

# NC STATE

# Engineering

SPRING/SUMMER 2014



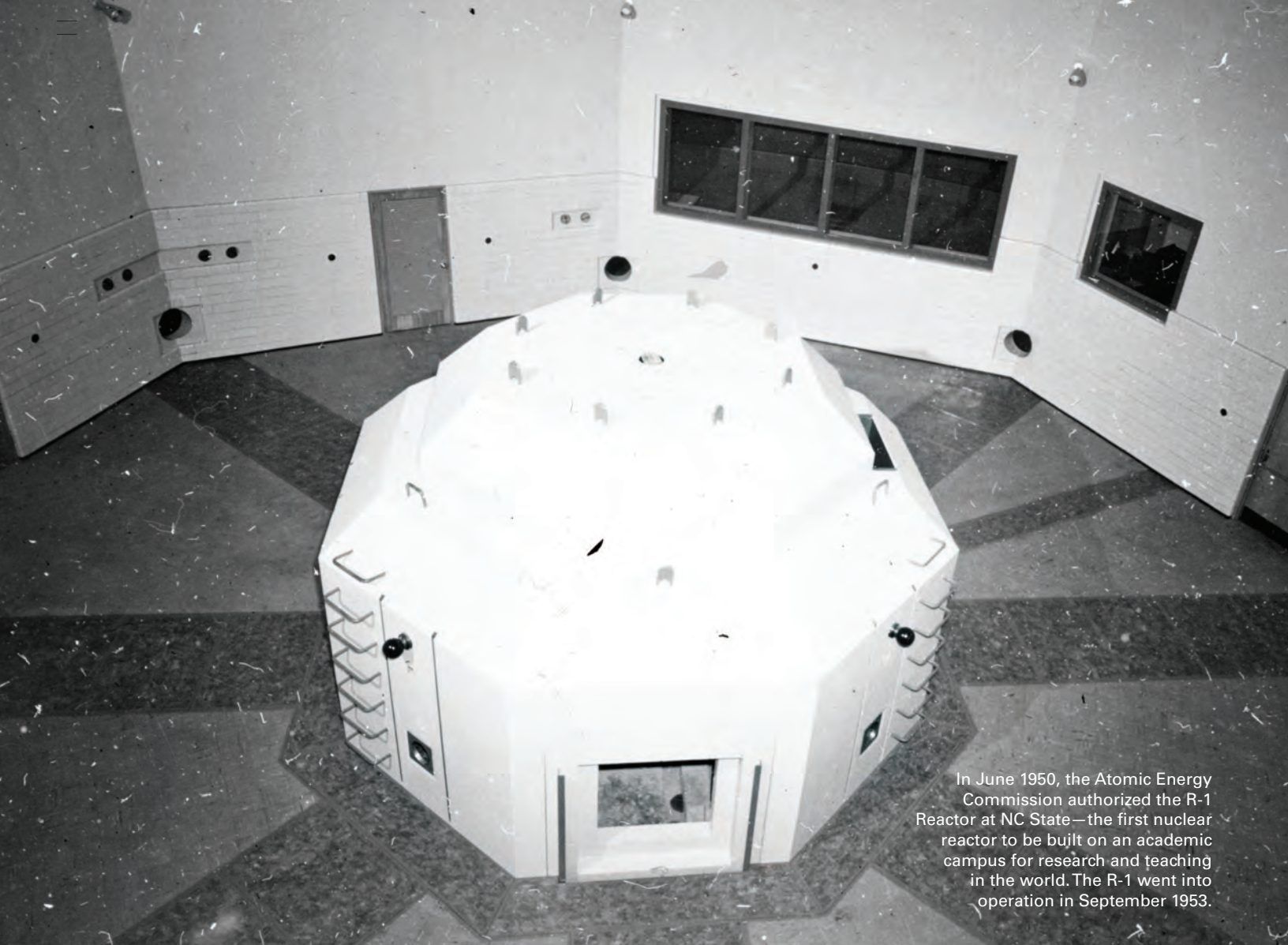
NC STATE  
UNIVERSITY

## NC STATE TO LEAD NATIONAL MANUFACTURING INNOVATION INSTITUTE

Goal is to further development and  
manufacturing of wide bandgap semiconductors

| 22





In June 1950, the Atomic Energy Commission authorized the R-1 Reactor at NC State—the first nuclear reactor to be built on an academic campus for research and teaching in the world. The R-1 went into operation in September 1953.

## ENERGY LEADERSHIP

NC State University has been a leader in the advancement of technologies dealing with the safe production and use of energy for decades. As early as 1953, NC State's College of Engineering was at the forefront of research with nuclear energy when it began operating the first public research nuclear reactor ever constructed.

There have been four nuclear reactors on the NC State campus. The PULSTAR Nuclear Reactor in the Department of Nuclear Engineering has been in operation since 1972. It is a 1-MW (soon to be updated to 2-MW) pool-type research reactor using 4 percent enriched, pin-type fuel consisting of uranium dioxide pellets in zircaloy cladding. The fuel gives the reactor

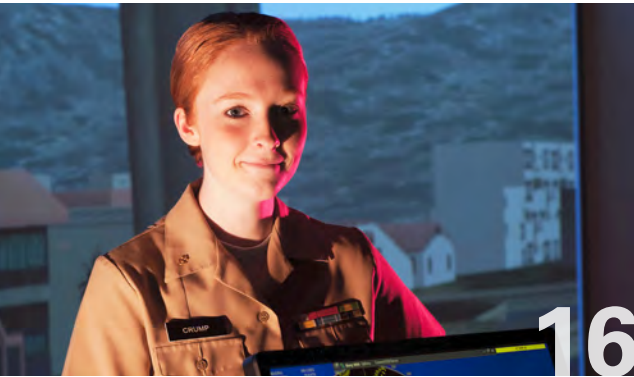
response characteristics that are similar to commercial light water power reactors, allowing for an assortment of teaching and research opportunities.

Today, NC State continues its leadership in energy technology. On Jan. 15, President Barack Obama announced that NC State would lead the Next Generation Power Electronics National Manufacturing Innovation Institute. The \$140 million project unites academic, government and industry partners to further the development and manufacturing of wide bandgap semiconductors that will make high-power electronic chips and devices that are more energy-efficient possible.

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# Q&A

## QUESTIONS FOR **ANGELITHA DANIEL**

Angelitha Daniel is director of Minority Engineering Programs (MEP) at NC State. She talks about the challenges colleges of engineering face when recruiting and retaining minority students and the successes happening at NC State.

### **What do Minority Engineering Programs at NC State aim to do?**

We want to recruit, retain and graduate talented minority students in engineering and computer science. We use professional development programs and support initiatives like the Overnight Minority Recruitment Stay, the Summer Transition Program, and Student Advancement and Retention Teams, or START, as recruitment and retention tools. We also support the university chapters of the American Indian Science and Engineering Society, the National Society of Black Engineers and the Society of Hispanic Professional Engineers.

### **What do enrollment numbers at NC State and in engineering programs throughout the country look like for students from underrepresented minority groups?**

Recruiting and enrolling more minority students is a top priority for educational institutions nationwide, including NC State. Minority students make up 10 percent of the College's undergraduate enrollment, and the College enrolls an average of 145 minority students each year. To keep a competitive edge in a very diverse and global economy, we must attract and keep academically sound students of all backgrounds.

### **Tell us about START.**

It's the College's formal peer-to-peer mentoring program for minority freshmen. The program pairs upper-class students with new freshmen, providing guidance to help them successfully navigate their first year at NC State. Social activities and academic workshops allow mentors and mentees to become acquainted and establish a big brother-big sister relationship.

### **Why aren't more members of underrepresented minority groups drawn to engineering and computer science?**

Many barriers block the enrollment, retention and graduation of minority students, including academic under-preparedness; some students don't have access to specific math and science courses at their high school, for example. Other obstacles include a lack of information about the application process and the engineering field, low scores on college admission tests, and lack of family support and financial resources like scholarships. MEP exists to knock down these barriers.

### **Can you share some recent success stories?**

The College ranks second in the number of bachelor's degrees awarded to African-American students among non-HBCUs. We also rank fifth in the nation for bachelor's degrees awarded to Native Americans. These rankings speak to the need for our program and the effectiveness of what we do each day for our students.

### **A lot of students in the program stop by your office to talk. What does it take to connect with today's college students?**

We love that our students enjoy coming by our offices and talking with us. We want our students to always feel welcomed. We create a family atmosphere as a result of the programs we offer and our involvement with minority engineering organizations.



# FROM THE DEAN



Louis A. Martin-Vega

When it comes to meeting basic societal needs — electricity, housing, clean water and communications among them — you need the work of engineers. And engineers develop the tools for society's aspirations: smart phones, travel to Mars, harvesting clean energy and exploring the stars. From farm to table, office to home, engineers are behind the success of America.

And the nation is beginning to grasp that future success and prosperity depends on having the engineering and computer science talent available to meet the future grand challenges of society.

As part of that national awakening, the Council on Competitiveness and Lockheed Martin developed the National Engineering Forum that begins with regional events to bring together leaders in industry, education and government to address ways to move engineering to the forefront of national dialogue concerning STEM education.

As a national leader in engineering education, our college recently hosted a regional dialogue in partnership with the National Engineering Forum. We partnered with our colleagues from Duke University's Pratt School of Engineering for this event as we have for previous national events on engineering and society. The event was a tremendous success, with more than 90 participants representing business, industry, education and government. Jim Rogers, former president and CEO of Duke Energy, provided the keynote address that informed round table discussions. These discussions will result in a regional report designed to inform a broader national report to be released in the summer of 2015.

In this issue of *NC State Engineering*, we give you many examples of how our engineers and computer scientists are impacting and improving your world. From using their engineering skills in defense of our country to developing new ways to treat diabetes and moving research from the lab to the marketplace, you will find that your college plays an integral part in the well-being of our citizens and the economic success of North Carolina and our nation.

As always, I encourage you to engage with me and my staff in an open dialogue on how our college can continue to provide the best engineering education and outreach to our students and our constituents.

A handwritten signature in black ink, appearing to read "Louis A. Martin-Vega".

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

## **Carbonell elected to the National Academy of Engineering**



Dr. Ruben Carbonell, Frank Hawkins Kenan Distinguished Professor of Chemical Engineering at NC State, is the College

of Engineering's newest member of the National Academy of Engineering (NAE).

He is the 14<sup>th</sup> NC State faculty member to be elected to the NAE. Of those, 12 are current faculty and two are emeritus faculty. Selection by the NAE is one of the highest professional distinctions in the field of engineering.

Carbonell was cited by NAE for "research and innovation in multiphase reactor design, high-pressure thin-film coating, and novel bioseparation processes."

Carbonell earned a bachelor's degree in chemical engineering from Manhattan College in 1969 and a PhD from Princeton University in 1973. He spent 10 years in the Department of Chemical Engineering at the University of California-Davis before joining the NC State faculty in 1984.

He served as head of the Department of Chemical Engineering at NC State from 1994 to 1999 and was also co-director of the National Science Foundation Science and Technology Center for Environmentally Responsible Solvents and Processes from 1999 to 2008.

Carbonell is director of the William R. Kenan Jr. Institute for Engineering, Technology and Science at NC State and has led the Golden LEAF Biomufacturing Training and Education Center on NC State's Centennial Campus since 2008. ■





## Lobo's 'super' bandages hold promise for chronic wound care

The nanofiber bandages being developed in Dr. Elizabeth Lobo's lab in the Joint NC State/UNC Department of Biomedical Engineering in collaboration with Dr. Behnam Pourdeyhimi in NC State's College of Textiles haven't been tested on humans. Well, maybe one human.

Lobo's bandages can deliver a timed release of antimicrobial, anti-inflammatory or antibacterial medications along with stem cells to a wound site. After doing its job, the bandage dissolves.

The technology has been tested on the skin of pigs and mice and on the leg of one human — Lobo herself.

When a mosquito bite on her leg became infected with the superbug MRSA, she saw a chance to put her new technology to the test. A topical antibiotic wasn't working, and a physician prescribed an oral antibiotic.

Instead of filling that prescription, Lobo applied one of her nanofiber bandages dosed with some antimicrobial and antibacterial materials. Lobo is an

associate professor in both biomedical engineering and materials science and engineering and associate department head in biomedical engineering.

"When will I ever get a shot like this again?" Lobo thought at the time.

Within three days, the site had begun to heal.

It might not be long before the use of such bandages is an everyday occurrence, not an experiment.

The bandages are made of a nano-size scaffolding built with different fiber

morphologies — solid, hollow and/or porous — that can be filled with the material that a wound needs. The bandage would be applied to the wound site, which could be sutured closed or left open, and would stay in place until it disintegrated. Through this technique, a physician wouldn't have to rely on the patient to change the bandage or add any medicine to it.

"The idea is that you put this on and you forget about it, and you're killing the microbes while the bandage

simultaneously releases compounds to help regenerate tissue at the site," Lobo said.

The rate of release for the materials can be adjusted, as can the rate at which the bandage disintegrates.

But a smart bandage doped with painkillers, anti-inflammatories or antimicrobials is just the beginning. Lobo's NC State research team has long been working on ways to program human stem cells to differentiate down specific pathways. Her research team takes stem cells derived from the fat removed from patients at UNC Hospitals during liposuction procedures and programs

them to turn into cartilage and even bone.

The super bandages developed in her lab would be able to deliver stem cells that would help tissue regenerate at the same time drugs to ease pain and kill germs are being applied.

Lobo sees the super bandages as a natural extension of her stem cell research and a solution for an important medical need for better treatment of chronic wounds and a way to battle dangerous infections like MRSA.

Lobo's team is moving closer to a commercial application, either as an enhancement to an existing product or as a new product. ■

## Two colleges — one degree

NC State announced in November that the university will offer a new one-year Master of Supply Chain Engineering and Management (MSCEM).

The new hybrid program represents a partnership between the Poole College of Management's Jenkins Graduate School and the College of Engineering's Edward P. Fitts Department of Industrial and Systems Engineering (ISE).

Over a year, students will take 30 credit hours of graduate coursework divided between MBA courses and engineering courses. The program is designed to equip students for work in operations, supply chain management or logistics.

"The MSCEM brings together a top-tier industrial engineering program and one of the strongest supply chain management programs available to address a real need in the market," said Dr. Steve Allen, associate dean of the Jenkins Graduate School of Management.

Allen said graduating students will be much more marketable to potential

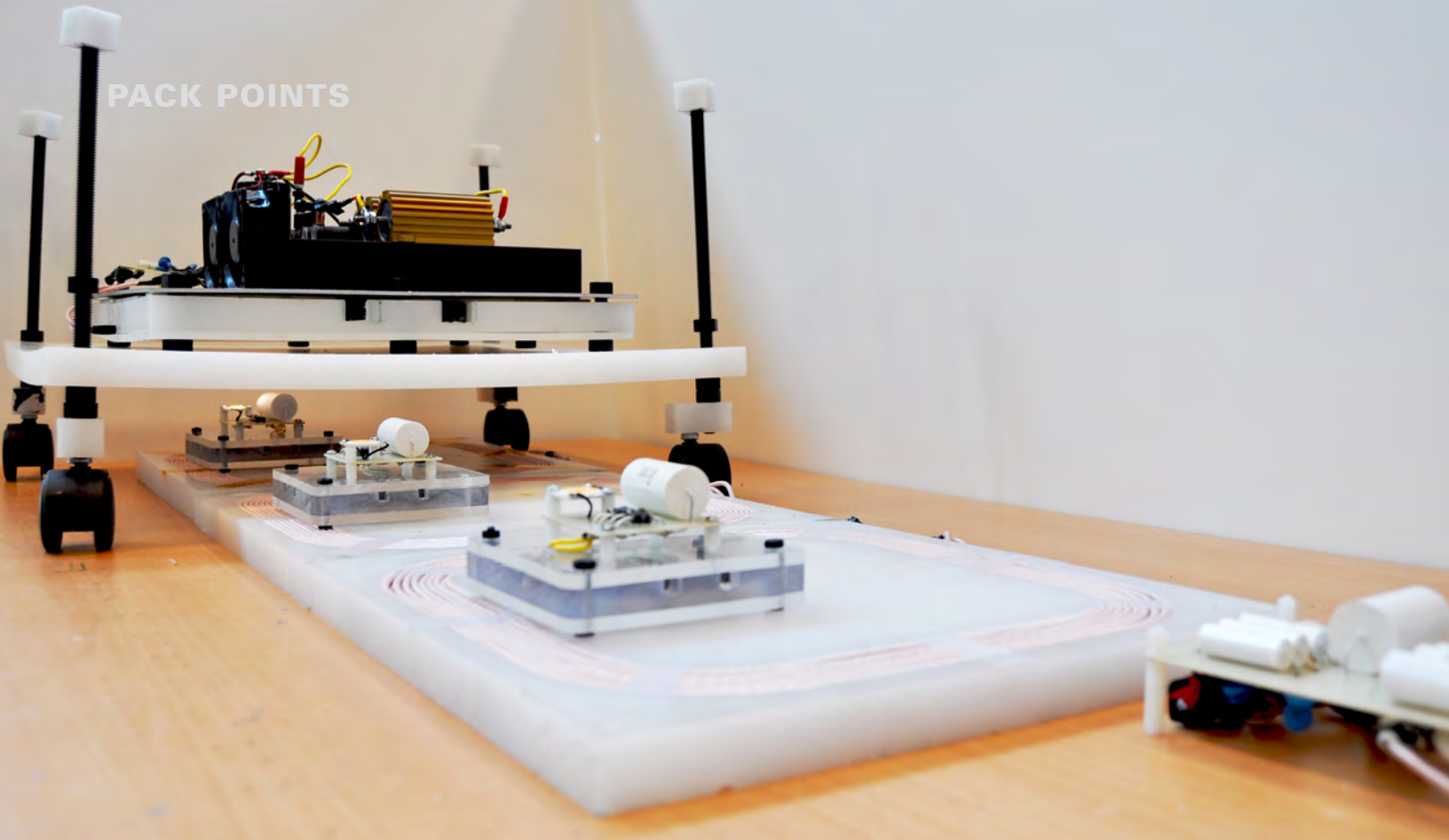
employers because they will come away with a working knowledge of engineering principles and tools combined with business principles focused on supply chain management.

"This program is specifically designed for students who have an engineering or STEM-related background to gain additional quantitative skills coupled with the business acumen that our industrial partners are seeking to solve the supply chain and logistical challenges they face," said Dr. Russell King, Edward P. Fitts Distinguished Professor and director of the Furniture Manufacturing Management Center in ISE.

Development of the MSCEM program is supported, in part, by a 2008 gift commitment of \$2.2 million from the Caterpillar Foundation and James E. Owens, retired Caterpillar Inc. chairman and CEO. Owens, an NC State alumnus, made the gift to support the university's academic, research and outreach activities in supply chain management.

Students can take MSCEM program classes beginning in June 2014 during Summer Session II. ■





## Recharging without stopping

Researchers at NC State have been working on an exciting new technology that would make electric cars much more attractive. Their final goal is to create a highway station where electric vehicles can drive by and be recharged without having to stop.

Dr. Srdjan Lukic, assistant professor of electrical engineering, and his team have developed a small, functional prototype of their system. Now, they are working to scale it up and increase the power of the system. The new approach improves on previous mobile, wireless power transfer techniques.

“We’ve made changes to both the receiver and the transmitter in order to make wireless energy transfer safer and more efficient,” Lukic said. “We tried to take the best from both of those approaches.”

### Previous approaches

One previous approach involved using large transmitter coils. However, this

created a powerful and imprecise field that could potentially couple to the frame of a car or other metal objects passing through the field. These electromagnetic field leaks raised safety concerns and reduced system efficiency.

Another approach used smaller transmitter coils. In this scenario, a very large number of transmitters were required to effectively cover a section of the roadway. An increased number of transmitters added substantial cost and complexity to the system and also required very precise vehicle position detection technology.

### In the future

At peak efficiency, the new system can transmit energy at a rate of 0.5 kilowatts (kW).

“Our goal is to move from 0.5 kW into the 50 kW range,” Lukic said. “That would make it more practical.”

Researchers will continue to improve upon this innovative technique. The new

approach could lead to a large increase in the number of electric cars on the road. Who wouldn’t want to drive a car that didn’t need to be refueled? ■

### THE NEW APPROACH: HOW IT WORKS

- A series of segmented transmitter coils broadcasts a low-level electromagnetic field from a recharging station.
- Receiver coils, the same size as the transmitter coils, are placed in cars or on other mobile platforms.
- When a receiver coil comes into range, the transmitter coil will automatically increase its current, boosting its magnetic field strength and the related transfer of energy by 400 percent.
- When the receiver coil passes out of range of the transmitter, the currents of the transmitter coils return to normal levels.

## Multi-drug technique kills cancer cells

Different drugs are more effective in targeting different parts of a cancer cell, and NC State researchers are using them to develop a new technique for killing cancer cells.

The new method involves creating nanoparticles that carry two different cancer-killing drugs into the body and deliver those drugs to separate parts of the cancer cell where they will be most effective.

For example, the protein drug TRAIL is most effective against the cell membrane, while doxorubicin (Dox) is most effective when delivered to the nucleus, said Dr. Zhen Gu, assistant professor in the Joint NC State-UNC Department of Biomedical Engineering and senior author of a paper on the research.

“We’ve come up with a sequential and site-specific delivery technique that first delivers TRAIL to cancer

cell membranes and then penetrates the membrane to deliver Dox to the nucleus,” Gu said.

Gu’s research team developed nanoparticles with an outer shell made of hyaluronic acid (HA) woven together with TRAIL. The HA interacts with receptors on cancer cell membranes, which “grab” the nanoparticle. Enzymes in the cancer cell environment break down the HA, releasing TRAIL onto the cell membrane and ultimately triggering cell death.

This new technique has additional benefits.

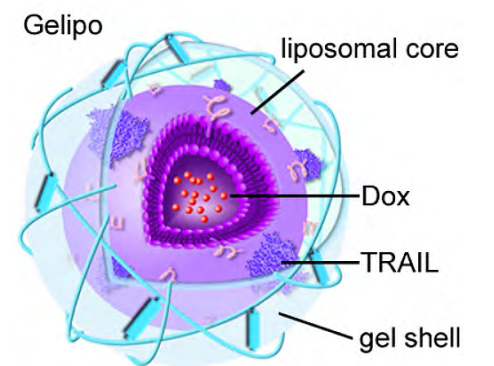
“Cancer cells can develop resistance to chemotherapy drugs but are less likely to develop resistance when multiple drugs are delivered simultaneously,” Gu said.

“In testing on laboratory mice, our technique resulted in significant

improvement in breast cancer tumor reduction as compared to conventional treatment techniques,” Gu said.

“Different drugs can be released at the right time in their right places,” said Dr. Ran Mo, a postdoctoral researcher in Gu’s lab and the other lead author.

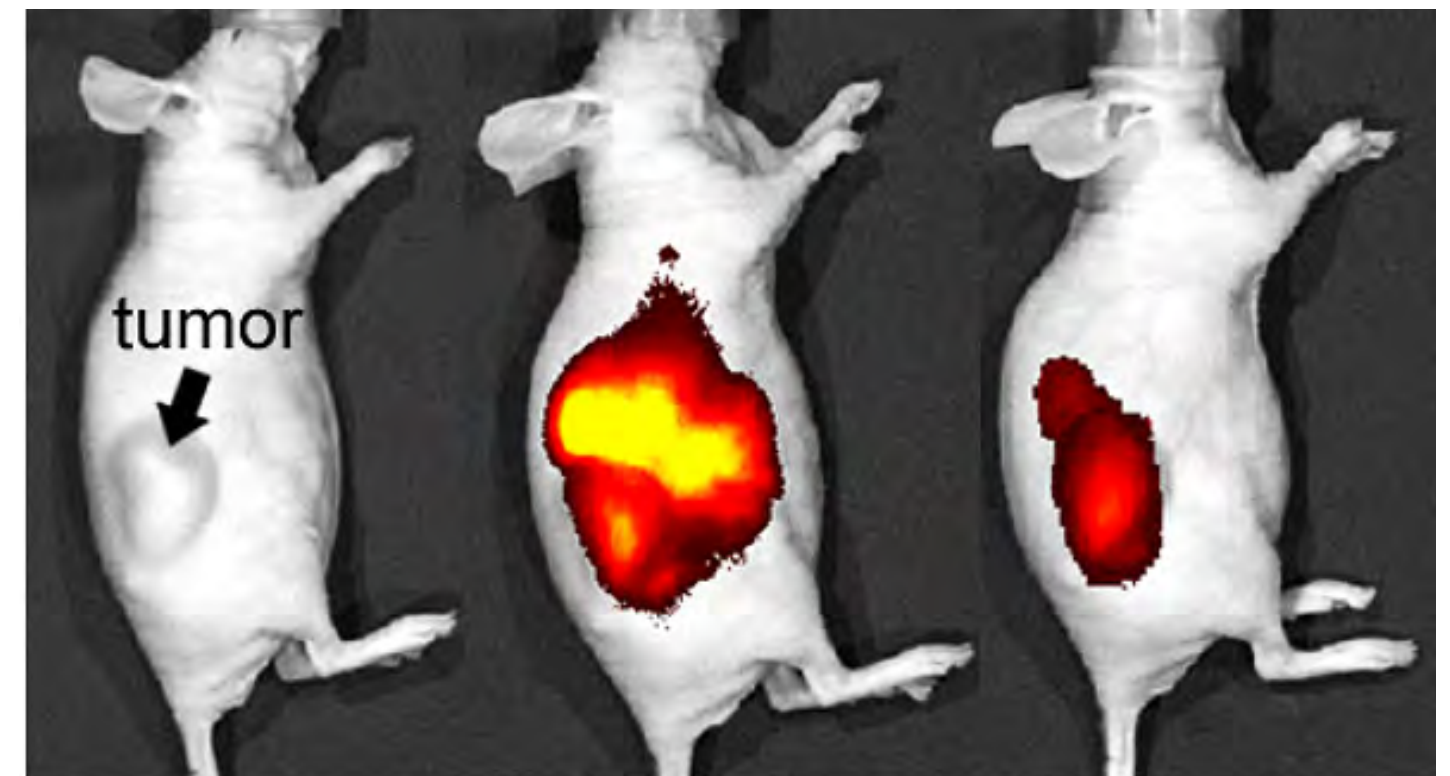
The technique was developed by researchers at NC State and UNC-Chapel Hill. ■



0 h

4 h

24 h







## Controlling wind power

Wind energy is one of the fastest-growing sources of renewable energy, which makes new research by NC State and Johns Hopkins University engineers even more promising.

These researchers have discovered that installing wind power plants at certain favorable locations in a power grid can make the grid more resistant to extraneous disruptions.

Typically, the power flowing through the transmission lines of a power grid suffers from small oscillations after a

disturbance. Generally, these oscillations are mitigated by controls inside the power generators. However, if the controls are not strong enough, the oscillations may be sustained, reducing the efficiency of power transfer and posing a threat to the stability of the grid. They can even lead to widespread power outages, such as the 1996 blackout that affected the West Coast of the United States.

The research team has discovered that, in certain circumstances, wind farms, if sited in the wrong locations, can worsen the oscillations. The primary cause of this

problem is the location of the wind farm in relation to the grid, but it also occurs because the wind generator models are very different than the models for conventional power generators.

Researchers have discovered that these oscillations can be mitigated by injecting wind power into the grid at favorable locations.

“The best way to solve this problem is to choose locations for wind farms that promise favorable impact on the oscillations,” said Dr. Aranya Chakraborty, assistant professor of electrical engineering at NC State and senior author of a paper describing the work.

“However, due to various geographical factors it may not always be possible to install the plant at that favorable location. In that case, to counteract this problem, we have

designed a technique that controls the flow of power from wind farms into the grid,” he added.

The research team developed algorithms that match control efforts between wind farms and energy storage facilities.

The rapid increase in wind farm installations is being accelerated by government mandates and the goal of providing 20 percent of the nation’s power needs through wind power by 2020. This new method for controlling wind power has become even more significant. ■

## More bang for the biofuel buck

Researchers at NC State have developed a technique that may drive down the cost of biofuel production. The simple and relatively inexpensive technique removes the lignin, nature’s way of protecting plant cell walls, from the plant material used to make biofuels.

Lignin is difficult to remove from plant materials. However, it needs to be extracted to reach the energy-rich cellulose in plants used to make biofuels.

“Finding inexpensive ways to remove lignin is one of the largest barriers to producing cost-effective biofuels,” said Ezinne Achinivu, a PhD student in chemical and biomolecular engineering at NC State and lead author of a study describing the new technique. “And our approach is very promising.”

The researchers began by making a number of liquid salts called “protic ionic

liquids” (PILs). PILs are made by mixing together an acid, such as acetic acid (more commonly known as vinegar) and a base (a chemical class of materials called amines), and are fairly inexpensive to prepare.

As part of the pretreatment process, one of the PILs is mixed with biomass and then heated and stirred. The lignin dissolves into the PIL, leaving the cellulose behind as a solid. The cellulose, which is now much easier to process, is then easily filtered from the mixture for use in the next biofuel production steps.

The remaining PIL-lignin liquid mixture can then be heated to distill the PIL, leaving the lignin behind as a black powder. The vapors from the PIL are collected and cooled to recover the liquid PIL so that it can be re-used.

The lignin is also valuable because it can be used to manufacture polymers

or other chemical products. This could supplement the cost of running the biofuel production facility.

“This PIL-based technique can be easily scaled up and is likely to be both more energy efficient and less expensive than existing biomass pretreatment techniques for removing lignin,” Achinivu said.

The researchers are now working to apply the technique to wood and other biomass feedstock materials and fine-tune the interactions between the PILs and lignin.

“If we can better understand how the PIL dissolves the lignin, we can make the process even more efficient by using less energy while extracting more lignin,” Achinivu said. ■





## Needleless insulin release for diabetics

A new technique for releasing insulin would eliminate the use of needles for diabetics and would allow patients to go days without needing to inject insulin into their bodies. This would be a huge departure from the current process in which diabetics must give themselves multiple injections each day to keep their blood sugar levels normal.

NC State researchers have developed a new nanotechnology-based technique for regulating blood sugar in which insulin would be released painlessly using a small ultrasound device.

The technique involves injecting biocompatible and biodegradable nanoparticles into a patient's skin. The nanoparticles are made out of poly (lactic-co-glycolic) acid (PLGA) and are filled with insulin.

Patients use a small, hand-held device to apply focused ultrasound waves to the site of the nano-network, painlessly releasing the insulin from its de facto reservoir into the bloodstream.

When the ultrasound is removed, the electrostatic force reasserts itself and pulls the nanoparticles in the nano-network back together. The nanoparticles then diffuse more insulin, refilling the reservoir.

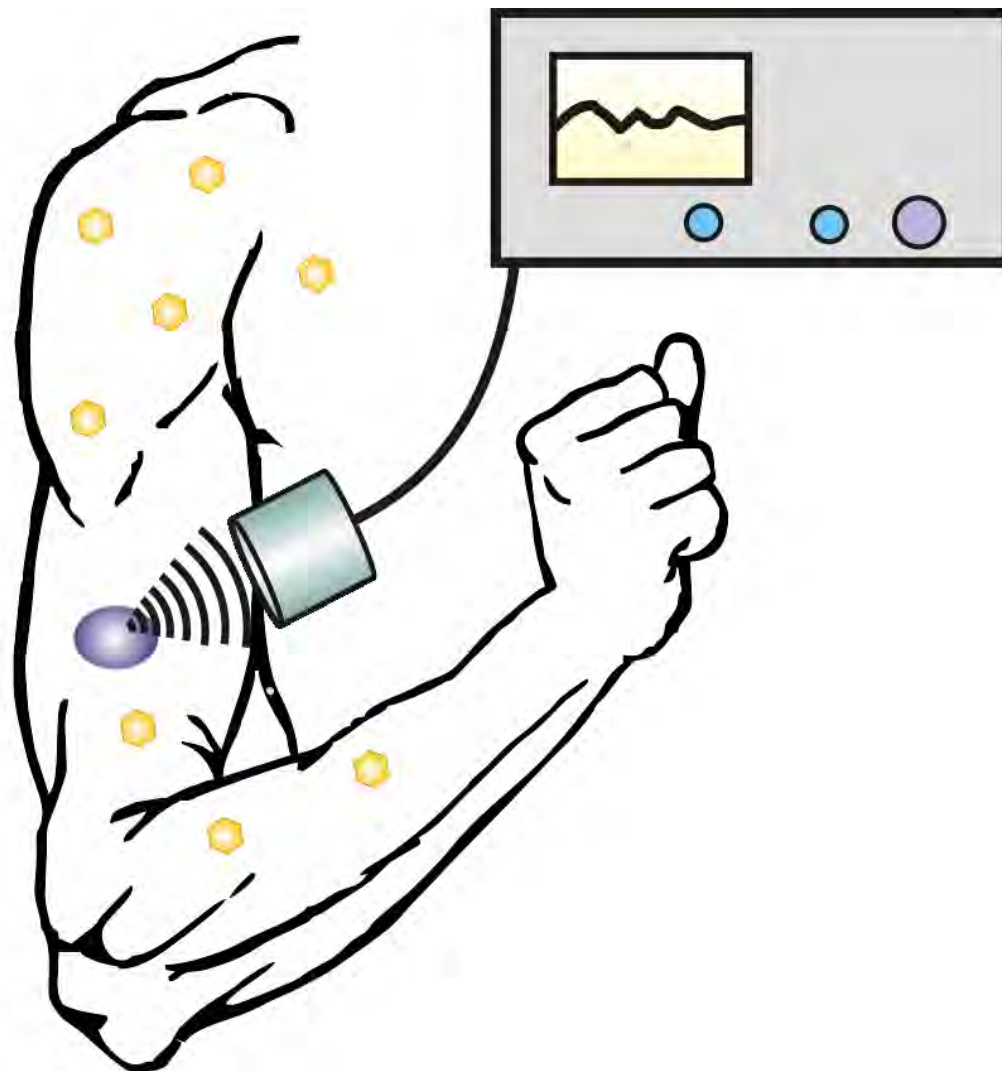
"We've done proof-of-concept testing in laboratory mice with type 1 diabetes," said Dr. Zhen Gu, assistant professor in the Joint NC State-UNC Department of Biomedical Engineering and senior author of a paper on the research.

"We found that this technique achieves a quick release of insulin into the bloodstream and that the nano-networks contain enough insulin to regulate blood glucose levels for up to 10 days."

"When the insulin runs out, you have to inject a new nano-network," said Jin Di, lead author of the paper and a PhD student in Gu's research lab. "The previous nano-network is dissolved and fully absorbed into the body in a few weeks."

The technique was developed by researchers at NC State and UNC-Chapel Hill.

"This advance will certainly give millions of people with diabetes worldwide hope that better days are ahead," said Dr. John Buse, director of UNC-Chapel Hill's Diabetes Care Center and deputy director of UNC-Chapel Hill's National Institutes of Health Clinical and Translational Science Awards program. "We must work to translate these exciting studies in the lab to clinical practice." ■



FROM LEFT: WENDY JOHNSON, DR. ROHAN SHIRWAIKER AND STEPHEN TAYLOR

## Breaking new ground in manufacturing

The student chapter of the Society of Manufacturing Engineers (SME) at NC State broke new ground this past fall when three of its members traveled to Kayser-Roth Corporation's hosiery manufacturing facility in Burlington, NC.

With this trip, they became the first student chapter on the East Coast of the United States and the third in the country to provide a company with a free assessment of its manufacturing processes and to recommend improvements.

Wendy Johnson and Stephen Taylor, seniors in industrial engineering, conducted the assessment under

Dr. Rohan Shirwaiker, assistant professor in the Edward P. Fitts Department of Industrial and Systems Engineering at NC State. He is also faculty advisor for SME's student chapter.

"This is a great educational program since it entails practical manufacturing experience for undergraduate students in addition to the local industry involvement," Shirwaiker said.

The project was part of a partnership with the Industrial Assessment Center (IAC) at NC State, one of 26 centers across the country sponsored by the US Department of Energy.

The SME student chapter at NC State has plans to conduct more process

assessments in conjunction with IAC as part of a three-year partnership.

Students are able to receive training while helping companies save money, mostly through energy, according to Dr. Stephen Terry, extension assistant professor in the Department of Mechanical and Aerospace Engineering and one of the directors of the IAC at NC State.

Creating the activity brought a \$2,000 grant to the student SME chapter, which the group will use to bring speakers to campus and to pay transportation costs when members tour local manufacturing facilities. ■



## College hosts National Engineering Forum regional dialogue

The College of Engineering, along with the National Engineering Forum (NEF) and the Pratt School of Engineering at Duke University, hosted a regional dialogue aimed at finding solutions to the top challenges facing American engineering.

The dialogue, held March 27 at the James B. Hunt Jr. Library on Centennial Campus, brought together executive-level representatives from industry, academia and government to discuss three engineering challenges: capacity, capability and competitiveness.

The Raleigh–Durham area is a key player in American engineering and was chosen for its significant role in biomedical research, IT, clean tech, and energy and smart grid innovations.

“As one of the nation’s largest and most preeminent colleges of engineering, we have a critical role in educating and preparing future engineers,” said Dr. Louis

Martin-Vega, dean of the College of Engineering at NC State. “We are pleased to continue our cooperative partnership with Duke and host this dialogue on advancing engineering at all levels, from kindergarten through graduate school.

Collaboration and interdisciplinary research and education are key to solving society’s greatest engineering challenges. As the lead institution on two National Science Foundation Engineering Research Centers, NC State demonstrates the power of inter-institutional partnerships. NEF is another great example of how industry, government and academia can



work together to develop a better path forward to economic growth and societal progress.”

Former Duke Energy President and CEO Jim Rogers delivered the keynote address. Student scribes from NC State and Duke recorded feedback from participants. The process will culminate in a cornerstone national NEF event. ■

## College names associate director of Women and Minority Engineering Programs



The College has created a new position to help its Women in Engineering and Minority Engineering programs work more closely.

As associate director of the Women and Minority Engineering Programs, Kesha Entzminger is assisting in the

development, implementation and evaluation of programs affecting the success of women and minority engineering students, such as summer bridge programs and mentor programs. She is also teaching sections of Academic and Professional Preparation for Engineering I and II.

Entzminger received a bachelor’s degree in math from the College of Charleston in 2004. She then began her career as a middle and high school math teacher in the South Carolina public school system. After three years of teaching, she enrolled at Georgia Southern University, where she received a Master of Education degree in higher education administration in 2008.

While attending Georgia Southern, Entzminger worked in the Office of Career Services and served as an academic advisor. She held similar positions at the University of South Carolina and the University of South Carolina Aiken.

Entzminger points to two different career arcs — secondary education and advising within higher education — as a strong foundation for her position at NC State.

“My experience in K-12 education helps me understand where students are coming from,” Entzminger said. “My experience in career services provides a framework for understanding where students are going.” ■

## NC State student relocating to Mars?

An NC State student may be relocating and not just across the country.

Charles H. Parrish II, a senior in biological engineering and Raleigh native, is one of 1,058 candidates to make the first cut to become Mars One astronauts.

More than 200,000 people from 140 countries applied to be part of a four-person crew that would depart for Mars in 2024, arrive in 2025, and live there indefinitely, beginning a permanent settlement. Subsequent crews would be sent to Mars about every two years until there is a settlement of 40 people.

Parrish wants to be part of the mission because it merges his life-long dream of becoming an astronaut with his research interests in sustainability and maximum utilization of resources.

“From an engineering perspective, the mission is a huge endeavor — testing the limits of human capacity in an extreme environment. Since the end rounds of the selection process will be televised, as well as the voyage and settlement, it will be possible to show people how to reduce our footprint on Earth,” said Parrish.

Parrish has passed the physical portion of the second round and awaits an

interview. He believes the crew will be chosen by the end of the year.

Two more rounds will follow and then the public will get to vote. If selected, Parrish would begin his decade-long training in 2015. And say a lot of goodbyes.

“I love living here. I have wonderful family and friends. I imagine it is the little things I will miss the most, but the realization of my dream, the novelty of the experience and its beneficial effects make it worth it.” ■







Baliga awarded IEEE Medal of Honor

**Dr. Jayant Baliga**, Distinguished University Professor of Electrical and Computer Engineering and founding director of NC State’s Power Semiconductor Research Center, has received the Medal of Honor from the Institute of Electrical and Electronics Engineers (IEEE).  
IEEE is the world’s largest professional association for the advancement of technology, and the Medal of Honor is the institute’s highest award.

Baliga is most famous for inventing, developing and commercializing the insulated gate bipolar transistor, an energy-saving semiconductor switch that controls the flow of power from an electrical energy source to any application that needs energy. In 2011, President Barack Obama awarded Baliga the National Medal of Technology and Innovation, which is the nation’s highest honor for technological achievement. ■



Ligler awarded distinction of Fellow by AAAS

**Dr. Frances Ligler**, Lampe Distinguished Professor of Biomedical Engineering, has been awarded the distinction of Fellow by the American Association for the Advancement of Science.  
A leader in the area of biosensors and microdevices, Ligler has more than 350 full-length publications and patents — a body of work that has been cited

more than 8,500 times. In addition, her research efforts have led to 11 commercial biosensor products. Prior to her arrival at NC State in fall 2013, Ligler spent 28 years at the US Naval Research Laboratory in Washington, DC, as Senior Scientist for Biosensors and Biomaterials. ■



Steer receives R.J. Reynolds Award

**Dr. Michael B. Steer**, Lampe Distinguished Professor of Electrical and Computer Engineering, has been selected as the 29<sup>th</sup> recipient of the R.J. Reynolds Tobacco Company Award for Excellence in Teaching, Research and Extension.  
The annual award is supported by the R.J. Reynolds Tobacco Company through the NC State Engineering Foundation to recognize scientific and

educational achievements in fields of engineering.  
Steer is an internationally recognized leader in the areas of radar and sensor systems, RF and microwave communication, and defense systems. He has authored 465 publications, including three books; graduated 36 PhD students and 36 research master’s students; and has been the principal investigator of \$35.2 million of research funding. ■



DR. ANDREW GRIESHOP



DR. JAMES LEBEAU



DR. LINYOU CAO

Three researchers receive NSF CAREER Awards

Three faculty members in the College of Engineering were recently awarded National Science Foundation (NSF) CAREER Awards. The award is one of the highest given by NSF to young faculty in science and engineering. The award has been granted to 62 of the College’s faculty since 2000.

Congratulations to this year’s recipients.

**Dr. Andrew Grieshop**, assistant professor in the Department of Civil,

Construction, and Environmental Engineering, wants to help minimize the human health and global climate impacts of indoor biofuel use by the poor.

**Dr. James LeBeau**, assistant professor in the Department of Materials Science and Engineering, will use state-of-the-art electron microscopy to advance the understanding of material interfaces, which will lead to exciting new electronic device functionality.

**Dr. Linyou Cao**, assistant professor in the Department of Materials Science and Engineering, will study the synthesis of large-area, uniform, and high-quality two-dimensional van der Waals epitaxial heterostructures with controlled band structures, which could lead to unexplored opportunities in the fields of information technology, solar energy harvesting, light emission diodes, and flexible electronic/photonic devices. ■



# ENGINEERED TO SERVE



NC State engineering students who serve in the university's ROTC programs prepare for duty while earning a degree from one of the top engineering programs in the nation

**N**C State engineering students take different paths after graduation. Some go on to pursue graduate degrees while others go directly into the workforce in cutting-edge industries.

Another group of graduates will take the skills they learned in one of the country's top engineering schools and employ them in service to their country.

Engineering students who participate in NC State's Reserve Officer Training Corps, better known as the ROTC, make a busy schedule even tougher, with early-morning workouts before a day full of challenging classes and hours of late-night studying. Collectively, they represent the US Army, Navy, Air Force and Marine Corps.

See what motivates them.



**MIDSHIPMAN BRADLI CRUMP**  
**NUCLEAR ENGINEERING**  
**NAVAL ROTC (NAVY OPTION) | CHAPEL HILL, NC**

"This was actually one of the reasons I picked NC State," Crump said. "I chose NC State because I wanted to study nuclear engineering and because we had two of the first ladies ever chosen to serve

note in her competitive a cappella group known as Wolfgang A Cappella.

"I like to think I lead three different lives," Crump said. "I lead the military life, the engineering life and the Wolfgang A Cappella life."

To help with the military life, Crump uses the state-of-the-art Mariner Skills Simulator at the James B. Hunt Jr. Library. The simulator is an exact replica of a ship's bridge. Midshipmen have a panoramic view of naval bases like the Naval Station Norfolk, the world's largest.

Crump has also received a chance to travel, taking courses at Nanjing Normal University in China last summer and traveling to Amsterdam shortly after.

"I really love the Navy," Crump said. "At some point, I hope to also earn a master's degree with the Navy. I really want to do plasma physics research. I like power generation, too."

Bradli Crump was a senior at a North Carolina high school when she heard an announcement that quickly changed the path she would take when she joined the US Navy: For the first time in US naval history, women would be allowed to serve aboard submarines.

The dream came into focus when she learned two soon-to-be alumnae of NC State's engineering and Naval ROTC programs were among the first commissioned officers to serve.

on submarines."

Now a rising senior at NC State with a focus on power generation in nuclear engineering, Crump has set her sights on joining the ranks of the extraordinary service members who help power the nation's submarines.

Her days are filled with balancing the demands of preparing for her future naval career, being a student in one of the top-ranked nuclear engineering departments in the country and hitting the right





**MIDSHIPMAN KEVIN ZIMMERMAN**  
**INDUSTRIAL ENGINEERING**  
**NAVAL ROTC (MARINE CORPS OPTION) | HILLTOWN, PENN.**

Learning more about the benefits of the university's ROTC program helped him pack his bags even faster.

Now a senior, Zimmerman is able to pursue all of his interests. He recently began his

third semester working at NC State's Crafts Center, where he spends an average of 10 hours each week helping others use tools and answering questions about woodworking techniques.

In May, he'll graduate with a degree from a highly ranked department and begin training with newly commissioned Marine Corps officers. He'll then attend a specialty school. He has

his sights set on training for a role with the Marine Corps infantry.

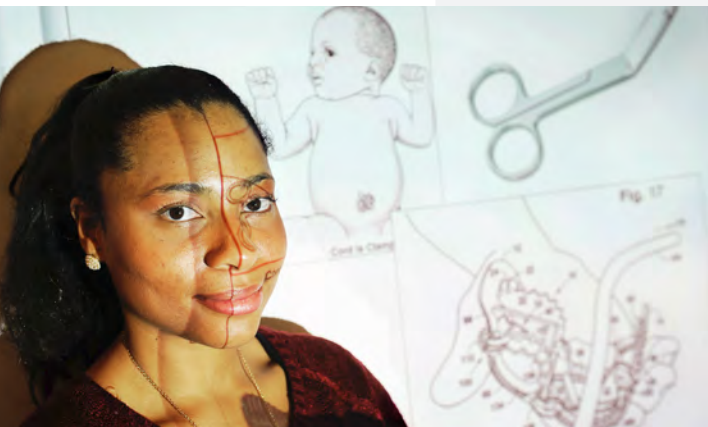
"I chose the US Marine Corps because of the pride associated with it, the history and the physical and mental challenge," Zimmerman said.

NC State's ROTC standards keep students in tip-top shape. Like many ROTC students, Zimmerman is in the gym each day of the week in addition to his morning workouts with his peers. He has prepared for the mental challenges he may face by taking courses like Leadership and Ethics, which includes reading on military philosophy.

Zimmerman's advice for balance: treat school like a 9-to-5 job and separate work life from personal life. While on campus, use time management skills.

Sandpaper. Hand saws. Chiseling tools. Kevin Zimmerman can spend hours with these woodworking essentials to craft and sculpt chairs, tables and other furniture pieces; it's been a passion since he was 13 years old.

So when it was time for the Pennsylvania native to choose a college, NC State's concentration in furniture manufacturing and management offered until recently was a perfect fit.



**CADET AMALIA OSBORNE**  
**BIOMEDICAL ENGINEERING AND BIOCHEMISTRY**  
**ARMY ROTC | WALDORF, MD.**

"I appreciate the fact that I understand the anatomy behind the body," Osborne said. "I'm not just operating a machine or reading numbers. I can tell you why your pulse is high and the possible cause."

Osborne will attend the School of Medicine at UNC-Chapel Hill in the fall, but her journey to medical school began with an overnight stay as part of a Minority Engineering Programs initiative. She quickly made her decision to attend NC State.

"Biomedical engineering was my first major when I came to school, and I think it was just because I like the focus that they have — how they help people," Osborne said.

Fast-forward to her senior design project. Osborne's four-person team

wants to decrease the amount of time it takes to cut the umbilical cord on newborns.

Currently, umbilical cord clamps have the ability to open and close once. If the clamps don't work properly, the doctor has to try again, increasing the amount of time the baby is away from the mother. Babies lose body heat twice as fast as adults, so it is important to get them back to their mothers quickly.

Medical school starts soon, but Osborne believes she is prepared thanks to the leadership skills she has developed, including her work with Theta Nu Xi Multicultural Sorority, Inc.

"NC State is a top ROTC program and a top engineering program," Osborne said. "I can't think of anywhere else I'd be. From the moment I came for an overnight stay, it's been a blessing."

When Amalia Osborne spends one weekend a month at the NC Army National Guard's Camp Butner Training Center, she's putting her biomedical engineering and biochemistry know-how to the test on some of the nation's most critical patients: soldiers returning from or preparing for deployment.

By conducting personal health assessments, which include checking everything from blood pressure to vision and hearing, Osborne's readings have real-world implications.

**On-campus service**

In 1894, the North Carolina College of Agriculture and Mechanic Arts, now known as NC State, established military science and welcomed its first professor in this area. One hundred and twenty years later, there are three Reserve Officer Training Corps (ROTC) programs exist: the Army, Air Force and Naval ROTC programs. The Naval ROTC program encompasses both the Navy and Marine Corps branches. Collectively, they are housed in the William Neal Reynolds Coliseum on main campus.

ROTC program units train young men and women for leadership roles in the US military, and graduates are commissioned officers in their respective units — the US Army, Air Force, Navy or Marine Corps.

Members of the ROTC program at NC State participate in military funeral honors at gravesite ceremonies for veterans across the Piedmont Region of the state. The Color Guard is also present during all major university athletic events. The four-year ROTC programs offer scholarships and other incentives to the bright young students who will serve our nation.

Visit [www.ncsu.edu/rotc](http://www.ncsu.edu/rotc) for more information. ■



**CADET WESLEY TEMPLETON**  
**AEROSPACE ENGINEERING**  
**AIR FORCE ROTC | BOONE, NC**

University Honors Program and a two-year tenure with NC State's marching band.

He first saw himself working with F1 cars, then became interested in the aerodynamics around the car.

Templeton enjoys solving problems — even the ones that remain unanswered. "I think that's the cool thing about aerospace engineering," Templeton said. "It's one of those unknown realms. There are still things that are unsolved."

In addition to his many other duties, Templeton is part of the Arnold Air Society, an honorary service organization made up of cadets in the university-level ROTC programs, as well as the US Air Force Academy.

Each Veterans Day, Templeton and his peers stand watch in front of NC State's Memorial Belltower, which was built to honor university alumni killed in World War I. It's a poignant moment as he reflects on the heroes he's honoring and the relationships he has formed during his time with the ROTC program and those he will form in the future.

"I remember my grandfathers, uncle, cousin, and all those who have served and sacrificed for our country. Their legacy inspires me," Templeton said. "That legacy and the motivation of the man next to you is what keeps you going. You pull each other out of the mud; you always have your wingman's back, and he has yours. It's a selfless mindset, and I try to apply it in everything I do." ■



# ENGINEERING ONLINE

## at NC State University

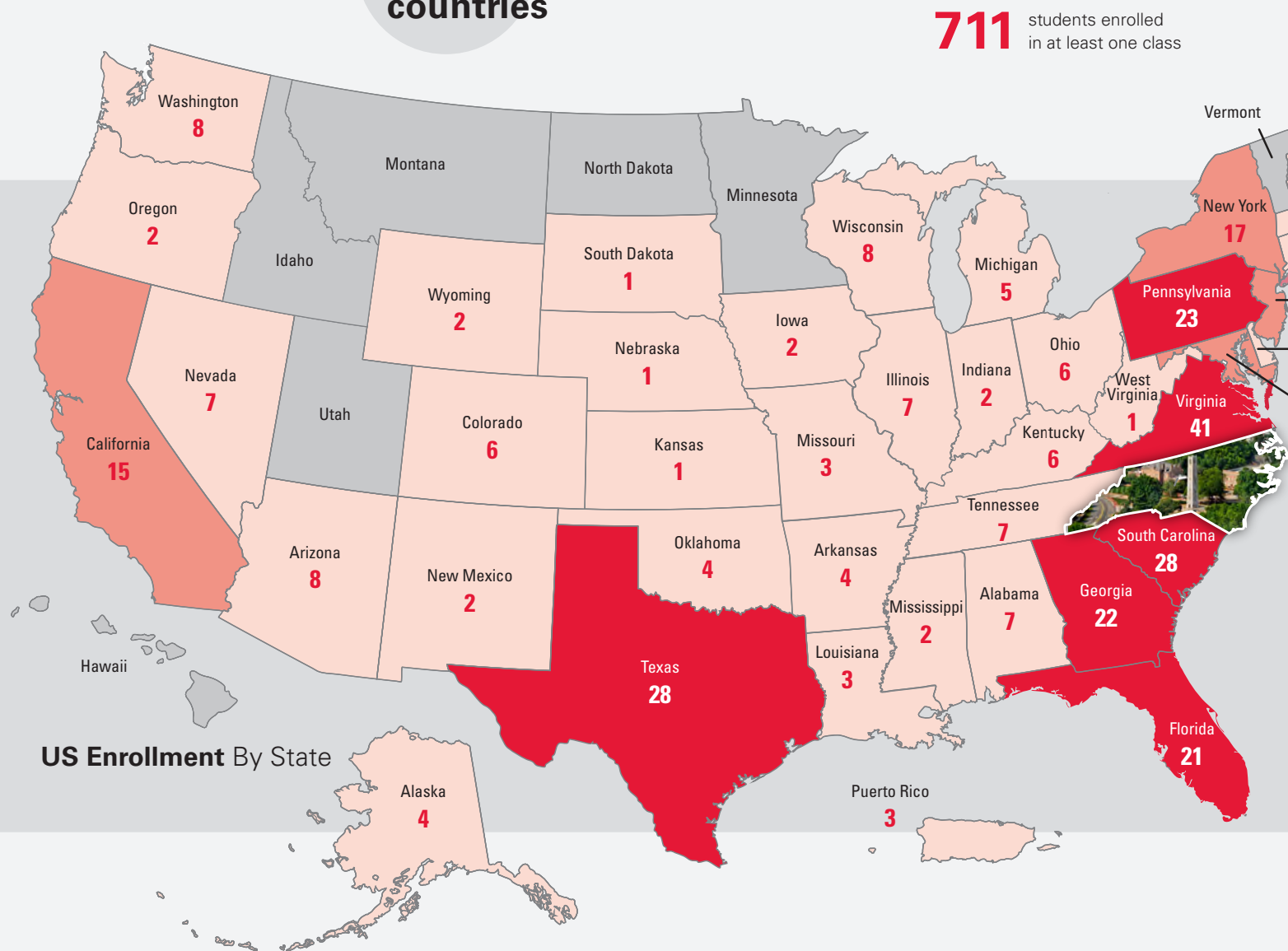
SPRING 2014 BY THE NUMBERS

The College of Engineering established distance engineering programs in 1978. Now known as Engineering Online, the program eliminates the barriers of attending classes at a physical campus and engages students around the world, providing distance engineering and computer science courses for both academic credit and professional development.

**24**  
countries

Forty international students represent 24 countries. Canada, India and Nigeria are among them.

**30** average student age  
**403** out-of-state and international students  
**711** students enrolled in at least one class



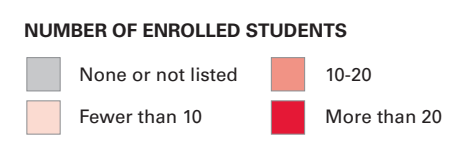
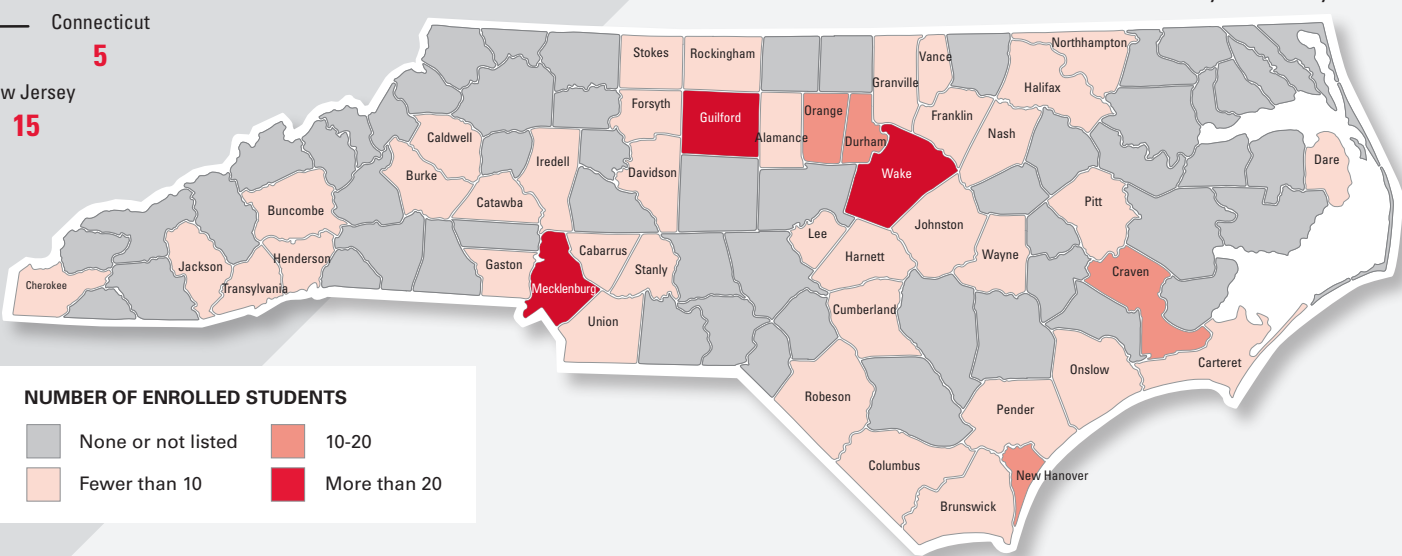
### ENGINEERING ONLINE MASTER'S DEGREE PROGRAMS

Aerospace Engineering  
Chemical Engineering  
Civil Engineering  
Computer Engineering  
Computer Networking  
Computer Science  
Electrical Engineering  
Engineering  
Environmental Engineering  
Industrial Engineering  
Integrated Manufacturing Systems Engineering  
Materials Science and Engineering  
Mechanical Engineering  
Nanoengineering  
Nuclear Engineering

### TOP 10 EMPLOYERS

1. GE
2. United States Air Force
3. Duke Energy
4. Boeing
5. Naval Air Systems Command (NAVAIR)
6. Lockheed Martin
7. United States Army
8. Cisco Systems
9. URS Corporation
10. AREVA

### NC Enrollment By County



### SPRING 2014 ENGINEERING ONLINE STUDENTS



**Captain Christopher T. Denzer | Master of Aerospace Engineering**  
US Air Force, Joint Base McGuire-Dix-Lakehurst, NJ

Accomplishing classes while deployed could not have been easier. I have recommended this program to every one of my young officers that are interested in a master's in engineering and have to balance workload with the operations tempo of combat airlift.



**Michael Hill | ISE alumnus, Non-Degree Studies, pursuing Master of Engineering**  
Schaefer Systems International, Charlotte, NC

In my current role, I travel frequently both domestically and internationally. It's important to note that with the ease of access and flexibility, the quality of course material does not suffer.



**Jane Monnier | Master of Engineering**  
Design engineer with Parker-Hannifin, Mobile Cylinder Division, military spouse and mom, Little Rock, Ark.

I've been allowed to pursue my career goals through higher education during a period of change in my family — what could have been a gap on my resume.





# PACK POWER

## NC STATE TAPPED TO LEAD NATIONAL MANUFACTURING INNOVATION INSTITUTE

Engineers at NC State have long been leaders in the development of leading-edge energy technology, and now they will help lead a new US Department of Energy advanced manufacturing institute.

During a visit to Raleigh on Jan. 15, President Barack Obama announced that NC State will lead the Next Generation Power Electronics National Manufacturing Innovation Institute, a \$140 million project that aims to further development and manufacturing of wide bandgap semiconductors.

The College of Engineering at NC State is at the forefront of research on wide bandgap semiconductors, which have higher temperature and voltage capacity than the silicon semiconductors that have been widely used for the last 50 years. That greater efficiency will make everything from household electronics to the nation's power grid more efficient.

"I believe the wide bandgap semiconductor technology is the next big step in power electronics," said Dr. Jayant Baliga, Distinguished University Professor in the Department of Electrical and Computer Engineering at NC State and one of the world's preeminent researchers in the area of power semiconductor devices.

Baliga is founder of the University's Power Semiconductor Research Center and is the inventor of the Insulated Gate Bipolar Transistor, an innovation credited with saving consumers more than \$15 trillion in energy costs.

College researchers have been working on wide bandgap semiconductors since the early 1980s. Engineering faculty members have been part of two Multidisciplinary University Research Initiatives focused on conducting research into wide bandgap semiconductors. As part of those efforts, NC State engineers have worked with other universities and the US Naval and Air Force Research Labs.

The National Science Foundation FREEDM Systems Center, an Engineering Research Center that was awarded in 2008, is headquartered on NC State's Centennial Campus. FREEDM is developing the next-generation power grid that will be more efficient and will incorporate renewable energy. Wide bandgap semiconductor technology will play a major role in making that new power grid work.

Dr. Louis Martin-Vega, dean of the College of Engineering at NC State, said the College's work in semiconductors and the devices they power has been a long process that has paid off.

"As we often say, there's no such thing as an overnight success," Martin-Vega said. "There's been so much work that has gone on over the years to build up the capacity and the expertise that allows NC State to be the leader in an effort of this nature."

Learn more about the Next Generation Power Electronics Innovation Institute and NC State's role at [www.ncsu.edu/power](http://www.ncsu.edu/power).



# Seachange

Faculty in the Department of Civil, Construction, and Environmental Engineering work with one of North Carolina's most valuable resources

Standing in waist-high surf off a North Carolina beach, you can feel the power that the ocean holds. It's enough to send you tumbling underwater if you aren't careful.

That power could also hold the keys to creating renewable energy and jobs for the state. However, it's also powerful enough to cause billions of dollars in damage and loss of life when a hurricane turns a thing of beauty into a menacing monster.

Faculty in the Department of Civil, Construction, and Environmental Engineering (CCEE) at NC State are working to preserve North Carolina's vital coastal resources while exploring ways to use the ocean to create energy and protect the state's residents during hurricanes.

## A STREAM OF ENERGY

CCEE professor Dr. Billy Edge serves as head of coastal processes and engineering at the UNC Coastal Studies Institute (CSI) on Roanoke Island. He's leading an effort to identify renewable energy resources on the North Carolina coast that state legislators hope will lead to new jobs.

When it comes to reliable sources of renewable energy on the coast, nothing is more consistent than the tides. Unfortunately, they aren't strong enough along the North Carolina coast to be a practical source of energy. Wave energy is fairly consistent on a short-term basis, Edge said. Solar and wind energy less so.

The Gulf Stream, which passes closer to Cape Hatteras on the Outer Banks than just about any beach on

the East Coast, may hold the most promise. It's consistent and strong. Think of the powerful two-mile wide Mississippi River. Now, think bigger.

"It probably has as much energy in it as a hundred Mississippi Rivers," Edge said.

Edge and his CSI colleagues want to know whether that massive current can drive a turbine that's as wide as a Boeing 747 from wing tip to wing tip moored to the ocean floor.

Measuring the magnitude and stability of a Gulf Stream resource is the first step. Then, researchers will need to know whether capturing this energy is economically feasible. Placing such a large structure in very deep water will be a real engineering challenge. Installation of such a system under the Gulf Stream would come later if a private concern

believes in the economics of the concept enough to invest.

Also of concern is the impact such a project would have on shipping lanes, the health of the ocean and the coastal culture. That is also part of CSI's work.

Now to another concept: energy storage. Renewable energy storage can be a challenge, and it's especially true for an intermittent resource like an offshore wind farm.

"The source of power is not constant, so you cannot dispatch it in a reliable manner," said Dr. Mohammed Gabr, Alumni Distinguished Undergraduate Professor. "If you're going to have this as a resource of power, you have to be able to provide it on a continuous basis."

Gabr is working on a system that would store energy from an offshore

renewable energy facility in a vessel moored to the ocean floor.

Gabr is part of an NC State research team that includes engineers from CCEE, the Department of Electrical and Computer Engineering and the National Science Foundation FREEDM Systems Center developing a way to store energy as compressed air at the bottom of the sea.

That air, when released, would drive a turbine on shore or even on an offshore platform to produce electricity. As air is released from the tank, the weight of the water outside the vessel would keep pressure inside constant.

Gabr is working on developing the tank and anchoring it to the ocean floor with concrete blocks. Dr. Joe DeCarolis, assistant professor in the department, developed a cost model for the project.

NC STATE RESEARCHERS ARE  
HELPING THE OUTER BANKS.

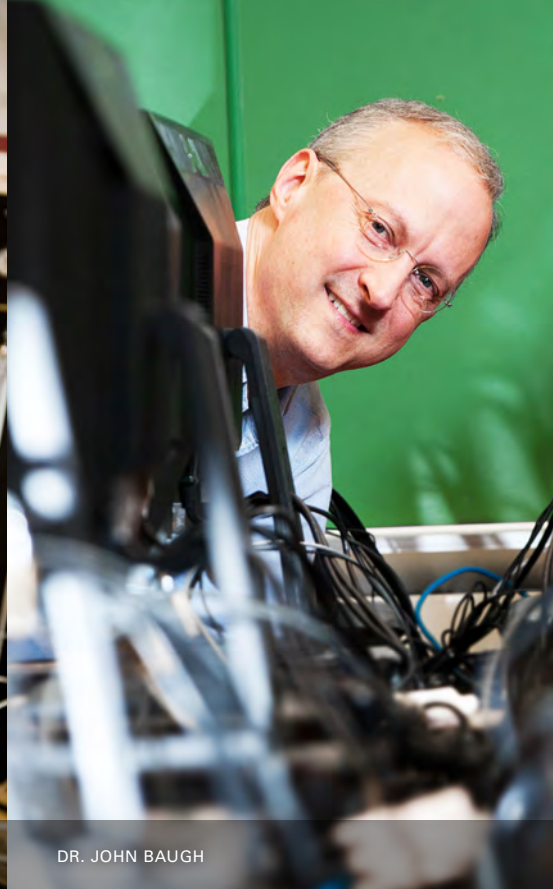




DR. CASEY DIETRICH



DR. BRINA MONTOYA



DR. JOHN BAUGH



DR. BILLY EDGE



DR. MOHAMMED GABR (TOP LEFT)  
AND DR. MARGERY OVERTON (TOP RIGHT)

## SAVING THE BEACHES AND MUCH MORE

Dr. Brina Montoya, an assistant professor in the department, was finishing her PhD dissertation at UC-Davis and had accepted a position at NC State when she read about damage Hurricane Irene was causing along North Carolina’s Outer Banks.

Montoya wondered if her work in California using naturally occurring soil bacteria to turn sand into sandstone under the water table and put buildings on a more solid footing could be used to give sand dunes a better chance to withstand a storm.

Most soil bacteria already have the ability to turn the organic compound urea into ammonia and carbonate. The addition of calcium along with the carbonate will form the mineral calcite through a process that would cement sand grains together and increase the strength and stiffness of the sand.

In this case, though, Montoya wants to speed the process up to “happen in engineering time instead of geologic time.”

Montoya is studying whether urea can be sprayed on sand dunes, possibly mixed with fertilizers already sprayed to help dune grass grow, to make them more stable and better able to withstand a storm.

Making sure there are no unintended environmental impacts will be key. So will finding the right mixture.

“We don’t want to create sandstone bluffs on the beach,” Montoya said.

“We just want to give them a little more strength to withstand storms on the coast.”

Dr. Margery Overton, a professor in the department, has been studying coastal processes on the Outer Banks of North Carolina since the late 1980s. Her previous work has focused primarily on beach and dune erosion, so when Hurricane Irene opened an inlet on Pea Island in approximately the same location that has opened and closed at least twice over the last hundred years, her attention turned to the problem of predicting inlet openings. What was it about this hurricane and that location that resulted in a new inlet?

Working with graduate research assistant M. Onur Kurum, they developed workflows that take advantage of advanced geospatial techniques and innovations to include the presence of vegetation, roads and the footprint of existing structures in a model called XBeach, which stands for Extreme Beach behavior. In doing so, the model successfully predicted the shape, the location and the depth of the inlet that opened during Irene.

Overton states that there were two significant pieces to the success. First are the detailed one-meter grids that represent the topography and capture critical influences on the hydraulics. Second, and perhaps most significant, was Kurum’s innovation in representing the vegetation and the presence of roads and structures in the model.

So why did the inlet open in this location? Water level and the topography at the time of the storm were to blame. Storm surge rose on the sound side while the ocean tide receded, setting up a large difference between the two water levels. With that and breaks in the oceanfront

dune, water flowed across the island at velocities sufficient to create the inlet.

The expectation is that this model will be used to identify coastal areas vulnerable to inlet formation. In addition, it can be used to explore alternatives that would likely prevent a new inlet from forming.

## BETTER MODELS, BETTER PREDICTIONS

Overton isn’t the only faculty member using computers to do coastal modeling. Dr. Casey Dietrich, an assistant professor in the department, is working to improve modeling of how hurricanes impact the coast.

Dietrich came to NC State with a wealth of experience in coastal modeling, most of it done along the Gulf Coast of the United States. He will soon begin a project with the National Oceanic and Atmospheric Administration to model North Carolina’s coast.

Dietrich is part of a research community using a computer model called ADCIRC to predict everything

from storm surge and flooding to the feasibility of dredging, or where material floating in the ocean might end up.

When a hurricane is bearing down on the coastline, running the models quickly is of the essence. But the faster the model runs, the less accurate it is. Improving the models so that the time and accuracy trade-off isn’t as sharp is part of Dietrich’s work.

So is figuring out the best ways to visualize the results and get the modeling information to local emergency management officials along the coast so that they can use it.

“It doesn’t help anybody if we are doing this in an empty room somewhere and not sharing the results with the community and sharing them in a way that will maximize their use and maximize their impact,” he said.

Dr. John Baugh, a professor in the department and director of the NC Japan Center at NC State, also uses ADCIRC and has created a new way to utilize it.

When Baugh looked at how modeling was used to forecast how hurricanes would impact coastal regions, he

noticed that the modeling was done on a large scale. This meant such an approach would be impractical when it came to trying out local infrastructure changes that might be considered for protecting the built environment or improving resilience.

What if an engineer wanted to see how a proposed sea wall or beach nourishment project would affect a coastal community? The capability wasn’t there.

“The science is good,” he said. “The modeling is good. But the approach is not very helpful from an engineering perspective out of the box. And that’s because, in engineering, we want to try out many different scenarios.”

Here’s what Baugh envisioned: a process in which engineers can model a smaller geographic area without re-running a simulation that covers a major part of the North Atlantic Ocean each time. Engineers would be able to change the lay of the land and observe the effect of the change in much less time.

Baugh’s subdomain modeling approach allows users to model anything that changes the topography — levees and culverts under a road, for example — and see how a big storm would impact that change.

His code is being incorporated in ADCIRC, and the US Army Corps of Engineers has used his model near New Orleans and has expressed interest in using it along the North Carolina coast.

“I’m obviously very biased, but I feel it’s a game-changer,” Baugh said.

It’s just one of many game-changers being developed in the department. ■



Initiative  
Centennial Campus

WY

300

Entrepreneur DR  
Centennial Campus 1900

# STARTING POINTS

NC State engineers nurture ideas that are born on campus. Their work puts the university's entrepreneurial ecosystem on display while delivering cutting-edge concepts.

It's not unusual for ideas to become life-changing products at NC State. For some, the idea starts in a classroom or lab. Others pinpoint a problem they've experienced and seek out a solution.

New projects that have received funding hold promise for making life safer and cleaner in the Third World, improving products ranging from textiles to insulation and giving the blind access to communication tools at a lower cost.

Grooming entrepreneurs and protecting their revolutionary ideas remains a top priority for NC State and the College of Engineering, which, during fiscal year

2013, launched 6 startups. The university's Entrepreneurship Initiative and College-based initiatives like the Engineering Entrepreneurs Program are among the reasons for success.

## RAISING DOTS, OPENING DOORS Polymer Braille

Dr. Peichun Yang learned Braille at the Rehabilitation Center for the Blind in North Carolina. An NC State materials science and engineering alumnus, Yang was recovering from an accident that led

to permanent blindness.

Today, with the advent of text-to-talk devices and the expense and fragile nature of Braille displays, the Braille acceptance rate continues to decline, locking out the blind population from computer usage and other mobile technologies. Current Braille displays allow one line at a time for viewing, making access to Internet content frustrating and limiting.

Yang wanted to give the blind more options, including a less expensive one.

"I tried many approaches, searched literature and communicated with engineers and scientists around the world,"

Yang said. "In 2005, I found a very good research paper published by Dr. Paul Franzon, professor of electrical and computer engineering at NC State, and one of his students." Yang and Franzon met in 2005, focusing on microelectromechanical systems, or MEMS, and Yang proposed to create an electroactive polymer system for tactile, full-page and refreshable displays. The conversation was the beginning of Polymer Braille.

A Department of Education grant jump-started the company's efforts, and Phase I and II National Science Foundation Small Business Innovation Research grants, received in 2012 and 2014, respectively, have kept the company going. Also in 2012, the company was named to NC State's inaugural class of the Fast 15. Today, Franzon, Yang and electrical engineering doctoral students David Winick and Shep Pitts comprise Polymer Braille.

Here's how the technology works: An electroactive polymer moves in response to an

electric voltage that's been applied to create a dot that moves precisely up and down. The force — far more delicate than that of a human hand — is nearly instantaneous. As the tiny dots are raised, latching mechanisms engage to support the weight from the user's passing fingers. Each display will comprise hundreds or thousands of dots.

Focusing on the education sector, the company's goals are to increase Braille acceptance, computer usage and mathematical literacy among the blind.

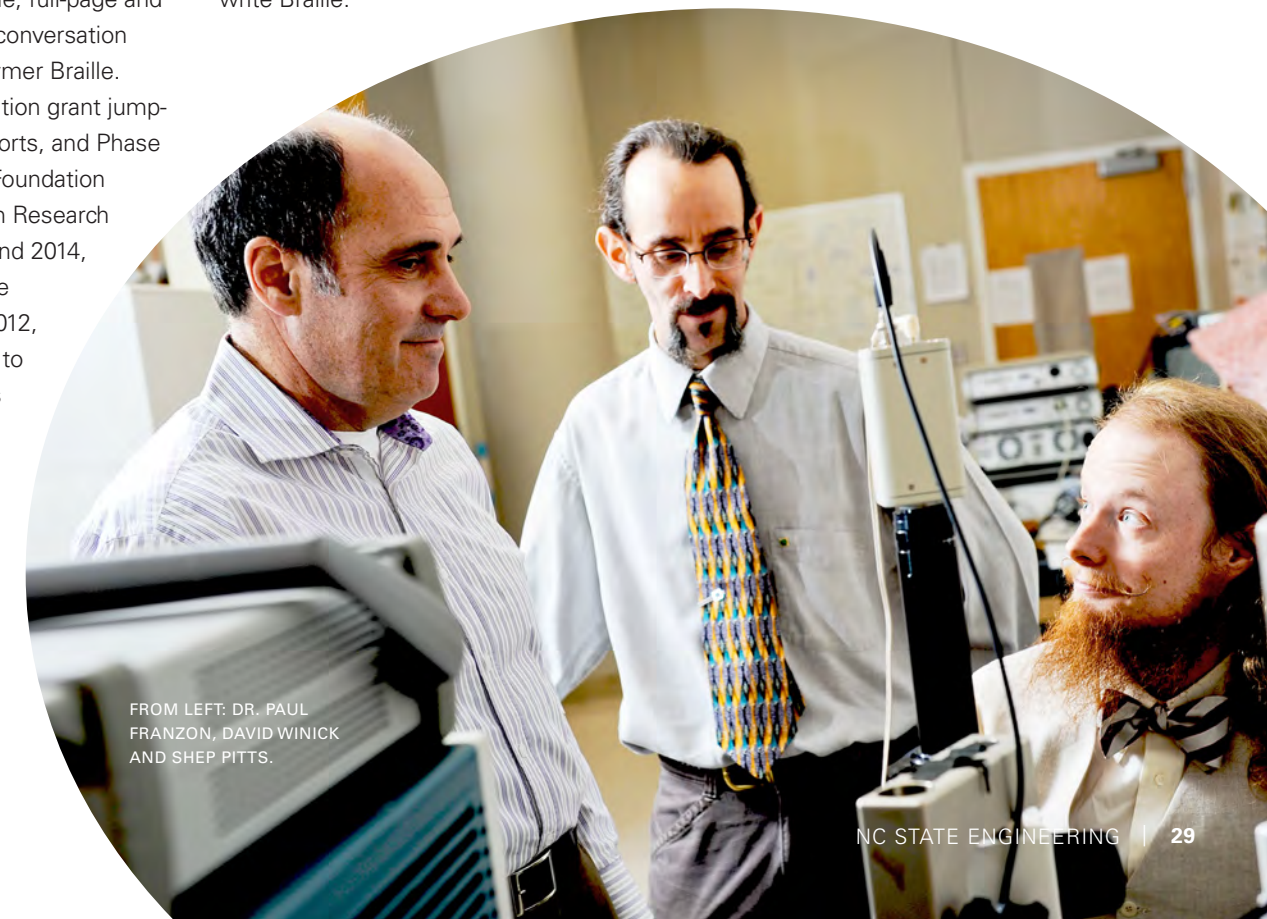
"All these people are locked out of the Internet world; they can't use the computer, and that's a big deal these days," Franzon said. "Having access changes the social aspect of being blind and the ability to integrate with the community."

Franzon adds that text-to-speech devices, while helpful, are most beneficial when a blind person is able to read and write Braille.

Current devices are expensive — around \$8,000 — because of the delicate ceramic component that is time consuming to produce and manipulate. Franzon's team is using a polymer, which can easily be cut using a razor blade and made out of flexible and less-expensive pieces.

To produce and manipulate the super-tiny pieces, the team relies on the "clean-room" and 3D printing machines in the Monteith Engineering Research Center on Centennial Campus. The work holds promise for transforming an industry.

"What's exciting is we'll have something in hand that will really make an impact. It will change everybody's idea of what Braille is and what it can be," Winick said. "Right now, it's strictly used for reading rather than as an interactive device or one with different display options."



FROM LEFT: DR. PAUL FRANZON, DAVID WINICK AND SHEP PITTS.

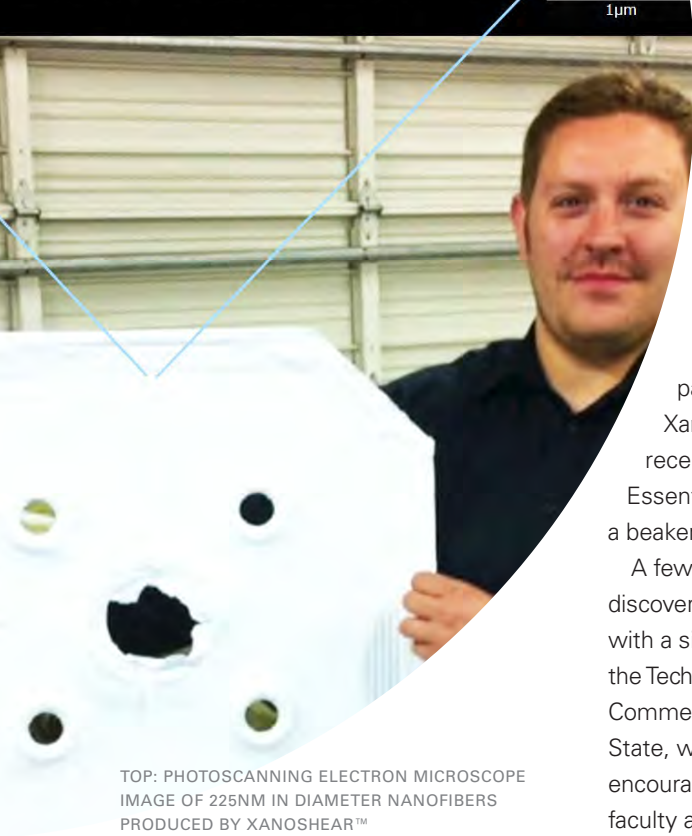
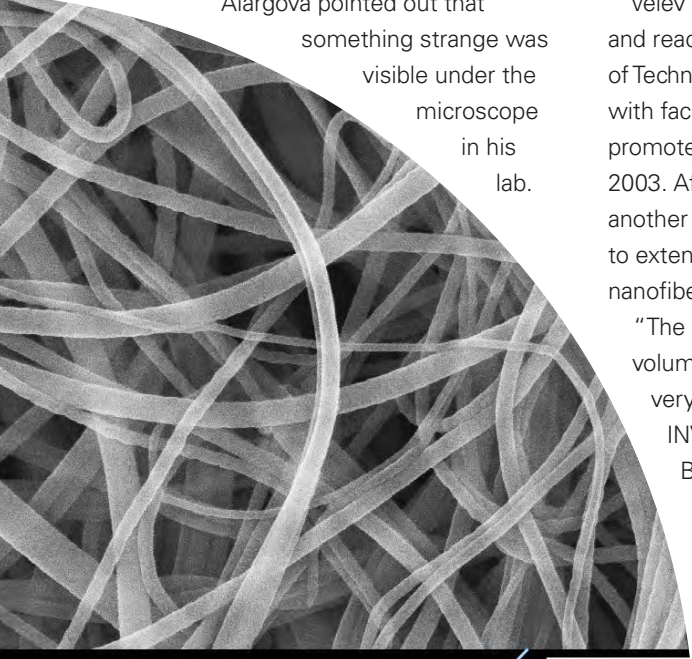


## REVOLUTIONARY RODS

Xanofi

NC State chemical engineering professor Dr. Orlin Velev had to take a closer look.

Post-doctoral researcher Dr. Rossitza Alargova pointed out that something strange was visible under the microscope in his lab.



TOP: PHOTOSCANNING ELECTRON MICROSCOPE IMAGE OF 225NM IN DIAMETER NANOFIBERS PRODUCED BY XANOSHEAR™

BOTTOM: DAN MORTON OF XANOFI HOLDS A LARGE MAT COMPRISED ENTIRELY OF NANOFIBERS

It was coming from a sample she had synthesized. Alargova was making polymeric spheres, but the spheres were stretching and becoming thinner over time. In other words, polymer rods were unexpectedly forming inside the liquid.

Velev knew he had something unique and reached out to the university's Office of Technology Transfer, which works with faculty and students to protect and promote their research discoveries. It was 2003. After patenting, Velev worked with another researcher, Dr. Stoyan Smoukov, to extend the technology to making nanofibers, a valuable industrial material.

"The point is, with a very small volume of polymer, you can create a very large surface area," said Velev, INVISTA Professor of Chemical and Biomolecular Engineering. "This is very useful in filters, a variety of biomedical products, insulation and non-woven textiles. There's a range of technologies that can use nanofibers to improve existing products."

Nanofibers differ from their normal-sized peers because of their size and unique properties, including a greater surface area. Nanomaterials can be just as strong as their larger peers, but much smaller in size.

Velev and his team eventually patented the technology, and XanoShear, which would officially receive its name in 2011, was born. Essentially, you can make nanofibers in a beaker, according to Velev.

A few years after the nanofiber process discovery, Velev and Smoukov teamed up with a six-student graduate team through the Technology, Entrepreneurship and Commercialization (TEC) program at NC State, which, since 1995, has worked to encourage interaction between students, faculty and technology companies. NC State's Poole College of Management hosts the program.

The team saw Velev's concept had potential for commercialization, and by the end of the school year, the students were months away from the formation of a company known as Xanofi. They began working with Miles Wright, now CEO of the Raleigh-based company.

During its first year, Xanofi scaled the technology from a test tube to a continuous flow commercial prototype. The company soon became able to produce kilograms of nanofibers each hour. Xanofi now has significant co-development projects with Fortune 100 and 500 companies in areas as diverse as water treatment, cell culturing and food additives.

To Velev, the combination of engineering and industry relationships forged by the TEC initiative was critical for the formation of a company like Xanofi. The company's placement on the university's inaugural list of promising business ventures — the Fast 15 — was also a benefit.

"You can make a discovery, but the discovery itself is not the technology," Velev said. "Making it work and making it a manufacturing process and organizing the product so it can be commercially viable is something that's very important."

Today, Velev remains a technical consultant for the growing company. He was named Innovator of the Year by NC State's Office of Technology Transfer in 2011.

## TOILET TALK

The Excrevator

Toilets. Fecal matter.

No one wants to talk about it, but sanitation issues plague roughly 2.6 billion people around the world. Dr. Robert Borden's environmental engineering senior design class didn't shy away from the topic, however, and his challenge to "think and do" spawned a simple, cost-effective device that is now being tested in developing countries.

Today it's called the "Excrevator," but more than two and a half years ago, environmental engineering student Tate Rogers simply envisioned an auger — a giant corkscrew — something that, through a twisting motion, could bring waste from latrines up to the surface. The auger would be fitted inside an inexpensive PVC pipe, eliminating the need to touch waste and risk getting sick.

"If you talk about waste, it seems taboo," Rogers said. "Changing that mentality worldwide can be a problem, as well."

Rogers thought of the idea while in class when Borden mentioned the request for proposals from the Bill and Melinda Gates Foundation. The challenge: create the next generation of sanitation technologies.

Rogers pitched his idea to Borden, and Dr. Francis de los Reyes, another professor in the department, helped to edit the final proposal. Joining more than 2,000 applicants, the team submitted their idea in May 2011.

Shortly before beginning his first semester as an environmental engineering graduate student, Rogers' team received word they had been selected for a \$100,000 grant. It was a pleasant surprise.

"Within the first phase of funding, we really wanted to get a prototype to the developing world to show we were at a stage where we had something working in the field," Rogers said.

The team's first prototype appeared at the Toilet Fair in Seattle in August 2012. Seven months later, as he was in the process of defending his master's thesis, Rogers and his team finished and shipped a prototype to South Africa, where they tested on several pit latrines.

Rogers believes most are drawn to the prototype because it's simple to use and made from local parts; if something breaks, a piece can easily be replaced.

In mid-October 2013, the team

received another round of great news: a \$250,000 grant would support Phase II funding. Since last November, the team has continued testing the prototype — from the lab inside Mann Hall on Main Campus to the plains of Malawi, South Africa, and India.

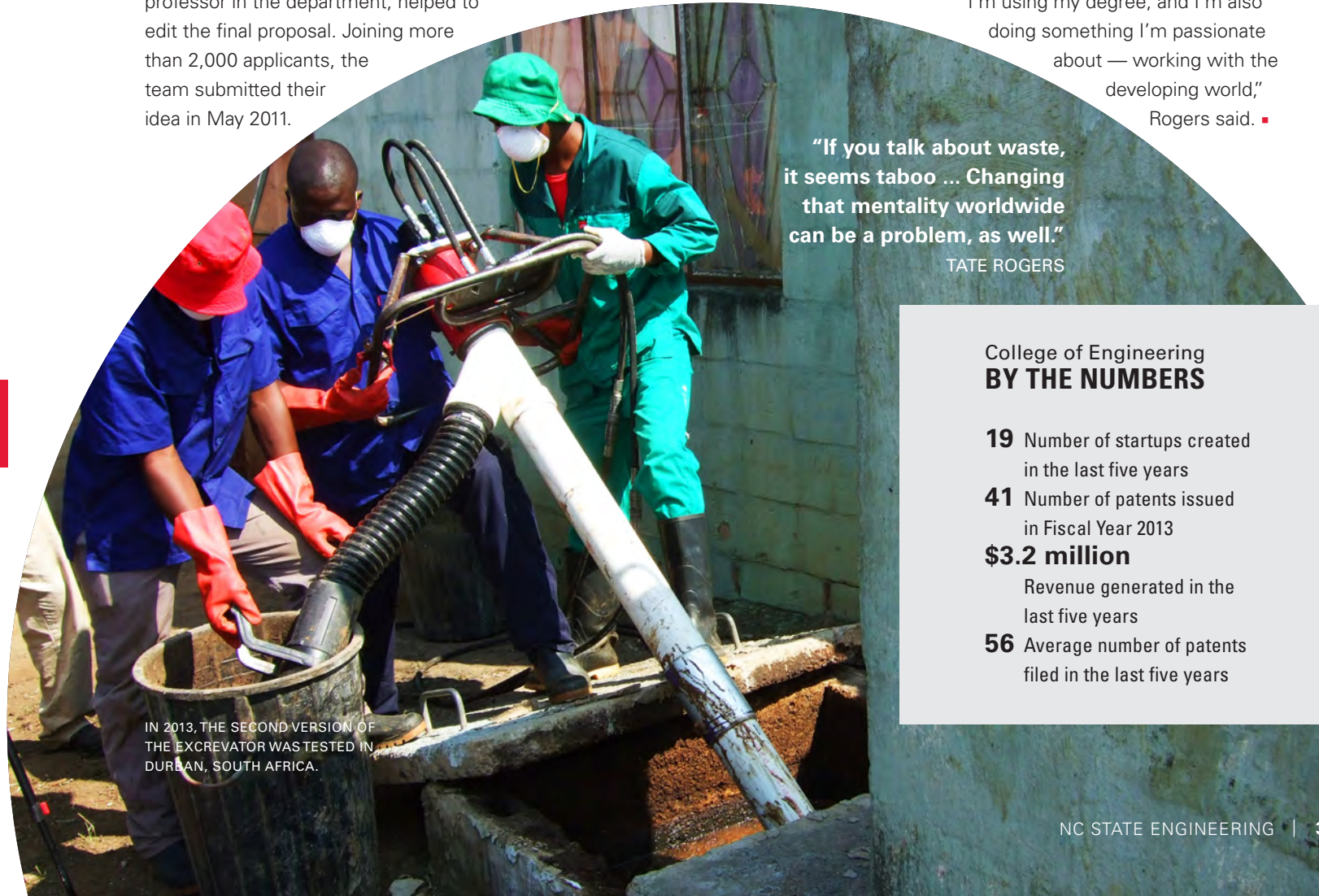
"Anywhere you have latrines, the waste in the pits is highly variable and you're not going to face the same situation every time," Rogers said. "We want to adapt the prototype to handle that variability in the waste and to empty anything it encounters."

The team's recent travel to New Delhi, India, for the second Reinvent the Toilet Fair was another opportunity to put the Excrevator on display. The experience provided a great platform for forming collaborations and continuing work after Phase II testing is completed. For Rogers, he couldn't imagine a better job description.

"I'm using my degree, and I'm also doing something I'm passionate about — working with the developing world," Rogers said. ■

"If you talk about waste, it seems taboo ... Changing that mentality worldwide can be a problem, as well."

TATE ROGERS



IN 2013, THE SECOND VERSION OF THE EXCREVATOR WAS TESTED IN DURBAN, SOUTH AFRICA.

## College of Engineering BY THE NUMBERS

- 19** Number of startups created in the last five years
- 41** Number of patents issued in Fiscal Year 2013
- \$3.2 million** Revenue generated in the last five years
- 56** Average number of patents filed in the last five years





## NC State engineering graduate, CEO returns to campus

JASON RHODE

Job seekers who stopped by Cirrus Logic's booth at the NC State Engineering Career Fair Feb. 5 were in for a surprise.

They got a chance to meet the CEO of the company — NC State engineering alumnus Jason Rhode.

Rhode has been president and chief executive officer of the Austin, Texas-based manufacturer of high-precision analog and digital signal processing components since May 2007. He earned master's and PhD degrees in electrical engineering from NC State.

Twice a year, NC State's College of Engineering hosts representatives of hundreds of companies and thousands of people seeking full-time jobs or internships. Along with NC State students, the career fair attracts students from as far away as Michigan and New Mexico.

Rhode returned to NC State to deliver a talk on the benefits of graduate school for electrical and computer engineering students. The talk, titled "Stay in School!: The Difference an MSEE Can Make in Your Career," was given on the evening of Feb. 5 in Engineering Building II, home of the departments of Electrical and Computer Engineering and Computer Science on NC State's Centennial Campus.

The timing of his speech aligned with the spring Engineering Career Fair, allowing him a chance to work with Cirrus Logic recruiters and meet the newest generation of NC State engineers.

Rhode developed his interactive presentation to give to students at the University of Texas-Austin because, he said, he realized that the United States produces a lot of talented engineering students who earn bachelor's degrees and then never make it to graduate school.

**"I can't imagine a better value in education."**

**JASON RHODE**

It's easy to understand why. The September 2013 edition of *Salary Survey*, a publication of the National Association of Colleges and Employers, identified average starting salaries for new graduates with a bachelor's degree in electrical engineering as \$62,500 and for those with a bachelor's in computer engineering as \$70,000.

That kind of opportunity is hard to pass up, Rhode says. But putting in a little more time in school to get a graduate degree can make a big difference in an engineer's career.

The majority of employees Cirrus Logic hires right out of school have master's or PhD degrees, Rhode says. And a lot of them come from NC State.

Electrical and computer engineering students at NC State can earn a bachelor's and master's degree in five years, which Rhode says is well worth the work.

"Your five-year master's program is really well constructed and it serves people extremely well," Rhode said. "I can't imagine there being a higher return on investment that you could do for your career."

Rhode says Cirrus Logic hires more graduates from NC State than from any other school. The company hired 11 NC State graduates last year, and Cirrus Logic's summer internship program always includes a contingent of NC State students.

NC State's graduate programs in electrical engineering are particularly well suited for the kind of work Cirrus Logic does, Rhode says.

The College of Engineering also produces a lot of graduates, ranking ninth among all US engineering schools in graduate enrollment.

Rhode, who finished his NC State PhD in 1995, said he came away impressed with Centennial Campus and all the progress his alma mater has made since he graduated.

Rhode said NC State is high on the list of schools he recommends to people who want to study engineering.

"I can't imagine a better value in education," he said.

The spring Engineering Career Fair attracted 197 companies and 3,272 job seekers. More than 20 percent of those job seekers were not NC State students. Students from North Carolina schools like Duke University, UNC-Chapel Hill and East Carolina University attended, as did students from Texas A&M, Rutgers, Purdue and other out-of-state schools.

The fall 2014 Engineering Career Fair will be held Sept. 30 and Oct. 1. ■

## Scholarship honors bright, young engineering alumnus



ALEX STUBER

For Alex Stuber, an impromptu weekend trip to see NC State's football team take on the University of Maryland Terrapins made perfect sense. The spontaneous move fell right in line with his zest for living life to the fullest and experiencing the moment with the ones he cherished the most — family and friends.

Alex graduated from NC State in 2010 with bachelor's degrees in mechanical and aerospace engineering; he maintained a perfect 4.0 and was among the valedictorians. Two years later, he earned his master's degree in aerospace engineering. The hard work was a buildup toward a promising career with one of the top organizations in the aerospace industry — NASA.

Tragically, Alex's life ended June 14, 2013, when he passed away following a car accident. He was 25 years old.

In his honor, Alex's family has endowed the Alexander Lee Stuber

Memorial Scholarship to support undergraduate students in the Department of Mechanical and Aerospace Engineering. The family has strong ties to NC State. Alex's father, Charles "Chuck" Stuber Jr., and paternal grandparents are alumni; his paternal grandfather, Dr. Charles Stuber, is professor emeritus of genetics and director of NC State's Center for Plant Breeding and Applied Plant Genomics.

"If we can help someone who has a dream of being an engineer and needs some financial help, NC State is a good place to put those resources," said Chuck Stuber, a special agent with the FBI. "Maybe one of those students will end up going to NASA and following in Alex's footsteps."

Alex's journey with NASA began when he received a prestigious scholarship in 2008.

"I think one of the things that attracted Alex to NASA was that the

people were incredible," Chuck Stuber said. "Their mission was different — it wasn't about making money. It was about maybe doing something that had never been done — exploring new frontiers."

While a student at NC State, Alex completed summer internships and was in the Co-op program in Edwards, Calif., at NASA's Dryden Flight Research Center, which was recently renamed the Armstrong Flight Research Center. During one of his assignments, he had a chance to work on the Stratospheric Observatory for Infrared Astronomy (SOFIA), the world's largest airborne astronomical observatory. Flying to an altitude of 45,000 feet, SOFIA captures infrared images that ground telescopes can't. Alex flew on one of SOFIA's missions.

**"Maybe one of those students will end up going to NASA and following in Alex's footsteps."**

**CHUCK STUBER**

Shortly after receiving his master's degree, Alex received a full-time job offer from NASA — he'd be working in the Aerostructures Branch on ways to improve how future planes are designed and constructed as both an analyst and test engineer. The skills and techniques he had learned as an engineering student at NC State were on full display.

Alex was in the sixth month of his new position when he passed away. His family and friends remember his passion for traveling, skiing and capturing life's moments through photography. Today, his memory lives on through the lives he touched as an organ donor and the future lives he will impact through an endowed scholarship.

"Alex would definitely want something like this to help NC State students," Chuck Stuber said. "I don't think there's any question." ■





## FOUNDATIONS



NC State engineering alumni return for

# HOMECOMING CELEBRATION

“This is a great university in a great state.”

DR. WARWICK ARDEN

Alumni of the College of Engineering at NC State returned to campus last November for a Homecoming celebration held in the James B. Hunt Jr. Library and at other locations on NC State’s Centennial Campus.

The College’s Homecoming Celebration, in its second year, provided a first-hand view of a college that has grown by leaps and bounds and has more goals within its reach. The College ranks in the top 15 nationally in several

categories, including graduate and undergraduate enrollment and number of degrees awarded. NC State engineering is well represented on prominent rankings from *US News & World Report* and the *Wall Street Journal*.

“It’s an important time for the College of Engineering, and it was great to see so many of our alumni reconnect during Homecoming,” said Dr. Louis A. Martin-Vega, dean of the College. “Our goal is to become and be perceived as the leading public college of engineering in the country and one of the premier colleges of engineering in the world. Alumni engagement plays a very significant role in that effort.”

Graduates of the College also brought their children and grandchildren to participate in an Engineering Mini-Camp held in Engineering Building III on Centennial Campus. The camp was a popular attraction last year, and children ages 5 through 18 took advantage of a variety of activities including “Newspaper Chairs,” “Build a Better Bug” and “Self-Folding Shapes.”

During an afternoon presentation in the Hunt Library auditorium, some of the College’s faculty and students presented their innovations and ideas that will change the world for the better.

Martin-Vega also provided a thorough look at the College’s achievements, highlighting national award winners and a steady growth of research expenditures. Additionally, NC State is the only university currently leading two National Science Foundation Engineering Research Centers (ERCs); the university is one of only two universities ever to receive three ERCs.

Dr. Warwick Arden, provost and executive vice chancellor at NC State, provided perspective on changes in higher education and the impact on NC State. Arden discussed how the university constantly adapts to keep pace with a changing world and how NC State has dealt with state budget cuts while handling growth.

“This is a great university in a great state,” Arden said. “But we are going to have to think very critically about how we can keep the momentum going.” Exploring diverse revenue sources instead of reliance on state funding is among the next steps, Arden said.

Two College faculty shared the important work they are doing with 3-D printing at NC State. Additive manufacturing processes such as 3-D printing make products by putting down successive layers of material rather than cutting material away using saws or drills. Dr. Michael Dickey, associate professor in the Department of Chemical and Biomolecular Engineering, gave a presentation on his research team’s work to create 3-D structures out of liquid metal. Researchers found that a liquid metal alloy of gallium and indium reacts with oxygen in the air at room temperature to form a “skin” that allows the liquid metal structures to retain their shape. Dickey’s team is exploring possible applications for their work.

Dr. Ola Harrysson, associate professor and Fitts Fellow in Biomedical Manufacturing in the Edward P. Fitts

Department of Industrial and Systems Engineering, explained how NC State engineers are using 3-D printing to make prosthetic limbs and custom orthopedic implants for animals and humans and to develop new materials for direct metal fabrication to benefit the aerospace, medical and technology fields. The Homecoming presentation then switched gears to focus on NC State engineering students and how they are taking learning outside the classroom. A team of engineering students has created a buzz with Jar~with~a~Twist, a new kind of container for peanut butter and other condiments that ensures every last ounce of product is used. Even better, consumers can now avoid the dreaded “peanut-butter knuckles” that

## FOUNDATIONS

result as they try to fish around with a knife for what’s left at the bottom of the jar.

Designed to work much like a stick of deodorant or a Push-Up Pop, Jar~with~a~Twist pushes the product up to the top without hassle or mess. The team has been featured on the television show “Good Morning America” and on several news websites. The students are seeking a patent.

Three students in NC State’s Engineers Without Borders student chapter discussed the chapter’s work supporting community-driven development programs overseas that are designed to help meet basic human needs. Initiatives include students traveling to communities in Bolivia and Sierra Leone to help ensure residents have clean drinking water and reliable access to electricity.

The afternoon ended with a barbecue dinner for alumni and their families at several locations around the Engineering Building complex on Centennial Campus.

Woody Smith, a 1966 NC State mechanical engineering graduate, traveled to

Raleigh for Homecoming from his home in Greenville, SC, with his wife, Theresa.

“Homecoming weekend was an exciting time to be on the new Centennial Campus — one of which to be very proud,” Woody Smith said. “As we were sitting in the newly opened Hunt Library auditorium listening to the dean, provost and others speak, it was so uplifting to hear the emphasis placed on academics in such an exciting way. Listening to the students talk about their particular projects with such enthusiasm was a ray of sunshine.” ■

The NC State Engineering Foundation plans to host another homecoming event this fall on Nov. 7.





FROM LEFT: FRANCES AND ALLEN FULLER



JOSEPH PIPPIN

The NC State Engineering Foundation's Endowment Dinner is held each spring. It's a chance for College of Engineering faculty, staff and students to meet the donors behind the scholarships, fellowships and professorships that have impacted their lives.

For first-year engineering student Joseph "Joey" Pippin, the dinner was the first time he met Frances Fuller, a fellow Randolph County, NC, native who established the Allen Jefferson and Frances Stalvey Fuller Scholarship in 2012. The scholarship — in memory of Frances Fuller's late husband, Allen, a 1960 electrical engineering alumnus who served in the US Army Signal Corps and was a Korean War veteran — has helped make the Staley, NC, native's first year at NC State a reality.

Pippin is pursuing degrees in chemical engineering and paper science and engineering. He is interested in a career in manufacturing and is leaning toward the paper industry.

Before committing to NC State, however, Pippin filled out a number of scholarship applications.

## Helping hands

Endowments provide life-changing opportunities

"It was stressful," Pippin said. "We didn't want our parents to pay for all of this, and we didn't want to get all these loans."

When Pippin found out that he had received the Fuller

Scholarship, he quickly sent an email to Frances Fuller, expressing his gratitude.

"She and her husband gave this money to help me get an education, and an education is the most important thing you can do with your life," Pippin said.

The Fullers grew up in Randolph County and wanted to provide future engineers from their home county an opportunity for a great education. Frances Fuller recalls her late husband's love for engineering, including his 25-year career with General Electric.



BENNY AND TEMPIE FURR WITH JUSTIN SAWYER, A PREVIOUS SCHOLARSHIP RECIPIENT.

"We're happy and proud of the way the scholarship is being managed."

**BENNY FURR**

The Fullers are not alone. For decades, alumni and friends of the College have generously given back.

Benny J. and Tempie L. Furr have attended most of the annual endowment dinners since they established the Jane Leigh Furr Memorial Scholarship Fund in 1992 in memory of their 21-year-old daughter who was killed in a car accident in 1984.

Benny Furr graduated from NC State with a bachelor's degree in mechanical engineering in 1962. He worked for Carolina Power and Light Co. in Raleigh for 30 years and retired from CP&L, now Duke Energy, in 1992. He says the matching program helped with his family's giving.

The endowment has generated more than 40 scholarships thus far and exemplifies how an endowment remains in perpetuity. One act of generosity impacts many.

"We're happy and proud of the way the scholarship is being managed," Benny Furr said. "We're satisfied with the way it is going. It gives us a lot of satisfaction to see the young folks helped along."

For the Furrs, it is refreshing to meet the students at the annual endowment dinners and hear future engineers and computer scientists talk about their schooling and aspirations.

They're joined by other donors who share the same motivation — to make an NC State education a reality for students today and generations to come.

Visit [www.engr.ncsu.edu/foundation](http://www.engr.ncsu.edu/foundation) for more information on ways to support the College. ■

## Scholarship honors memory of outstanding professor

Dr. Peter L. Mente, associate professor of biomedical engineering at NC State, passed away on Jan. 20. He was 52.

Mente, who received his PhD in biomedical engineering from Northwestern University in 1995, joined the Department of Biological and Agricultural Engineering at NC State in 1999. In 2003, he became a founding member of the Joint NC State-UNC Department of Biomedical Engineering (BME). He led the Tissue Mechanics Laboratory, focusing his research on arthritis.

"His students loved him because they learned from him. He built their confidence."

**DR. LIANNE CARTEE**

Dedicated to his students, Mente was voted BME Outstanding Teacher by seniors on five occasions. He received the College's Outstanding Teacher Award in 2007 and the University's Alumni Distinguished Undergraduate Professor Award in 2008.



DR. PETER MENTE

Dr. Lianne Cartee, teaching associate professor of biomedical engineering and the Department's director of undergraduate studies, said, "His students loved him because they learned from him. He built their confidence."

According to Cartee, students have long praised Mente on teaching evaluations and more recently in letters of support. One student's comment exemplifies their high regard for him: "I consider myself lucky to have had many excellent professors while at NC State,

but I can say without hesitation that none have been as outstanding as Dr. Mente."

Cartee explained that the students' desire to honor Mente inspired the Department to collaborate with the Mente family to establish the Peter Mente Undergraduate Biomedical Engineering Scholarship in recognition of his passion for teaching.

Mente's commitment to helping biomedical engineering students continues through the scholarship. It is a fitting legacy. ■

Donations to the Peter Mente Undergraduate Biomedical Engineering Scholarship fund can be made online at [go.ncsu.edu/engineering-giving](http://go.ncsu.edu/engineering-giving) or by mail to the address below. Be sure to reference the scholarship by name.

NC State Engineering Foundation  
Campus Box 7901  
College of Engineering  
NC State University  
Raleigh, NC 27695-7901





## Paving the way

Civil engineering alumnus wants to ensure opportunity is still there

In the early 1960s, Tom Coffey completed a construction option civil engineering degree at NC State while also playing on the university’s men’s golf team and participating in ROTC.

There were no golf scholarships in those days. The Raleigh native tried out for the team as a freshman in 1960 and made the cut. Al Michaels, then an assistant coach on the Wolfpack football team, also coached the men’s golf team.

Players were provided a sleeve of balls, lunch money, a ride to the course and not much else, Coffey said. They used multiple local courses as their home course.

Coffey’s civil engineering degree required 152 hours in four years to graduate, and students had to have the dean of engineering’s approval to stray from the curriculum. Playing golf “was a good respite,” he said.

It was a busy time, Coffey remembers, but also a great time.

Many of his friends from Raleigh’s Broughton High School also attended

NC State. Those are friendships he still keeps today.

“I look at it as being four of the best years of my life, being at State,” Coffey said.

After serving more than three years in the US Army stationed in Germany, Coffey returned to Raleigh, where he joined a local engineering firm. He also received his Professional Engineer and Registered Land Surveyor designations.

He later co-founded another Raleigh firm, Triangle Engineering. He sold his portion of that company to a partner and went to work as a consultant in the late 1970s.

Coffey and some partners started a group called Development Associates that built commercial projects around Raleigh, including the Stonehenge subdivision and shopping center on Creedmoor Road.

Coffey and his wife, Louise, have lived in Florida since 1990. They have three children and nine grandchildren, and Coffey spends much of his time now

growing orchids, a hobby he picked up when he lived in Raleigh.

They return to Raleigh several times a year to visit family and friends and attend Wolfpack football games.

The couple has endowed scholarships for the men’s and women’s golf teams at NC State and have supported the Lonnie Poole Golf Course and Carol Poole Clubhouse on Centennial Campus.

Coffey is also a financial supporter of the Department of Civil, Construction, and Environmental Engineering (CCEE) and sits on its Departmental Fellows and Development Committee. His recent \$1 million gift to CCEE will endow undergraduate scholarships and an endowed fellowship in the department.

Giving back to the university “is so ingrained in me,” Coffey said, because of what an NC State degree meant to his career.

“NC State gave me the ability to succeed. It needs to be there for anybody that wants it.” ■

NC STATE Engineering

# 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.

If you would like to include the College of Engineering in your long-term financial planning, here are some ideas to help you achieve your goals.

### BEQUEST

Include the NC State Engineering Foundation in your will and receive an estate tax deduction.

### CHARITABLE GIFT ANNUITY

Provide fixed income for yourself or a loved one.

### CHARITABLE REMAINDER TRUST

Create life income for you and your spouse.

### CHARITABLE LEAD TRUST

Pass property and other assets on to your family with substantial tax benefits.

If you have already made the NC State Engineering Foundation part of your plans, please let us know. Call Martin Baucom at 919.515.7458 to discuss any of these charitable options or visit [www.engr.ncsu.edu/foundation](http://www.engr.ncsu.edu/foundation) for more information.



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FROM LEFT: MARTIN BAUCOM, ANGELA STALLINGS, LORA BREMER, BRIAN CAMPBELL, MARGARET MCENDARFER, ERIKA KNOX, AND TASHA MARTIN.

## Who's Your Foundation Rep?

The NC State Engineering Foundation, Inc., has raised private funds and worked with alumni and others to advance education, outreach and research in the College of Engineering since 1944. Today, the Foundation's staff members continue that effort and are dedicated to addressing the evolving needs of one of the best and largest colleges of engineering in the nation.

Led by Brian Campbell, executive director of development and college relations, and supported by an administrative staff, the directors of development work across the College to raise funds and to engage with alumni

and others in support of College-wide priorities and initiatives within the College's nine departments. Their primary goal is to build endowments that have lasting impact through scholarships, fellowships, professorships, academic programs, faculty research and other initiatives in the College while establishing a legacy for donors. Donors have stepped up to drive tremendous growth in endowments over the past several years.

It is private philanthropy that empowers the College to achieve excellence in its research, teaching and public engagement mission.

Here are the people who work behind the scenes to make this happen. ■

##### BRIAN E. CAMPBELL

##### Executive Director of Development and College Relations

Major gift contact for the Edward P. Fitts Department of Industrial and Systems Engineering  
919.515.7458

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# BY THE NUMBERS

SOME OF THE FIGURES THAT SHAPE THE COLLEGE OF ENGINEERING

A background image showing students walking on a set of stairs. The image is partially obscured by red rectangular overlays containing text. The students are wearing casual clothing, and the stairs have a yellow handrail.

# 72

Percentage of College's incoming freshmen who placed in the top 10 percent of their high school class.

# 4

Number of National Manufacturing Innovation Institutes established by the United States government between August 2012 and February 2014. The Next Generation Power Electronics National Manufacturing Innovation Institute led by NC State was the second one announced.

# 14

College faculty who are members of the National Academy of Engineering.

# 16

College's rank among public colleges of engineering in the United States, according to *US News & World Report*.

Ranking for Engineering Online at NC State's computer science and computer networking programs in *US News & World Report's* list of the Best Online Graduate Computer Information Technology programs.

# 4



## NC STATE Engineering

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