

NC STATE

Engineering

FALL/WINTER 2016



FAMILY TIES

NC State's Minority Engineering Programs continue to grow

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PUTTING PLANS IN MOTION

Since its establishment in 1887, the campus of what is now called North Carolina State University has been in a constant state of change and growth, with ideas for expansion and improvement always in the heads of university leaders and on the pages of planning documents. Today is no exception.

The plan is for the entire College to eventually move to Centennial Campus, save for the nuclear reactor in Burlington Labs. That's staying put.

On page 20 and 21, you can learn about the fate of the buildings that long lined 'Engineering Row' (now



Using a model on display in Riddick Engineering Laboratories in 1949, Colonel John William Harrelson (far left), then-chancellor of North Carolina State College, shares future plans for the campus.

A close perusal of the display shows that it leaves out a lot of the sprawling NC State campus that today's students are familiar with, including Centennial Campus.

The College of Engineering is in the middle of a move from North Campus to Centennial Campus that has been a university priority for two decades. Six of the College's nine primary departments have made the move and the Department of Civil, Construction, and Environmental Engineering and the Edward P. Fitts Department of Industrial and Systems Engineering will be next, when the new Engineering Oval building is completed.

Stinson Drive) and how they will be used as the College completes its move to Centennial. What's next for the building where you took engineering classes?

You'll learn that Riddick, where this photo was taken and the home at various times of chemical, materials, industrial and mechanical engineering, is now occupied by the Department of Physics and the Department of Animal Science.

Also, find out what will replace Harrelson Hall, the recently demolished circular wonder named after the man showing off a bigger, better NC State in this photo. Harrelson, a mechanical engineering graduate, was the first alumnus of NC State to serve as its chancellor. ■

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DEAN Dr. Louis A. Martin-Vega

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Q&A

QUESTIONS FOR JONATHAN ADDISON

Jonathan Addison completed his NC State career in the spring with Atlantic Coast Conference championships in the outdoor and indoor long jump, indoor high jump and outdoor men's 4x100 meter relay, along with earning a degree in industrial engineering and starting a job with Eaton.

Which drew you to NC State first, athletics or engineering?

Engineering. My main priorities for selecting a school were engineering, track and a large university. I initially wanted to venture out of the state of NC, maybe to Georgia Tech because of their engineering program, but I attended the NC State engineering open house and it swayed me. Also because NC State recruited me for track and other engineering schools did not.

How did you settle on industrial engineering as a major?

A family friend of mine while I was in high school gave me some insight on the different types of engineering and why she chose industrial engineering back in college. So I looked into industrial engineering a lot while I was researching schools and I noticed the many different fields and industries in which industrial engineering could be used and it drew me in.

What does it take to balance a challenging course load with competing in college athletics at a high level?

I have been an athlete for as long as I can remember so I have had to balance school and sport my entire academic career. I believe it takes dedication to both school and sport as well as time management. It was very difficult at times but patience and belief in your abilities helps.

What was your favorite engineering course?

Probably my product production and design class. I got to create a product from the brainstorm stages to the actual machining and got to really see my work result in a useful project and it gave me a feeling of fulfillment. Second would be solid works graphic design for the same reasons.

What does NC State Athletics do to support athletes' academic pursuits?

We have a very robust academic support center with tutors available. They also put on different workshops for resume building, interview help and host a student-athlete career fair every year.

You've received a 2016 ACC Postgraduate Scholarship to continue your studies. What will that entail?

After my rotational program with Eaton, I will likely find a place where I can pursue an MBA or master's in sports administration. The scholarship gives \$5,000 toward an accredited graduate program that I choose to pursue.

Tell us about your career goals.

I would like to end up in administration of some sort. Hopefully, I can find my way back into sports and get involved with sports administration. I love sports and having the ability to work with them day in and day out would be a dream come true. ■



FROM THE DEAN



LOUIS A. MARTIN-VEGA

Each year, the beginning of the fall semester brings a flood of students to campus, all celebrating some milestone in life — the first year away from home, matriculation into a chosen discipline, the final semester or two before graduation. This fall marks a special milestone. Our entering first year students are the much anticipated "Engineers of 2020."

In 2004, the National Academy of Engineering published *The Engineer of 2020: Visions of Engineering in the New Century*.

This publication made the case for institutions to anticipate and adapt to the dramatic changes that would come to the practice of engineering in order to enhance productivity and improve the quality of life around the world. This publication greatly influenced engineering education across the nation and informed many of the choices made within our College.

Our response was to look at how our College could give our students not only an education that gives them an edge in the global marketplace but also makes them valuable contributors to the solution of our many societal challenges. We found ways to encourage cross-disciplinary study, global experiences and exploration of entrepreneurial opportunities. At the center of our vision was the integration of research and education, providing research opportunities not just to graduate students but to our undergraduates as well.

As a result, a 2010 *Wall Street Journal* survey of top recruiters placed our college 15th in the nation for producing graduates who were well prepared for industry. Companies like IBM, Cisco and NetApp hired more NC State engineering and computer science graduates than from any other engineering college in the country, and our graduates continue to lead in the creation of new start-up companies. This steady flow of highly educated and skilled graduates from our College fuels economic growth in North Carolina and across our nation. Also, consistent with our vision, our undergraduates are now playing vital roles in our nationally recognized Engineering Research Centers addressing global challenges in sustainability, health, security and other areas.

We heard the call in 2004, implemented strategic changes, and now as the "Engineers of 2020" move through the next four years, we continue to find ways to enhance their experience and prepare them for the Grand Challenges of the 21st century and beyond.

In this issue, we have provided an overview of the "things to come" for the College — the investments we are making to continue to enhance the education we provide our students, the research we conduct to improve lives and the economy, and the outreach we conduct to ensure that the "Engineer of 2030" and beyond will be prepared for the exciting world he or she will encounter after graduation.

As always, I hope you enjoy this issue of *NC State Engineering*, and I thank you for your support of our College.

Sincerely,

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

Martin-Vega begins term as ASEE president



Engineering Dean Dr. Louis A. Martin-Vega assumed the presidency of the American Society for Engineering Education

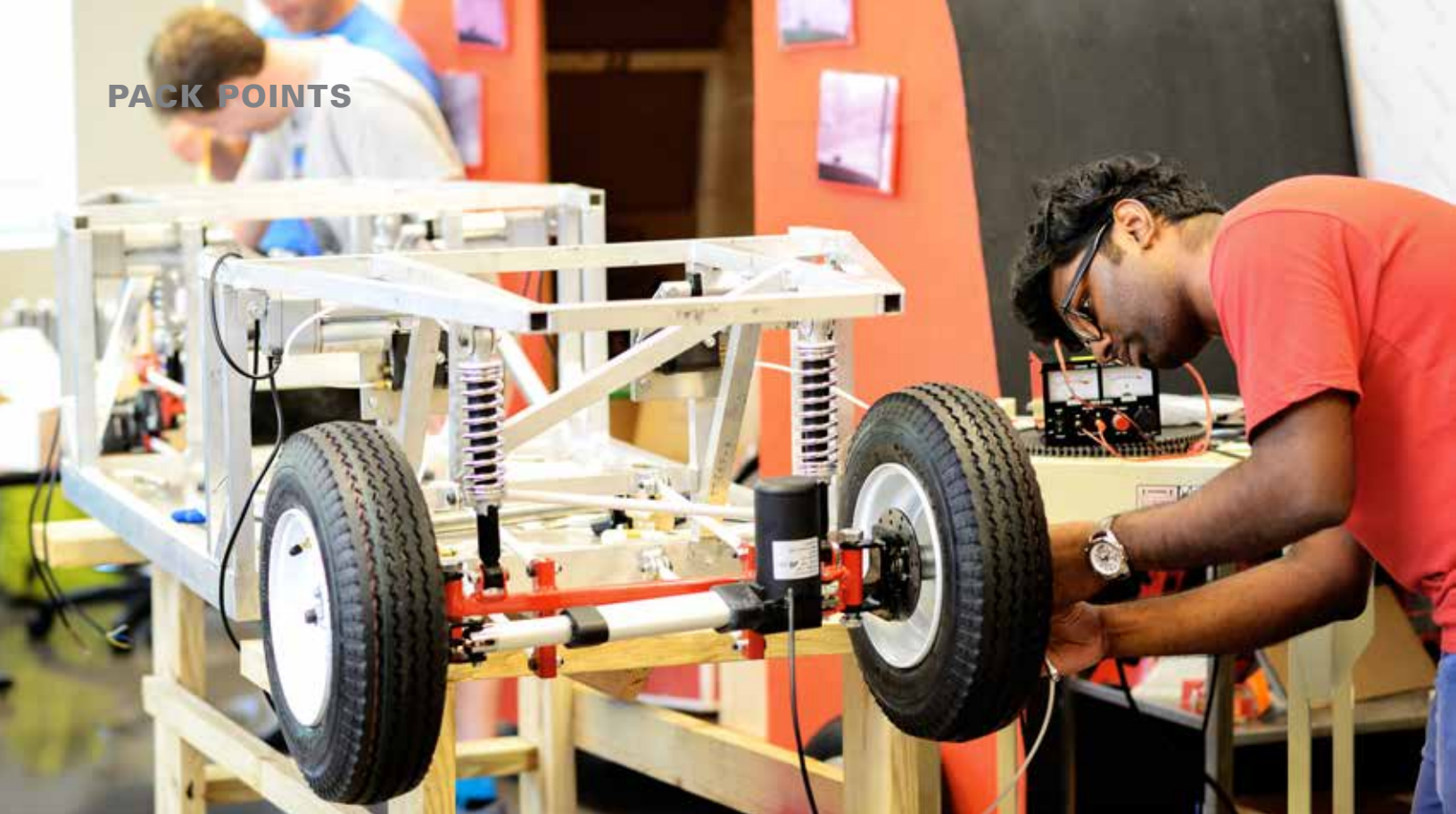
(ASEE) at the society's annual conference on June 29.

"ASEE's role in shaping the engineering education landscape has never been more important," he said. "In order to solve the Grand Challenges of this century we are going to need a talented and diverse engineering workforce, and with its many resources ASEE helps its members do their jobs better. I'm honored to serve as president."

He follows Joseph Rencis, dean of the School of Engineering at Tennessee Tech University, as president. The incoming president-elect is Beville Watford, associate dean for academic affairs at the College of Engineering at Virginia Tech. Martin-Vega will serve one year as president, and one year as immediate past president.

Martin-Vega came to NC State in 2006 after spending five years as dean of engineering at the University of South Florida. He has also held several prestigious positions at National Science Foundation (NSF), including acting head of its Engineering Directorate and director of NSF's 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.

ASEE is a nonprofit organization committed to furthering education in engineering and engineering technology. ■



EcoPRT will bridge the gap between NC State's two campuses

TWO FACULTY MEMBERS in the College are creating a new transportation system that would link Centennial Campus with the University's main campus.

The EcoPRT (ecological personal rapid transit) is an ultra-light and low-cost transit system featuring autonomous two-person cars that would drive on a guideway railing system. NC State engineers Marshall Brain, director

of the Engineering Entrepreneurs Program, and Dr. Seth Hollar, teaching assistant professor in the Department of Mechanical and Aerospace Engineering, have been working on the project since 2013.

The pair has proposed an EcoPRT system to run from James B. Hunt Jr. Library on Centennial Campus to D.H. Hill Library on North Campus.

"We're going to completely revolutionize transportation on NC State's campus," Brain said of the project's impact on campus travel. "If we can get this built, and get the two libraries connected together – it just makes the two campuses feel like one."

The first prototype has been run on a test track run behind Engineering Building III on Centennial Campus. "This track will help to provide a proving ground for burning in vehicles before they would be tested out in the wild. It's an exciting step," said Hollar.

With the help of a \$300,000 grant from the North Carolina Department of Transportation, Hollar, Brain and a group of engineering students have begun work on building five cars. Currently, a second prototype, the first car for the grant, is being built. The frame for this new model was designed by students and then fabricated by an outside company.

The fabrication of the outer shell, creating the mold and making multiple copies for multiple vehicles will also be outsourced to two companies located in the Carolinas.

Currently, the second prototype is a shiny metal frame, measuring 31 inches wide and 7 feet long. Changes from the first prototype to the second include the aluminum frame, overall reduction of vehicle weight, the addition of custom made air conditioning, brakes, and suspension that were not initially part of the first vehicle design. Hollar jokes that a cup holder may be part of the new design as well. ■



NC State joins with UNC Pembroke in dual engineering degree program

NC STATE and the University of North Carolina at Pembroke have established a joint undergraduate degree program that will allow students to spend three years at UNC Pembroke and two years at NC State and graduate with bachelor's degrees from both institutions.

NC State Chancellor Dr. Randy Woodson and UNC Pembroke Chancellor Dr. Robin Gary Cummings

made the partnership official during a signing ceremony on July 12.

Under the program, which launched in August, students will spend three years at UNC Pembroke and two at NC State and graduate with a bachelor's degree in physics from UNC Pembroke and a bachelor's degree in either electrical or mechanical engineering from NC State.

"This partnership is yet another step in the continued growth upon the

existing relationships between UNC system campuses to improve higher education opportunities for North Carolina students," Woodson said.

The College has similar dual-degree partnership programs with Elon University, Fayetteville State University, North Carolina Central University and Meredith College. ■





DR. GAIL JONES became hooked on nanotechnology as a professor at UNC Chapel Hill 15 years ago.

Her colleagues there developed a nanomanipulator that controlled an atomic force microscope that uses a needle-like probe and allowed for tactile feedback. This exciting tool could be operated remotely, allowing middle and high school students to feel objects like a cold virus at the nanoscale from their classrooms.

That sparked an interest in nano that Jones carried with her to NC State. She arrived in Raleigh and joined the NC State Nanotechnology Initiative led by Dr. Gregory Parsons of the Department of Chemical and Biomolecular Engineering as it was getting started. Jones, Alumni Graduate Distinguished Professor of STEM Education, led the educational component of the Nano Initiative. She

of nanotechnology goes beyond just graduate students. The technology, and the impact it is having on many aspects of human life, is too important.

“In the lifetime of the people coming to NanoDays these products are going to revolutionize their world, and I think it’s important for them to know about the excitement, know about the opportunity and to begin to think about the potential risks and ethical implications of these highly advanced technologies that literally are engineering the world atom by atom.”

As the event, started 12 years ago, grew more popular, the Nanoscale Informal Science Education Network caught on to the idea and turned it into a nationwide festival. Jones was a member of the organization’s advisory board and helped to get this national effort off the ground. In 2016, NanoDays

NC State’s NanoDays grows into a national effort

started an annual event called NanoDays, recognizing that the need to provide education on the world

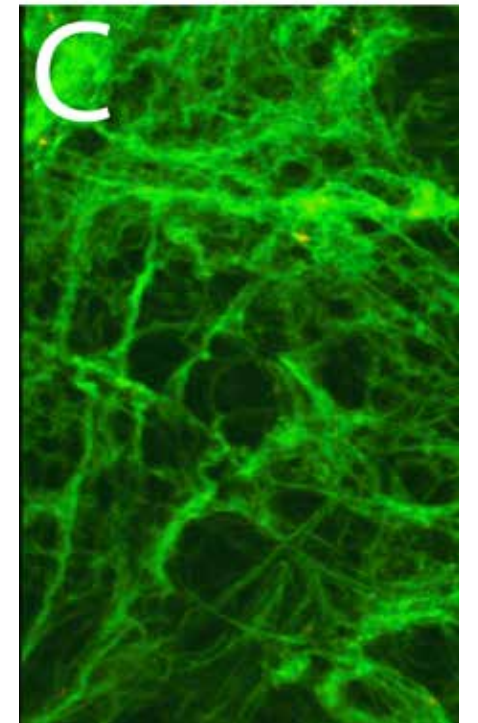
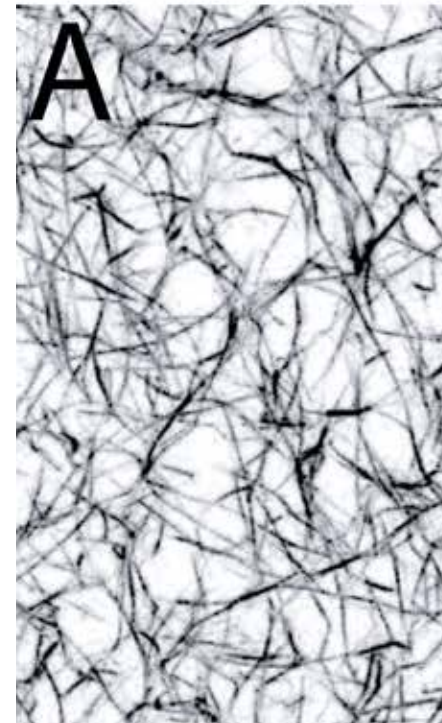
events were held at more than 250 science museums, research centers and universities nationwide, from Puerto Rico to Hawaii.

Kayla Telford was a NanoDays volunteer as an undergraduate at NC State. Now she is in her fourth year as a teacher at Apex High School and is co-coach of the school’s Science Olympiad team.

“After that experience of doing fun science demonstrations and seeing the children’s reactions at NanoDays, I knew for sure that I wanted to teach science,” Telford said.

The 2016 NC State event was held in Engineering Building III on Centennial Campus. Middle school and high school students from across North Carolina attended.

The event was supported by PowerAmerica, the Eastman Chemical Company, the Research Triangle Nanotechnology Network and the Research Triangle Materials Research Science and Engineering Center. Several College of Engineering faculty members took part, running demonstrations and leading tours of their laboratories. ■



LASER SCANNING CONFOCAL MICROSCOPY IMAGES OF CLOTS CONSTRUCTED FROM ADULT FIBRINOGEN (A), NEONATAL FIBRINOGEN (B), OR A MIXTURE OF THE TWO (C). SCALE BAR= 20 μ m.

Study sheds new light on post-operative bleeding

A NEW STUDY finds significant differences between the blood clot structure in adults and newborns, helping researchers better understand the challenges in addressing post-operative bleeding in neonatal patients. The researchers also found that the current standard of care for treating post-operative bleeding may pose an increased risk of thrombosis in newborns compared to adults, which researchers hadn’t suspected. The study was performed by researchers at NC State, UNC Chapel Hill, Emory University, Children’s Healthcare of Atlanta and the Georgia Institute of Technology.

“We knew that neonates – infants less than one month old – are more likely than adults to suffer from severe bleeding after heart surgery, which poses a variety of health risks,” says Dr. Ashley Brown, assistant professor

in the UNC/NC State Joint Department of Biomedical Engineering.

“The current standard of care is to give neonatal patients blood products – such as a protein called fibrinogen – derived from adult blood,” Brown says. “But neonatal blood and adult blood aren’t the same; many of the components involved in clotting in newborns have differing levels of activity, or effectiveness, compared to the same components in adults. Our goal was to better understand how clotting in neonates differs from that in adults, so that we can move closer to developing more effective treatment strategies for these infants.”

The researchers’ hypothesis was that fibrinogen – the main blood-clotting protein – from neonates would form clots that are different from those formed by adult fibrinogen, and they were correct. However, they were

surprised to find that fibrinogen from adults did not integrate well with the fibrinogen in neonates. In other words, the fibrinogen from adults and newborns wouldn’t stick to each other and form a clot.

To test this hypothesis, the researchers took samples of neonate fibrinogen and adult fibrinogen and compared how they formed clots. They looked at clots formed solely of adult fibrinogen, clots formed solely of neonate fibrinogen and clots formed of mixed adult and neonate fibrinogen.

The researchers found that neonate fibrinogen formed less dense, more fragile clots than adult fibrinogen. And they found that a mixture of adult and neonate fibrinogen formed clots that were also fragile and less dense – even if there was relatively little neonate fibrinogen in the mixture. ■



HUSSAIN, LEFT, AND BENKARAACHE

Engineering startup aims to bring accurate pricing to the trucking industry

MOAAD BENKARAACHE AND TAYYAB HUSSAIN have set out to solve a problem in the commercial trucking industry, just not the problem they originally thought they would.

As seniors and members of the College's Engineering Entrepreneurs Program (EEP), they wanted to find a fix for underutilized trailer capacity. But after talking with trucking companies, they learned that technology used to track how much space is occupied and how much has been filled is already being utilized.

But they kept talking to potential customers, asking what problem needed to be solved rather than telling those customers what problem their EEP project would solve for them.

"You'll realize that your idea might not be exactly what they want, but if you keep talking to enough people, you'll catch a pattern," Hussain said.

The pair learned that as the trucking industry has shifted from pricing based on weight to a pricing plan that also takes the dimensions of items to be shipped into account, the industry often

must rely on customers to provide the measurements by which pricing is determined.

While some larger companies can afford laser-scanner technologies, smaller ones have employees use tape measures, a difficult task when assessing a pallet of items that is irregularly shaped. Whether intentionally or not, customers often provide inaccurate measurements, and trucking companies don't have the time or resources to double-check everything.

Trakex's idea combines sensors and software that measure a pallet of goods as it moves from the point at which a customer drops the pallet off to a truck, providing the shipping company with measurements that lead to accurate pricing.

Benkaraache and Hussain, spring 2016 graduates with degrees in industrial and chemical engineering, respectively, won first place in the New Venture Challenge at Lulu eGames, the annual entrepreneurship startup competition. They followed it up with a fellowship from Y Combinator (YC), the Silicon

Valley startup incubator that has helped Dropbox, Airbnb and other companies get their start.

Benkaraache and Hussain spent eight weeks over the summer receiving help from a YC counselor and \$20,000 in the form of a convertible security for seed funding. At the end of the eight weeks, they had a chance to pitch to investors during a Virtual Demo Day.

The partners adjusted their model again during the YC experience and turned their attention to smaller parcel shipments. E-commerce is one of the fastest growing markets in the world, and the most expensive aspect of it is shipping cost. Billions of dollars are wasted because of bad dimensional measurement and inefficient packing.

The company has done \$20,000 in sales and has reached a deal with German logistics company DHL, Hussain said.

Trakex now plans to attack a \$22 billion parcel shipping market that includes potential customers like Amazon, Walmart, Nike and other major distributors. ■



Engineering researchers help NASA learn more from the stars

TELESCOPES CREATED in the Precision Engineering Consortium (PEC) will help NASA scientists gain a better understanding of star formation.

Star formation is the process by which dense regions within molecular clouds in interstellar space, referred to as stellar nurseries, collapse to form stars. The region of interest is stars that are 2,500 light years away from the earth – meaning the light reaching the telescope left the star 2,500 years ago.

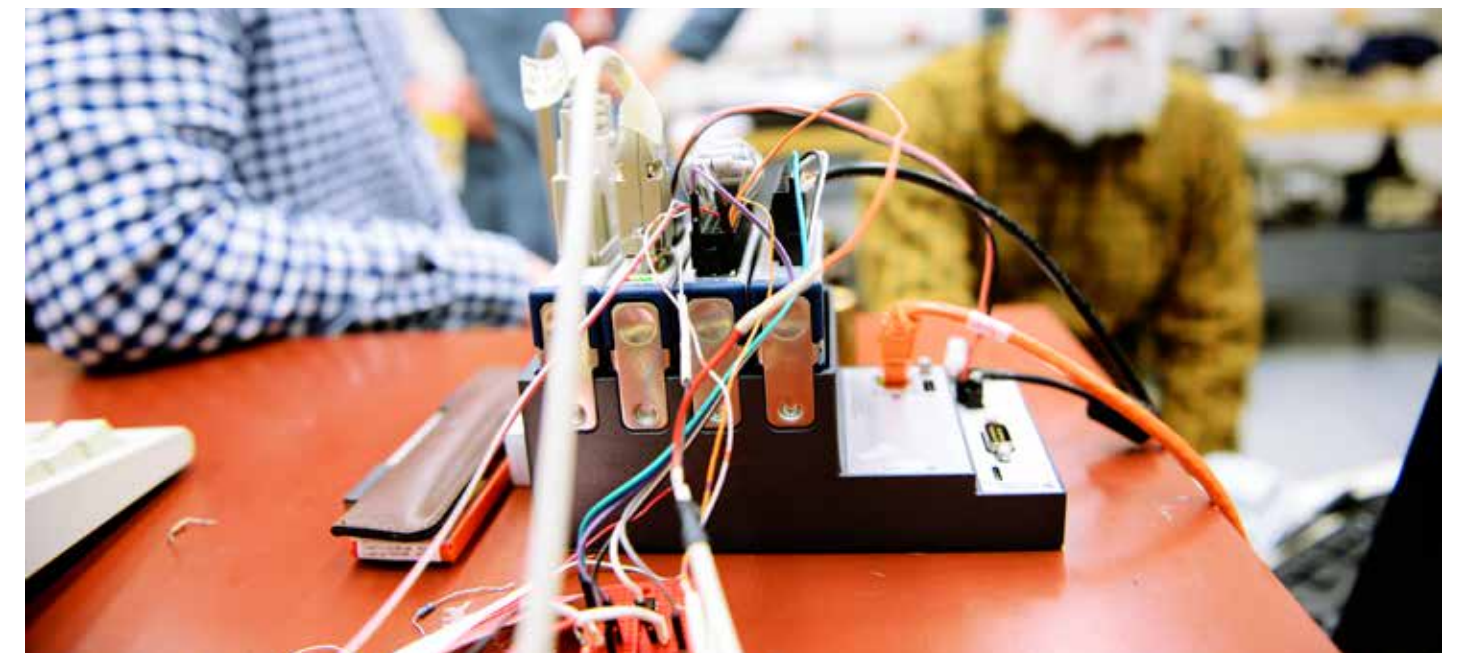
The PEC, part of the Department of Mechanical and Aerospace Engineering (MAE), is assisting NASA's Goddard Space Flight Center with its Balloon Experimental Twin Telescope for Infrared Interferometer (BETTII). BETTII is a binocular telescope that will be launched in a balloon to 26 miles above the earth's surface. At its heart is a prototype optical system that uses interference between the beams of infrared light captured by each telescope to measure the position and spectrum of a star. The fine resolution of this binocular telescope can distinguish between single stars



and multiple stars in stellar nurseries that are usually enshrouded by dust, which hides them at visible light wavelengths. Spectral measurements of the long-wavelength infrared signal may uncover proto-planetary disks and the temperature and composition of the dust that formed them.

PEC Director Dr. Thomas A. Dow, Duncan Distinguished University Professor in Mechanical Engineering; Kenneth P. Garrard, PEC senior research scholar; and Dr. Stephen J. Furst, adjunct assistant professor in MAE, are working on this NASA-funded project.

The PEC has assisted with design modifications to the telescope structure and is in the process of building the optics for the pair of telescopes. Dow managed the project and, along with Furst, came up with the design for the mounting structures and the light-weight mirrors, while Garrard programmed the machine tool-path and developed the control software. The PEC is creating two identical telescopes. Each has a 21-inch primary mirror, an eight-inch flat turning mirror and a pair of smaller mirrors to turn and shape the light beams and deliver them to the interferometer. ■



Researchers can tune mechanical properties of radiation-sensitive material for biomedical use

AN INTERDISCIPLINARY TEAM of researchers at NC State has developed a composite material that emits light and heat when exposed to specific wavelengths of radiation and that can be customized to have specific mechanical characteristics. The composite holds promise for use in biomedical imaging, drug delivery and therapeutic treatments.

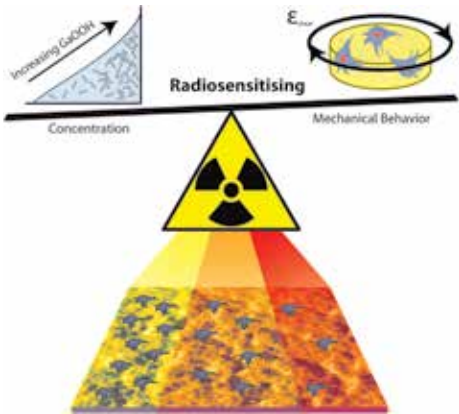
“The radiosensitivity is what makes the material useful for biomedical applications, and the ability to tune the mechanical properties makes it less likely to be rejected by the surrounding tissue in the body,” says Nora Berg, a Ph.D. candidate in the Department of Materials Science and Engineering and lead author of a paper describing the work.

The material is a composite of a biological gel made of proteins and gallium oxyhydroxide (GaOOH), which is

a semiconductor material. Specifically, the GaOOH is dispersed in the biological gel in the form of crystals that are 200-300 nanometers in diameter and approximately one micron — or micrometer — in length.

“When the composite is exposed to wavelengths of radiation that would be used in clinical settings, the GaOOH responds by heating up and emitting light,” Berg says.

“This response to radiation makes it attractive for use in some therapeutic applications,” says Albena Ivanisevic, corresponding author of the paper and a professor of materials science and engineering. “The radiosensitive response can help generate reactive oxygen species – like peroxide – that can be used to kill cells. So, this material may have value for targeting localized cancer sites.”



The mechanical properties of the composite can be tuned by adjusting the concentration of GaOOH; adjusting the amount of GaOOH changes the structure of the gel, which affects the gel’s stiffness. The mechanical properties were investigated in collaboration with Dr. Saad Khan’s research group in the Department of Chemical and Biomolecular Engineering. ■

NC State engineers will help further civilian nuclear energy in Vietnam

TRAINING FROM FACULTY members in the Department of Nuclear Engineering is part of an agreement on civil nuclear clean energy cooperation signed by leaders in the United States and Vietnam.

In 2014, the two countries signed an agreement under Section 123 of the Atomic Act that opened the door to nuclear trade and cooperation. An administrative arrangement signed in May 2016 under the auspices of that 2014 agreement established their intention to cooperate further in training and education, building of institutional connections, strengthening of export controls and securing and tracking nuclear

and radiological materials, among other areas.

One of those training and education initiatives, according to a White House statement, will “complement Vietnamese university nuclear curriculum programs with the Department of Energy supported remote reactor training from North Carolina State University.”

Dr. Tran Chi Thanh, president of the Vietnam Atomic Energy Institute, toured NC State’s PULSTAR nuclear reactor



DRS. HAWARI, LEFT, AND THANH

on May 26 with Drs. Ayman Hawari and Nam Dinh, professors of nuclear engineering. Hawari is also director of NC State’s Nuclear Reactor Program.

The three discussed possible interactions that would include both online and in-person training and visits to and lectures in Vietnam by Hawari. ■

NC State selected for new manufacturing innovation hub

FACULTY MEMBERS in the College will help lead the Southeast hub for a new Smart Manufacturing Innovation Institute (SMII) that aims to spur technological innovation to improve the efficiency of advanced manufacturing in the United States.

The new institute will be led by the Smart Manufacturing Leadership Coalition, based in Los Angeles, Calif., in partnership with the U.S. Department of Energy. NC State will be the home of one of five regional hubs. Dr. Phillip Westmoreland, professor in the Department of Chemical and

Biomolecular Engineering, will serve as director.

SMII will be backed by \$800 million in federal and non-federal resources and will include nearly 200 partners from industry, federal research labs, academia and state and local government across 30 states.

SMII is the ninth announced hub in the National Network for Manufacturing Innovation (NNMI). NC State is the lead institution for one of those hubs, Power America, which is advancing the research, design and manufacturing in the area of wide

bandgap semiconductor-based power electronics.

The institute will work in the areas of advanced sensors and controls, data analytics, advanced predictive modeling and simulation software, and application toolkits that can dramatically reduce energy expenses in advanced manufacturing.

The NC State-led hub will include a technical focus on the energy-intensive pulp and paper industries, carbon fiber, primary metals, chemicals, pharmaceuticals and other industries. ■



Seven faculty members earn NSF CAREER awards

Seven young faculty members in the College have been chosen to receive Faculty Early Career Development (CAREER) awards from the National Science Foundation (NSF).

The NSF CAREER award is one of the most prestigious awards in support of junior faculty members who exemplify the role of teacher-scholars through outstanding research, excellent education and the integration of education and research within the context of the mission of their organizations. The recipients are:

Dr. Alper Bozkurt, assistant professor of electrical and computer engineering, for his research proposal, “Bio-electro-photonic Microsystem Interfaces for Small Animals.”

Dr. Chih-Hao Chang, assistant professor of mechanical and aerospace engineering, for his research proposal,



FROM LEFT, DRS. SRIKANTH PATALA, ALPER BOZKURT, EDGAR LOBATON, HSIAO-YING SHADOW HUANG, BRINA MONTOYA, CHIH-HAO CHANG, AND BRENDAN O’CONNOR

“Three-Dimensional Nanolithography with Inexpensive Hardware.”

Dr. Hsiao-Ying Shadow Huang, assistant professor of mechanical and aerospace engineering, for her research proposal, “Restoring Function in Chronic Venous Insufficiency: Unraveling the Structural Mechanics of Venous Valve Tissues.”

Dr. Edgar Lobaton, assistant professor of electrical and computer engineering, for his research proposal, “Data Representation and Modeling for Unleashing the Potential of Multi-Modal Wearable Sensing Systems.”

Dr. Brina Montoya, assistant

professor of civil engineering, for her research proposal, “Stabilization of Mining and Energy Related Byproducts Using Bio-Mediated Soil Improvement.”

Dr. Brendan O’Connor, assistant professor of mechanical and aerospace engineering, for his research proposal, “Mechanical Behavior of Flexible Electronic Films.”

Dr. Srikanth Patala, assistant professor of materials science and engineering, for his research proposal, “Mapping the Genome of Metallic Grain Boundaries — Structure, Thermodynamics and Kinetics.” ■

Allbritton receives national award in chemical instrumentation



DR. NANCY ALLBRITTON

Dr. Nancy Allbritton, Kenan Distinguished Professor and chair of the UNC/NC State Joint Department of Biomedical Engineering, received the 2016 American Chemical Society (ACS) Division of Analytical Chemistry Award in Instrumentation at the 252nd ACS National Meeting and Exposition in August.

The award recognizes advances in the field of chemical instrumentation including conceptualization and development of unique instrumentation, stimulation of other researchers to use chemical instrumentation, and authorship of research papers or books that have had an impact in the use of chemical instrumentation.

Dr. Michelle Kovarik, an assistant professor of chemistry at Trinity College, organized a symposium in Allbritton’s honor during the ACS meeting. Kovarik, who worked with Allbritton as a post-doctoral scholar, and four other speakers were part of the program. Kovarik said that each session focused on how the innovation of new technology is being used to probe the biology of single cells, an area where Allbritton is a clear leader, and that her talk, “Microfluidic Chemical Cytometry and Peptide Substrate Reporters: Expanding Applications and Access,” examined how technology developed in Allbritton’s lab is being applied and used by researchers who aren’t specialists. ■

Narayanaswamy wins Air Force Young Investigator Research Program award



DR. VENKATESWARAN NARAYANASWAMY

Dr. Venkateswaran Narayanaswamy, assistant professor of mechanical and aerospace engineering, received a Young Investigator Research Program award from the Air Force Office of Scientific Research (AFOSR).

The goal of his project, “Investigation of Shock Boundary Layer Interactions to Unravel the Physics of Unstart in Axisymmetric Inlets,” is to develop autonomous hypersonic platforms, which can have a game-changing impact on high-speed commercial travel, defense technology and commercial space access, and make a profound difference in world trade and commerce. “Unstart” is a sudden compressor stall that can occur in the

jet engines of super sonic aircraft. The results of this project will contribute to bringing down the operating speed of the scramjet that would facilitate better vehicle integration and unravel the physics of inlet unstart phenomenon by elucidating the flow interactions that initiate and sustain unstart.

The educational component of the project will engage with different organizations within NC State to provide a research experience to undergraduate students, especially from traditionally underserved communities, and collaborate with K-12 outreach activities to bring middle and high school students to campus during the summer to learn about current research. ■

Dickey receives ASEE research award



DR. MICHAEL DICKEY

Dr. Michael Dickey, a professor in the Department of Chemical and Biomolecular Engineering, was awarded the American Society for Engineering Education’s (ASEE) Curtis W. McGraw Research Award for 2016.

The Curtis W. McGraw Research Award was established in 1957 to recognize outstanding early achievements by young engineering college research workers and to encourage the continuance of such productivity. The annual award is sponsored by the Engineering Research Council (ERC) with the assistance of the McGraw-Hill Book Company. The award includes an honorarium and a certificate, as well as travel costs to attend the ERC Annual Conference, where the award is presented.

Dickey’s research areas include new ways to actuate and pattern soft

materials including polymers, liquid metals and gels. His work is focused on the study of materials with remarkable properties in order to enable new applications, such as energy harvesting devices, sensors, soft and stretchable electronics and self-folding sheets, in a simple, inexpensive and scalable manner.

He has coauthored more than 70 publications and has previously received a National Science Foundation CAREER Award (2010), the Sigma Xi Faculty Award (2011) and the Outstanding Teacher Award – Member of the Academy of Outstanding Teachers at NC State University (2012). He was honored as a University Faculty Scholar (2013) and received the ASEE Southeastern Section New Faculty Research Award (2013). ■

IN OUR LABS

THESE ARE THE SPACES THAT ENABLE
GROUNDBREAKING RESEARCH

SOUND AND VIBRATION LAB

DEPARTMENT OF MECHANICAL AND AEROSPACE ENGINEERING (MAE)

THIS ANECHOIC CHAMBER mimics an infinite space by absorbing acoustic and electromagnetic waves, providing a perfect environment to test those waves without reflectivity affecting the measurements being taken.

The walls of the chamber, located in an annex building behind Engineering Building III on NC State's Centennial Campus, are lined with foam wedges backed by fiberglass. The wedges line the chamber from floor to ceiling, with a metal grate over the floor to allow walking. A wire cage that covers the panels makes the chamber a Faraday cage, which blocks outside electric fields and prevents radio frequency

interference from affecting the measurements being taken inside.

A mechanism on the door ensures that you can't accidentally lock yourself inside, since no one would be able to hear you yell and your cell phone wouldn't be able to make a call.

The noise level in the chamber is in the range of 15 to 18 decibels (the average conversation is 50 to 60 decibels), so quiet that it takes a little getting used to.

"It's a little bit of a sensory deprivation experience," said Dr. Richard Keltie, professor in MAE. For that reason, Keltie does not recommend closing the chamber door and turning out the lights.

MAE SPENT \$250,000 to construct the facility on Centennial Campus after utilizing a similar chamber beginning in the 1960s in Broughton Hall on North Campus.

Keltie used that chamber to test underwater acoustic sensors for the U.S. Navy. The College of Textiles tested looms and other heavy machinery in that chamber to determine why they are so noisy and

how to make them quieter.

Recent clients for the new anechoic chamber have included a company developing low-noise refrigeration systems for medical applications and wine chillers. The company needed a low-noise environment to test the acoustic pattern coming from the equipment, and MAE offers the only one in the area.

DR. YUN JING, an assistant professor in MAE, specializes in acoustics and is an adjunct professor in the UNC/NC State Joint Department of Biomedical Engineering.

He has used the chamber for several research projects, most recently to study the manipulation of acoustic waves from a speaker as they pass through a passive array made of 3D printed metamaterials. Manipulation of the waves using this material can generate different holographic images on the imaging plane without the need for complex and expensive circuitry and active phased arrays. Jing, who came to NC State in 2011 after a postdoctoral fellowship at the Harvard Medical School, said he would not have been able to accept a teaching position at an engineering school that did not have access to an anechoic chamber.

THE MAE DEPARTMENT partners with private industry to develop small class autonomous aerial vehicles for military use.

These vehicles, commonly referred to as drones, have a tremendous electromagnetic and acoustic signature, said Dr. Larry

Silverberg, professor and director of undergraduate programs in MAE.

Testing the acoustic and electromagnetic signature of these vehicles in the anechoic chamber informs work on reducing both so that they are harder to hear and pick up on radar.

IN THIS PHOTO, MAE GRADUATE STUDENT THOMAS POWERS, RIGHT, WORKS WITH WOODUS (ROCKY) MINTZ IN THE CHAMBER ON A MULTIROTOR HEXACOPTER THAT MINTZ BUILT. MINTZ IS THE OWNER OF SANDHILLS ROBOTICS IN FAYETTEVILLE, NC. IN PARTNERSHIP WITH TFM & ASSOCIATES, INC. SANDHILLS ROBOTICS WORKS WITH THE MAE DEPARTMENT ON DRONE RESEARCH.

The College plans to invest \$250 million in infrastructure and faculty hiring over the next five years

Forward MOTION

IT'S BEEN A GREAT DECADE for the College of Engineering.

Over the last 10 years, the College has seen tremendous growth in enrollment, research funding, fundraising and faculty hiring.

Research expenditures have nearly doubled over the last decade, while research awards have more than doubled.

The number of female faculty members has tripled while the number of faculty members from minority groups has doubled.

The number of master's students in the College has more than doubled while the number of Ph.D. students has grown by 50 percent.

In the last five years alone, the amount of new annual gifts to the NC State Engineering Foundation has more than doubled.

The College is one of only two in the nation to lead two National Science Foundation Engineering Research Centers at once and is a leader in major research centers sponsored by the Department of Energy and National Security Agency.

But this is no time to stop. The best never rest.

Over the next five years, the College will invest \$250 million in infrastructure and faculty hiring, moving closer to what Dr. Louis Martin-Vega, dean of engineering, has identified as its overarching goal: to become and be perceived as the leading public college of engineering in the nation and one of the premier colleges of engineering in the world.

The College will build a new cutting edge facility – the Engineering Oval building or EB Oval – to continue its move

to Centennial Campus and hire 100 new faculty members to do groundbreaking, interdisciplinary research.

The new home of the College's Departments of Civil, Construction, and Environmental Engineering (CCEE); the Edward P. Fitts Department of Industrial and Systems Engineering (ISE); and the dean's administration, Engineering Oval will encourage collaboration across disciplines in the areas of biomanufacturing, environmental engineering, additive manufacturing, transportation systems and more.

It will also bring the University one step closer to having a united College of Engineering on Centennial Campus. It's a vision decades in the making and a move that will solidify NC State's position as one of the top research-intensive public universities in the nation.

"Our College of Engineering is a powerhouse when it comes to research, outreach, economic impact and, of course, education," said NC State Chancellor Dr. Randy Woodson. "These investments are a vital part of making our University and College even stronger. The strength of Engineering is a major driver for NC State's brand and reputation."

NO ONE IS STANDING STILL

Across the country, states are recognizing the true value of their schools of engineering. These schools turn students into graduates who can improve their communities while earning good salaries. Their outreach programs expose grade school students to science, technology, engineering and mathematic (STEM) concepts and help make local industries more efficient.

The research that comes from engineering laboratories has a tremendous economic impact on their communities.

So engineering schools like Purdue University, Texas A&M University and the University of Florida have announced major investments in recent years.

Along with serving their own states and communities, the nation's engineering schools have been tasked with two high-profile challenges. The President's Council on Jobs and Competitiveness has called on U.S. colleges and universities to increase the number of annual engineering graduates by 10,000. The National Academy of Engineering has identified 14 Grand Challenges for mankind to help guide engineering education and research in the 21st century.

With one of the largest and most reputable engineering schools in the nation, NC State will be called upon to play a major role in helping reach both of these goals.

Continuing the College's upward trajectory while also continuing to play a significant role in addressing these important challenges will require investments in people and facilities. The College has an outstanding faculty and, on Centennial Campus, facilities that are second to none among engineering schools in the United States.

As the College prepares to hire 100 new faculty members over the next five years for positions in academic departments, centers and interdisciplinary clusters, continuing to

"Once the land was available, we said that engineering research will have to go to Centennial Campus"

DR. PAUL ZIA

recruit the absolute best candidates is a top priority.

Moving ISE to Centennial Campus will be a big advantage, said Dr. Paul Cohen, department head in ISE.

"We compete against the very top ISE programs in the country, and this move is critical to help us recruit the right people."

ROOM TO GROW

As dean of engineering in the late 1970s, Dr. Larry Monteith identified a need for more research space for the College. He tasked a committee made up of Drs. Paul Zia, Nino Masnari and Carl Zorowski, department heads in the three largest academic departments in the College, with finding the space.

It was no easy task. The site of the former Riddick Stadium was about the only vacant land they could identify on which to build.

In 1983, Gov. Jim Hunt announced plans to give part of the Dorothea Dix Hospital property south of Western Boulevard to the University. Zia, Distinguished University Professor Emeritus in CCEE, recalls being invited to the state capitol for the announcement.

"Once the land was available, we said that engineering research will have to go to Centennial Campus," Zia said.

Since then, the College has built four engineering buildings on Centennial

and has a presence in several others. Six of the College's nine main academic departments have made the move, but ISE,

CCEE and the Department of Nuclear Engineering (NE) are still waiting.

CCEE's Mann Hall was built in 1964, ISE's Daniels Hall in 1926 and NE's Burlington Laboratories in 1953. These departments are doing groundbreaking work, but are dealing with facilities that are outdated. The size and shape of the laboratories don't work. Students taking classes in Engineering Building III on Centennial Campus have electric sockets by their desks to power their laptop computers, while students in Mann Hall don't.

"We have emerging programs in additive manufacturing and smart manufacturing, and the building simply cannot handle them right now," Cohen said. "The infrastructure is not there."

Dr. Morton Barlaz, department head in CCEE, had to relocate graduate students in order to make laboratory space for a new faculty member. Barlaz's department has lab space in three different buildings and students based in five.

"I think right now some of our students might feel a little like orphans because so much of engineering is on Centennial," Barlaz said.

If the department needs more electricity to power servers or laboratory equipment, it has to pay to increase capacity. If it wants to start a new research center, it will have to rent space. Those hits to the department's bottom line take funds away from other

uses. Before moving to Centennial, the Department of Computer Science was spread out over eight different buildings.

"We were very disjointed," said Dr. Mladen Vouk, head of the department. "People would work in clusters but didn't really know anyone else. That was not very helpful. The collaboration was reduced."

Along with having better facilities, moving to Centennial will offer ISE and CCEE increased chances for interdisciplinary collaboration amongst departments. Cohen now describes Daniels as a square with four wings; faculty members in those four wings don't have a chance to interact effectively with each other.

Being on Centennial and sharing lab space has led to increased collaboration between the Departments of Computer Science and Electrical and Computer Engineering and a joint networking degree program, Vouk said.

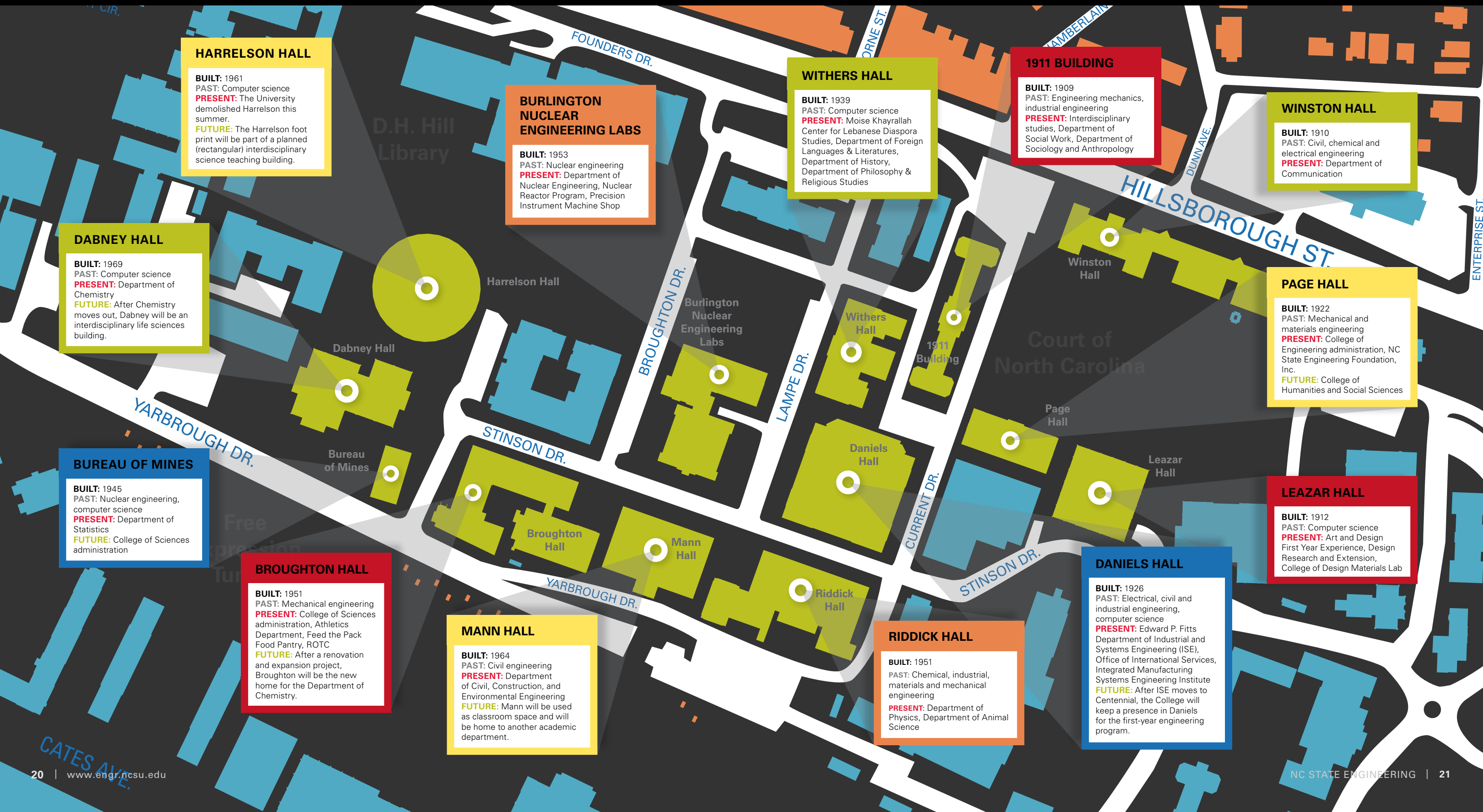
The passage of the Connect NC bond package by North Carolina voters in March provided \$75 million for EB Oval. The NC State Engineering Foundation has raised more than \$21 million of the \$60 million in private donations needed to complete the cost of construction.

"The move of Engineering to Centennial Campus has been a priority on this campus for almost 20 years," Martin-Vega said. "The Engineering Oval building is a major step toward completing the College's move to Centennial and part of an important investment that will help NC State Engineering and the University reach its full potential." ■



ROOM TO GROW

FROM HUMBLE BEGINNINGS in Holladay Hall, engineering at NC State grew to occupy several buildings on the university's North Campus. As the College of Engineering continues its eventual complete move to Centennial Campus, many of these spaces will take on a new life. Alumni can see what the buildings where they took engineering classes are used for today and what future plans might be in store.



HARRELSON HALL

BUILT: 1961
PAST: Computer science
PRESENT: The University demolished Harrelson this summer.
FUTURE: The Harrelson foot print will be part of a planned (rectangular) interdisciplinary science teaching building.

DABNEY HALL

BUILT: 1969
PAST: Computer science
PRESENT: Department of Chemistry
FUTURE: After Chemistry moves out, Dabney will be an interdisciplinary life sciences building.

BUREAU OF MINES

BUILT: 1945
PAST: Nuclear engineering, computer science
PRESENT: Department of Statistics
FUTURE: College of Sciences administration

BROUGHTON HALL

BUILT: 1951
PAST: Mechanical engineering
PRESENT: College of Sciences administration, Athletics Department, Feed the Pack Food Pantry, ROTC
FUTURE: After a renovation and expansion project, Broughton will be the new home for the Department of Chemistry.

MANN HALL

BUILT: 1964
PAST: Civil engineering
PRESENT: Department of Civil, Construction, and Environmental Engineering
FUTURE: Mann will be used as classroom space and will be home to another academic department.

BURLINGTON NUCLEAR ENGINEERING LABS

BUILT: 1953
PAST: Nuclear engineering
PRESENT: Department of Nuclear Engineering, Nuclear Reactor Program, Precision Instrument Machine Shop

WITHERS HALL

BUILT: 1939
PAST: Computer science
PRESENT: Moise Khayrallah Center for Lebanese Diaspora Studies, Department of Foreign Languages & Literatures, Department of History, Department of Philosophy & Religious Studies

1911 BUILDING

BUILT: 1909
PAST: Engineering mechanics, industrial engineering
PRESENT: Interdisciplinary studies, Department of Social Work, Department of Sociology and Anthropology

WINSTON HALL

BUILT: 1910
PAST: Civil, chemical and electrical engineering
PRESENT: Department of Communication

PAGE HALL

BUILT: 1922
PAST: Mechanical and materials engineering
PRESENT: College of Engineering administration, NC State Engineering Foundation, Inc.
FUTURE: College of Humanities and Social Sciences

LEAZAR HALL

BUILT: 1912
PAST: Computer science
PRESENT: Art and Design First Year Experience, Design Research and Extension, College of Design Materials Lab

DANIELS HALL

BUILT: 1926
PAST: Electrical, civil and industrial engineering, computer science
PRESENT: Edward P. Fitts Department of Industrial and Systems Engineering (ISE), Office of International Services, Integrated Manufacturing Systems Engineering Institute
FUTURE: After ISE moves to Centennial, the College will keep a presence in Daniels for the first-year engineering program.

RIDDICK HALL

BUILT: 1951
PAST: Chemical, industrial, materials and mechanical engineering
PRESENT: Department of Physics, Department of Animal Science

FAMILY TIES

Minority Engineering Programs continue to grow

THREE YEARS out of mechanical engineering classes at NC State, Brooke Wages is giving back to the program that meant so much to her during her time on campus.

After three student internships with Marathon Petroleum, Wages was chosen to participate in British Petroleum's competency-based rotational program for promising young professionals, gaining valuable engineering experience in a variety of positions. She is completing her last rotation in Houston, Texas, as an area maintenance engineer.

This year, Wages made a donation of \$15,000 to the College's Minority Engineering Programs (MEP).

"The experience and opportunities that were afforded to me by MEP are priceless," she said. "I can never give enough to repay what the program has done for me, when it comes to my personal, academic and professional growth."

MEP is a resource for African-American, Native-American and Hispanic students who want to become engineers or computer scientists.

The program works to increase the College's recruitment of students from underrepresented minority groups, help in retention of those students once they arrive on campus and aid in their personal, academic and professional growth both before and after graduation.

For more than two decades, MEP has offered tutoring, mentoring and a bridge program called STP (Summer Transition Program) that gives incoming minority students a head start on freshman year academics while introducing them to a network of NC State students.

Now, through new programs and partnerships, MEP is offering more help for students beyond freshman year and is tapping into new ways to recruit minority students into the College.

Everything MEP does starts with a support network that helps students handle being away from home and in an environment where they don't see many classmates who look like them.

MEP director Angelitha Daniel and staff members Kesha Entzminger, Kimberly Pender and Dr. Javon Adams receive constant visits from MEP



BROOKE WAGES

students who just want to check in and talk about how they are doing.

"If you ask students, they really talk about the community that they establish by participating in STP and MEP in general," said Entzminger, who is associate director of both MEP and the College's Women in Engineering program. "It's something that we think about a lot."

As Wages puts it, "MEP is family."

SUMMER AND BEYOND

While many newly minted high school graduates might use the summer before freshman year to relax by the pool, students who participate in STP are asked to spend six weeks on campus taking math and chemistry classes.

They also get a chance to begin networking during industry visits and participate in sessions on important topics like diet and nutrition and keeping a budget. Plus, there's time to hang out with a new group of friends and get accustomed to the freedom of college life.



“Getting to learn the campus before everyone arrived in the fall was a nice advantage to have,” Dr. Tylisha Brown said. “It was definitely a good decision.”

Brown participated in STP in 1994 and earned a B.S. in chemical engineering from NC State and a Ph.D. in the same field from Michigan State. This summer, she was back in the MEP fold, teaching a refresher chemistry course to this year’s group of STP students.

By the end of the summer, STP students have completed a college-level math course, along with that chemistry course and exposure to E 115, a computer course required for first-year students in the College.

Making research opportunities available for undergraduates is a College focus, and MEP has started a new summer program to ensure more minority engineering students are

participating. The Minority Summer Research Program, which was piloted in summer 2015, pairs incoming minority freshmen with faculty members, and participants showcase their research in a summer undergraduate research symposium. The hope is that they will continue to work on research throughout their time on campus and consider attending graduate school.

After STP, MEP students can take advantage of professional development courses and tutoring resources and can be paired with an older mentor via the START (STudent Advancement and Retention Teams) Mentor Program. Khalia Braswell, a 2013 computer science alumna who went on to earn a master’s degree from UNC Charlotte, was paired with a mentor who played on the Wolfpack women’s basketball team and served as an inspiration. Braswell

later served as an MEP mentor herself.

“I figured if she could play varsity basketball and get a computer science degree, then I could definitely do it,” said Braswell, who works for Apple, Inc. and started a Charlotte nonprofit called INTech that hosts software coding camps for middle-school age girls.

Just as important are the networking opportunities offered by MEP. Starting with that first summer in STP, MEP students receive instruction in professional development and are provided with opportunities to meet with industry leaders and apply for internships.

Andrew Pita, who earned electrical engineering bachelor’s and master’s degrees in 2008 and 2010, remembers mock interviews in front of his MEP classmates. He did student internships with IBM and ExxonMobil, where he

accepted a position after graduation and now works in Houston, Texas, as a project manager.

“Because of the program, I was able to network with a lot of corporate recruiters who were looking for people like me,” he said.

BY THE NUMBERS

Each year, minority students make up about 10 percent of the College’s undergraduate enrollment. When it comes to graduate school, that number falls to about six percent.

That’s why Daniel would like to see the College establish a program similar to MEP that focuses on recruiting and supporting minority graduate students.

NC State is second in the nation among schools that are not Historically Black Colleges and Universities when it

comes to the number of undergraduate degrees in engineering awarded to minority students.

Funding for scholarships would be key to taking the top spot, Daniel said. Georgia Tech is the leader in the category, and benefits from the state’s HOPE Scholarship Program that funds the education of Georgia residents at Georgia colleges and universities. Providing more scholarship dollars to talented minority students interested in the College is the key to increasing the numbers, Daniel said.

MEP has started new outreach efforts with the NC School of Science and Math and a Charlotte nonprofit called the YBM (Young Black Men) Leadership Alliance that are paying off.

YBM, a college preparation and leadership development program for young African-American men, brings

students to campus to learn more about NC State and will be expanding into Raleigh with MEP’s help.

“About 10 percent of the African-American males in the College are as a result of our connection with YBM,” Daniel said.

ALWAYS THERE

The need for the kind of support that the program offers became especially clear when two MEP students took their own lives during the 2015-16 school year. The MEP staff took action, putting together a midyear motivational wellness retreat. With sponsorship funds from Praxair, Inc., they took students to Winterplace Ski Resort in West Virginia for a weekend to regroup before mid-term exams and snow ski, a first for many of the students.

As soon as they arrived, students participated in a Skype session with a university counselor to talk about stress, knowing when it’s not normal and knowing when to reach out for help.

On a Tuesday during the semester, Daniel bought boxes of Krispy Kreme doughnuts and simply asked students to stop by the MEP offices in Page Hall to check in.

“Students came in, just for us to see their faces and let them know that we are thinking of them.”

When Daniel isn’t on campus working with current MEP students, you might find her off campus continuing to support alumni who have graduated from the program. She receives invitations to concerts, weddings, baby showers and other big life events for students she has mentored.

“When I was at my highest and lowest Ms. Angie was there,” Wages said. “(She) found me tutors freshman and sophomore year, and the MEP office always made themselves available. They are awesome.” ■



SOMETHING TO BUILD ON

ASSIST makes progress with testbed, other technologies

YEAR FOUR SAW BREAKTHROUGHS

and new directions in research for the Nanosystems Engineering Research Center for Advanced Self-Powered Systems of Integrated Sensors and Technologies (ASSIST).

The National Science Foundation Engineering Research Center led by NC State and headquartered on Centennial Campus is building hassle-free wearable devices “that are doing not just something that’s cool, but something that’s really important,” said Dr. Veena Misra, ASSIST’s director. “The big vision that we have is to build technologies that make a difference in your wellness.”

ASSIST research will take wearables from gadgets that count your steps and help you find your way home after a run to integrated, self-powered health monitoring systems that provide detailed information on what is happening in a patient’s body and take readings from the surrounding environment.

ASSIST is making important progress on one of its two testbeds (platforms into which different tools for measuring health can be built) and on the technologies that enable

those testbeds, which also have value beyond the ASSIST platform. Sensors being developed by ASSIST and the technology that allows them to talk to each other, for example, have broader uses for the Internet of things in which everyday objects can be networked together to function at a higher level.

To make these platforms work, ASSIST researchers are extracting more power from the human body, creating sensors and antennas that run on ultra-low power and resilient and functional materials that make actually wearing an ASSIST device a comfortable experience.

The Health and Environmental Tracker testbed consists of a wristband, a patch that adheres to an asthma patient’s chest and a nonwearable spirometer that takes breathing measurements. The system measures environmental factors — including volatile organic compounds and ozone in the air as well as ambient humidity and temperature — along with the wearer’s motion and heart rate and the amount of oxygen in the blood.

ASSIST researchers described their progress in a paper published in the spring. The next steps are producing

enough prototypes to conduct large scale clinical trials and, eventually, to find a partner to manufacture the system and get it into the hands of physicians and patients.

Once the platforms are perfected, the ways in which they can be used to measure human health can grow. The center is moving into sweat research, for example, and using nanocellulose to extract sweat from the skin and test for glucose and lactates without causing the wearer any discomfort. A next step would be removing interstitial fluid from just under the skin in a non-invasive way.

What’s next? What if these technologies can be implanted under a patient’s skin so she doesn’t have to wear anything? ASSIST is embarking on a research project jointly with biotechnology company Profusa and funded by the Defense Advanced Research Projects Agency on an implantable sensor.

“We are trying to build new directions for ASSIST that rely on the strength of ASSIST but also help us get into spaces where our technology can be really useful, such as implantables,” Misra said. ■

DOWN THE HOME STRETCH

FREEDM Systems Center moves closer to a vision realized

IN YEAR EIGHT, the Future Renewable Electric Energy Delivery and Management (FREEDM) Systems Center led by NC State moved closer to the vision that led to the center’s establishment.

That vision is a more efficient grid that allows bidirectional electricity flow and renewable energy sources to integrate seamlessly with the existing power grid.

In early June, FREEDM completed its annual review with the National Science Foundation (NSF) and a site visit with NSF officials on the campus of partner institution Florida State University.

With two years to go on NSF’s 10-year funding commitment, the center is drawing closer to a field-deployed FREEDM system, one of its goals by the end of the initial NSF funding.

But it won’t stop there. The center is working toward long-term financial sustainability with a combination of private funding, research grants and dues from industry partners. A \$1.5 million gift from the Duke Energy Foundation last year was a big start toward building a sustaining endowment for the center.

“The FREEDM concept is a longer-term vision addressing a very large

system that can’t change overnight,” said center Director Dr. Iqbal Husain.

NSF established FREEDM in 2008 with a charge to develop technology that will seamlessly integrate distributed renewable energy sources and storage into the electric grid infrastructure.

As the way we harness energy changes from centralized fossil-fuel-based generation to renewable generation produced by decentralized solar or wind installations, so too must the grid that distributes that energy. In the FREEDM system, electricity will be generated close to the loads and managed with a distributed control system that is responsive to price signals, customer preferences, and situational considerations.

With the addition of the Nanosystems Engineering Research Center for Advanced Self-Powered Systems of Integrated Sensors and Technologies (ASSIST) in 2012, NC State is one of only two schools currently leading two NSF engineering research centers and one of only two schools to ever be awarded the lead role in three.

Work in the last year advanced the development of three key elements of the FREEDM system: a solid

state transformer (SST) that allows bi-directional electricity flow and is more efficient than traditional transformers, a more efficient fault isolation device (FID), and the algorithms that will allow the devices to work together. While the SST and FID play a major role in the FREEDM system, they are also useful to improve a traditional power grid. FREEDM researchers hope to demonstrate new versions of both by the end of year nine.

The center is also conducting a cost/benefit analysis to evaluate the business case for utilities implementing the FREEDM system as well as for consumers who will be able to actively participate in the energy market. After successful field demonstrations planned over the next two years, it will be up to industry to take up the new technology and implement it.

“As the center transitions past NSF program funding, we will continue our core research activities in power electronics and power systems,” Husain said. “However, our faculty and industry partners will have state-of-the-art technologies for power grid modernization that are further along the path for deployment as we work together to realize the FREEDM vision.” ■





BEYOND THE CLASSROOM

DRS. JAMES LESTER, LEFT, AND ERIC WIEBE

The Center for Educational Informatics is changing the way we learn

ADVANCES IN DRIVERLESS CARS, stories about computers learning to best mankind in games of skill and the prospect of a computer posing as a human handling your next online customer service experience have brought fresh recognition to the field of artificial intelligence (AI).

An important acknowledgement of the work done by researchers who are using AI in the field of education came in the National Academy of Engineering's list of Grand Challenges facing humanity in the 21st century. That list recognizes the need to advance personalized learning.

Because of time and money constraints that mean a single instructor has traditionally taught a group of students, education often takes a one-size-fits-all approach. But students learn in different ways, and thanks to technology, teaching can be customized to fit their individual strengths in ways never before dreamed possible.

"People in my field have been working on this problem since 1970," said Dr. James Lester, Distinguished Professor of Computer Science and director of the Center for Educational Informatics (CEI). "It was gratifying to get official

recognition that this is a critical endeavor."

Housed in Engineering Building III on NC State's Centennial Campus, CEI conducts research on advanced learning technologies such as educational games or intelligent tutoring systems and works to develop and disseminate them. The center has a focus on STEM education for K-12 students and undergraduates, and on computer science education, but it is broadening its scope to include other types of learning and even the field of healthcare.

Led by faculty members from the Department of Computer Science who specialize in AI, the multidisciplinary center includes research scientists, game developers and digital artists.

Most research on education technology is conducted in colleges of education by teams of curriculum instruction specialists, instructional design specialists, science education specialists and educational psychologists, Lester said.

"We're one of the very few places in the country, in the world actually, that investigates advanced learning technologies and is housed in a college of engineering."



"We're one of the very few places in the country, in the world actually, that investigates advanced learning technologies and is housed in a college of engineering."

DR. JAMES LESTER

A TEACHER THAT SCALES

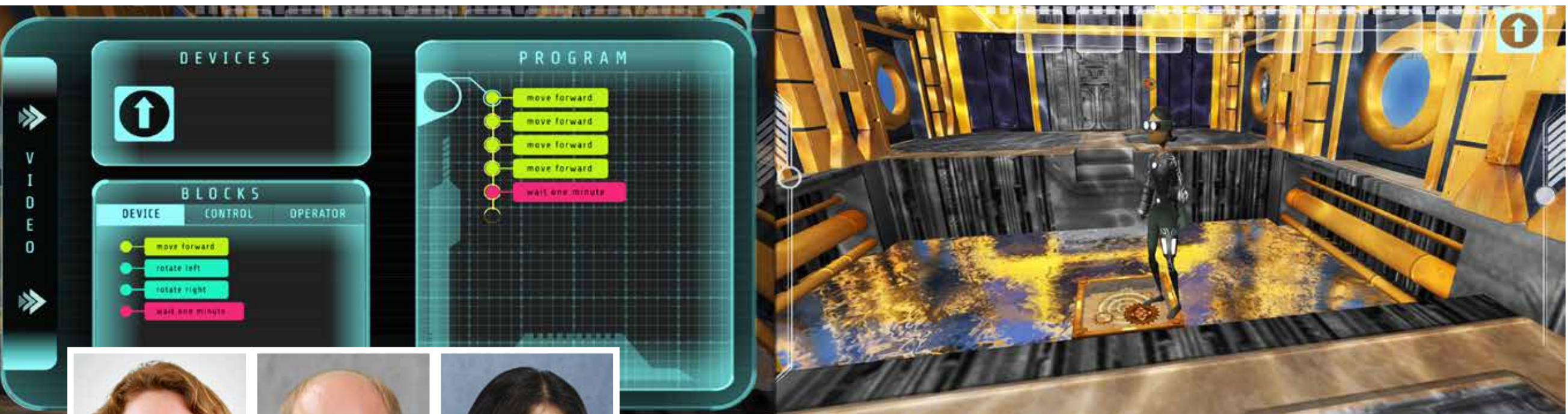
Lester cites what he calls "an enormous body of evidence" showing that the best educational outcomes come from one-on-one interaction between a human tutor and a human learner.

"That's a marvelous thing, but unfortunately it's completely unscaleable."

But software is, and education is an area in which AI technologies can have a significant societal impact by creating experiences that are effective and engaging. Students supplementing their learning with AI systems learn more deeply, exhibit greater learning gains and can transfer what they learn to new problems.

The research that underpins these systems touches on the language that humans use when they teach one another, the role that narrative naturally plays in learning and how a virtual human tutor should interact with a learner.

Much of that research starts with educational data mining — finding out as much as possible about how students learn, whether in a traditional classroom,



DR. TIFFANY BARNES



DR. COLLIN LYNCH



DR. MIN CHI

as part of an online course or by working on their own with educational technology. In some cases, it means intensive study of how a student is reacting with measures of posture, body temperature and heart rate and lots of video.

That data informs how the technologies CEI develops come together. In order to build robust systems that proactively customize the learning environment, this data must go beyond what students learn to include how they learn it.

“Educational informatics can make this happen,” said Dr. Min Chi, assistant professor of computer science. “Using the traditional paper-based tests to assess student knowledge has many drawbacks; through educational data mining we can look at how students are interacting with the system and whether

they are making the ‘good choices’ during the process.”

Dr. Collin Lynch, an assistant professor of computer science, is studying how students in massive open online courses and blended courses use online tools. What conclusions about outcomes can be drawn by how often students log into the system and how long they stay there? Can that information be used in a system that would let the instructor know when a student hasn’t logged into the system for a while or would give students reminders?

When Dr. Tiffany Barnes, an associate professor of computer science, studied how her students reacted when confronted with homework assignments they didn’t understand, she assumed that the students would simply give

up. That wasn’t the case; they kept trying, spinning their wheels without a way to get past the roadblock.

By using software, which includes a trace of what other students have done with the same problems in the past, Barnes and her colleagues build digital maps of how students have solved these open-ended problems in the past and give hints when a student working alone gets stuck. She likens it to using Google’s popular Maps tool.

“You’re on a journey and not only does Google Maps have the map, knowing where you start and where you go, it also knows where everyone else has gone and how other people made that journey,” Barnes said. “It can tell you where to turn next, and that’s exactly the kind of hint we generate.”

FROM MIDDLE SCHOOL TO WEST POINT

CEI has developed game-based learning environments for middle grade students that teach science and literacy and introduce computer science

concepts. At the opposite end of the spectrum, one of the center’s projects is building a similar program for cadets at the United States Military Academy.

“It’s a lot more high-stress, it’s a little more real-world,” Lester said. “But the technologies can support the learning experiences for the cadets and the students in a middle school science classroom. Many of the same problems and solutions are useful.”

Lynch has worked on intelligent systems that teach physics and is now building a system that helps students improve their written and oral argumentation skills by using software that breaks out hypotheses, claims and citations in a diagram structure that is easier to grasp than a linear form.

The center also sees a growing opportunity in healthcare, where intelligent systems can be used to educate patients. A National Science Foundation-supported project with Benioff Children’s Hospital in San Francisco is building an interactive narrative experience that will teach adolescents about the risks of alcohol.

Chi is involved in a collaborative project with a colleague in the Edward P. Fitts Department of Industrial and Systems Engineering that mines data from emergency room visits in hopes of predicting which patients will develop sepsis.

No matter the student targeted, or the subject matter covered, the system must model a learner’s knowledge, plans, goals and beliefs and intervene at the right time with customized hints, advice and feedback to maximize learning.

HELP FOR EDUCATORS

A sharp teacher can tell when her students are confused, frustrated or bored, when she needs to double back on the course material to get everyone on the same page or plow ahead.

It’s harder for a machine to do that. Part of the center’s research looks at affect — teaching machines to recognize and understand students’ reactions and make adjustments.

So will technology one day replace human teachers? Faculty members in

the CEI don’t think so. They see these technologies as a way to help solve the fact that there are too many students who need individual attention and not enough experienced human teachers to go around — that problem of scale that Lester mentions.

Chi sees educational technology as a helpful supplement for learners who are behind in class or are ahead and want to learn even more. Some students, she said, just like to learn on their own.

In addition to building data-driven systems, Barnes works to ensure that there are new teachers learning to teach computer science – and as they and their students learn about computation, they will be more comfortable using educational technologies as they will become creators.

Lester describes a scenario in which students work individually with a customized learning system, then attend a class with a strong teacher equipped with a dashboard that shows what the students have accomplished on their own.

One of the center’s research projects in partnership with Concord Consortium, a nonprofit educational technology laboratory in Massachusetts, is examining how to provide these customizable learning tools to students while also supporting teachers in the classroom.

“Technologies are fabulous,” Lester said. “They are changing people’s lives. Kids 10 years from now are going to learn very differently than they learn now. But the question is how can you leverage the capabilities of the teacher that are well beyond anything that a piece of technology can do now.” ■



JAN AND ANDY AMMONS



LARRY BOWMAN



FRANK CULBERSON

TEAM EFFORT

Join alumni and friends who are supporting the Engineering Oval project

PASSAGE OF THE CONNECT NC BONDS by North Carolina voters in March meant \$75 million to help make the College’s Engineering Oval project a reality.

The funding goes a long way. But it won’t cover the entire cost of the \$154 million building. That’s where alumni and friends of the College come in.

The College plans to raise \$60 million in private funds to help build the new home of the Edward P. Fitts Department of Industrial and Systems Engineering (ISE), the Department of Civil, Construction, and Environmental Engineering (CCEE) and the dean’s administration.

Meet four alumni who recognize how important the Oval project is for the future of the College and have pledged their financial support.

ANDY AND JAN AMMONS

As student sweethearts at NC State, Andy and Jan Ammons have fond memories of meeting in Metcalf Hall and racing from the top of Harrelson Hall down that circling walkway.

Jan Ammons studied business management and economics, and Andy Ammons received a civil engineering degree with a construction concentration.

Andy Ammons’ father was an NC State agricultural engineering graduate and a Raleigh developer. After working with a couple of big construction companies in Florida, the son returned to North Carolina to work with his father on two big development projects in Wilmington and Nags Head.

The Ammonses returned to the Triangle to raise their three children and

start a new project near Wake Forest. Today, Heritage is a sprawling residential and commercial development with 4,500 housing units on 2,600 acres.

As their development work has begun to wind down, the couple created a family foundation to give back by supporting projects in line with their values. The Jandy Ammons Foundation supports capital projects that speak to their passions: parks, trails, the arts and volunteerism for her and conservation for him.

They say the Oval project checks boxes for both, and acknowledges their passion for NC State.

The couple likes the progress the University is making on Centennial Campus.

“Seeing just what is happening is pretty impressive,” Jan Ammons said.

“A lot of great things are coming out of NC State.”

“It’s time to get civil engineering over there,” her husband added.

LARRY BOWMAN

“It was a blur,” Larry Bowman said of his time at NC State.

Bowman completed a degree in industrial engineering in less than three years. After that final exam, he remembers feeling more than just relief. He knew he had learned marketable skills in that relatively short stay on campus and was excited about the opportunities ahead. He felt prepared.

“I felt that I had built a good foundation.”

After graduation, Bowman returned to his native Hickory, NC to begin a 30-year career in the telecommunications business. After working for two companies in the area, he and a partner acquired a satellite technology company and later sold it to General Dynamics.

It was work that took him to some interesting places as the company marketed its commercial satellite technology in areas that didn’t have it, including China, India, Indonesia and the Eastern Bloc countries after the Iron Curtain fell.

He reconnected with NC State in the late 1980s and has served on the advisory board for the Edward P. Fitts Department of Industrial and Systems Engineering (ISE), the University’s Board of Visitors and the board for the NC State Engineering Foundation. He is also an ISE Distinguished Alumnus.

“The College of Engineering has continued to develop, to rise and be recognized,” he said. “It’s been fun to be a part of that.”

That ISE home department will benefit from the move to Centennial Campus. Bowman knows the Oval project represents a major step forward as the College aims to reach its full potential.

“Having the College of Engineering completely on Centennial Campus is extremely important,” he said. “I think it’s essential.”

FRANK CULBERSON

If there is a way for an alumnus to support the College of Engineering, Frank Culberson has probably done it.

Culberson earned a bachelor’s degree in chemical engineering in 1960. After working with the Shell Oil Company/ Shell Chemical Company and the Pace Company, he joined and later led Rimkus Consulting Group, Inc. He is now a director and chairman of Rimkus, a forensic consulting company that performs engineering and business assessments concerning accidents, injuries and structural and mechanical failures.

A 2002 Distinguished Engineering Alumnus, Culberson is a past president of the NC State Engineering Foundation and served four years as director of the NC State Achieve! campaign.

Culberson and his wife established the S. Frank and Doris Culberson Academic Enhancement Fund and have endowed two professorships in the Department of Chemical and Biomolecular Engineering.

Always looking to stay involved with the College and University, Culberson has agreed to serve as campaign volunteer chairman for the College for an upcoming University wide fundraising campaign that will include support for the Oval building.

He recalls a Foundation board visit to CCEE in Mann Hall. The board members recognized that upgrading the facilities in Mann, built in 1964, is an important priority.

Culberson sees great value in uniting the College on Centennial Campus, making first-class facilities available to all of its students and faculty members.

“There are a lot of advantages to having everything together,” Culberson said. “I think this is critical for NC State.”

READY TO HELP?

Cornerstone Society

Early donors of \$50,000 or more to the Oval project will be part of the Cornerstone Society, a select group of donors who will:

- Receive named recognition on a donor wall inside the Engineering Oval building atrium
- Be invited to a special groundbreaking ceremony on Centennial Campus when construction is set to begin
- Receive an invitation to other VIP events and receive special insider information about the project

Make your mark

Naming rights are available for classrooms, atriums and laboratory spaces in the Engineering Oval and are a great way to leave a legacy in the College’s new premier facility.

Contact **Lora Bremer**, executive director of major gifts and campaign planning, at **919.513.0983** or **lora_bremer@ncsu.edu**

MEET THE DEAN'S CIRCLE

ASK ANY OF THE NUMEROUS DONORS to the College why they give, and their reasons might vary from helping support future students to attracting the best and brightest faculty members and everything in between. As the College continues to grow and captivate young students from around the world, the members of the Dean's Circle are helping to ensure that the College maintains a competitive edge and creates an outstanding educational experience for students and faculty members. The Dean's Circle is a comprehensive society for all unrestricted gifts of \$1,000 or more to the College and its departments. Meet three Dean's Circle donors, and learn why they give.



DR. NANCY ALLBRITTON



BLAKE MILLER



ALLEN MCCALL

DR. NANCY ALLBRITTON

Powerhouse, teaching innovation, and dynamic. If you were to ask Dr. Nancy Allbritton to describe what attracted her to working at NC State and UNC Chapel Hill as the chair of the two schools' joint biomedical engineering department, those are just some of the words she would use.

Allbritton is a Kenan Distinguished Professor at UNC Chapel Hill, having been recruited to the Department of Chemistry in 2007; holds a joint appointment with the UNC School of Medicine in the Department of Pharmacology; and was named head of the UNC/NC State Joint Department of Biomedical Engineering (BME) in fall 2009. She is the first woman department head in the College's history.

She has received widespread acclaim for her research on cell signaling networks and microfabricated systems for cellular analysis and has more than 150 publications to her credit. Her research program has received more than \$55 million in grant funding from the National Institutes of Health over the past 22 years. She is the scientific founder of four companies based on her lab's work, and she holds 13 issued patents with five more pending.

As chair of the BME department, Allbritton knows firsthand how funding for college departments is essential in helping enrich both students and faculty members.

"To have money that can be used to support student activities that state money wouldn't be able to support, to be able to do things that couldn't otherwise be done, it's important."

Allbritton and her husband, Dr. Christopher Sims, a rheumatologist in the Triangle, donated toward the BME department fund.

"I think donating is the only way to build a university. I've had such a great time at NC State, and I think it's important to give back."

BLAKE MILLER

For Blake Miller, attending NC State was an easy choice.

"Both my grandfather and father attended NC State so I grew up bleeding red and howling," said Miller, who earned his undergraduate degree in 2009 from the Department of Electrical and Computer Engineering. "I knew in high school that I wanted to pursue engineering, and with the great buzz going around about Centennial Campus, I knew NC State was where I wanted to be."

Nine days after graduating, Miller began work at Progress Energy in Raleigh, where he held various engineering roles within the company, including moves to Wilmington and Wade, NC. Miller was working with delivery operations in Wade when Duke Energy bought Progress Energy, so he was relocated to Charlotte working toward a leadership position. In April, he was promoted to construction and maintenance supervisor and now resides in Mount Airy, NC.

Thinking back on his time at NC State, Miller laughs and says that some of it was a blur.

"I met some of my lifelong friends, faced new challenges, was in situations that make you more independent – during that time and struggle, it made me a success."

According to Miller, learning the balance between life and engineering is one of the greatest things NC State afforded him. "NC State gave me more than an education, it helped shape me into the person I am today."

He has donated toward the College's Leadership Fund and hopes that it will help others in achieving success and striking that balance.

"I want new students to have great opportunities, and this is my way of investing in their futures."

ALLEN MCCALL

Thinking back to his time spent at NC State, Allen McCall recalls the life lessons he learned while living on campus and the bonds he formed with fellow engineering students.

"Through the years we learned how to handle the vigorous academic challenges of the engineering school while at the same time enjoying the social opportunities NC State offered us," said McCall, a 1974 graduate of the Department of Mechanical and Aerospace Engineering. "My years at NC State were some of the best years of my life."

Upon graduating, McCall worked for five years in several states for Helena Chemical Company in agricultural chemical sales. Upon returning home to Laurinburg, NC, he began his career with Canal Wood Corporation, now known as Canal Wood, LLC, as an entry-level forester, holding various supervisory roles over the years. Today, McCall is Canal's president.

"We are proud to say that Canal is one of the largest privately owned fiber supply organizations serving the nation's largest forestry companies in seven Southeastern states," said McCall. "(I) am honored to work with the finest men and women in our industry."

With a successful career, McCall feels the disciplines he learned in engineering have helped mold his approaches to problem solving and feels it is time to give back to the place that was most informative and memorable for him.

"I left Raleigh with not only a strong academic education but also a sense of belonging to something bigger than myself — the Wolfpack nation." ■

Gift pays tribute to a family of NC State alumni



ALICE BENNETT

ALICE BENNETT's father, husband and son were NC State graduates. Before her death earlier this year, she made a gift to the College that would make all three of those alumni proud.

Bennett endowed a faculty fellowship for the Department of Electrical and Computer Engineering (ECE) at the end of 2015. She passed away on March 29 at the age of 99 in Salisbury, NC.

After her death, representatives of

the NC State Engineering Foundation learned that she had left the College additional funds through her estate plans.

Bennett was proud of her family's connection to NC State, her daughter Barbara Furmanski said. Bennett was also motivated to follow up on plans to support the College that her son had made but was not able to follow through with.

Her son R. Ray Bennett Jr. earned a bachelor's degree in electrical engineering in 1966 and spent his career as an electrical engineer with

MeadWestvaco. Before his death in 2012, he had begun work with the Foundation on a planned gift to the College.

Ben Hughes retired as director of the Foundation in 2011 and now serves the organization as a special development advisor. Hughes had worked with Ray Bennett on that planned gift and later connected with his mother, Alice Bennett, and invited her to attend an NC

State football game in the engineering dean's suite.

Alice Bennett's husband, Roy R. Bennett, was a 1934 graduate who served as a cooperative extension agent before joining the University's Agronomy Department, providing the leadership for the tobacco extension program.

Alice Bennett's father, James Claudius Barber, was a 1904 NC State mechanical engineering graduate.

"We are extremely grateful for Mrs. Bennett's generous gift," said Dr. Dan Stancil, ECE department head. "Recruiting and retaining top faculty members is critical to the continued success of the department, and the early years following a new hire are particularly important for getting a faculty member's career off to a good start. Mrs. Bennett's gift will significantly enhance our ability to recruit and support the success of new faculty members. The success of these outstanding faculty members will, in turn, enhance the education and experience of our students." ■

Alumnus endows scholarship for veterans



DAWN AND MARK CARTER

THERE ARE MANY different paths to success. Just ask **MARK CARTER.**

The youngest of seven children from Alamance County, NC, he married Dawn, his high school sweetheart. Once married, they both joined the Marines, heeding her father's advice to learn a skill in the military. The couple trained at the 29 Palms Marine Corps base in California and spent most of their enlisted time at

Marine Corps Air Station Cherry Point in Havelock, NC, as electronic technicians.

They returned home after four years of honorable service. Dawn enrolled at UNC Greensboro to study interior architecture and history, and Mark paid a visit to Dr. William Easter, a professor in electrical engineering at NC State, to ask for his help.

The Marine Corps had changed him; he was more focused and mature. Not only had he learned a lot about electronics but a great deal about himself as well.

"I'm a veteran," he told Easter.

"My service has prepared me for greater challenges. Would you give me an opportunity?"

Easter did.

Mark Carter completed his electrical engineering degree and worked for three companies before starting his own electrical contracting company in Raleigh. Wells Global installs backup power systems for federal agencies, including

the Federal Aviation Administration and the Department of Defense and employs 38 people, including several NC State engineers.

The Carters decided to endow a scholarship that would support an undergraduate engineering student who is also a veteran, preferably one interested in electrical engineering. They named the scholarship after Mark

Carter's mother, Mary Gammon Carter, a tough textile worker who left a legacy of hard work and strong family values.

Mark Carter credits his mother, who instilled discipline, a little stubbornness and the ability to work hard, for his career success.

"The military gave me the confidence, and NC State gave me an opportunity to prove myself," he said. ■

Cirrus Logic continues to invest in the College and in electrical engineering

WHEN DR. JASON RHODE was applying to graduate programs in electrical engineering, he was accepted by several schools. But one stood out.

"NC State really went out of their way to make sure I knew that they wanted me to come there," said Rhode, who earned master's and Ph.D. degrees in electrical engineering in Raleigh.

Rhode is now president and CEO of Cirrus Logic, a premier supplier of high performance, low-power integrated circuits for audio and voice signal processing applications based in Austin, Texas.

He says NC State, and the College of Engineering, continue to stand out.

His company has built a strong relationship with the College and particularly the Department of Electrical and Computer Engineering (ECE). Rhode has returned to campus to talk to ECE undergraduates about the value of earning a graduate degree and spoke to engineering and computer science freshmen at the 2015 College of Engineering Welcome. Cirrus Logic recruits heavily from ECE, for both interns and full-time employees.

The department's master's degree track in circuit design applies particularly well to Cirrus' work processes.

"We can hire people out of there with a master's degree, and they can really hit the ground running," Rhode said.

Cirrus Logic is continuing to invest in ECE by creating a Distinguished Professorship and Term Professorship with a total gift of \$708,106. Utilizing the Distinguished Professors Endowment Trust Fund, which was established in 1985 by the North Carolina General Assembly, the goal is to receive the state match of \$334,000 to then establish a \$1,000,000 distinguished professorship.

The company also created the Cirrus Logic Michael L. Hackworth Design Fellowship Program in 2013, which provides an award of \$80,000 over two years and an internship opportunity to ECE students interested in mixed signal circuit design. In 2015, Cirrus Logic made a \$100,000 commitment for discretionary support to provide the department with the resources needed to have optimal flexibility and respond to opportunities and challenges quickly. ■



JASON RHODE

PLANNED GIVING

ENGINEERING FOUNDATION

Have you included the NC State Engineering Foundation in your will, trust or other estate plans? It's a great way to make sure the opportunity that meant so much to you is there for future generations.

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Call Lora Bremer at 919.513.0983 to discuss any of these charitable options or visit www.engr.ncsu.edu/foundation for more information.

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Name the Foundation to receive part or all of your IRA, 401(K) or 403(B).

Always an engineer

Twenty years after retirement, Dr. Paul Zia is still an important part of CCEE

DR. PAUL ZIA was set to retire from the Department of Civil, Construction, and Environmental Engineering (CCEE) when he received some good news.

A research proposal Zia had worked on would be funded. Zia was committed to seeing it through, and a new faculty member in the department would collaborate. Zia retired, but decided to keep working on the project.

That was in 1996.

Over the next 20 years, that research project has led to others. It's allowed Zia, who turned 90 in May, a chance to continue work as a researcher and keep his mind sharp. By collaborating with other faculty members, Zia says, with the characteristic warm smile known by anyone who has met him, he can focus on technical matters and doesn't have to deal with much paperwork.

"As long as I am physically and mentally able, I can continue to contribute to the education of grad students here and at the same time collaborate with younger faculty members to help them become established career wise," Zia said.

A National Academy of Engineering member, Zia is a preeminent researcher and teacher in the areas of reinforced and prestressed concrete structures, concrete materials and construction. He came to NC State in 1961 and served as department head in CCEE from 1979 to 1989.

Zia is an honorary member of both American Concrete Institute (ACI) and American Society of Civil Engineers (ASCE); a Fellow, Titan, and Medal of Honor recipient of Precast/Prestressed Concrete Institute (PCI) and served as president of ACI in 1989-1990. In 1999,

the National Park Service presented him the Citizen's Award for Exceptional Service for his work on the relocation of Cape Hatteras Lighthouse.

The department established the annual Paul Zia Distinguished Lecture to bring the engineers behind some of the world's most important civil engineering projects to campus. Past lectures have had audiences of as many as 600.

Zia was a new department head and Dr. Larry Monteith a new dean of engineering when Zia proposed a new lab for large-scale structural testing that would offer the kind of space and capability that the labs in the basement of Mann Hall did not. That facility, the Constructed Facilities Laboratory (CFL) on Centennial Campus, was completed in 1996 just when Zia began that first post-retirement project.

When Zia comes to campus, the CFL is where you will find him. It's also where students and faculty members threw a surprise 90th birthday party for him.

His ongoing involvement with his department has included annual financial support. He and his wife, Dora, have also made gifts for continuing support to CCEE in their estate plans.

Zia had planned to continue work in his field during retirement, taking on consulting work and staying involved with the professional societies.

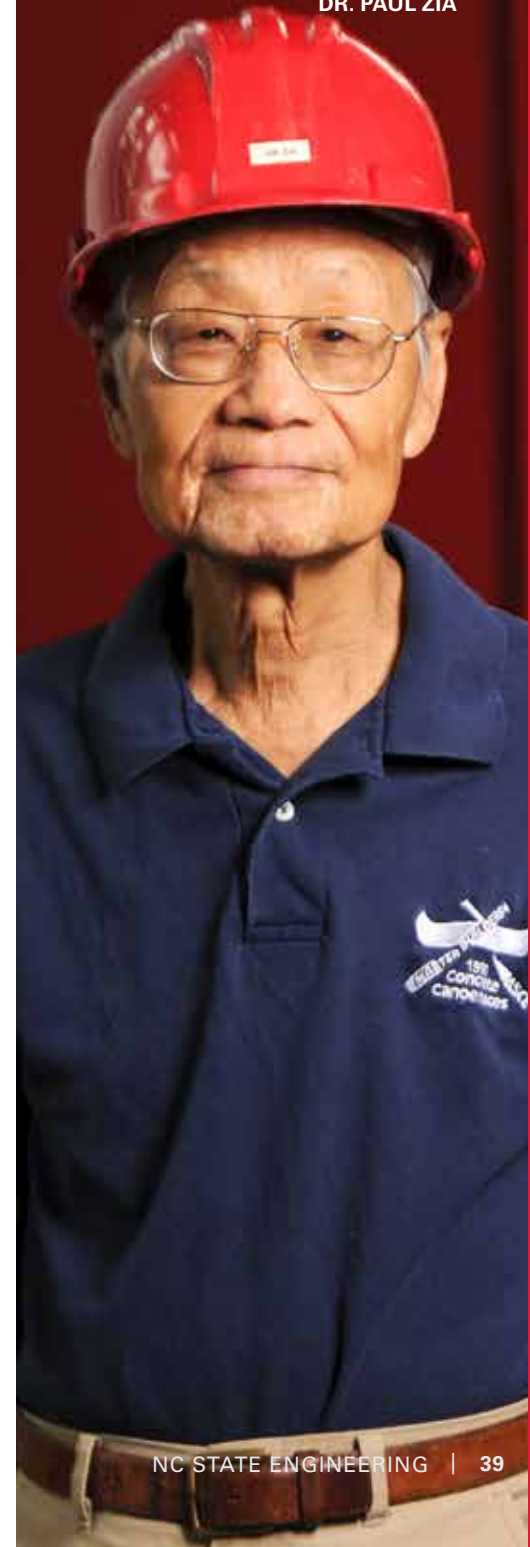
"When I retired I intended to remain active because I didn't want to be sitting in a rocker and withering away," he said.

Fortunately for the faculty members and students in CCEE, staying active has Zia remaining a vital part of the department. ■

FOUNDATIONS

"As long as I am physically and mentally able, I can continue to contribute to the education of grad students here and at the same time collaborate with younger faculty members to help them become established career wise"

DR. PAUL ZIA



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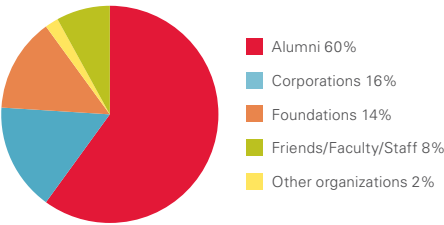
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Foundation Year in Review

GIFTS AND NEW COMMITMENTS BY GIFT SOURCE, FISCAL YEAR 2015-16

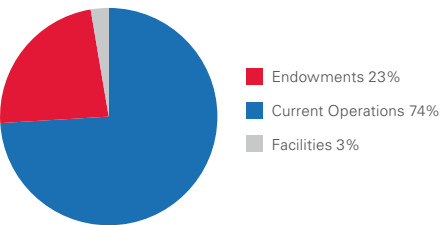


FUELED BY STRONG and early support for the Engineering Oval building project, the NC State Engineering Foundation had another record setting fundraising year with giving totals to the College at \$30,468,121. Fiscal year 2016 ended on June 30, 2016.

The Campaign for Engineering Oval launched this past year with leadership gifts recorded at \$15,275,000 (the goal is \$60 million). Endowment gifts were off slightly this year at \$7,094,856 (compared to \$9.2 million in fiscal year 2015). Endowments to the College generally fall into one of two categories: scholarships or professorships. There are now 292 permanently endowed scholarships in the College and 44 permanently endowed professorships.

In spite of our success this year, the needs of the College remain great and clearly articulated. Private funds will have to make up a substantial portion of the cost of Engineering Oval. This project gets us closer to our goal of unifying the College on Centennial Campus and

GIFTS AND NEW COMMITMENTS BY GIFT USE, FISCAL YEAR 2015-16



unleashing our full, interdisciplinary potential. In spite of the large number of scholarships, the majority of our need-based student population will not receive sufficient financial support and will be faced with choices that include increasing their debt load. Finally, it's hard to have a truly great College of Engineering without a great faculty. The ability to provide our faculty private funds is often the difference maker, particularly in the discovery process.

On behalf of the students, faculty and staff at the College of Engineering, the Foundation expresses its sincere appreciation to all who continue to give so generously.

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: <https://foundationsaccounting.ofa.ncsu.edu/foundations/nc-state-engineering-foundation-inc/>

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FROM THE OUTBACK TO THE WOLFPACK

DR. PAUL FRANZON LEARNED TO FLY as a student in his university glider club, chasing kangaroos up and down the ridges of the Outback in south Australia. Today, you can catch a glimpse of him in the sky above Carter-Finley Stadium before the Wolfpack football team takes the field.



Franzon, Distinguished Professor of Electrical and Computer Engineering (ECE) and an instrument-rated commercial pilot, is a member of the Bandit Flight Team, a precision formation team that you might see passing over NASCAR races, sporting events, parades and festivals across North Carolina. The team is scheduled to appear at all seven of NC State's home football games this fall.

Franzon pilots a Van's RV-8, one of a line of kit-built experimental aircraft. The Bandit pilots fly RVs or Yaks, a line of Russian flight trainer aircraft.

On the day Franzon passed his check ride for a private pilot's license, he caught a glimpse of an RV at the airport.

"I said that's what a plane should look like," he recalled. "Since then, I have

gravitated toward that experimental end of aviation."

Franzon became involved in the local RV community after receiving his power license in North Carolina in 1993. After being accredited for formation flying, he met a couple of local Yak pilots who needed more pilots to practice with

in order to receive their formation license.

The Bandit Flight Team was born, and NC State football was its first customer.

The Bandit formation passes over the packed stadium at the end of the pre-game National Anthem and makes another pass as the home team charges onto the field.

While formation flying is difficult, flying in formation and arriving at a certain spot at a certain time is even tougher, Franzon said.

As a flight lead, Franzon must coordinate with a spotter on the ground who will relay when the marching band's conductor climbs atop his perch to lead the Anthem performance. If the team is headed toward the stadium and things on the field are running behind, they must delay, doing S-turns in the skies above west Raleigh. It helps when a game is televised; that means things will run on schedule.

"The standard National Anthem is only one minute, 15 seconds," he said. "So it's a narrow window. You have to be at the right place a minute and fifteen out."

As the planes fly over the stadium, they

drip paraffin oil into the engine exhaust to create smoke. In recent years they have added colored smoke to the flight.

About half of the team members are former Air Force fighter pilots, some of whom have been commercial jet pilots. That includes Andy Stanaski, who earned a Ph.D. in electrical engineering from NC State after flying F-15s in the Air Force.

Franzon, who is head of the graduate program in ECE, enjoys the additional challenge of flying in formation. And being part of a team makes flying – usually a solitary endeavor – into a group activity.

"It's hard, but it's a lot of fun," he said. "It's a really different type of flying." ■



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