and nuclear. The project started at Savannah River National Lab, focused on plastic film used in packaging, and is continuing at NC State.

"You can take a polyethylene bag, do treatment of it, generate ethylene, which then can be reacted again to make new polyethylene," he said. "These materials are so useful that it's a waste to dispose of them if you can use them again."

Open-ocean filtration

Another facet of the plastics problem is collecting the pieces that are already in environments where they shouldn't be. Plastic pollution in the world's oceans is especially concerning. As larger plastics have broken down, they've become microplastics. which are plastic pieces less than 5 millimeters long. These are becoming a threat to human and wildlife health.

In CBE, Carol Hall, Worley H. Clark, Jr. Distinguished University Professor in Engineering, is the principal investigator (PI) on a project focused on developing a self-sustaining, circular system of "microcleaners" that remove functionalized with peptides. Hall is microplastics from the ocean. Orlin lev, S. Frank and Doris Culberson Distinguished Professor, and

Crook, assistant professor, are the co-Pls. The team is working with researchers from Cornell University on artificial intelligence (AI) capabilities to accelerate the process.

societal problem," Velev said. "There is quite a bit of interest in doing research are consumed by the engineered that highlights the fundamental aspects microbes to be used as fuel or to be that would allow us to solve this problem."

hope that by answering these Innovation program.

The fundamental questions that the researchers are trying to address include: What are the particle interactions between the plastic and microcleaners? What material is best and safest for creating microcleaners? How can we engineer microbes to consume the plastic? And how can Al scale up and optimize the process? The microcleaners will be made of soft dendricolloids that will be studying the interactions between the plastic particles' surfaces and peptides to design peptides that best bind to plastics. Velev's lab has developed new can be applied, and challenges include materials called soft dendricolloids, which are fibrillar with a large surface area; they collect the microplastics, ball up and then float to the surface along "It's an important environmental and with the microplastic waste.

> At the next step, microplastics metabolized in a way that produces more microcleaners. While there is



The work will be published in the open literature, and the researchers fundamental questions, others will be able to advance their work on plastic waste removal. It is funded by a grant from the National Science Foundation's faster. Emerging Frontiers in Research and

one species of bacteria known to consume plastic, it does so extremely slowly. Crook is trying to take genes from this organism and put them into a fast-growing bacterium to create an organism that could consume plastic

To make this process sustainable, the researchers will make these microcleaners from naturally occurring polymers. They are exploring chitosan, which is derived from crab shells.

"The hope is that when you feed the microplastics to the microbes, the microbes would then shuttle that energy to construct chitosan or another polymer, which can be used in the same way," Crook said. "Then you make more cleaners using the plastic you've collected."

The circular economy concept behind using the waste to collect more waste will be supported by AI. But there is still a long way to go before these concepts the lack of a one-size-fits-all approach, as different types of plastic particle surfaces will have varying interactions with the microcleaners.

"Every step is a challenge," Hall said. "We are now trying to assemble the pieces and make each of them work well. Down the road, we will weave the pieces together into a system that hopefully will make a difference."

University and College place an emphasis on wellness and mental health

cultu

Tragedy has struck NC State University and the College of Engineering during the 2022-23 school year. Fourteen students died during the academic year, including several in the College of Engineering.

Like many higher-ed institutions, NC State is working to support students and faculty and staff members through what the American Psychological Association has called a mental health crisis on campuses.

The University has inserted wellness days into the calendar. Classes are canceled and faculty members are asked to refrain from deadlines, while students are encouraged to rest and engage in activities that help them recharge. In addition to the NC State Counseling Center, which provides online and in-person services, as well as group therapy, the University has partnered with community providers and enlisted the help of other University of North Carolina System schools to expand counseling services for students. NC State has also invested nearly \$400,000 in a partnership with AcademicLiveCare, a teletherapy provider, to provide free online counseling appointments for students.

Health Task Force, which issued a report Centennial Campus, where eight of the during the spring 2023 semester that offers short-term and long-term actions to help improve student mental health.

Meanwhile, the College has added two "embedded" counselors located closer to its students in hopes of making scheduling and attending sessions more connected with the College's student convenient. It is also implementing other programs to encourage students to reach out when they need help and to comfortable. support each other.

With current efforts, the College is focused on creating a culture of care where students feel as if they are seen and heard and that they have a community of support.

The reasons for this mental health crisis are complex, campus leaders say, but the disruption caused by the pandemic played a large part.

"As a society, we have to realize that this took a big toll," said Angela Harris, an assistant professor in the Department of Civil, Construction, and Environmental Engineering who has done work on student mental health during her career and is implementing new techniques in her classroom. "We are going to be dealing with it for a long time."

COMFORTABLE AND **CONVENIENT**

The Counseling Center has added a total of six new therapist positions embedded within NC State colleges this academic year. The two in the College of Engineering, Miranda Liu

NC State has created a Student Mental and Hannah Lavasque, are set up on College's nine academic departments are now located. Students can make appointments or take advantage of weekly drop-in hours. Hopefully, Counseling Center Director Monica Osburn said, as the two become more population, students who may be hesitant to ask for help will become

> That's also the idea behind other College efforts, the Share Your Heart Campaign and the Safe With Each Other / Safety Pin Crew. Share Your Heart allows students to let a group of staff and faculty volunteers within the College know how they are doing and if they need support. Students are asked to put "Share Your Heart" in the subject line of an email and send it to a staff/ faculty list so that someone can follow up. The Safety Pin Crew is a team of staff and faculty volunteers who wear a gold safety pin that signals they are available to talk with those who are struggling, feeling alone, feeling ignored or unheard, having trouble with a class, or simply want to chat with another member of the College of Engineering community. The Safety Pin Crew is deploying across campus during the semester to do in-person check-ins, and to offer a snack and encouragement as students navigate their day.

In February, the College offered two days of Mental Health First Aid training for staff and faculty members and an event on the University's Feb. 16 wellness day where students were invited to come bond with professional staff, snack and chat. The event was scheduled for two hours. It lasted for five.

MISSED TIME

The Counseling Center's staff has more than doubled in the last few years, reflecting growing issues amongst the University community that were exacerbated by the pandemic.

Most of the issues reported by the center's clients are related to depression, anxiety and personal relationships. While the center's professionals sometimes refer students out for longer-term treatment, most of the time they can help them develop the coping skills that they need to be successful and move forward in a few interactions.

For many of us, Osburn said, the pandemic greatly affected our ability to develop those skills. That's especially true for young people, who learn much of this in high school and college or the workplace and who missed out because of the isolation during the worst of the pandemic.

Making up for that lost time will be difficult, but teaching students how to reconnect as they navigate a rigorous academic program during unprecedented times is part of the College's current efforts, said Ar Daniel, the College's assistant dean for diversity, equity and inclusion. Particularly important is watching for what Daniel calls "transition times" such as spring break or the end of a semester, when students who are having trouble connecting may feel particularly alone.

Without this help, it becomes harder for students to thrive once they have completed their NC State degree.

"The reality for students is that you have to develop these coping strategies as you move into the corporate environment," Daniel said.



HOME REPAIRS



Revitalizing a small North Carolina town is a passion for Ed and Deb Fitts

academic department in the College. It's also becoming a familiar name in his hometown of Littleton, North Carolina, where Fitts and wife, Deb, have undertaken the kind of revitalization that so many rural communities across the nation dream of and need. The goal is to help eliminate the kind of generational poverty that is endemic to so many small towns. Fitts graduated from NC State in 1961 with a degree in industrial engineering. After buying part of his employer's carton division and turning it into an industry leader called Dopaco, Fitts sold the company in 2004. He and Deb then turned their attention to a Napa Valley winery and now to the small town in northeastern North Carolina where he spent most of his childhood. At the same time, he has focused on supporting NC State, helping move the College and his home department forward through leadership and philanthropy. In the span of a few years, the Fittses have remade Littleton's Main Street by adding a coffee shop, wine

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"What we are trying to do is add to the town... Add value. Add opportunities." DEB FITTS

The name Ed Fitts is likely a familiar one to students, faculty and staff members, and alumni of the College of Engineering.

The newest engineering building on NC State University's Centennial Campus, Fitts-Woolard Hall, bears his name. So does the Edward P. Fitts Department of Industrial and Systems Engineering, the first named



store and restaurant, have opened a private school in the dilapidated high school where he graduated, connected downtown to the rest of the world with free wireless access and helped to rehab local housing. There are plans for an outdoor amphitheater, a brewery and more.

The focus will be on what Littleton and its residents want to see. Since taking up the effort, the couple has worked with residents to help the town thrive.

"What we are trying to do is add to the town," Deb Fitts said. "Add value. Add opportunities."

CHIPPING IN

Much as he did with NC State, Ed Fitts stayed in touch with Littleton as he built a career.

He and Deb chipped in to help fund town projects, like planting crepe myrtles or improving the local library, and they came back for reunions with his former classmates at houses on nearby Lake Gaston.

It was during one of those get-togethers that the couple was approached with a bigger ask. The old high school, which had been turned into a performing arts center, was in terrible shape. One of his classmates asked for help paying off a loan taken to repair the building.

"There was a hole in the roof," recalls Deb, a Philadelphia native trained in statistics at Penn State University. "The walls were falling in. It was a disaster. That was the beginning of it." The Fittses had sold their winery in 2019 and were looking to move on to a new endeavor. The couple, clearly a team, like to bite off more than they can chew and then figure out how to chew it.

"We don't know what we can't do," Ed said during an interview in Littleton in 2022, looking over at his wife with a sly grin.

That investment in the Lakeland Cultural Arts Center soon led to others. Starting on Main Street.

A TRIBUTE TO DAPHNE

Ed Fitts' mother, who passed away 20 years ago at the age of 87, was a practical nurse who also painted portraits of townspeople to help make ends meet. She moved Ed and his older brother, also an NC State engineering graduate, to Littleton from Macon, North Carolina, when Ed was 5.

"She was so frugal," he remembers. "She could stretch a dollar further than anyone you ever saw."

When Ed and Deb bought a row of 100-year-old buildings along Main Street, one that had been used as a garage for 65 years was full of 40,000 pounds of junk that had to be removed. Folks in town had mentioned a desire to have a place where people could gather. Ed and Deb decided to pay homage to Ed's mother, and Daphne's Coffee Shop was born.

Next door, the Blue Jay Bistro provides patrons with quality crafted cocktails and meals that rival any city's 5-star restaurant. Main Street Wines offers Littleton and lake residents a selection practically unheard of in a rural North Carolina setting and hosts tastings once a month.

Chef Ashleigh Fleming oversees it all. A veteran of the restaurant business who was looking for a change, Fleming was attracted to a life in Halifax County by an opportunity to build a restaurant environment that is welcoming to all and to better use her skill set.

The crown jewel is Littleton Academy, a K-6 private school in that formerly ruined school building that brought Ed Fitts home. Out of 54 students enrolled in fall 2022, 52 were on scholarship. They enjoy a curriculum that is heavy on learning job-ready skills and providing experiences that most children in a rural setting don't have access to.

CORNERSTONE

Ed had been to Raleigh exactly once — for a field trip — when he enrolled at North Carolina State College and moved into Tucker Dormitory. After graduation, he worked for 18 years for Sonoco Products Company, which eventually sent him to Pennsylvania to run its carton division. When Sonoco wanted to divest itself of that business, he sold two plants and bought the third one himself. Fitts founded Dopaco in 1979 and when he sold it in 2004, it was the number-one fast-food packaging producer in the world.

When he turned his attention to the Department of Industrial and Systems Engineering, the goal was to make it one of the country's top five departments in national rankings. Fitts endowed his first scholarship in industrial engineering in 1999 and his first professorship in the department in 2002. But he had plans for something bigger.

In 2005, he donated \$10 million to NC State and the Edward P. Fitts Department of Industrial and Systems Engineering became the first named academic department in the University's history. Several years later, he and fellow industrial engineering alumnus and former DuPont CEO Edgar S. Woolard donated a combined \$25 million toward the College's newest engineering building on Centennial Campus, and the University named it Fitts-Woolard Hall.

As with Littleton, Fitts has supported NC State to give back to a place that he says has given so much to him.

"I've always attributed NC State as being the cornerstone of my career."





Three receive **Distinguished Engineering Alumnus award**

WINNERS OF THE DISTINGUISHED ENGINEERING ALUMNUS AWARD FOR 2022, FROM LEFT: QUINT BAREFOOT, DAN PLEASANT AND MARK WYATT.

Three College of Engineering alumni - Quint M. received the Distinguished Engineering Alumnus (DEA) award during a dinner and ceremony on campus on Nov. 2, 2022, as part of Red and White Week.

The award was established by the College's faculty in 1966 and is the highest honor bestowed upon alumni.

Quint M. Barefoot received his B.S. in chemical engineering in 1985 and his MBA at Duke University in 1996.

After engineering school, Barefoot joined Four Seasons Environmental Inc. and led the company from less than \$1 million in annual revenue to \$42 million employing over 280 personnel in six offices when the business was sold to Great Lakes Chemical Corporation. He continued as president, leading the firm as a division of a publicly traded company and expanding to 16 offices with over 500 employees.

He was a founder of Monosep LLC, started in 2001 to provide water treatment systems to the energy sector. The company is now integrated into Siemens Water Technologies. Barefoot then started Zappa-Tec LLC, a polymer converting business focusing on super absorbent polymer compounds used in telecommunication products, energy applications and medical devices. The business was acquired by Chase Corporation.

He is the CEO of Info-Gel LLC, which produces thixotropic gels for the fiber optic industry.

Dan M. Pleasant earned B.S. and M.S. degrees in civil engineering in 1973 and 1974, respectively. He has spent more than 50 years in the consulting engineering profession.

Pleasant has held several key positions with Dewberry since managing the startup of an office in Danville, Virginia, including southeast division manager, and president of Dewberry Engineers Inc., a Dewberry Company of 1,800 employees. In 2010, Pleasant was named chief operating officer. During his tenure, he helped direct the company through significant market segment growth and expansion. He also managed the acquisition of seven companies. In April 2022, Pleasant

transitioned into a consulting role. He continues to guide critical initiatives for Dewberry, and he is also active with Dewberry's clients, serving as an executive client manager for several strategic clients.

Pleasant has a long history of volunteer and board service, and he is an advisory board member for the Department of Civil, Construction, and Environmental Engineering.

Mark D. Wyatt received a B.S. degree in computer science in 1980. He retired from Duke Energy in 2013 with 34 years of senior management and utility experience. Wyatt served as vice president of grid modernization, where he was responsible for delivering enhanced operational efficiencies for the company's transmission and distribution system, as well as providing a platform for growing the company's revenue through leveraging grid modernization investments to provide value-added products and services to the company's retail customer base.

Wyatt started with Duke Energy in the information management department. He moved to the distribution department several years later. Following this assignment, he experienced a series of promotions within the company in the retail customer services, transmission, distribution, generation, unregulated business operations and information technology areas.

Wyatt has been a member of numerous boards throughout his career, including the Computer Science Strategic Advisory Board and the NC State Engineering Foundation Board of Directors.



Before this year, the College of Engineering's best Day of Giving was 2021. That day ended with \$6.1 million from 1,615 gifts. Now, the College has a new goal to beat in coming years: \$6.5 million from 1,661 gifts.

Thanks to an outpouring of community support, the College finished in second place for most gifts received during the 2023 Day of Giving.

This groundswell of gifts ensured that the departments met their challenge goals. The Department of Civil, Construction, and Environmental Engineering (CCEE) finished the day atop the departmental leaderboard with 283 gifts and met a challenge from the department's advisory board to unlock an extra \$19,950.

The Edward P. Fitts Department of Industrial and Systems Engineering (ISE)'s advisory board set a match challenge for an additional \$17,100, and alumnus David Whitley created a challenge for the Department of Computer Science for an extra \$10,000. Alumni Calvin Carter and John Edmond donated \$10,000 through a match challenge to the Department of Materials Science and Engineering in memory of their friend, alumnus and Wolfspeed co-founder John Palmour. The departments also competed for shares of Dean Louis Martin-Vega's prize money. Like previous years, \$15,000 of the dean's discretionary fund was up for grabs. CCEE took home the largest portion of the prize, followed by ISE and the Department of Mechanical and Aerospace Engineering.

Among the College's challenge wins, one stands out for the sheer distance traveled to make it happen. India.

Two major gifts went to the Department of Computer Science (CSC). Alumnus Tony Brown and the Brown family made a \$1 million pledge to the department to create a named distinguished professorship, a named graduate fellowship and a named undergraduate scholarship. Alumnus Keith Collins and his wife, Margie, announced a \$2.8 million increase of their existing planned estate gift to the department to create a \$2.5 million named endowed department chair and increase the funding for a \$1 million planned distinguished professorship already in place. Alumni, students, faculty and staff members, friends and parents gave 16,774 gifts to the University for a total of \$34,019,746 to beat last year's totals for both and to

set the record for most gifts given in a total day.

COE students and faculty members are the real winners on record-setting Day of Giving

dayofgiving.ncsu.edu

STREET STREET

Daniel Findley, alumnus and senior research associate at the Institute for Transportation Research and Education, won a social media challenge for CCEE. He shared his photo of the Tai Mahal from Agra.

The College also finished in second place for dollars raised on

the day, thanks in part to several generous gifts. One anonymous donor gave \$978,000 to College-wide scholarship initiatives early in the day.



ANNUAL GIVING ENGINEERING FOUNDATION

HOW TO GIVE

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GIVE TO THE ENGINEERING LEADERSHIP FUND

Gifts made to the Engineering Leadership Fund support College-level initiatives.

JOIN THE DEAN'S CIRCLE

Annual gifts of \$1,000 or more qualify for membership in the Dean's Circle, the College's leadership annual giving program. For alumni up to 10 years after graduation, gifts of \$250 or more qualify. go.ncsu.edu/ engineering-deanscircle

SUPPORT THE COUNSELING CENTER

Our students' well-being and mental health are important to all of us at the College of Engineering. Two counselors are working on Centennial Campus, and private philanthropy can help the Counseling Center bring on more counselors and resources to support students. give.ncsu.edu/dasa





Inaugural COE Key Volunteers Day results in ways to advance NC State Engineering

Community and fellowship are the cornerstone of any successful volunteer strategy. In November, as part of Red and White Week, volunteer leaders from throughout the College of Engineering (COE) gathered to discuss strategies, share ideas and get to know each other better.

The College has 11 advisory boards, more than any other college or unit at NC State University. There are 174 advisory board members representing each of the nine academic departments and an additional 34 advisory board members representing young alumni and the Women and Minority Engineering Programs. Each advisory board or department sent a representative to the inaugural COE Key Volunteers Day.

"We all have a unique role for a common purpose: advancing the College of Engineering," explained Hannah Kunkel, assistant director of development, alumni engagement & stewardship.

Advisory boards help reach alumni, who in turn can help the College and its students through their networks, talents and support. Volunteers shared initiatives that helped advance their home departments, including: starting mentorship programs, developing new slogans and refreshed marketing campaigns, helping students on their design projects and engaging advisory board members in department research.

David Whitley, electrical engineering '92 and chair of the development committee for the NC State Engineering Foundation Board of Directors, emphasized the need to pull together all the different specializations in the College.

"When I hire an NC State grad, I don't know how to say it, other than they tend to be different," he said. "There is a continual need to understand and learn and to make progress."

To learn about opportunities to get involved with an advisory board, please reach out to the College's advancement staff at **engr.ncsu.edu/ alumni-and-giving/ncsef**.

The representatives from each department in attendance were:

LAURA SCHRANZ,

Joint UNC / NC State Department of Biomedical Engineering (BME), *BME Director of Development*

RUSS O'DELL, Department of Chemical and Biomolecular Engineering (CBE), *CBE Director of Alumni Relations*, Chemical Engineering, B.S. '75, Ph.D. '78

TYLER HIGHFILL

Department of Civil, Construction, and Environmental Engineering, *Founding Manager and President of Highfill Infrastructure Engineering*, Civil Engineering, BSCE '92, MSCE '94

KIM CALHOUN, Department of Computer Science, Founder and CEO of Guardianator and Senior Executive Producer of MoneyMasters.TV

SONALI LUNIYA,

Department of Electrical and Computer Engineering, *Vice President Corporate Development at Holmusk,* Electrical Engineering, Ph.D. '06

PATRICK MURRAY,

Edward P. Fitts Department of Industrial and Systems Engineering (ISE), *Adjunct Lecturer; Industry / Executive Coach for ISE; retired from Intel,* Industrial Engineering, B.S. '88 JULI TREXLER, ISE, Vice President, Global Partner Ecosystem, IBM Technology Support Services, Industrial Engineering, B.S. '97

SARA SELTZER,

Department of Materials Science and Engineering (MSE), *MSE Director of Development*

DOUG UTLEY,

Department of Mechanical and Aerospace Engineering, *Owner* of *DEUtley LLC*, Mechanical Engineering, B.S. '73

LISA MARSHALL,

Department of Nuclear Engineering (NE), *NE Extension Assistant Professor, Director of Outreach, Retention and Engagement*

ANTONIA ARNOLD-

MCFARLAND, Women and Minority Engineering Programs Manager, STEM Diversity Advancement at John Deere, Mechanical Engineering, B.S. '96

ALBERTO QUIROGA,

Young Alumni Advisory Board, Lead Commodity Specialist, Pegasus, Aerospace Engineering, B.S. '19

Alumnus honored for work in nuclear energy and foreign policy



As a Ph.D. student nearing graduation in 1975, Alex R. Burkart hadn't anticipated that his nuclear engineering degree would lead to a career in foreign policy.

Burkart, who also earned his B.S. in 1972 in nuclear engineering from NC State University, spent more than 40 years in various leadership positions with the United States government, where he forged a unique career path combining technical skills and international diplomacy in pursuit of global energy progress and peace.

His contributions to global nuclear energy management and dedication to maintaining high standards of safety, security and nonproliferation are widely recognized by officials across the globe. In 2021, he was elected Fellow of the American Nuclear Society (ANS). While ANS has categories for academic and research accomplishments, there is no category that matches Burkart's work in international cooperation, making the recognition especially meaningful.

"I only hope that a few nuclear engineers see that while the technical-policy interface is frequently dominated by political scientists, it needs more nuclear engineers," he said.

PACK LEADER

Burkart applied to NC State because it was one of five U.S. schools with an accredited undergraduate nuclear engineering program at the time. It was also closest to his home in New Jersey.

As a student, he earned excellent grades, took on leadership roles and never missed a home game during the eras of football coach Lou Holtz and basketball star David Thompson. He joined the Alpha Phi Omega (APO) National Service Fraternity, later serving as chapter president, and was selected for Tau Beta Pi. He was in the Reserve Officer Training Corps, in the Student Senate and on the Engineering Council. He also received the Dean's Leadership Award in 1972.

He stayed at NC State for his Ph.D. with support from the U.S. Atomic Energy Commission, and he later served as president of the Graduate Student Association

"My extracurricular experiences, which taught me leadership and non-academic skills, were just as important to my career as my academic achievements," he said.

NAVIGATING NUCLEAR POLICY

Nearing graduation, Burkart was gratified to be recruited by the CIA as an intelligence analyst in 1975. He knew little about nuclear weapons or intelligence, but after six months, he was in charge of examining the large national nuclear weapons program of "a worrying adversary."

From there, his career took off. He worked on a variety of projects related to weapons and nuclear nonproliferation issues that informed policymakers on nuclear policy strategy, including the U.S. president.

"Though, my work in the CIA always stopped short of developing solutions to the problems I identified ---a frustrating limitation," he said.

His interest in being part of the solution influenced his career. In 1982, he served at the Arms Control and Disarmament Agency for a year, where he led preparation for the initial US-USSR non-proliferation bilateral discussions, at the height of distrust between the U.S. and the Soviet Union.

Burkart later transferred to the State Department in 1987 as a senior technical advisor in the Office of Nuclear Technology and Safeguards and worked on solving the problems he identified as an intelligence analyst for the CIA. He led efforts to remove spent research reactor fuel containing weapons-grade plutonium from Taiwan, to address South Korea's desire for reprocessing spent power reactor fuel and to tackle proliferation concerns regarding new, advanced fuel cycle technologies.

"This work required substantial knowledge of nuclear technology, constant creativity and interactions

with senior foreign and domestic nuclear officials all the way up to the minister level," he said. "I felt like all my strengths were in demand." Burkart strengthened his policy skills at the Industrial College of the Armed Forces, now the Eisenhower School for National Security and Resource Strategy, graduating in 1993. He then started his new role as deputy director of the Office of Nuclear Energy Affairs, where he stayed for 24 years before being promoted to a newly established senior level position in 2017. In his positions at the State Department, he took on leadership responsibilities to help other countries, including Taiwan, South Korea, Argentina, Japan, Ghana, Kenya, Nigeria and Uganda, grow their nuclear programs. He was also a part of the senior level U.S. team negotiating a new regime for ensuring that states' activities were for peaceful purposes. "This regime was described by President Clinton as the most important strengthening of International Atomic Energy Agency (IAEA) safeguards in a generation," he said. "With the onset of the nuclear renaissance in the mid-1990s, many developing countries began to see nuclear energy as key to meeting their energy needs and their economic development goals."

entities.

AN IDEALIST

Burkart's long career has been recognized internationally. He received a medal from the President of South Korea, an honor never before given to a foreign scientist, as well as recognition from the Korea Nuclear Policy Society and a prestigious award from Taiwan's Minister of Atomic Energy.

"The people I worked with believed in the importance of their work and in doing things for the best interests of the people of their countries," he said. "They were idealists, and so was I."

Retired from his diplomatic career, Burkart now serves as a consultant and advisor to a number of

"Giving back to the institutions that supported me as I developed my foundation is important for aiding future engineers." he said.

He is a member of the Dean's Circle, which provides funding to support the College's students. Also, as a Silver Founders Circle member of APO, he supports students to encourage them to take advantage of service opportunities.

"This work required substantial knowledge of nuclear technology, constant creativity and interactions with senior foreign and domestic nuclear officials all the way up to the minister level... I felt like all my strengths were in demand." ALEX BURKART





From the board

FROM LEFT TO RIGHT, CARLOS BANEGAS, DRAKE BRINKLEY, JACOB T. "JAKE" HOOKS, DAVID WAGNER, IV AND SAM WURST.



MEMBER UPDATES

The Foundation Board has added five new members, plus a new student representative:

- Drake Brinkley, CE '02
- Jacob T. "Jake" Hooks, MSE '78
- David Wagner, IV, BME '05, 10
- Sam Wurst, ISE '15
- Carlos Banegas, MAE '24 (student representative)
 The following members have completed their terms:
 Bob Brooks, EO '69
- Pamela Townsend, CE '84, '87

BOARD PRESIDENTS CELEBRATE DEAN LOUIS MARTIN-VEGA:

"At the beginning of Dean Martin-Vega's first semester, he joined the Foundation's planning session, where we helped flesh out a blueprint for his objectives. The timing couldn't have been better ... The dean left our session and went directly to the North Carolina State Senate offices with a fresh plan in hand." — John McCarter, NE '73, 2005-06

"Dean Louie was the Energizer Bunny for the College of Engineering. He came in with a vision of what NC State Engineering could be that was not dampened by what had been. ... The result: the engineering buildings on Centennial Campus." — E.O. Ferrell, EE '66, 2007-08

"I worked with Louie on the recruitment of students to the College, board members for the Engineering Foundation, and raising money for the endowment and Dean's Circle. Louie put his heart and soul into all of these

Engineering Foundation, Inc. Board of Directors

efforts and made all of our jobs easier." — S. Edward White, ISE '78, 2009-10

"We couldn't have had a better dean than Dean Louie, in my opinion. He did everything right, and the results show." — S. Frank Culberson, CHE '60, 2011-12

"Dean Martin-Vega leads the College of Engineering with vision, grand aspirations and enthusiasm. Importantly, he leads it with his warm personality. He is the perfect fit for the NC State family of high achievers." — Tom McPherson, EE '76, '77, 2013-14

"I can't remember when I didn't know Dean Louie. This is not true of course, but it seems like we have been close friends all our lives. He has a way of making everyone feel this way." — Robin Manning, EE '78, 2015-16

"I consider Dean Louis a true visionary having elevated the College in position and stature. ... His financial achievements during his tenure are truly unequaled." — Len Habas, EE '66, 2017

"Dean Louis motivates others with his compelling energy and calms people through his exceptional interpersonal skills. He is intentional in moving the College forward, is always kind and is quick to recognize others' contributions." — Suzanne Gordon, CSC '75, '80, 2018-19

"One of the things that always stood out to me about Louis was his energy and passion, no matter if the topic is engineering research, budget discussions or expansion of the college." — Nelson Peeler, EE '88, 2020-21

"For the last 17 years, Louie has been our guiding star. He has directed and driven our success with integrity, authenticity and knowledge." — Deborah B. Young, CE '77, 2022-23

SPOTLIGHT : ALBERTO QUIROGA

Alberto Quiroga's path to NC State University was not a straightforward one. During high school, he was a University of North Carolina at Chapel Hill fan set on attending the United States Air Force Academy.

Now, Quiroga, aerospace engineering '19, is working in a field he loves and is an enthusiastic champion of NC State — for its academics and sports — and has big dreams about giving back to the University through student mentorship and as a member of the College of Engineering's Young Alumni Advisory Board (YAAB).

Born in the U.S. while his father was in the country on an engineering assignment, Quiroga spent most of his childhood in Monterrey, the largest city in Nuevo León, Mexico. In 2008, at 11 years old, he moved back to the U.S. to live with his brother, who settled in North Carolina after finishing his college degree. His parents wanted him to have better education opportunities.

"I wouldn't be where I am without him," he said. "And by offering that opportunity, he helped my parents a lot."

With a love of airplanes, Quiroga maintained good grades and played sports throughout high school in preparation for the Air Force Academy. He was flown out for a visit and made it through his interview. But a few months later, he failed the health exam, and his application was denied.

Quiroga was born with an arachnoid cyst, which prevented his brain fluid from circulating throughout his body. When he was six, he had surgery to put in a shunt to release the fluid. This disqualified him from military service.

"I was really bummed because I wanted to give back," he said. "Especially being a firstgeneration American and the son of immigrants, I've been given so many opportunities. I wanted to do something to give back to the country."

Quiroga was heartbroken, but not defeated. Inspired by his pre-calculus teacher, an NC State alumna and his mentor, he decided to go to NC State for aerospace engineering.

GET INVOLVED

To learn more

about board service for the College of Engineering or to nominate someone, contact Griffin Lamb at grlamb@ncsu. edu.

FOUNDATIONS

Despite some academic challenges during his sophomore year, Quiroga persevered, in large part because of his friends and family. While he was in college, his brother became a U.S. citizen — a ceremony that brought Quiroga to tears. When he turned 21, he was able to apply for his parents to come to the U.S. to pursue citizenship, and they moved here in August 2019, shortly after he graduated and achieved his dream of working on airplanes. Quiroga's first job out of college focused on airplane interior design. He is currently a lead commodity specialist at Collins Aerospace, working on Pegasus, the next generation of helicopter rescue hoist. As an

early-career engineer, he is passionate about mentoring current students and fellow young alumni through YAAB. "A lot of people made a difference in my life," he said. "That's what drives me: to always give back where I can."



"...being a firstgeneration American and the son of immigrants, I've been given so many opportunities. I wanted to do something to give back to the country." ALBERTO QUIROGA

Ways to give to the **NC State** Engineering Foundation

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College Advancement Staff

Michael Auchter

Griffin Lamb Assistant Dean for Development and College Relations Executive Director of the NC State Engineering Foundation, Inc. grlamb@ncsu.edu • 919.515.9956

Molly Andrews Assistant Director of Annual Giving • meandre2@ncsu.edu

Director of Development / Major gift contact for the De of Civil, Construction, and Environmental Engineering mrauchte@ncsu.edu • 919.515.6243 ment / Major gift contact for the Department Josh Bowman Senior Director of Development / Major gift contact for the Department of Chemical and Biomolecular Engineering jcbowma7@ncsu.edu • 984.234.8519

Carissa S. Burroughs Lead Event and Alumni Relations Cool csburrou@ncsu.edu • 919.515.9975

Lucas Carpenter Senior Director of Development / Maior gift contact for the Department of Mechanical and Aerospace Engineering lbcarpen@ncsu.edu • 919.616.5098

Allison Gorrell argorrel@ncsu.edu • 919.515.9974

Anna Knight Director of Development / Major gift contact for the Department of Electrical and Computer Engineering and the Department of Nuclear Engineering anna_knight@ncsu.edu • 919.513.7604

Hannah Kunkel Assistant Director of Development, Alumni Engagement and Stewardship heallen3@ncsu.edu • 919.515.7458 Savannah Lammers Assistant Director, Leadership Annual slammer@ncsu.edu • 919.515.0522 rship Annual Giving for the College of Engineering

Sarah Lawlor Director of Development for Operations and Programs selawlor@ncsu.edu • 919.513.7557

Angela S. Martin Associate Director of Annual Giving and Prospect Development Contact for the Dean's Circle and Annual Giving anstalli@ncsu.edu • 919.513.1714

Vanessa May Administrative Support Associate vsmay@ncsu.edu • 919.515.7458

Sara Seltzer Sala Selicer Director of Development / Major gift contact for the Department of Computer Science and the Department of Materials Science and Engineering skseltze@ncsu.edu • 919.515.3973

Wanda Urbanska Value of Davelopment / Major gift contact for the Edward P. Fitts Department of Industrial and Systems Engineering wmurbans@ncsu.edu • 919.515.9976

Department Representatives

Russ O'Dell Department of Chemical and Biomolecular Engineering russ_odell@ncsu.edu • 919.513.2071

Laura Schranz บทบ / NC State Joint Department of Biomedical Engineering Ischran@ncsu.edu • 919.513.7937

Kenneth M. Tate Department of Computer Science tate@csc.ncsu.edu = 919.513.4292

SAUL INDUCTED INTO BROWN **ATHLETICS** HALL OF FAME





Katherine Saul, professor in the Department of Mechanical and Aerospace Engineering, was immersed in movement biomechanics long before she became director of the Movement Biomechanics Lab (MoBL) at NC State University.

As the coxswain for the Brown University Varsity 8 women's rowing team, thinking about mechanics was an essential part of her role as the eyes of her boat, guiding her teammates' movements, analyzing their stroke rating and adjusting the race plan as needed.

"Rowing is truly a mechanical sport," she said. "It continues to be a good example I can use in classes, whether from the boat design or the way the oars work or human movement."

Last fall. Saul and her teammates were inducted into the Brown Athletics Hall of Fame for their

1999 and 2000 NCAA national championships. Women's rowing was designated an NCAA sport in 1997, and Brown's team has been to every NCAA championship.

of Fame together.

team," Saul said.



Rowing is a team sport — everyone is literally in the same boat. The team's coaches, who have been there since the 1980s, elected to wait until all the women on the 1999 and 2000 teams could be inducted into the Hall

"Our team feels really strongly about the team, and generally doesn't nominate individuals who have earned a position in the Hall of Fame because of the importance of the

At the ceremony in Providence, Rhode Island, many of her teammates brought their children with them, and Saul was struck by how many women there had a Ph.D., M.D. or DVM. "Almost everyone is also

successful in their careers at this

extremely high level, which I think is really remarkable," she said.

Saul started rowing in high school, when friends' older siblings suggested that her short stature at just under 5-foot-1 and assertive personality were good qualities for a coxswain.

She was drawn to engineering and medicine from a young age, and at Brown, which had strong rowing and engineering programs, she was able to start connecting her interests. Her time as a coxswain influences her work today, including her research in dynamics and neural control of the musculoskeletal system, as well as in her team-oriented approach to teaching.

"It shapes everything else about my life, and it was such a value," she said. "It says a lot about what it takes to be a student athlete and to have that kind of commitment, and that teamwork, and how that helps you in the rest of your life as well."



Campus Box 7901 Raleigh, NC 27695-7901 www.engr.ncsu.edu

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We wouldn't be where we are without our students, alumni, faculty and staff members, and friends. In honor of a century of NC State Engineering achievements, we are gathering stories and memories from our community to share throughout the year on our website, at events and on social media.

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