

NC STATE

Engineering

MAGAZINE SPRING / SUMMER 2021



THE RIGHT SPACE

Fitts-Woolard Hall provides an environment for success

BASNIGHT REMEMBERED AS A CHAMPION FOR THE COLLEGE OF ENGINEERING

State Sen. Marc Basnight, a Dare County Democrat who served as president pro tempore of the NC Senate longer than anyone in history, died on Dec. 28, 2020, at the age of 73.

He was first elected to represent the Senate's 1st District in 1985 and would hold that seat until 2011. He served as president pro tem from 1993 to 2011.

Basnight has been remembered as perhaps the most powerful state legislator in North Carolina's history. His support of the College of Engineering was vital to its growth and the steady improvement of its national reputation. That support has been especially important as the College moved from NC State's main campus to Centennial Campus.

Basnight played a key role in designing and passing a \$3.1 billion bond referendum for state colleges and universities that funded construction of Engineering Buildings I and II on Centennial. The two buildings are the current homes of the Departments of Materials Science and Engineering, Chemical and Biomolecular Engineering, Electrical and Computer Engineering, and Computer Science.

When the College needed additional financial support to help fund construction of a third engineering building on Centennial, Basnight helped guide funding through the General Assembly.

Louis Martin-Vega, dean of the College, said that he established a relationship with Basnight soon after arriving on the NC State campus in 2006. His predecessor as dean, **Nino Masnari**, knew Basnight well and emphasized to Martin-Vega that it would be a beneficial relationship for the College to continue.

Martin-Vega said that he had only been in his new role in Raleigh for a couple of weeks when he received a phone call from Basnight asking if he could do anything to help the College, and the new dean.

That phone call led to Basnight helping guide legislative funding to the College that finished Engineering Building III, home of the Department of Mechanical and Aerospace Engineering and the UNC / NC State Joint Department of Biomedical Engineering, and helped increase faculty hiring.

"It had a very significant impact on the College," Martin-Vega said. "That gave us a really good push forward in our quest for national prominence in engineering education and research."

Civil engineering alumnus **Glenn Futrell** got to know Basnight while developing Pirate's Cove residential community and marina in Basnight's hometown of Manteo, NC. Futrell, a former president of the NC State Engineering Foundation and recipient of the College's Distinguished Engineering Alumnus award, helped build the relationship between the College and the late senator by hosting several meetings with Basnight and NC State chancellors and engineering deans.

"All of those engineering buildings on Centennial Campus, Marc had a major influence on getting those monies through the legislature," Futrell said. ■

DEAN LOUIS MARTIN-VEGA, RIGHT, SHOWS THE LATE SEN. MARC BASNIGHT AROUND NC STATE'S CENTENNIAL CAMPUS IN 2010.

Simon named head of Department of Chemical and Biomolecular Engineering



SINDEE SIMON

Sindee L. Simon, a recognized leader in the area of polymer physics and an experienced educational administrator, will succeed **Peter**

Fedkiw as head of the Department of Chemical and Biomolecular Engineering effective July 1, 2021.

Simon is a P.W. Horn Distinguished Professor in the Department of Chemical Engineering at Texas Tech University and served as the Whitacre Department Chair from 2012 to 2019.

Her research interests include the physics of the glass transition, cure and properties of thermosetting materials, and properties and reactivity at the nanoscale.

Her honors and recognitions include the International Award, as well as the Research / Engineering Technology Award, from the Society of Plastics Engineers; the Mettler Toledo Outstanding Achievement Award from the North American Thermal Analysis Society; and Fellowship in the American Institute of Chemical Engineers, the American Physical Society, the Society of Plastics Engineers and the North American Thermal Analysis Society.

With Simon as chair, the Department of Chemical Engineering at Texas Tech saw a near doubling of its undergraduate enrollment, a 50-percent increase in doctoral student enrollment and 50-percent growth in research expenditures. Simon earned a bachelor's degree (cum laude) from Yale University and a Ph.D. from Princeton University, both in chemical engineering.

Prior to joining Texas Tech, she held a faculty position at the University of Pittsburgh and worked as a materials engineer with Beech Aircraft Corporation. ■

NC STATE Engineering

Welcome to the
spring / summer 2021
issue of *NC State
Engineering* magazine.



As the spring winds down, even as we mark the difficult anniversary of the onset of the COVID-19 pandemic in the United States, I am optimistic today and hope that you feel the same way. Across our nation and all over the world, the administration of safe and efficacious vaccines (including on the NC State campus) is offering hope for a return to the lives we lived before. These vaccines, developed in record time, are now also being deployed rapidly across our country, illustrating the power of scientists, physicians and engineers working collaboratively across disciplines to take on the vexing problems that face humanity. You can read insights on this incredible effort in our Q&A with **Julie Swann**, department head and A. Doug Allison Distinguished Professor in the Edward P. Fitts Department of Industrial and Systems Engineering and a globally recognized expert on vaccine distribution and logistics.

At NC State, a rigorous testing program coupled with continued adherence to safety protocols has allowed us to have a successful spring semester, with some students living and attending classes on campus and our research enterprise continuing to thrive while keeping faculty members and students safe.

You'll find more positive news in this issue on new *U.S. News & World Report* rankings of online graduate engineering programs, which placed our Engineering Online sixth in the country, and on a very successful 2021 Day of Giving, during which our alumni and friends contributed more than \$6 million to the College.

Fitts-Woolard Hall, our newest building on NC State's Centennial Campus, is being utilized by students and faculty members and we are increasingly hopeful that we will be able to welcome you to visit this amazing new facility later this year as conditions continue to improve. The College has commitments of \$49 million toward our goal of \$60 million and I hope that you will consider a contribution that will help us close the remaining gap.

At the same time, our College continues to commit itself to creating an environment that is welcoming to all, including members of groups that are historically underrepresented in the field of engineering. **Angelitha Daniel**, the longtime director of our Minority Engineering Programs, has begun work as a special advisor to the dean for faculty and student diversity, equity and inclusion. Angie is helping to chart a path forward as the College builds that welcoming community that we all want.

Unfortunately, we are seeing increased levels of harassment and violence across the country against members of the Asian, Asian American and Pacific Islander communities. In a personal statement I issued this spring, I called on our entire College of Engineering to be bold in continuing to stand together with all marginalized groups to combat racism and keep a spotlight on this critical issue.

Thank you, again, for your continued support of your College of Engineering. I am hopeful that we are much closer to a time in which we can welcome you back to campus to see firsthand the outstanding work that our faculty, students and staff are doing.

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

DEAN

Louis A. Martin-Vega

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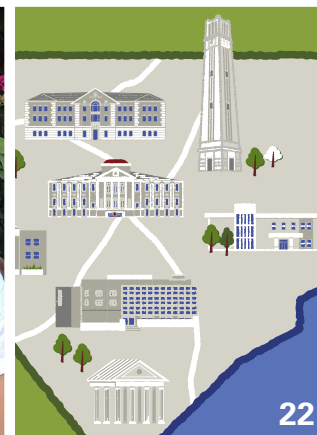
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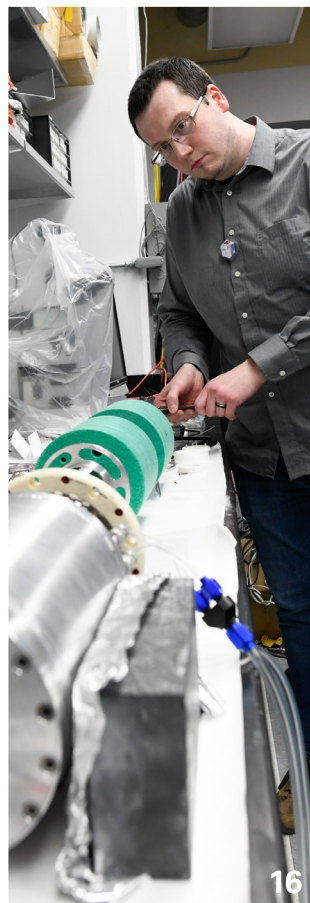
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Graduate students play a key role in the groundbreaking research that is conducted in the College of Engineering.



ON THE COVER

Fitts-Woolard Hall, the newest engineering building at NC State, represents an important step toward the College's unification on Centennial Campus and a major milestone in its growth. Read more on page 24.

Q&A

QUESTIONS FOR JULIE SWANN

Julie Swann, head of the Edward P. Fitts Department of Industrial and Systems Engineering, is an expert on supply chains and pandemics and has provided guidance on COVID-19 vaccine distribution.

What has affected the speed of the vaccine rollout?

This is a complex undertaking, and in many ways, the most challenging part is the last mile. In recent weeks the rollout has sped up as much greater supply is available, initial populations with high demand became eligible for the vaccine, and health jurisdictions and their partners worked through the details of administering a large number of vaccines quickly.

What logistical challenges have already been overcome, and what still needs to be improved?

Health departments and providers have figured out the infrastructure needed to keep the vaccine at the required cold temperatures to ensure it remains safe and effective. Providers have also been working through operational challenges to schedule vaccine appointments, including mechanisms for people with less technology. We've seen some challenges in ensuring that the vaccine is available and accessible to all populations. North Carolina has put in place some practices that have increased equity in the coverage of the vaccine and has also demonstrated success with large vaccination events. There is starting to be an increased and more predictable supply, which helps health departments and providers in planning their operations. It is easier to ensure a supply chain is efficient, effective and equitable when there is data

available to help with decision-making and reporting; data systems are an area of continuous improvement.

What has gone into determining vaccine phases?

There has been a lot of guidance at the federal level about vaccine phases and prioritization over summer and fall 2020. Some of the guidance also changed the priorities in 2021, including focus on populations 65 and over earlier than previously planned. Ultimately, the goals are to prevent deaths, reduce hospitalizations, ensure that society can continue to function and reduce inequities.

There are currently three approved vaccines in the U.S. — should people take whichever is available to them?

All of the approved vaccines are highly effective at preventing severe disease and deaths. The vaccine trials were done at different places and times before some of the new strains had become dominant, so it is difficult to compare exactly across all the vaccines. I would absolutely take any of the approved vaccines that are offered to me, and I would encourage others to do the same (consulting with their physicians for any special cases).

Is there a timeline for when life in the U.S. will be able to "return to normal"?

A lot will depend on whether the pace of vaccine administration stays the same, which at this point is dependent on demand and reducing barriers to access the vaccine. If the pace from the end of March is maintained, then 70 percent of the entire U.S. could have at least one dose by mid-June. However, we may find it difficult to achieve high uptake everywhere. Any individual who is unprotected will continue to be at risk even after we reach a high level of overall vaccination. It would be a mistake to lift measures like wearing masks and reduced gatherings especially given the new strains. In considering my actions, I think about risks to myself, my overall household, my friends and family, and to the overall community, based on the level of protection in each of those groups. ■



Understanding and controlling materials' antiviral properties can lead to better PPE



"We're very committed to ... thinking about how we leave a legacy of infrastructure."

ARAM AMASSIAN

IN THE EARLY WEEKS of the COVID-19 pandemic, an interdisciplinary team of researchers from the College of Engineering and the College of Sciences began meeting weekly to figure out how they could contribute to slowing the spread of the virus and protecting frontline workers.

Their immediate solution? Work on developing an antiviral coating that could be integrated into personal protective equipment (PPE) or applied to surfaces to inactivate SARS-Cov-2 and other viruses. The team has been working with the Nonwovens Institute in the College of Textiles for guidance on how developments from their research could be integrated into PPE.

But their project goals are broader. "I think our real goal is to understand the mechanisms, and then what attributes of the materials give rise to those particular inactivation mechanisms," said

Elizabeth Dickey, Distinguished Professor Emerita in the Department of Materials Science and Engineering (MSE) at NC State and current head of the MSE department at Carnegie Mellon University. "So, the ultimate goal is that (our research) will create knowledge that will enable the design and discovery of materials that have antiviral and antimicrobial activity."

To do this, the team is working to understand the fundamental processes behind the generation of reactive oxygen species, which are believed to be central to the antiviral properties of certain oxide materials like titanium dioxide, also called titania. In the lab, reactive oxygen species are generated by tuning titania particles through a flow-synthesis processing route, which was developed from technology created in the lab of Milad Abolhasani, assistant professor in the Department of Chemical

and Biomolecular Engineering. Researchers then use thermal annealing, a heat treatment, to make the material photoactive.

Understanding this process is key to controlling materials' antiviral and antimicrobial activity, and therefore critical to the development of coatings that can protect against viruses, bacteria and environmental decontamination.

As part of this work, the team also aims to develop systematic and reproducible processes for controlling these materials, which are essential to being able to examine their antiviral properties.

"One of the things I think we're very committed to doing, beyond the specifics of the research, is thinking about how we leave a legacy of infrastructure," said Aram Amassian, associate professor in MSE.

They are hopeful that one unanticipated benefit of

the pandemic is a better framework for interdisciplinary research, and the work has been especially beneficial for their large team of graduate students from engineering, chemistry and biological sciences.

The project is funded by a year-long National Science Foundation Rapid Response Research grant, but the researchers plan to continue their work and are applying for more funding. Dickey is the principal investigator of the project. Along with Abolhasani and Amassian, Reza Ghiladi, associate professor in the Department of Chemistry, and Frank Scholle, associate professor in the Department of Biological Sciences, are co-principal investigators. ■

Study reveals extent of privacy vulnerabilities with Amazon's Alexa

A RECENT STUDY outlines a range of privacy concerns related to the programs users interact with when using Amazon's voice-activated assistant, Alexa. Issues range from misleading privacy policies to the ability of third parties to change the code of their programs after receiving Amazon approval.

"When people use Alexa to play games or seek information, they often think they're interacting only with Amazon," said Anupam Das, co-author of the paper and an assistant professor of computer science. "But a lot of the applications they are interacting with were created by third parties, and we've identified several flaws in the current vetting process that could allow those third parties to gain access to users' personal or private information."

At issue are the programs that run on Alexa, allowing users to do everything from listen to music to order groceries. These programs, which are roughly equivalent to the apps on a smartphone, are called skills; there are more than 100,000 skills for users to choose from. Because the majority of these skills are created by third-party developers, and Alexa is used in homes, researchers wanted to learn more about potential security and privacy concerns.

They used an automated program to collect 90,194 unique skills found in seven different skill stores. The research team also developed an automated review process that provided a detailed analysis of each skill.

One problem the researchers noted was that the skill stores

display the developer responsible for publishing the skill. This is a problem because Amazon does not verify that the name is correct. In other words, a developer can claim to be anyone. This would make it easy for an attacker to register under the name of a more trustworthy organization. That, in turn, could fool users into thinking the skill was published by the trustworthy organization, facilitating phishing attacks.

The researchers also found that Amazon allows multiple skills to use the same invocation phrase.

"This is problematic because, if you think you are activating one skill, but are actually activating another, this creates the risk that you will share information with a developer that you did not intend to share information with," Das said. "For example, some skills require linking to a third-party account, such as an email, banking or social media account. This could pose a significant privacy or security risk to users."

In addition, the researchers demonstrated that developers can change the code on the back end of skills after the skill has been placed in stores. Specifically, the researchers published a skill and then modified the code to request additional information from users after the skill was approved by Amazon.

The paper was co-authored by Sheel Jayesh Shah, a graduate student at NC State, and William Enck, an associate professor in the Department of Computer Science. ■



Dean Martin-Vega elected to National Academy of Engineering

LOUIS MARTIN-VEGA, dean of the College of Engineering, has been elected as a member of the National Academy of Engineering (NAE). Election to the NAE is among the highest professional distinctions accorded to an engineer.

Martin-Vega, elected in recognition of distinguished contributions to engineering “for support of engineering and engineering education through industry-academic collaboration and opportunities for underrepresented groups,” is one of 106 new members and 23 international members elected for 2021. With his election, the faculty of the College of Engineering includes 19 NAE members.

“While I am very honored and humbled by my election to the NAE, I am also glad and proud for the bright light that it also shines on our College of Engineering and

all of the progress that we have made in our research, education and outreach endeavors,” Martin-Vega said. “A recognition of this nature, even when associated with an individual, is never really the result of one person’s effort. In my case I owe it to the efforts of numerous academic faculty colleagues, students and staff, as well as government and industry colleagues that I have been privileged to collaborate and work with over so many years.

“Last, and most importantly, I owe this recognition to my wife, Maggie, and my children and extended family whose support has enabled so much of what has gone into making a recognition of this nature possible.”

Under his leadership, NC State’s College of Engineering has grown to more than 10,500 students, 750 faculty and staff members and more than \$200 million in annual research expenditures. The College is internationally recognized for the excellence of its research, education and outreach programs. It also has the distinction of being one of only two colleges of engineering to lead two National Science Foundation (NSF) Engineering Research Centers at once and one of only two colleges to ever take the lead role in three.

The College is also ranked among the “top 10” colleges of engineering nationwide in annual research expenditures and is listed by *U.S. News & World Report* as the 11th best public graduate engineering program in the country.

Martin-Vega joined NC State in 2006 after serving for five years as dean of engineering at the University of South Florida. He has also held several prestigious positions at NSF, including acting head of its Engineering Directorate and director of the Division of Design, Manufacture and Industrial Innovation. Additionally, he has served as chairman of the Department of Industrial and Manufacturing Systems Engineering at Lehigh University and Lockheed Professor in the College of Engineering at Florida Institute of Technology. He has also held tenured faculty positions at the University of Florida and the University of Puerto Rico at Mayaguez.

Martin-Vega served as the 2013-15 chair of the American Society for Engineering Education (ASEE) Deans Council Executive Board and as president of ASEE from 2016-17.

He also served as president of the Institute of Industrial and Systems Engineering (IISE) in 2007-08 and received the Frank and Lillian Gilbreth Award, IISE’s highest honor, in 2012. He received the Tampa Museum of Science and Industry (MOSI) National Hispanic Scientist of the Year Award in

2007 and was inducted into the Hispanic Engineering National Achievement Awards Corporation Hall of Fame in 2011. He is also a Fellow of the American Association for the Advancement of Science (AAAS), the Institute of Industrial and Systems Engineers (IISE) and the Society of Manufacturing Engineers (SME) and is a member of INFORMS, Tau Beta Phi, Alpha Pi Mu and Sigma Xi.

He received his B.S. (magna cum laude) in industrial engineering from the University of Puerto Rico at Mayaguez, an M.S. in operations research from New York University and M.E. and Ph.D. degrees in industrial and systems engineering from the University of Florida.

NAE membership honors those who have made outstanding contributions to “engineering research, practice, or education, including, where appropriate, significant contributions to the engineering literature” and to “the pioneering of new and developing fields of technology, making major advancements in traditional fields of engineering, or developing / implementing innovative approaches to engineering education.”

Election of new NAE members is the culmination of a yearlong process. The ballot is set in December and the final vote for membership occurs during January.

The new class of NAE members brings the total U.S. membership to 2,355 and the number of international members to 298. ■

“A recognition of this nature, even when associated with an individual, is never really the result of one person’s effort.”

LOUIS MARTIN-VEGA



NC State ranks in top 10 for online master’s engineering programs (again)

THE 2021 U.S. NEWS & WORLD REPORT list of Best Online Graduate Engineering Programs ranked NC State’s Engineering Online as the sixth best program nationally. It’s the fourth straight year in which the program has landed in the top 10.

The Engineering Online master’s program was also listed in the top 10 for Best Online Graduate

degree or professional certificate distance education program. Engineering Online is fully accredited by the Commission on Colleges of the Southern Association of Colleges and Schools, and is authorized in every U.S. state for delivery of online degree programs.

“Part of our success in being ranked in the top 10 online

degree programs that are the same high-quality engineering and computer science degree programs offered on campus, but with the flexibility of online learning to help meet students’ educational and professional goals.

“We’ve been able to develop a reputation of providing quality educational experiences for our distance students,” Krute added.

“The College of Engineering is dedicated to providing lifelong learning experiences for our alumni and professional engineers.”

The *U.S. News & World Report* rankings look at metrics including faculty credentials and training, services and technologies made available to students, student excellence and how engaged faculty members are.

The College’s long history with distance learning has been a tremendous asset during the COVID-19 pandemic. When NC State, like many colleges and universities around the

country, moved classes online in spring 2020, engineering students benefited from the Engineering Online infrastructure in place and the fact that many of the College’s faculty members were already familiar with teaching online thanks to participating in the program.

“These things haven’t happened overnight,” **Louis Martin-Vega**, dean of the College, said of Engineering Online’s success. “It’s taken a lot of hard work and taken a number of years to develop the infrastructure that we have.” ■

Engineering Programs for Veterans, coming in at seventh nationally. In rankings of online engineering specialties, the College of Engineering was fourth for its mechanical engineering program. The College also ranked 11th in civil engineering, 11th in industrial, 13th in electrical and 15th in engineering management.

NC State ranked 15th on the list of Best Online Master’s Computer Information Technology Programs.

Established in 1978, Engineering Online is the College’s master’s

engineering programs for the past several years is our focus on student services,” said **Linda Krute**, director of distance engineering education programs. “We have faculty who are dedicated to working with our distance students and we provide the services they need to be successful. We’ve been working with adult learners for several years and our faculty value the input and contributions they can make to their classes.”

Engineering Online offers 17 different graduate engineering



Rural Works! program continues to grow, despite pandemic

SOPHOMORE INDUSTRIAL and systems engineering major **Tabitha Gardner** learned a lot during a summer 2020 internship with idX Corporation. When NC State changed the fall 2020 semester to end earlier than normal, Gardner saw an opportunity to continue that internship over the longer winter break and learn even more.

The company designs, manufactures and installs interior fixtures and decorations for a wide range of retailers. During her internship experiences at the idX location in Washington, NC, Gardner developed considerable proficiency with CAD platforms and also learned important skills that complement her technical knowledge, including networking and communication.

Gardner said that she was introduced to engineering concepts during the internship that she hadn’t yet seen in the classroom.

“When I got to those topics in my classes, I had a better understanding of what the professor was talking about,” she said.

Gardner found the internship through *Rural Works!*, a program that matches NC State students with summer internship opportunities in

rural communities with companies and local governments that might not normally be able to attract them. The College provides participating students with a stipend from the Engineering Enhancement Fee, which is used to add and enhance educational opportunities.

Many rural communities in North Carolina and across the U.S. report talented young people leave to attend college and choose not to return. *Rural Works!* hopes to address this issue by matching interest and opportunity, as some students return to their home counties for rewarding summer opportunities and others explore new towns and industries.

“The *Rural Works!* internships provide important on-the-job learning experiences for our students, which helps them contextualize their courses on campus. In addition, through the community service and reflection elements of the program, students gain a critical understanding of the issues that face rural areas,” said **Jerome Lavelle**, associate dean for academic affairs in the College and program advocate.

The College placed four students

around the state as part of a pilot program in summer 2018, and then 18 students during summer 2019. The program was affected by the pandemic during summer 2020, but the College hopes to place 60 students in internships across the state in summer 2021. Industry Expansion Solutions, the College’s extension service, and Director **Phil Mintz** help attract North Carolina companies to the program.

Six engineering students took advantage of the longer winter break between fall 2020 and spring 2021 to continue gaining valuable experience with *Rural Works!* companies.

Sophomore **Brady Jones** is majoring in aerospace engineering. He worked on several projects with packaging manufacturer Sealed Air Corporation in Lenoir, NC, both during summer and over the holiday.

“I wanted to set myself apart early in my undergrad in order to set myself up for future positions,” Jones said. “In today’s professional environment, especially in engineering, if you do not have experience coming out of college you will not be a preferential candidate.” ■

“Through the community service and reflection elements of the program, students gain a critical understanding of the issues that face rural areas.”

JEROME LAVELLE

Pericardial injection effective, less invasive way to get regenerative therapies to heart

“We wanted a less invasive way to get therapeutics to the injury site.”

KE CHENG

INJECTING HYDROGELS

containing stem cell or exosome therapeutics directly into the pericardial cavity could be a less invasive, less costly and more effective means of treating cardiac injury, according to new research from NC State and the University of North Carolina at Chapel Hill.

Stem cell therapy holds promise as a way to treat cardiac injury, but delivering the therapy directly to the site of the injury and keeping it in place long enough to be effective are ongoing challenges. Even cardiac patches, which can be positioned directly over the site of the injury, have drawbacks in that they require invasive surgical methods for placement.

“We wanted a less invasive way to get therapeutics to the injury site,” said **Ke Cheng**, Randall B. Terry Jr. Distinguished Professor in Regenerative Medicine at NC State’s Department of Molecular Biomedical Sciences and professor in the Joint UNC / NC State Department of Biomedical Engineering. “Using the pericardial cavity as a natural ‘mold’ could allow us to create cardiac patches — at the site of injury — from hydrogels containing therapeutics.”

In a proof-of-concept study, Cheng and colleagues from both universities looked at two different types of hydrogels — one naturally derived and one synthetic — and two different stem cell-derived therapeutics in mouse and rat models of heart attack. The therapeutics were delivered via intrapericardial (iPC) injection.

Via fluorescent imaging the researchers were able to see that

the hydrogel spread out to form a cardiac patch in the pericardial cavity. They also confirmed that the stem cell or exosome therapeutics can be released into the myocardium, leading to reduced cell death and improved cardiac function compared to animals in the group who received only the hydrogel without therapeutics.

The team then turned to a pig model to test the procedure’s safety and feasibility. They delivered the iPC injections using a minimally invasive procedure that required only two small incisions, then monitored the pigs for adverse effects. They found no breathing complications, pericardial inflammation or changes in blood chemistry up to three days post-procedure.

“Our hope is that this method of drug delivery to the heart will result in less-invasive, less-costly procedures with higher therapeutic efficacy,” Cheng said. “Our early results are promising — the method is safe and generates a higher retention rate of therapeutics than those currently in use. Next, we will perform additional preclinical studies in large animals to further test the safety and efficacy of this therapy, before we can start a clinical trial.”

“I anticipate in a clinical setting in the future, iPC injection could be performed with pericardial access similar to the LARIAT procedure. In that regard, only one small incision under local anesthesia is needed on the patient’s chest wall,” said Joe Rossi, associate professor in the Division of Cardiology at UNC-Chapel Hill and co-author of the paper. ■

Reduced heat leakage improves wearable health device

NC STATE FACULTY MEMBERS

working in the National Science Foundation ASSIST Center continue to improve the efficiency of a flexible device worn on the wrist that harvests heat energy from the human body to monitor health.

In a paper published in *npj Flexible Electronics*, the researchers report significant enhancements in preventing heat leakage in the flexible body heat harvester they first reported in 2017 and updated in 2020. The harvesters use heat energy from the human body to power wearable technologies — think of smart watches that measure your heart rate, blood oxygen, glucose and other health parameters — that never need to have their batteries recharged. The technology relies on the same principles governing rigid thermoelectric harvesters that convert heat to electrical energy.

Flexible harvesters that conform to the human body are highly desired for use with wearable technologies. **Mehmet Ozturk**, an NC State professor of electrical and computer engineering and the corresponding author of the paper, mentioned superior skin contact with flexible devices, as well as the ergonomic and comfort considerations to the device wearer, as the core reasons behind building flexible thermoelectric generators, or TEGs.

The performance and efficiency of flexible harvesters, however, historically trail well behind rigid devices, which have been superior in their ability to convert body heat into usable energy.

The NC State proof-of-concept TEG originally reported in 2017 employed semiconductor elements that were connected electrically in series using liquid-metal interconnects made of EGaln, a non-toxic alloy of gallium and indium. EGaln provided both metal-like electrical conductivity and stretchability. The entire device was embedded in a stretchable silicone elastomer.

The upgraded device reported in 2020 employed the same architecture but significantly improved the thermal engineering of the previous version, while increasing the density of the semiconductor elements responsible for converting heat into electricity. One of the improvements was a high thermal conductivity silicone elastomer — essentially a type of rubber

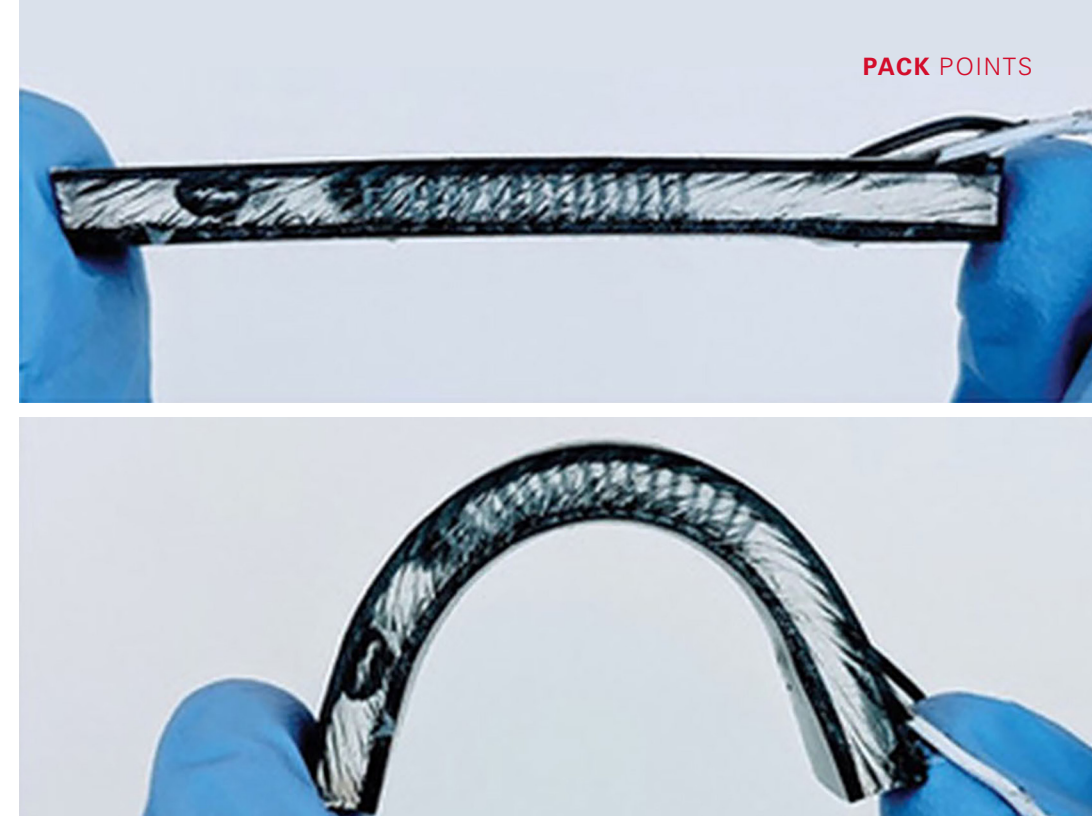
— that encapsulated the EGaln interconnects.

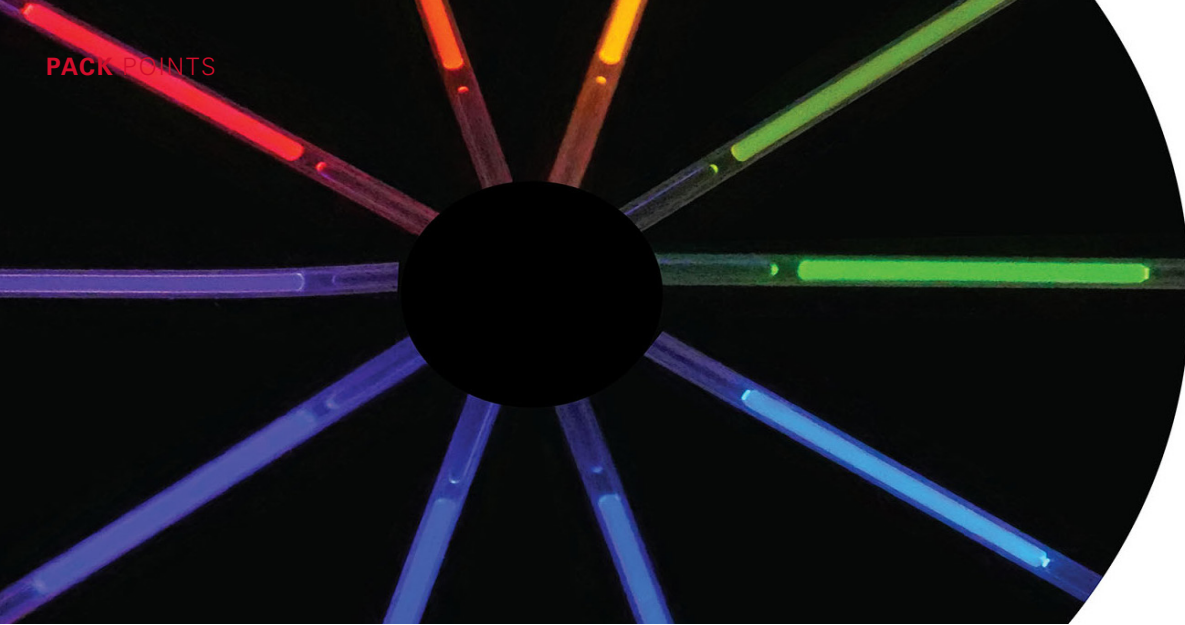
The newest iteration adds aerogel flakes to the silicone elastomer to reduce the elastomer’s thermal conductivity. Experimental results showed that this innovation reduced the heat leakage through the elastomer by half.

“The addition of aerogel stops the heat from leaking between the device’s thermoelectric ‘legs,’” Ozturk said. “The higher the heat leakage, the lower the temperature that develops across the device, which translates to lower output power.”

NC State colleagues **Viswanath P. Ramesh**, **Yasaman Sargolzaeiaval**, **Taylor V. Neumann**, **Veena Misra**, **Michael Dickey** and **Daryoosh Vashaee** co-authored the paper.

ASSIST — the Advanced Self-Powered Systems of Integrated Sensors and Technologies Center led by NC State, is creating self-powered wearables capable of long-term multi-modal sensing without having to replace or charge the batteries. ■





“This is how the brain of the robotic system learns the materials chemistry.”

MILAD ABOLHASANI

Artificial Chemist 2.0: Quantum dot R&D in less than an hour

A NEW TECHNOLOGY, called Artificial Chemist 2.0, allows users to go from requesting a custom quantum dot to completing the relevant R&D and beginning manufacturing in less than an hour. The tech is completely autonomous, and uses artificial intelligence (AI) and automated robotic systems to perform multi-step chemical synthesis and analysis.

Quantum dots are colloidal semiconductor nanocrystals, which are used in applications such as LED displays and solar cells.

“When we rolled out the first version of Artificial Chemist, it was a proof of concept,” said **Milad Abolhasani**, corresponding author of a paper on the work and an assistant professor of chemical and biomolecular engineering. “Artificial Chemist 2.0 is industrially relevant for both R&D and manufacturing.”

From a user standpoint, the whole process essentially consists of three steps. First, a user tells Artificial Chemist 2.0 the parameters for the desired quantum dots. For example, what color light do you want to produce?

The second step is effectively the R&D stage, where the technology autonomously conducts a series of rapid experiments, allowing it to identify the optimum material and the most efficient means of producing that material. Third, the system switches over to manufacturing the desired amount of the material.

“Quantum dots can be divided up into different classes,” Abolhasani said. “For example, well-studied II-VI, IV-VI and III-V materials, or the recently emerging metal halide perovskites, and so on. Basically, each class consists of a range of materials that have similar chemistries.

“And the first time you set up Artificial Chemist 2.0 to produce quantum dots in any given class, the robot autonomously runs a set of active learning experiments. This is how the brain of the robotic system learns the materials chemistry,” Abolhasani said. “Depending on the class of material, this learning stage can take between one and 10 hours. After that one-time active

learning period, Artificial Chemist 2.0 can identify the best possible formulation for producing the desired quantum dots from 20 million possible combinations with multiple manufacturing steps in 40 minutes or less.”

The researchers note that the R&D process will almost certainly become faster every time people use it, since the AI algorithm that runs the system will learn more — and become more efficient — with every material that it is asked to identify.

Artificial Chemist 2.0 incorporates two chemical reactors, which operate in a series. The system is designed to be entirely autonomous, and allows users to switch from one material to another without having to shut down the system. Video of how the system works can be found at youtu.be/e_DyV-hohLw.

Co-first authors of the paper are **Kameel Abdel-Latif** and **Robert W. Epps**, who are Ph.D. students at NC State. The paper was co-authored by **Fazel Bateni** and **Suyong Han**, who are also Ph.D. students at NC State. ■

Think and Lead: Master’s program offers management training for engineers

IN TODAY’S EVER-SHIFTING job climate, professionals value flexibility and the College’s newly redesigned Master of Engineering Management (MEM) program offers just that. Along with traditional concentrations in entrepreneurship and supply chain management, the program includes what organizers call a “choose-your-own-adventure” track, where students are allowed to pick their own classes to align with their interests and career goals.

The MEM program was developed in response to the growing demand for engineering graduates with the skills necessary to manage and succeed in today’s complex engineering environments. Further, many engineering graduates are interested in MBAs but would prefer to gain their management skills focused on STEM environments, while also deepening their technical skills. This program provides a mechanism for those who want to maintain their engineering focus while learning about managing and communicating inside technical organizations.

“We did an assessment of what industry needs are and our corresponding strengths and then we redesigned it to be what it is today,” said **Brandon McConnell**, assistant research professor in the Edward P. Fitts Department of Industrial and Systems Engineering. “We are leveraging NC State strengths to directly target market needs, both in North Carolina and across the country, and we are providing students choices along the way.”

The original program, introduced in 2013, focused on supply chain engineering and management, but the 2020 revamp expanded on and added to those offerings.

The degree is taught over 10 courses, offered both on campus and online. Students complete a five-course core curriculum, along with five courses in their chosen concentration including a master’s project to apply their skills in a practical setting. Students can choose from one of seven concentrations: Analytics, Entrepreneurship, Facilities Engineering, Health & Human Systems, Professional Practice, Supply Chain Engineering & Management and Build Your Own.

MEM students benefit from a highly interdisciplinary curriculum with courses and faculty members from all over NC State. All departments from the College of Engineering participate, and several classes are offered in partnership with other colleges, such as the

College of Sciences, the College of Humanities and Social Sciences and the Poole College of Management. The program also provides professional development and career services.

Since the program’s introduction, reception has been promising and has attracted a diverse range of students.

As for the future? As McConnell put it, “We want to be the go-to choice for NC State undergrads interested in continuing education. We also want to aggressively increase U.S. military and veteran enrollment. As a land-grant institution, our program will actively pursue partnerships with North Carolina companies to support their educational and workforce development programs. We should be the number one Engineering Management program in North Carolina, hands down.”

Learn more about the MEM program by visiting mem.grad.ncsu.edu. ■





Six engineering faculty members named AAAS Fellows

Six engineering faculty members have been elected as Fellows of the American Association for the Advancement of Science (AAAS) for 2020.

They are part of a group of 10 new Fellows from NC State that represents the largest class of AAAS Fellows elected from the University since it was founded in 1887. AAAS, the world’s largest scientific society and publisher of the journal *Science*, has been awarding fellowships since 1874.

NC State had the second-highest number of AAAS Fellows of any university in 2020. New Fellows from the College are:

Ruben Carbonell, the Frank Hawkins Kenan Distinguished Professor in the Department of Chemical and Biomolecular Engineering (CBE).

Elizabeth Dickey, Distinguished Professor Emerita in the Department of Materials Science and Engineering (MSE). Dickey is now head of the Department of Materials Science and Engineering at Carnegie Mellon University.

Peter Fedkiw, Alumni Distinguished Graduate Professor and head of CBE.

FACULTY HIGHLIGHTS

Munindar Singh, Alumni Distinguished Graduate Professor in the Department of Computer Science.

Paul Turinsky, professor emeritus in the Department of Nuclear Engineering.

Cliff Wang, adjunct professor in the Department of Electrical and Computer Engineering and director of the Computing Sciences Division in the Army Research Office in Durham, NC. ■

Ligler recognized by National Academy of Engineering with leadership award

Frances S. Ligler, Ross Lampe Distinguished Professor in the UNC / NC State Joint Department of Biomedical Engineering, received the National Academy of Engineering’s (NAE) Simon Ramo Founders Award.

Ligler, a member of NAE since 2005, is being recognized “for the invention and development of portable optical biosensors, service to the nation and profession,

and educating the next, more diverse generation of engineers.” The award acknowledges outstanding professional, educational and personal achievements to the benefit of society and includes a commemorative medal.

Prior to joining the faculties of NC State and UNC-Chapel Hill in 2013, Ligler worked at the U.S. Naval Research Laboratory for 28 years, serving since 1995 as the U.S. Navy senior scientist for biosensors and biomaterials. She is currently working in the fields of biosensors, microfluidics, tissue-on-chip and regenerative medicine; she has also conducted research in biochemistry, immunology and analytical chemistry. ■

Grant elected as 2022 AIChE president

Christine S. Grant has been elected president of the American Institute of Chemical Engineers (AIChE). AIChE is a professional society of over 60,000 members in more than 110 countries. Serving as president is a three-year commitment; Grant is the 2021 president-elect, will

become AIChE president in 2022, and become past-president in 2023. Grant, an AIChE Fellow, has served the Institute as a member of the Board of Directors, a member of the Chemical Technology Operating Council (CTOC) and the Awards and Nominating Committees, as chair of the Minority Affairs Committee and as a member of the steering committee for the Henry T. and Melinda C. Brown Endowment for the Education of Underrepresented Minority Chemical Engineers. Grant, a professor in CBE for more than 30 years, has served as the College’s inaugural associate dean of faculty advancement and is currently working on an Intergovernmental Personnel Act assignment with the National Science Foundation. ■

Jones receives 2020 R.J. Reynolds Tobacco Company Award

Jacob Jones, Distinguished Professor in MSE, is the thirty-sixth recipient of the R.J. Reynolds Tobacco Company

Award for Excellence in Teaching, Research and Extension. Jones gave his award lecture titled, “Embracing Convergence Research: The Journey from Ferroelectric Materials to Nanotechnology, Bayesian Statistics, and Water-Food Systems” through a virtual presentation in November.

The award, established in 1981, honors a College of Engineering faculty member who has demonstrated superiority in several areas of activity that relate to NC State’s three-fold mission of teaching, research and extension.

Jones is a leading researcher in the areas of oxide materials and materials characterization and is a passionate, dedicated educator.

Since 2014, he has served as director of NC State’s Analytical Instrumentation Facility (AIF), which is the largest shared core facility at the University and offers students, faculty members and external clients access to state-of-the-art analytical and materials characterization instrumentation. Since 2015, he has served as principal investigator and director of the Research Triangle Nanotechnology Network, a multi-institutional site within the National Nanotechnology Coordinated Infrastructure that is increasing access to nanotechnology research facilities and education. ■

TOP, LEFT TO RIGHT, RUBEN CARBONELL, ELIZABETH DICKEY, PETER FEDKIW, CHRISTINE GRANT, JACOB JONES, FRANCES LIGLER, MUNINDAR SINGH, PAUL TURINSKY AND CLIFF WANG.



70 years of nuclear engineering

NC STATE WAS THE FIRST UNIVERSITY TO DEVELOP A NUCLEAR ENGINEERING CURRICULUM, OPEN REACTOR

Seventy years ago, when nuclear science was a secretive field, what was then called North Carolina State College began looking toward the future, becoming the first higher-education institution in the world to install a nuclear reactor and establish a curriculum on campus.

In the 2020-21 academic year, the Department of Nuclear Engineering is celebrating its 70th anniversary of the decision to start the program, and the 60th anniversary of the department, which was established in 1961. Today, the department focuses on a wide range of research topics, and its graduate program is ranked third by the *U.S. News & World Report* while its online



master's program is ranked first by *Best Colleges Review*. Its nuclear reactor is one of the most active in the U.S., used by international organizations, companies and students through an online simulator.

"That pioneering spirit is still very much here," said **Kostadin Ivanov**, department head since 2015. "And the vision of the College of Engineering and Dean **Louis Martin-Vega** is a critical point in all of this success."

BUILDING ON MANY FIRSTS

Dean **J. Harold Lampe** decided in 1950 to establish a nuclear engineering curriculum and build the first on-campus reactor, R1, which was operational three years later in Burlington Nuclear Laboratories.

The University continued to increase the department's faculty, and develop textbooks and degree programs. It awarded the first Ph.D. in nuclear engineering in the world in 1954. By 1972, NC State built its fourth reactor, the PULSTAR reactor that is on campus today.

The on-campus reactor is an educational tool for students, bringing to life concepts and methods. Students can train to be reactor operators while other academic institutions are able to witness its operation and analyze real-time data. The PULSTAR reactor is one of 10 Nuclear Science User Facilities commissioned for basic and applied nuclear research.

The pioneering spirit is still very much here.

KOSTADIN IVANOV

Its clients include the Environmental Protection Agency, National Cancer Institute and the International Atomic Energy Agency.

The department is a strong candidate for a microreactor that the Department of Energy (DOE) plans to build on some college campuses. Microreactors are more compact and based on newer nuclear reactor technologies.

"This is a new type of reactor in which to perform education and training of students for advanced reactor technology," Ivanov said. "We are very much in a position to apply for this if there is a call for proposals."

A GROWING DEPARTMENT

Last year, two of the department's longest initiatives — the Consortium for Advanced Simulation of Light Water Reactors, of which the department was a founding member, and the Consortium for Nonproliferation Enabling Capabilities — wrapped up their years-long projects. These DOE-funded consortia helped solve nuclear reactor challenges like longevity and efficiency, leading to better designs, and improved the nation's ability to detect special nuclear material around the world.

Now, the department is in an important transition period.

"We're moving to more distributed funding ... which in certain ways I like more," Ivanov said. "Because it helps establish faculty members as leaders with their own groups. They still cooperate, but they now have capabilities and abilities to participate in different projects."

While faculty members are still focused on the core areas of power application and radiation detection, the department now has 10 research groups that include plasmas, machine learning, artificial intelligence and risk assessment.

The department has grown its plasmas research groups, Fourth State Applications Research Lab (4-STAR) and Plasmas for Life Sciences. Plasma science has many different applications, from industrial to medical, and it is part of the future of nuclear engineering as there is a growing focus on overcoming technical challenges to transition from using nuclear fission to fusion to create power.

PARTNERSHIPS AND PEOPLE

In the last two decades, the department has grown steadily, tripling its number of tenure-track faculty members to 23 and increasing its number of graduate students from 70 to 130.

Nuclear engineering has grown into a collaborative field, and the department values its partnerships with international agencies, national labs, corporations and startups.

Faculty members play important roles within the International Atomic Energy Agency and the Organization for Economic Co-operation and Development's Nuclear Energy Agency, leading research projects and courses focused on a number of initiatives. The department also partners with other countries to help develop infrastructure for nuclear energy.

"This is very beneficial for us because we can advertise our efforts, we can work internationally and recruit international graduate students," Ivanov said. "It increases the visibility of our department."

Currently, faculty members are involved in two teaming agreements focused on developing nuclear reactors that can be licensed within seven years rather than the typical 10 years. These projects — one with Terrapower and General Electric Hitachi Nuclear Energy and the other with X-Energy — are funded by DOE to help increase clean power sources.

In addition to diversifying its research efforts, the department is also focused on bringing in more women and underrepresented minority faculty members, staff members and students. A more diverse department helps develop new perspectives, something they've already had success with on their department advisory council.

"There is much more to be done," Ivanov said. "We're not standing still." ■

STEFANO MENEGATTI, AND NATHAN CROOK, FAR RIGHT, ARE AMONG THE COLLEGE'S FACULTY MEMBERS MOST INVOLVED IN CRISPR RESEARCH.



Few technological developments have created as much of a buzz as CRISPR, the gene editing tool that, like scissors, can cut DNA, making it much easier to create edits that can cure severe genetic and infectious diseases, or improve crop resistance to disease and drought.

In just a few years, CRISPR has revolutionized biological sciences and opened avenues across engineering, biomanufacturing and medicine that might have never been possible — or at least not as easy.

At the College of Engineering, faculty members in the Department of Chemical and Biomolecular Engineering (CBE) are growing a rich portfolio of CRISPR-focused technologies by introducing novel CRISPR-Cas reagents, using CRISPR techniques to engineer new organisms and developing new bioprocesses to mass manufacture CRISPR products in anticipation of a slew of clinical approvals from the U.S. Food and Drug Administration.

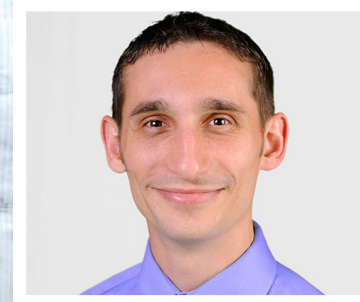
“I think it is so unique of NC State to be the home of developers, manufacturers and users of CRISPR,” said **Stefano Menegatti**, assistant professor in CBE. “These three groups of scientists must listen to each other and work with each other to ensure the success of the CRISPR revolutions.”

ENDLESS POSSIBILITIES



Engineering research is creating CRISPR breakthroughs

CHASE BEISEL, BELOW LEFT, AND RODOLPHE BARRANGOU.



WHAT IS CRISPR?

CRISPR, which stands for “clustered regularly interspaced short palindromic repeats,” was originally discovered as a defense mechanism by bacteria to protect against viruses. The DNA repeats are interspersed with small segments called “spacers,” which bacteria take from viruses and use as a “memory” to recognize and stop viruses that attack again. A portion of the CRISPR section is then copied and processed into CRISPR RNA (crRNA). The strand of crRNA guides the Cas protein, or “CRISPR associated” protein, to cut and deactivate the virus’ DNA.

The technology today known as CRISPR-Cas is a toolbox of enzymes adapted from that “bacterial immunity” system and was first developed in 2012. Scientists use CRISPR to precisely cut DNA and then generate a desired change that is incorporated when the DNA repairs itself. Using this tool, possibilities are endless.

DEVELOPING, USING AND
MANUFACTURING CRISPR AT NC STATE

Rodolphe Barrangou, the Todd R. Klaenhammer Distinguished Professor in the Department of Food, Bioprocessing and Nutrition Sciences within the College of Agricultural and Life Sciences, leads the CRISPR Lab at NC State. He was one of the first to show how bacteria incorporated new spacers into their CRISPR regions after viral attacks in a seminal 2007 paper, and has remained one of the field’s leading researchers.

“(NC State) actually used to be quite ahead of the curve, in covering the whole CRISPR spectrum,” he said. “Others have caught on since then. And it’s been democratized enough that other universities can aspire to catch up, is a nice way to put it.”

As a land grant university, NC State is well-positioned to turn CRISPR discoveries into usable technology.

“That’s where engineering programs come in, so we can take some of that science and turn that into tech. CRISPR, the immune system to CRISPR, the genetic tech,” said Barrangou. “And then if you are applications-minded, if you are real world, Grand Challenges, humanity-minded, like we are, some of what you should do is apply that technology and deploy it toward addressing real problems.”

Within CBE, Menegatti and fellow assistant professor **Nathan Crook**, along with associate professor **Chase Beisel**, are working on developing scalable tools that will increase the availability of CRISPR reagents — such as the CRISPR-Cas proteins and the guide RNA — that are needed to implement CRISPR technologies.

Crook’s research focuses on using CRISPR to engineer microbes to improve human and environmental health. For example, microbes in our gut can be engineered to degrade a toxin. In the ocean, they can be made to break down microplastics. Within roots, engineered microbial bacteria can help plants grow faster.

“CRISPR is a great tool because it’s basically scissors that you can guide to the genome in a very specific way,” Crook said. “Before CRISPR, that ability was very hard to come by. CRISPR, if you design it right, will cut in exactly one place and nowhere else.”

On the biological side, Beisel’s research group is continuing to examine how bacteria use CRISPR to fight off attacks and how their findings can be translated to better CRISPR technologies. Many bacteria have native CRISPR systems, and while Cas9 is the protein most commonly associated with gene editing, it’s one of many that can cut DNA, Beisel explained.

"CRISPR is a great tool
because it’s basically
scissors that you can
guide to the genome in
a very specific way."

NATHAN CROOK



“My group has been trying to find other ones that exist in nature, and have functions that we could use for different technology purposes,” he said.

As CRISPR tools become more widely understood and utilized by research groups, industries, and — eventually — clinics, the technology to produce them must keep up. That’s where the biomanufacturing side comes in, which both Crook and Beisel agreed is strong at NC State.

Menegatti and his team are developing technology that will make it easier to scale up the production of CRISPR tools to further advance science and address real-world problems.

His lab develops “affinity adsorbents,” namely filter-like materials functionalized with synthetic binders known as “ligands,” to purify biological therapeutics from complex sources. In his recent project related to CRISPR, he developed an affinity adsorbent to selectively purify CRISPR-Cas9 from bacterial cell culture fluids.

“To our knowledge, this is the first adsorbent ever made for the scalable purification of CRISPR Cas proteins,” he said.

This process is just one of a series of ligands Menegatti is developing to make the purification of biomolecular pharmaceuticals cheaper and faster.

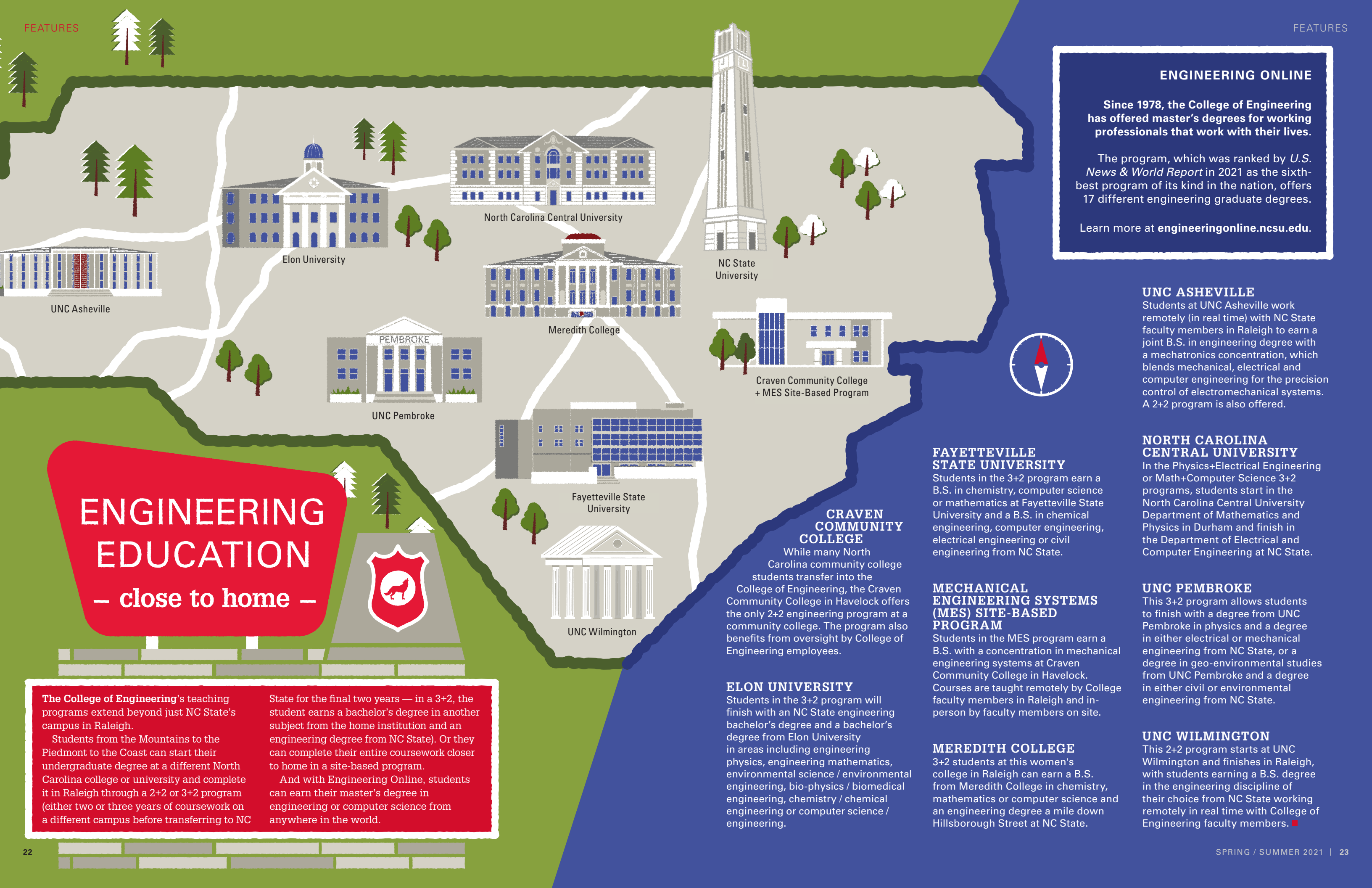
“Our goal is to develop today the affinity technology that will serve the pharmaceutical industry of tomorrow, by providing it with a toolbox that will accelerate, simplify and reduce the cost of the bioseparation segment of the biopharmaceutical manufacturing pipeline,” he said. “This way, more drugs with higher efficacy and safety will become available to more people.”

THE BIG PICTURE

Taken all together, CRISPR is a complex and exciting technology, with so much untapped potential. With support from the Office of Research Commercialization, NC State and COE faculty members have launched new companies from their research, including Locus Biosciences, co-founded by Barrangou and Beisel, and LigaTrap, co-founded by Menegatti.

The toolboxes and frameworks are there — with more in development — for future breakthroughs that include improved pest management and crop disease resistance that ensure global food supply keeps up with demand, as well as better treatments of diseases.

“What excites me is that on one hand, we’re studying this really quirky, fascinating defense system that’s in bacteria,” said Beisel. “But at every turn, there can be a new discovery that becomes an entirely new technology, but also technology that can have a very real and immediate impact on society.” ■



ENGINEERING ONLINE

Since 1978, the College of Engineering has offered master's degrees for working professionals that work with their lives.

The program, which was ranked by *U.S. News & World Report* in 2021 as the sixth-best program of its kind in the nation, offers 17 different engineering graduate degrees.

Learn more at engineeringonline.ncsu.edu.

UNC ASHEVILLE

Students at UNC Asheville work remotely (in real time) with NC State faculty members in Raleigh to earn a joint B.S. in engineering degree with a mechatronics concentration, which blends mechanical, electrical and computer engineering for the precision control of electromechanical systems. A 2+2 program is also offered.

NORTH CAROLINA CENTRAL UNIVERSITY

In the Physics+Electrical Engineering or Math+Computer Science 3+2 programs, students start in the North Carolina Central University Department of Mathematics and Physics in Durham and finish in the Department of Electrical and Computer Engineering at NC State.

UNC PEMBROKE

This 3+2 program allows students to finish with a degree from UNC Pembroke in physics and a degree in either electrical or mechanical engineering from NC State, or a degree in geo-environmental studies from UNC Pembroke and a degree in either civil or environmental engineering from NC State.

UNC WILMINGTON

This 2+2 program starts at UNC Wilmington and finishes in Raleigh, with students earning a B.S. degree in the engineering discipline of their choice from NC State working remotely in real time with College of Engineering faculty members. ■

FAYETTEVILLE STATE UNIVERSITY

Students in the 3+2 program earn a B.S. in chemistry, computer science or mathematics at Fayetteville State University and a B.S. in chemical engineering, computer engineering, electrical engineering or civil engineering from NC State.

MECHANICAL ENGINEERING SYSTEMS (MES) SITE-BASED PROGRAM

Students in the MES program earn a B.S. with a concentration in mechanical engineering systems at Craven Community College in Havelock. Courses are taught remotely by College faculty members in Raleigh and in-person by faculty members on site.

MEREDITH COLLEGE

3+2 students at this women's college in Raleigh can earn a B.S. from Meredith College in chemistry, mathematics or computer science and an engineering degree a mile down Hillsborough Street at NC State.

CRAVEN COMMUNITY COLLEGE

While many North Carolina community college students transfer into the College of Engineering, the Craven Community College in Havelock offers the only 2+2 engineering program at a community college. The program also benefits from oversight by College of Engineering employees.

ELON UNIVERSITY

Students in the 3+2 program will finish with an NC State engineering bachelor's degree and a bachelor's degree from Elon University in areas including engineering physics, engineering mathematics, environmental science / environmental engineering, bio-physics / biomedical engineering, chemistry / chemical engineering or computer science / engineering.

North Carolina Central University

NC State University

Meredith College

Craven Community College + MES Site-Based Program

UNC Pembroke

Fayetteville State University

UNC Wilmington

Elon University

UNC Asheville

ENGINEERING EDUCATION — close to home —

The College of Engineering's teaching programs extend beyond just NC State's campus in Raleigh.

Students from the Mountains to the Piedmont to the Coast can start their undergraduate degree at a different North Carolina college or university and complete it in Raleigh through a 2+2 or 3+2 program (either two or three years of coursework on a different campus before transferring to NC

State for the final two years — in a 3+2, the student earns a bachelor's degree in another subject from the home institution and an engineering degree from NC State). Or they can complete their entire coursework closer to home in a site-based program.

And with Engineering Online, students can earn their master's degree in engineering or computer science from anywhere in the world.

THE RIGHT SPACE

Fitts-Woolard Hall provides the environment that faculty members and students need to succeed

Kevin Han joined the faculty of the Department of Civil, Construction, and Environmental Engineering (CCEE) in 2016. With the opening of Fitts-Woolard Hall, his research group now has laboratory space.

Han, an assistant professor, conducts research creating and using existing computer vision and machine learning analytics that leverage visual data and Building Information Modeling to improve communications, efficiency and safety in construction sites.

In Mann Hall, CCEE's home on North Campus since the building opened in 1964, Han had his own office and offices for graduate students. But, because of limited availability of laboratory space in the building, he and his group had to conduct their research in the Constructed Facilities Laboratory (CFL) on Centennial Campus. Mann and the CFL are a couple of miles away from each other. And because the CFL is a shared facility, they did not have their own desks or dedicated space for storage and conducting experiments.

"It was definitely not convenient," Han said.

In Fitts-Woolard Hall, the College's newest building on Centennial, Han has a dedicated lab on the first floor with open space and high ceilings. His graduate students are using a shake table, which can be used to test the seismic performance of structures, to test whether a visual monitoring system can gather data on the structural performance more effectively than an accelerometer.

“

We are getting much closer to completing a vision for the College.

LOUIS MARTIN-VEGA

”

Moving to Centennial will also make it easier for Han to interact with colleagues he collaborates with in mechanical and electrical engineering and in computer science.

Fitts-Woolard Hall, which opened in summer 2020, is the new home of CCEE, the Edward P. Fitts Department of Industrial and Systems Engineering (ISE) and the dean’s administrative offices.

The College now has eight of its nine academic departments on Centennial Campus. It’s part of a decades-long process to move the entire College over and take full advantage of one of the country’s most innovative academic research campuses. Unifying on Centennial will give the College the tools needed to take a place as one of the preeminent public colleges of engineering in the United States.

“The opening of Fitts-Woolard Hall represents a tremendous step forward in reaching our full potential,” said **Louis Martin-Vega**, engineering dean. “We are getting much closer to completing a vision for the College.”

Current and future needs

For CCEE and ISE, the move means leaving behind antiquated facilities that don’t match up with the ways in which today’s cutting-edge engineering research is conducted, either in capacity or functionality.

ISE moved out of the former Daniels Hall (known today by its street address — 111 Lampe Dr. — until it is renamed), which opened in 1926.

Unlike in Fitts-Woolard Hall, laboratory spaces in both buildings were inflexible. When additional electrical capacity was needed to power labs in Mann Hall, the department and College had to consider sizable investments in infrastructure, or just go without.

Cassie Castorena, an associate professor in CCEE who is part of a team of researchers in the department working on asphalt materials, ran into that electrical capacity problem in Mann. Her research team worked in several rooms in the building’s basement. “I don’t know if any of those spaces were originally intended for the purpose that we were using them for,” she said.

Castorena didn’t have dedicated space in Mann for her group’s unusual storage requirements — they use a lot of asphalt binder and aggregate materials. They utilized space next door in Broughton Hall and in University surplus facilities on another part of campus. Now, she has a 7,000-square-foot lab space that is functional, with adjacent storage capacity.

“It meets all of our current needs, and I anticipate it will meet all of our needs in the future,” she said.

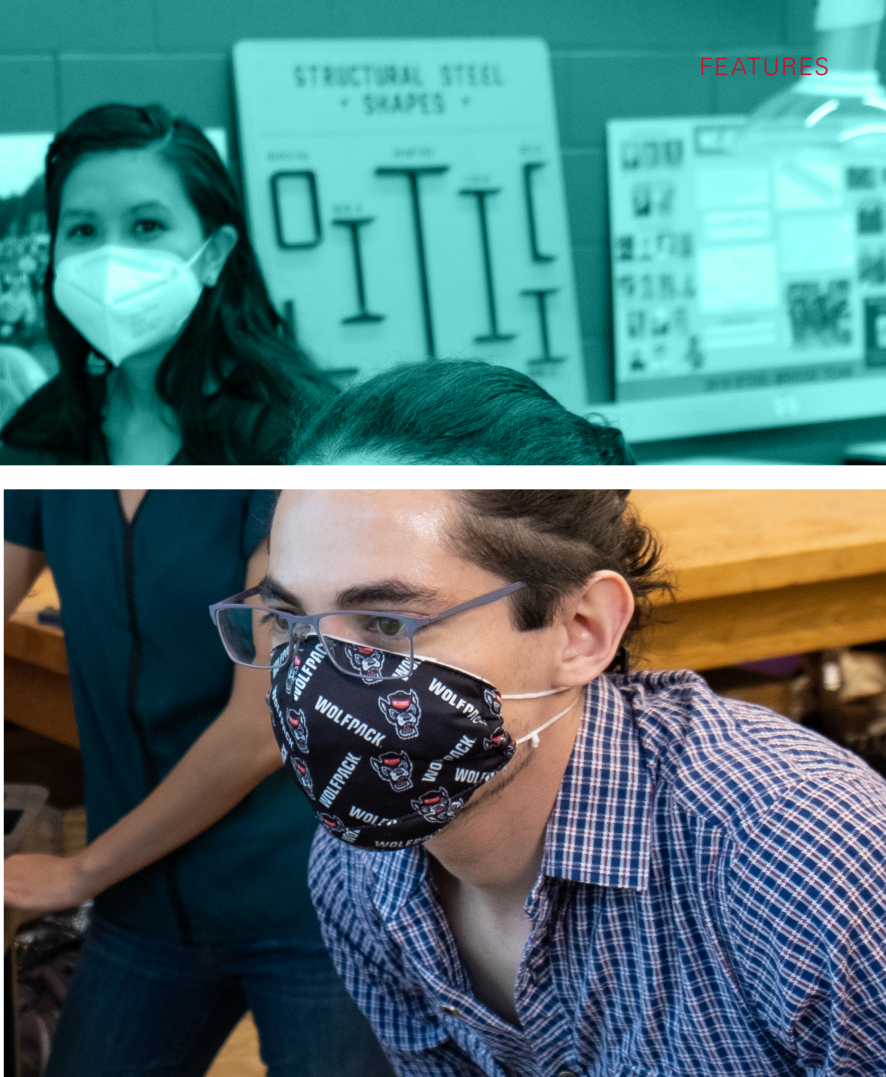
Laboratory spaces in the old buildings also weren’t very accessible. That’s not the case in the new facility, which uses “engineering on display” as a design concept. Labs on the first two floors of the building are placed in prominent spots with floor-to-ceiling glass walls so that visitors can see the important work that is going on inside.

ISE’s Center for Additive Manufacturing and Logistics (CAMAL) occupies a prominent spot on the second floor and is visible from outside the building on the Engineering Oval and in the lobby.

In 111 Lampe, CAMAL had six additive metal printers in the same room. The risk of cross-contamination severely limited when the machines could be run and necessitated a lot of extra time spent cleaning. A storage room where the powders used in the machines was kept was not close enough to be efficient, said **Ola Harrysson**, CAMAL director and Edward P. Fitts Distinguished Professor in ISE.

In the new building, each machine has its own room with its own HEPA filter and materials storage nearby in what is referred to as the “clean corridor.” CAMAL’s machines are arranged in a much more efficient layout so that teaching machines, which often are crowded with students, aren’t close to higher-end machines.

Nearby, the Fincher Lab provides the same flexibility for student groups in CCEE.



The space used by the groups in Mann Hall was next to a loading bay (students had to stop their work if a delivery was coming in) and each group had to use the same fixed benchtop. In the new space, each group has its own rolling tool chest.

“This allows us to make this space into whatever project function is needed at the time,” said **Steve Welton**, a senior lecturer in CCEE who serves as a faculty advisor for a few of the groups.

The space has a high ceiling, plenty of storage and good natural light from the outside. It’s well ventilated and features an eye wash station. Plus, in keeping with the engineering on display concept, it’s in a prominent spot on the first floor where other students can see what the groups are doing and potentially take an interest in joining.

The Earthquake Engineering Research Institute student chapter uses Fincher Lab as a working area to build and test structures that can help promote students’ knowledge of structural engineering and seismic design, said chapter president and Ph.D. student **Jessi Thangjitham**.

The lab is home to the chapter’s shake table and offers a working space for students to build a 17-story balsa wood structure under realistic earthquake ground motion for an international Seismic Design Competition.

Closing the gap

The project represents a new funding model for NC State and the UNC System, with the College pledging to raise \$60 million toward the cost of construction through private philanthropy. Thanks to the generous \$25 million gift from engineering alumni **Edward P. Fitts** and **Edgar S. Woolard** and commitments made by more than 400 alumni and friends, the College has just over \$49 million in pledges — leaving an \$11 million gap to fill. ■

Though the building may be complete, the College continues to seek support from alumni and asks them to step up and help fill the funding gap. If you are interested in learning more about fundraising efforts for Fitts-Woolard Hall, please contact **Hannah Kunkel** with the NC State Engineering Foundation at heallen3@ncsu.edu or **919.515.7458**.



TIMOTHY HOLDER

GRAD STUDENTS MAKE THE COLLEGE GO

GRADUATE STUDENTS DEVELOP and contribute to groundbreaking research, mentor undergraduate students, help bring in valuable funding and make the College of Engineering feel welcoming. Their day-to-day lives are busy, and without them, the College couldn't be the world-class research enterprise that it is today.

Since the beginning of **Louis Martin-Vega's** tenure as dean, he has focused on increasing the number of graduate students, especially Ph.D. students. As faculty members have expanded their research activities, more graduate students are needed to work on solving these research problems. And as the College has become more successful in its research endeavors, it has ascended through the rankings.

"NC State Engineering graduate students have a 'can-do' attitude that aligns perfectly with NC State's Think and Do motto. They work on real problems, many supported by industry or research centers, consortia or laboratories," said **Richard Gould**, interim associate dean of graduate programs. "Many can attend graduate school at any of the top schools in the country, but they chose NC State because of our excellence."

MEET SOME OF THE COLLEGE'S EXCELLENT PH.D. STUDENTS

LAUREN ALVAREZ

SECOND-YEAR PH.D. STUDENT
IN THE DEPARTMENT OF COMPUTER SCIENCE

Lauren Alvarez wants to use computer science as a tool to expose and combat racial and gender discrimination. As a first-generation college student, Alvarez was involved in the McNair Scholars Program, which aims to help low-income, first-generation students or underrepresented students learn and prepare for graduate school. During a summer research program, she worked on a project about news bias detection.

"I realized computer science could be used as a social justice tool, and to change some of the discrimination that people felt, especially people like me or those in the communities I was involved in," she said. Alvarez is still finishing her preliminary research before starting her dissertation. She recently worked with undergraduate students to develop a racial equity education chatbot using the IBM Watson framework.

Outside of the classroom, she is a passionate mentor for students and is still involved with the McNair Scholars Program. "I think James Baldwin said it best — that when one becomes educated and conscious, one begins to examine the society in which he is being educated," she said. "I think that that's a responsibility of people who are educated: to use their education and share it, to not be gatekeepers." Alvarez's goal is to become a professor continuing her research and mentoring students through teaching to expand awareness and access to higher education and STEM.



LAUREN ALVAREZ

TIMOTHY HOLDER

FIFTH-YEAR PH.D. STUDENT
IN THE UNC / NC STATE JOINT
DEPARTMENT OF BIOMEDICAL ENGINEERING

As a student with a long list of interests, Timothy Holder knew that he wanted to be in an environment where he could acquire a skill set to take a product from ideation to market. He found that in the UNC / NC State Joint Department of Biomedical Engineering, where his research has primarily focused on the development of wearable devices.

"I've had a tremendous amount of collaboration," he said. "To be able to collaborate with other people who think differently than you, who have a different perspective, made me a much better engineer, and, I think, human." Holder is involved with several research teams, but his main project is an interdisciplinary one that uses wearable devices to study human-dog interactions to optimize animal therapies for PTSD or cancer. One of his main roles has been to ensure that the study runs smoothly, as people in the community are the ones reporting back data.

“(The Ph.D. program) has really required an active mind and people who want to solve problems quickly,” he said. “It’s pretty amazing, and it gives me the sense that biomedical engineering and the biological sciences in the health space in general have a very, very bright future.”

Holder has also been a consistent mentor for undergraduate students, and he likes to bring in students who don’t have an engineering background.

“My goal is to get more people introduced to this field and to understand that they can do these things even though they thought otherwise,” he said.

MEGAN JOHNSON

**FOURTH-YEAR PH.D. STUDENT
IN THE DEPARTMENT OF CIVIL, CONSTRUCTION,
AND ENVIRONMENTAL ENGINEERING**

Megan Johnson, who is working on her Ph.D. in environmental engineering, has taken an interdisciplinary approach to her research, using computer models to understand how smoke from wildfires and prescribed burns may affect public health. Additionally, she is creating and sending surveys through the NC State Parks Department to directly ask people their thoughts regarding fires.

“We’re trying to improve communications related to prescribed burning so that we might address potential misconceptions about the practice, and maybe to be able to understand where people might be more apprehensive about the practice,” she explained.

Johnson grew up in Colorado, where she saw early effects of climate change while outdoors with her family, and she developed an interest in atmospheric science and air quality.

Her computer modeling results have helped land managers understand smoke impacts from prescribed burns, which are necessary for certain ecosystems and help reduce wildfire risk. Her public surveys, which she presented at an international conference in December, are of interest to scientists in other parts of the U.S. who deal with prescribed burns and wildfires.

After graduation, she wants to find a role that combines technical research with outreach and communication.

“It’s important to keep (the public) in mind and understand what their concerns might be and how you might be able to address those concerns while still helping them, rather than just creating science, and hoping that people will understand,” she said.



MEGAN JOHNSON

SAYAK MUKHERJEE

**PH.D. 2020
THE DEPARTMENT OF ELECTRICAL
AND COMPUTER ENGINEERING**

As the world moves toward more sustainable energy sources like solar and wind, the power grid must evolve to handle more complex and varied energy systems. Sayak Mukherjee’s research at the intersection of control systems, machine learning and power systems aims to make those adaptations more efficient.

“I want to make sure that we decrease the carbon footprint and improve sustainability. But to do that, you need to use techniques from the fields of controls, optimization and learning,” he said. “So, it’s a balance between your technical tools — control theory and machine learning — and your application domain expertise, which is the power and energy systems.”

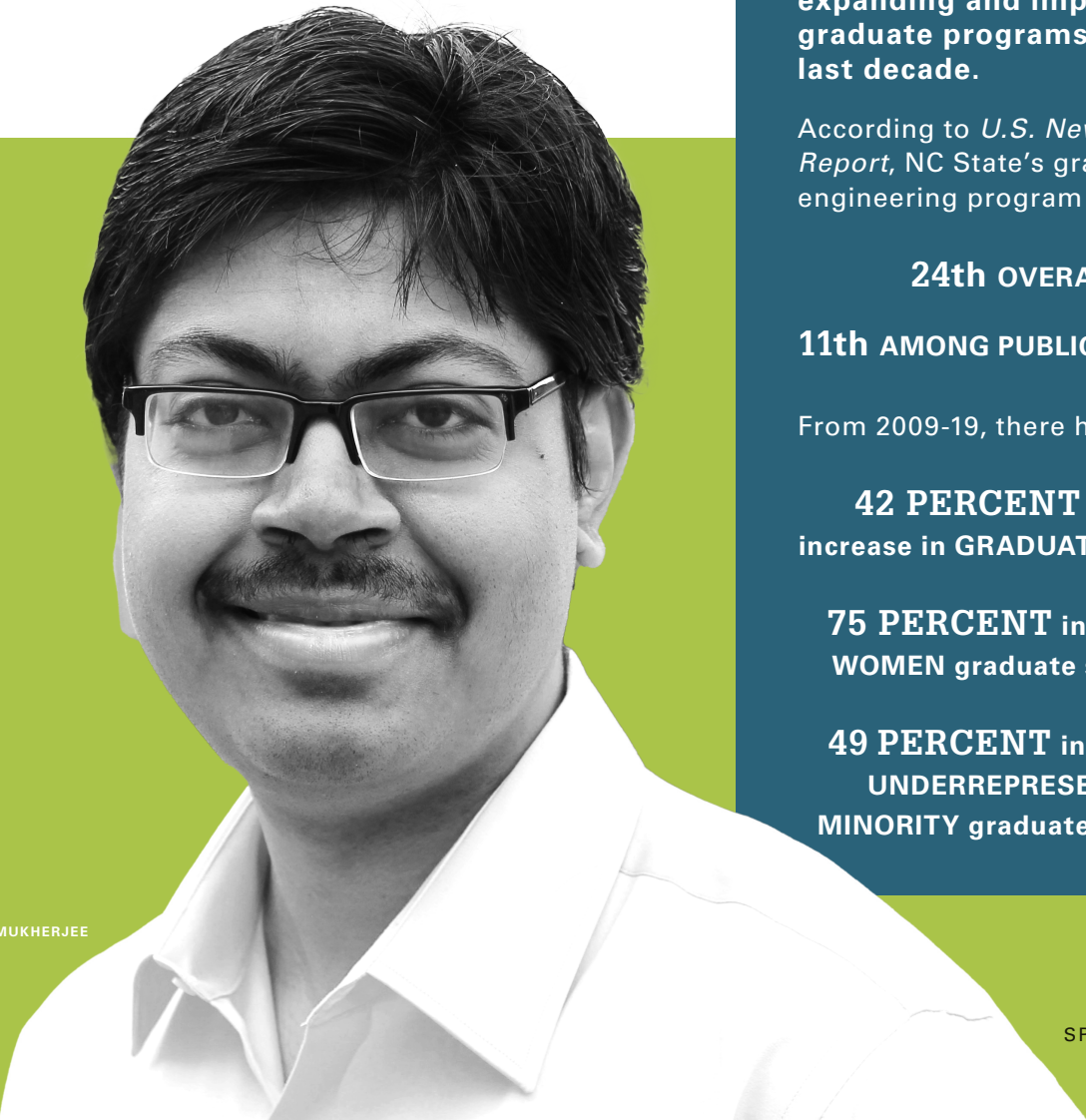
Control theory is essential to provide desired performances for dynamical systems such as the power grid, Mukherjee explained. But as the grid becomes more complex, tractable control designs

for the grid become heavily data-dependent, which requires the use of machine learning.

Now a postdoctoral research associate at Pacific Northwest National Laboratory (PNNL), Mukherjee’s results from his research at NC State have already made an impact on the industry.

Mukherjee grew up in Kolkata, India, and he was drawn to NC State for graduate school because of the FREEDM Systems Center, which is developing a smarter electricity grid that can efficiently provide power from renewable sources.

At PNNL, he is working on several projects related to developing learning techniques for dynamics and control with applications to energy systems, and he wants to eventually work in a leadership role guiding technical lab research strategies related to optimization and control of the power and energy sector. ■



SAYAK MUKHERJEE

BY THE NUMBERS

The College has made significant strides in expanding and improving its graduate programs over the last decade.

According to *U.S. News & World Report*, NC State’s graduate engineering program is:

24th OVERALL

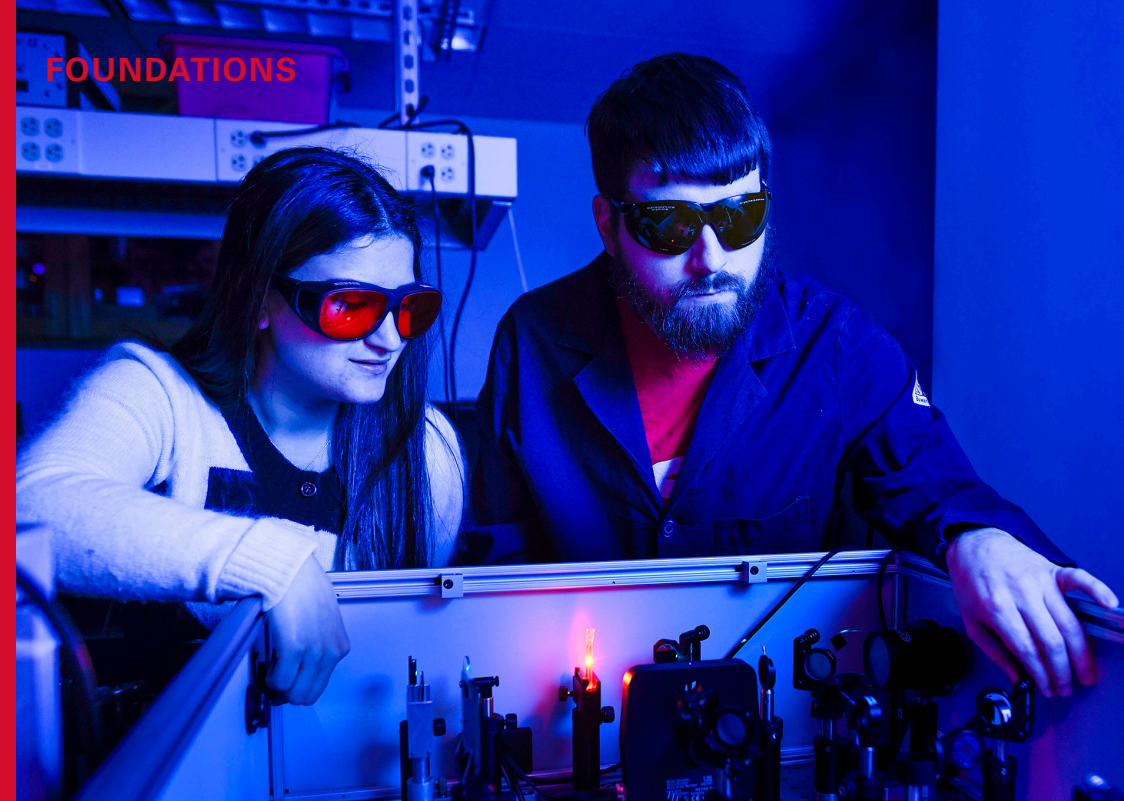
11th AMONG PUBLIC SCHOOLS

From 2009-19, there has been a:

42 PERCENT overall increase in GRADUATE students

75 PERCENT increase in WOMEN graduate students

49 PERCENT increase in UNDERREPRESENTED MINORITY graduate students



College of Engineering meets campaign fundraising goal

“It’s a testament to the dedication of our alumni and friends and how well they understand the impact that this College can have and why it’s worth supporting.”

— GRIFFIN LAMB

NC State’s College of Engineering has met its ambitious \$230 million fundraising goal for the University’s Think and Do the Extraordinary capital campaign.

This generous financial support from alumni and friends of the College will grow NC State Engineering’s impact for generations to come by funding graduate fellowships, professorships, undergraduate scholarships and support for student programs and capital projects.

“We set an ambitious goal and were amazed that we met that goal a year ahead of schedule,” said **Griffin Lamb**, assistant dean for development and alumni relations and director of the NC State Engineering Foundation. “It’s a testament to the dedication of our alumni and friends and how well they understand the impact that this College can have and why it’s worth supporting.”

The record-breaking Think and Do the Extraordinary campaign launched in October 2016 and is set to conclude at the end of 2021. NC State surpassed its overall goal of \$1.6 billion in November 2019, more than two years ahead of schedule.

Throughout the campaign, the College prioritized funding for student scholarships, professorships and the construction of the new Fitts-Woolard Hall on Centennial Campus, as well as for many more areas requiring private, programmatic support, such as the College’s Women and Minority Engineering Programs (WMEP).

With the campaign under way, the University broke ground on Fitts-Woolard Hall in April 2018. A \$25 million gift from alumni **Edward P. Fitts Jr.** and **Edgar S. Woolard Jr.** bolstered fundraising efforts for the building, which will be home to the Department of Civil, Construction, and Environmental Engineering (CCEE); the Edward P. Fitts Department of Industrial and Systems Engineering (ISE); and the dean’s administrative offices, unifying the College on Centennial Campus.

The College has always made efforts to increase the availability of student scholarships, but these have never been more important amidst a pandemic affecting families’ budgets and students’ ability to afford higher education.

For **Zhanía Deterville**, a native of the U.S. Virgin Islands, paying out-of-state tuition to study at a mainland university was difficult. The Dr. Chisa K. Brookes Scholarship has helped Deterville, a senior in the UNC / NC State Joint Department of Biomedical Engineering, overcome that challenge.

On campus, Deterville is involved in the National Society of Black Engineers, The Helping Hands Project, National Society of Leadership and Success and the Caribbean Student Association. After graduation, she plans to return home for her career, with a focus on the health of the residents of the U.S. Virgin Islands, namely St. Croix.

“Receiving this scholarship is just another factor that motivates me to continue to strive for excellence,” Deterville said. “The scholarship is providing me with the ability to study the field of biomedical engineering at NC State, a challenging learning environment. I will have the opportunity to gain the qualities and skills needed not only to succeed as a biomedical engineer, but also for effective leadership and a successful collegiate life. Let me again express my sincere gratitude for the generous scholarship awarded to me, it has made a profound impact on my life.”

Though the College and University have met their campaign goal, fundraising efforts will continue for ongoing student, faculty and programmatic support.

More than 72 percent of NC State undergraduates apply for financial aid; the average need is \$16,431, while the average scholarship or grant is \$9,133. Sophomore **Rylee Sepesi** is studying paper science and engineering with the help of the Mark and Robin Wyatt Scholarship and is planning a career in industry.

“With this scholarship I will not be as financially burdened,” Sepesi said. “This donation alleviated some anxiety I have experienced due to not having a college fund. This scholarship has allowed me to start my college career with less stress and being able to focus more on my studies versus worrying excessively

about being able to afford college.”

Though Fitts-Woolard Hall has opened, the College still needs to raise \$11 million in additional support to meet its \$60 million fundraising commitment. Without meeting that goal, the College would have to borrow to help close the gap, taking money away from necessary programs.

“Those whose lives have been impacted by this College know the value of its research, education and extension activities,” said **Louis A. Martin-Vega**, dean of the College of Engineering. “These are the people who have given so generously to help us meet our fundraising goal. They are making a tremendous impact on the lives of our students and faculty members and they have my sincere gratitude.”

To learn more about the campaign, including how to contribute, visit campaign.ncsu.edu. ■

A total of **19,282** donors have supported the College during the campaign. With their help:

202 scholarships and fellowships have been created

30 named professorships have been established

181 new planned gifts have been committed

THINK
AND DO
THE
EXTRAORDINARY



The Campaign
for NC State

Fitts-Woolard Hall is driven by alumni support

Fitts-Woolard Hall, the College’s newest building on NC State’s Centennial Campus, opened in summer 2020 and is becoming busier by the month.

During the spring 2021 semester, more students attended classes in person in the facility, laboratories started cranking up and faculty and staff members began unpacking in their new offices.

The opening of the new home of the Department of Civil, Construction, and Environmental Engineering (CCEE); the Edward P. Fitts Department of Industrial and Systems Engineering (ISE); and the dean’s administrative offices is a key moment in the College’s history.

Taking another important step toward finishing the move to Centennial will continue NC State Engineering’s climb to a leading spot among public colleges of engineering in the United States.

More than 300 alumni donors have supported the College in its effort to raise \$60 million in private donations to help fund construction. Meet two College of Engineering alumni who recognize the impact that the new facility is making and decided to support the fundraising effort.

LISA COOK

Growing up near Raleigh, NC, **Lisa Cook** learned the importance of teamwork and service from her family early on. She got to know NC State’s campus from a young age, attending engineering camps, gymnastic meets and Kay Yow basketball camp — studying industrial and systems engineering and getting involved on campus was a natural progression.

As a freshman, Cook lived on the top floor of the Women in Science and Engineering (WISE) Village, with a skyline view of downtown Raleigh. It was there that she met a group of young women who changed her life.

“It made a difference to be part of a group of strong, amazing and smart women ready to conquer the engineering world,” she said.

Cook stayed busy at NC State, doing a co-op with BMW that included time working in Munich, Germany, and volunteering as an engineering ambassador, WISE mentor and an orientation counselor.

“I have been reminded many times throughout my life how precious life is. It is important to seize every phase of life and try to make it better for those around me along the way,” she said. In college, that meant seeking leadership positions in the College, University, academic societies and Greek life, as well as enjoying intramural sports. In her professional life, that has meant building an influential brand to strengthen the pipeline of women in technology, serving as a counselor and mentor in a male-dominated financial and technology sector and leading innovative, global programs.

In 2013, she accepted a consulting job in Charlotte with Ernst & Young, ending up being the first woman in the office’s newly created technology program.

With the support and confidence fostered in WISE, the College and department, she entered the workforce as an ABET-accredited engineer from a top ISE department.

Now with Bank of America in enterprise data management operations, Cook works to ensure the company has quality data to make informed decisions.

The experiences and people at NC State changed her life, Cook said. She is proud of her home department for the quality of education and invaluable skill set every student leaves with.

When given a chance to support ISE by contributing to the Fitts-Woolard Hall building effort, the choice was easy. “If I can have a positive impact on someone’s collegiate experience, and contribute to the legacy of NC State — that’s an opportunity I can’t pass by.”

HANS WARREN

Hans Warren studied in Mann Hall, the previous home of CCEE on NC State’s North Campus, and graduated in 1984 with a degree in civil engineering, construction option. The company he leads as president and CEO, Warco Construction, Inc. in Charlotte, did interior work on his home department’s new building. He’s also supporting the construction effort as an alumnus donor.

“I’m excited to be able to give back, particularly in a way that will have benefits for years to come,” Warren said.



LISA COOK



HANS WARREN

As the son of an NC State engineer, choosing to study in Raleigh made sense. It was an exciting time to be on campus — in the spring of 1983, Warren was trying to focus on his junior-year classes while watching Jim Valvano’s men’s basketball team make an improbable nine-game run to win both the Atlantic Coast Conference tournament and then a national championship. On the evening of the national championship game against the University of Houston, Warren watched in his apartment on Gorman Street and then celebrated on the Brickyard.

Warren takes inspiration from Valvano’s message, delivered during a courageous battle with cancer, to “never give up.”

“When you have challenges, you don’t quit,” he said. “You have challenges, but you keep moving forward.”

A year after graduation, Warren started Warco with his father, Bud, and brother, Bill, as a drywall and fireproofing contractor. In 2002, his father passed

away. His brother died a year later, and Warren found himself as the sole proprietor.

Today, Warren is the president and CEO, and the company’s offerings have expanded to include acoustical treatments, window treatments and fireproofing.

Warren has stayed in touch with NC State as a board member for the Wolfpack Club, the CCEE Advisory Board, the University Foundation and now the NC State Engineering Foundation. He has made donations to the University in memory of his father and brother, including endowing a scholarship in the Poole College of Management in honor of Bill, who received his degree from one of its programs.

Warren is married to the former Elizabeth Carver Morrow of Charlotte. Together, they have blended their family and share four grown children. His sons Bob and Trey are both CCEE graduates who also work for Warco.

“It’s been a generational benefit, what engineering has done for the Warren family,” he said. ■

“It is important to seize every phase of life and try to make it better for those around me along the way.”

LISA COOK

Butler, Stutts and Washington receive Distinguished Engineering Alumnus award



FROM LEFT TO RIGHT, LINDA BUTLER, CARL STUTTS JR. AND GREGORY WASHINGTON.

LINDA BUTLER, CARL STUTTS JR. and GREGORY WASHINGTON received the Distinguished Engineering Alumnus award (DEA) from the College for 2020. The DEA award is the highest honor the College of Engineering bestows upon its graduates.

After earning a bachelor’s degree in nuclear engineering in 1986, Butler earned a master’s in medical physics from the University of Florida and a medical degree from UNC-Chapel Hill. Since 2009, she has served as vice president of medical affairs and chief medical officer at UNC REX Healthcare in Raleigh, where she is responsible for quality and performance improvement, infection prevention, risk management, case management and medical staff affairs for a hospital with more than 7,400 staff members and multiple facilities.

Prior to this appointment, Butler specialized in pediatrics and served as a managing partner for Capitol Pediatric and Adolescent Center.

Butler has provided many significant contributions to the College through her interactions with COE leadership and as a mentor for its faculty members and students. She has organized visits to REX Hospital for current nuclear engineering students interested in pursuing a healthcare profession.

She currently serves on the NC State Engineering Foundation Board of Directors and was inducted into the Nuclear Engineering Distinguished Alumni Hall of Fame.

Stutts retired as chairman and CEO of Cyanco, a leading global supplier of sodium cyanide for gold mining, and is focused on work with nonprofits.

The 1968 graduate began his career as a production engineer at Union Carbide and then worked at Tenneco, rising through management ranks to become a corporate vice president. Along the way, he received an MBA from the University of Houston. He transitioned to Columbine Venture Funds, where he became a general

partner. He then served as president and CEO of Texas Petrochemical Holdings before joining Cyanco.

He serves on the Engineering Foundation board and was honored by the Department of Chemical and Biomolecular Engineering (CBE) as a Distinguished Alumnus.

Stutts has been a very generous supporter of the College and CBE. He has funded scholarships for both the department and College. He has also donated to support the construction of Fitts-Woolard Hall and is an annual donor to the College of Engineering Director’s Fund.

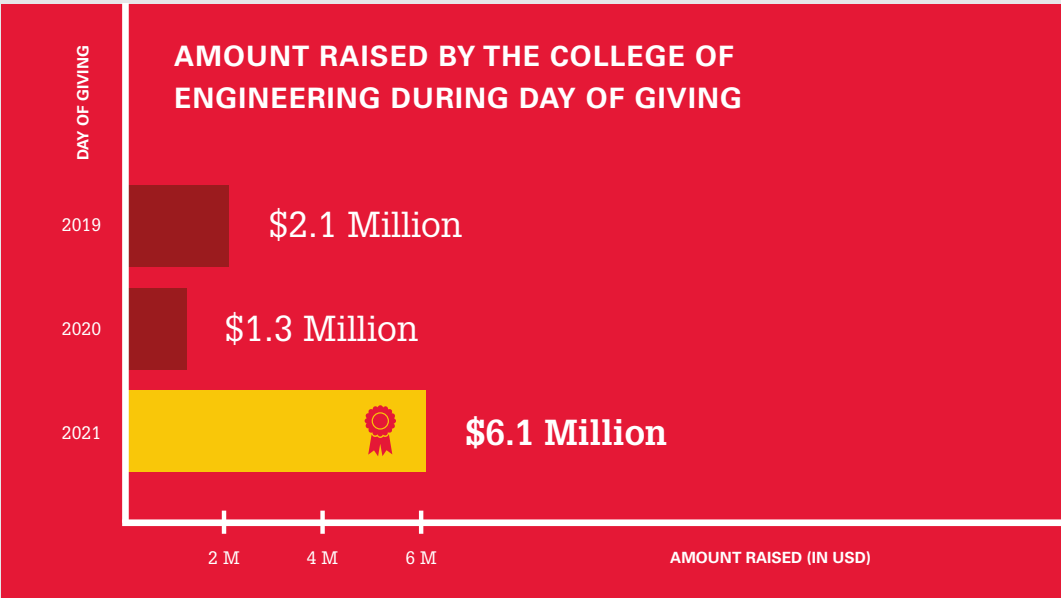
Washington earned bachelor’s, master’s and doctoral degrees in mechanical engineering from NC State in 1989, 1991 and 1994, respectively.

An accomplished researcher and proven academic leader, he was appointed president of George Mason University in Fairfax, Va., in 2020. His duties include providing visionary leadership, oversight and management of Virginia’s largest and most diverse university.

In 2011, Washington was appointed as the dean of the Henry Samueli School of Engineering at the University of California, Irvine, becoming the first African American dean of engineering for a University of California engineering program.

Washington has been a mentor for faculty members and students and his prominent role as a higher-education leader has helped highlight the strength of NC State Engineering. He is also a member of the Engineering Foundation board and has assisted the College with a number of alumni and development events in the Southern California area. Washington is a member of the NC State Department of Mechanical and Aerospace Engineering Hall of Fame.

A fall 2020 awards dinner honoring the three recipients was postponed. The College hopes to recognize these three winners, along with 2021 honorees, during a live event in fall 2021. ■



Thank you for making **Day of Giving** extraordinary for the College of Engineering!

Alumni and friends of the College help set new Day of Giving record

The College of Engineering turned out strong for North Carolina State University’s Day of Giving 2021 on March 24, raising more than \$6 million from 1,615 gifts — both records for the College.

As alumni, faculty and staff members, and friends of the College came together in support of their favorite department, program or fund, they helped drive NC State to a record-setting day. Overall, the University raised \$58 million from more than 14,000 gifts, setting a national record for dollars raised during a college or university giving day, according to the consulting firm State of Wow. The previous record for the highest total funds raised during a single day was held by Purdue University, when \$42 million was raised in 2020.

Day of Giving is a 24-hour fundraising campaign to raise money to support the University’s world-class research, develop new opportunities and improve existing programs for students. Now in its third year, NC State has seen a rise in giving every year since 2019. Remarkably, the 2021 record-setting total comes just six months after the 2020 Day of Giving, which was postponed to September due to the COVID-19 pandemic.

Competing against other colleges and units at NC State, the College won two of the hourly challenges — most gifts made from 12 - 1 a.m. and the “Show Us Your Wolfies” photo challenge — earning an extra \$3,500. Despite spending a good portion of the day at the top of the leaderboard for total funds raised, the

College was runner-up for both total funds and number of gifts.

Throughout the day, the College’s nine academic departments engaged in a friendly competition, trying to receive the most gifts to win a greater share of \$15,000 in prize money from Dean **Louis Martin-Vega**. The Department of Civil, Construction, and Environmental Engineering (CCEE) won, with 234 gifts, closely followed by the Edward P. Fitts Department of Industrial and Systems Engineering (ISE) with 221 and the Department of Mechanical and Aerospace Engineering (MAE) with 193.

These three departments — MAE, CCEE and ISE — also competed amongst each other to see which would receive 150 gifts first. While CCEE reached its 150 gifts matching challenge first, all three departments made their challenge, receiving extra funds from their departmental advisory boards.

The College of Engineering Young Alumni Advisory Board also competed against the Wilson College of Textiles Dean’s Young Alumni Leadership Council. The College of Textiles won the day, receiving more total gifts from its board than the College of Engineering, so Martin-Vega made a gift to Wilson College at the end of the day.

The College is grateful to everyone who participated in this year’s Day of Giving. The incredible support will have an impact for future engineers and computer scientists for generations to come. ■

ANNUAL GIVING

ENGINEERING FOUNDATION

Have you made your annual gift to the College of Engineering?

Gifts from alumni like you keep the College moving forward by supporting faculty and student recruitment and retention efforts. Your donation is a great way to make sure the opportunity that meant so much to you is there for students today.

If you would like to include the College of Engineering in your yearly charitable donations, here are some options for giving back.

If you have already made your 2020-21 gift to the College of Engineering, please accept our sincere thanks. If you have questions or would like to learn more about your giving options, contact Hannah Kunkel at 919.515.7458 or heallen3@ncsu.edu.

WAYS TO GIVE

- Make your gift online at go.ncsu.edu/engineering-giving
- Use the return envelope included in this magazine to pay by check
- Make a gift over the phone by calling 919.515.7458

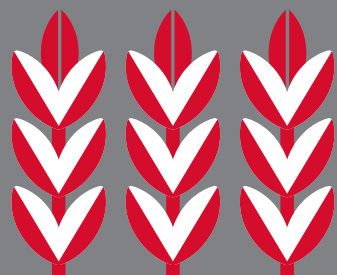
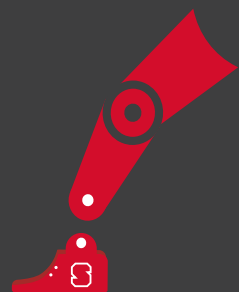
JOIN THE DEAN'S CIRCLE

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. Visit go.ncsu.edu/engineering-deans-circle for more information.

INCREASE YOUR IMPACT

Explore your company's matching gift policy, which may greatly enhance the level of support you can extend to deserving students. Visit www.matchinggifts.com/ncsu and contact your human resources representative to learn more.

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Recent Kolbas gift supports ECE students academically and socially

FROM LEFT TO RIGHT, YAN KOLBAS, DAN STANCIL, ROBERT KOLBAS AND HIS CHILDREN SARAH KOLBAS DILL, MICHAEL KOLBAS AND MARY KOLBAS.

A parent of a former student wrote on **Robert (Bob) M. Kolbas'** memorial website, "His effect on my son was enormous... As impossible as it seems, I miss a man I never met."

Kolbas passed away in June 2020. He was a professor in the Department of Electrical and Computer Engineering (ECE) for 35 years. He served as the department head from 1995-2000 and as the interim head from 2008-2009. In continuing his long legacy of supporting students, he and his wife, Yan Kolbas, made a gift to the Kolbas MakerSpace, an initiative he helped get off the ground in 2017.

The ECE MakerSpaces are a valuable resource for students, where they can create and work on electronics projects for their classes, extracurriculars and personal interests.

Yan Kolbas shared that the MakerSpace initiative was important to Bob Kolbas because when he was a student, he wished he had access to equipment and materials to create and explore. He wanted students to be able to have and use the things they needed to be creative and to build without having to expend their personal funds.

At NC State, Bob Kolbas created a senior design course giving students the opportunity to make prototype circuits and systems.

"The MakerSpace was an extension of Bob's desire to not only teach students how to make and prototype things, but actually provide them with access to

the tools, instruments and components to enable students to build. This most recent gift in 2020 will be a critical resource enabling us to continue to supply the consumable components, tools and instruments used in the MakerSpace," said **Dan Stancil**, ECE department head.

The support of the MakerSpace will be beneficial for students' academic interests, but Bob Kolbas wished to support his students outside of their coursework and research as well.

"His recent gift also funds an annual social gathering for students for many years to come," said Yan Kolbas.

Bob Kolbas' love for teaching and his interactions with the students have had a profound impact on their professional and personal lives. Yan Kolbas has received messages from his former students from around the world who took the time to share how much they appreciated his patience, enthusiasm and interest in their academic and personal lives. One former Ph.D. student mentioned his dissertation completed in November 2020 is dedicated to his grandfather and to Bob Kolbas. This March, another former student dedicated a paper published in *Science Advances* to him.

"Students have shared that Dr. Kolbas opened their minds to new ideas and ways of thinking," said Yan Kolbas. "Exploring, making a difference and helping others grow was what motivated Bob. He touched many lives, and he will be missed." ■



Anonymous donors provide vital support for deans’ priorities

“My education at NC State was probably the investment of a lifetime.”

with the important needs to have as much spending flexibility as possible. **Louis Martin-Vega**, dean of the College since 2006, said that he has used discretionary funds in many different ways that include promotion and enhancement of the College’s academic programs, providing matching funds for research grants or supporting unexpected expenses.

Over the last few years, the College has used discretionary funding to support the National Science Foundation Center for Advanced Self-Powered Systems of Integrated Sensors and Technologies (ASSIST) led by NC State and students from underrepresented groups who have received GEM fellowships. It has purchased personal protective equipment for faculty and staff members and students during the COVID-19 pandemic and supported an effort to provide food for members of the campus community who are experiencing hunger, among other priorities.

“The level of flexibility it provides to do those things that cannot be done through our academic budget or other budgets is what makes it extremely valuable,” Martin-Vega said of discretionary funds.

While discretionary funding can be used to provide continuity during tight times if needed, that’s not the primary goal. Instead, the intent is that they will be utilized on needs that can advance the College even further on its path to preeminence. As the College looks to continue its growth in national rankings among colleges of engineering, no institution is standing still. With many of NC State Engineering’s peer colleges making significant investments that enhance their research capabilities and ability to recruit top students and faculty members, these kinds of investments are crucial for the College, Martin-Vega said. ■

A College of Engineering alumnus and his wife have provided a significant legacy gift to the College. The couple, who wish to remain anonymous, have made a bequest through their estate plans that will provide funding to the College of Engineering dean’s discretionary funds. These philanthropic monies will be used by future deans of NC State Engineering to pursue their priorities related to research, teaching and programmatic needs that may not be covered through other revenue sources.

The electrical engineering alumnus, who has retired after a career in the aerospace and defense technology industry, has been an annual donor to NC State for more than 40 years and wanted to give back out of a recognition of the value that the engineering degree had for his career.

“My education at NC State was probably the investment of a lifetime,” he said.

Both husband and wife were executives during their working careers and believed in empowering the colleagues that they managed to make decisions. That attitude helped motivate the nature of this unrestricted gift. His belief, the alumnus remarked, is that it’s wise to allow those in an organization who are familiar

IS A PLANNED GIFT RIGHT FOR YOU?

Planned gifts allow alumni and friends of the College of Engineering to meet their family’s goals while also establishing a legacy at NC State.

If you have already included the NC State Engineering Foundation, Inc. in your estate plans please let us know. Call **Hannah Kunkel** at 919.515.7458.



ELIN GABRIEL

GAYLE LANIER

Wolfpack Women in Philanthropy give back, together

A new volunteer group with a strong engineering presence gives women who have ties to NC State a way to connect to giving opportunities campus-wide — and connect with one another. Wolfpack Women in Philanthropy (WWiP) has a stated mission of building a sustainable, engaged network of diverse women committed to NC State through their leadership, philanthropy and influence.

Comprising alumnae and friends of the University, along with a staff support team and the direct support of Chancellor **Randy Woodson** and Vice-Chancellor for University Advancement **Brian Sischo**, WWiP spans ages, disciplines and careers. Its immediate goals include recognizing and celebrating contributions by women to the University, increasing the number of women serving on University boards and educating women about exciting events, accomplishments and needs across campus, along with ways they can provide financial support or get involved.

So far, the group has supported NC State’s annual Day of Giving and highlighted the University’s Women’s Center and its Women’s Center Survivor Fund, as well as helped produce a congratulatory graduation video coordinated by the Alumni Association for spring commencement and a Pack Appreciation Day video for students during Red and White Week. The group’s leaders have begun visiting volunteer boards across campus to advocate for a culture that intentionally embraces a range of experiences, perspectives and backgrounds. And in March, they hosted their first live virtual event: “Women Making a Difference.”

WWiP’s nine-member leadership council includes six alumnae from STEM fields; four of them are accomplished COE graduates. **Elin Gabriel**, ChE ’85, is the group’s chair and **Gayle Lanier**, IE ’82, its vice

chair. They are joined by **Barbara Mulkey**, CE ’77, ’83; and **Anna Sullivan**, CE ’83.

While the group has no official role or decision-making authority, its members hope to serve as influencers, advocates, mentors and role models. They view their effort as particularly important because nearly 40 percent of NC State’s living alumni are women. And the 2019-20 incoming class was the first to include a higher percentage of women students than men; this year, 50.3 percent of incoming students identify as female.

In general, women are the fastest growing philanthropy group with wealth, influence and commitment to leading change, Gabriel said. Women now hold an estimated 40 percent of global wealth and over 50 percent of U.S. wealth, heavily influence much of family spending and tend to give more to nonprofits than men.

She noted that more than 100 data points from recent research indicate that gender makes a difference in the philanthropy decision process — one size doesn’t fit all, of course, but women’s motivations and patterns for giving demonstrate unique trends. Traditionally, however, men often have been the focus of institutions’ volunteer leadership groups, and of donor conversations and appeals. Understanding and appealing to women specifically is an important opportunity for the University.

“Wolfpack Women in Philanthropy is dedicated to providing opportunities for women’s giving, engagement, influence and leadership at NC State,” said Gabriel, who, like Lanier and Mulkey, is a Distinguished Alumna of the College of Engineering. “We aim to accomplish this by applying the latest research about women’s philanthropy and engagement. We want to educate women both about the amazing things happening at NC State and about the importance of philanthropy and its impact.” ■



From the board

Learn more about the work of the NC State Engineering Foundation, Inc. Board of Directors

ABOVE, FROM LEFT TO RIGHT, STEFFANIE EASTER, TIFFANY CHIN MOORE, BASIL HASSAN, DEVAL PARIKH AND SAHAJ ZALAVADIA.

GET INVOLVED
To learn more about board service for the College of Engineering or to nominate someone, contact **Sara Seltzer** at skseltze@ncsu.edu.

The NC State Engineering Foundation (NCSEF) was established in 1944 to aid and promote, by financial assistance and otherwise, engineering education research at NC State. A board of directors made up of alumni and friends of the College of Engineering works with the Foundation staff and the dean of engineering to set the Foundation’s agenda. The board is led by President **Nelson Peeler Jr.** and Vice-President **Deborah Young.**

NEW MEMBERS

The Foundation Board has added five new members:

- **Steffanie Easter**, CHE '85
- **Basil Hassan**, AE '88, '90, '93
- **Deval Parikh**, CHE '94, EC '95
- **Tiffany Chin Moore**, IE '01
- **Sahaj Zalavadia**, CSC '22 (student representative)

The following members have completed their terms and rotated off of the board after dedicating several years of distinguished service: **Ashley Barnes** (10 years of service), **Ralph Edwards** (eight years), **John Freeman** (six years), **Greg Washington** (eight years), **Bob Womack** (eight years), **Mark Norcross** (eight years) and **W. 'H' Clark** (eight years).

THE NCSEF BOARD STRATEGIC PLAN

The Foundation is undergoing a strategic planning process for the first time since 2013.

Young, as chair of the Strategic Planning Committee, states: “The NCSEF Board Strategic Plan is continuing to evolve to achieve, sustain and maintain recognition as one of the preeminent Colleges of Engineering (COE) throughout the world. The Centennial Campus has been the strategic focus over the last eight years:

culminating with the opening of the Fitts-Woolard Hall (FWH) in the Summer of 2020.”

The strategic focus for the next five years will be Four Pillars:

1. Active Engagement
2. Effective, Resilient and Inclusive Foundation
3. Supporting the Academic Experience
4. Advancing Diversity, Equity, Inclusion and Well-Being

“The plan will be achieved through conscientious / intentional actions to recognize, address, include and implement all aspects. As the world changes, the Foundation will broaden its views to ensure all are welcomed, supported, and sense the unification of NCSEF.”

Lindsay Smith, director of development for the Department of Civil, Construction, and Environmental Engineering, is the lead facilitator for the effort.

“Using the knowledge of board members and staff, we are well on our way to documenting the Foundation’s intended direction,” Smith said. “This process is being used to aid us in prioritizing our efforts, effectively allocating resources and aligning stakeholders and employees on the organization’s goals. Most importantly, we want to ensure those goals are backed by data and sound reasoning to help the College of Engineering reach its vision of becoming the leading public college of engineering in the country and one of the preeminent colleges of engineering in the world.”

Young said that she “looks forward to leading and teaming with President Peeler, Dean (Louis) Martin-Vega, Foundation Executive Director (Griffin) Lamb, the Board of Directors and the NCSEF staff to develop and implement a plan to accomplish the desired and identified goals.” ■

SPOTLIGHT
YOUNG ALUMNI



HOMETOWN
Durham, NC

GRADUATION YEAR
2012

DEGREES
B.S. Chemical Engineering, NC State
B.S. History, NC State
Ph.D. Chemical Engineering, Stanford University, 2018

CURRENT JOB TITLE
Postdoctoral Researcher, University of Michigan

MATTHEW OSTROWSKI

Matthew Ostrowski loves connecting science to real-world problems. As a postdoctoral researcher in a University of Michigan lab, he gets to develop that connection — his research on how the gut microbiome processes xanthan gum, a common food additive, will have an impact on public health.

Ostrowski grew up in Durham, NC, and while he considered engineering programs outside of the state, ultimately, he decided to stay closer to home. “I was fortunate enough to interact with some of the engineering faculty members prior to matriculating at NC State through one of the high school engineering summer programs,” he said of his decision to attend. “For a superb engineering education with a large enough program to offer both breadth and depth in many disciplines, NC State is one of the best.”

He graduated from NC State University in 2012 as a Benjamin Franklin Scholar with a B.S. in chemical engineering and a B.S. in history.

Of his time in the College of Engineering, Ostrowski said one of his favorite memories was the senior capstone experience. “I worked with a team of other students to try to take an idea from **Dr. [Robert] Kelly’s** (Alcoa Professor of Chemical and Biomolecular Engineering and director of NC State’s Biotechnology Program) research lab and ... use our core chemical engineering training to justify assumptions and decisions about how to solve a real-world engineering problem,” he said.

This experience helped him understand how powerful teamwork can be and how complex societal

and engineering problems can be broken down into manageable pieces.

After receiving his Ph.D. in chemical engineering from Stanford University in 2018, Ostrowski continued to apply what he learned at NC State to his career as a researcher. Most days, he spends his time in the lab working on isolating microbes and testing the enzymes they make to carry out chemical reactions inside human bodies. He was also awarded a clinically focused fellowship, where he collaborates with physicians to try to understand the microbiome in the development and progression of inflammatory bowel disease.

His research work on how the microbiome processes xanthan gum has connections to both public health as well as numerous other consumer products and industries.

“This is the first time this process has been described and has implications for how we think about food additives and their impact on ... human health,” he said. “I’m excited to connect our results to public health and how society thinks about diet and its ability to impact our health, both positively and negatively.”

Outside of work, Ostrowski enjoys soccer, playing jazz trumpet and volunteering with his wife with the Huron River Watershed Council, a local nonprofit organization. He also likes to explore the variety of outdoor adventures that Michigan has to offer, whether hiking, backpacking, road biking or paddling its lakes and rivers on a kayak trip. ■

For more information on how young alumni can become involved with the NC State Engineering Foundation, contact **Hannah Kunkel** at heallen3@ncsu.edu or **919.515.7458**.

The NC State Engineering Foundation, Inc., established in 1944, is the fundraising arm of the College of Engineering. For more information on the Foundation, including financial statements, audits and tax identification number, please visit ofa.ncsu.edu/foundations/nc-state-engineering-foundation-inc.

Ways to give to the NC State Engineering Foundation

ANNUAL GIVING: Annual gifts to the College are generally for an unrestricted purpose. Gifts of more than \$1,000 qualify for membership in the Dean’s Circle. Annual gifts from alumni are measured as “participation rate” and directly affect national rankings.

ENDOWMENT: An endowment is a fund held in perpetuity that benefits a specific purpose. Most endowments held by the Engineering Foundation are either for scholarships or endowed faculty positions.

PLANNED GIVING: Planned gifts can be as simple as a bequest (including us in your estate plans). Other options include trust vehicles and annuities, which have the potential to provide an income stream and significant tax benefits.

CAPITAL GIFTS: These gifts go toward “bricks and mortar” projects. Donors are given “naming opportunities.” Opportunities include Fitts-Woolard Hall and other engineering buildings on Centennial Campus.

IN-KIND GIFTS: These are gifts of goods or services to the College at a discount or no cost.

SPECIAL GIFTS: These gifts are directed to unique projects, centers or initiatives and approved by the dean of engineering. ■

COE DEPARTMENTS GET CREATIVE FOR COMMENCEMENT

The class of 2020 attended their classes online, took exams online, and ultimately ended their time as undergraduates online with virtual commencement ceremonies put on by NC State University on Dec. 4, 2020 and by the College of Engineering’s academic departments.

The Fall 2020 graduates had safe but celebratory sendoffs, as the College’s departments worked hard to make them special for a class that has faced unprecedented challenges in their final year of undergraduate studies due to the COVID-19 pandemic.



Anna Owens, who graduated with her B.S. in computer science and is now working on her master’s degree, said the Department of Computer Science publicized the event months in advance and worked with students to get photos and quotes to make a special presentation. Owens was one of two student speakers for the department’s commencement ceremony.

“Since the event was virtual, I was able to share the invitation with family members that live across the country who might not have been able to make it to Raleigh had the event been in person,” she said. “This allowed my family to connect in a way that might

not have happened during a ‘regular’ graduation.”

Most of the College’s departments streamed or posted videos of their ceremonies online, so family members and friends could watch.

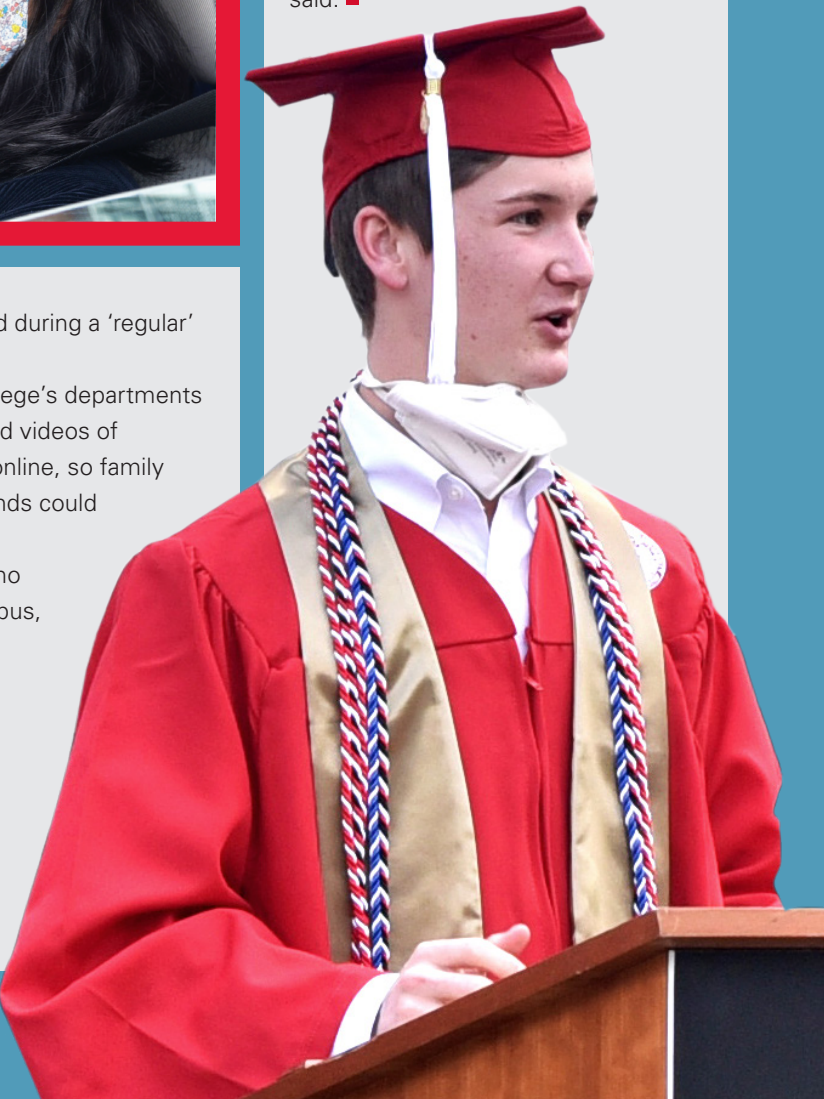
But for those who lived close to campus, the Edward P. Fitts Department of Industrial and Systems Engineering also put on a drive-in ceremony, which was later shared online.

Spencer Matthews, who graduated with his B.S. in industrial engineering in December, spoke at the event. He will graduate in December 2021 with a master’s degree and hopes to have a more normal ceremony then.

“It was strange talking to cars instead of to people,” he said. “And when you said something worth applause, people were blasting their horns instead of clapping.”

Of course, in 2020 fashion, the ceremony was not without its hiccups. Matthews’ father had been exposed that week to COVID-19 at his dental practice and was avoiding close contact with his family, so he drove in a different car than Matthews’ mother and sister, while Matthews and his girlfriend attended in a third car.

“With everything being so chaotic because of COVID, it was a relief and nice to have some sort of ceremony where we could be recognized,” he said. ■



Board of Directors

- V. Nelson Peeler, Jr., President, EE '88
- Bruce Baldwin, ME '92
- Suzanne Beckstoffer, CE '82
- Michael Broaders
- Robert (Bob) Brooks, EO '69
- Linda Butler, NE '86
- Calvin Carter, Jr., MSE '77, '80, '83
- Wes Covell, EE '84
- Mike Creed, CE '73, '84
- Casey Dean, EE '67
- Heather Denny, CE '95
- David Dove, AE '69
- Steffanie Easter, CHE '85
- Suzanne Gordon, CSC '75, MA '75, ST '80
- Len Habas, EE '66
- Basil Hassan, AE '88, '90, '93
- Rashida Hodge, ISE '02, '03
- Seneca Jacobs, CE '99
- Rob Loftis, EE '02
- Helene Lollis, CHE '87
- Samuel (Sam) McCachern, CE '85
- Tiffany Chin Moore, IE '01
- Chi Nguyen, AE '92
- Deval Parikh, CHE '94, EC '95
- Leah Pursell, ME '21
- Scott Stabler, MAE '82
- Carl Stutts, Jr., CHE '68
- Alvin Sumter, ISE '87
- Pam Townsend, CE '84, '87
- Hannibal (Hans) Warren, Jr., CE '84
- David Whitley, EE '92
- Mark Wyatt, CSC '80
- Deborah B. Young, CE '77
- Sahaj Zalavadia, CSC '22

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Leaders Needed

Donors who support the College's Fitts-Woolard Hall project receive recognition and exclusive benefits as part of their important gift. Along with recognition in this iconic new engineering building, members will receive regular insider updates on the project and will be invited to exclusive events, including the building dedication.



Cornerstone Society

For gifts beginning at \$100,000

Your name will be permanently associated with the space of your choosing, and your gift will be recognized in a central location in Fitts-Woolard Hall along with a special recognition biography and photo.



Dean's Oval Club

For gifts of \$50,000 to \$99,999

You will receive permanent recognition with a donor profile in a central location in Fitts-Woolard Hall.



Dean's Young Alumni Oval Club

For gifts of \$25,000 over five years by young alumni up to 15 years after graduation

You will receive permanent recognition with a donor profile in a central location in Fitts-Woolard Hall.

To learn more about how you can support Fitts-Woolard Hall and about membership in these groups, contact Hannah Kunkel with the NC State Engineering Foundation, Inc. at heallen3@ncsu.edu or 919.515.7458.

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