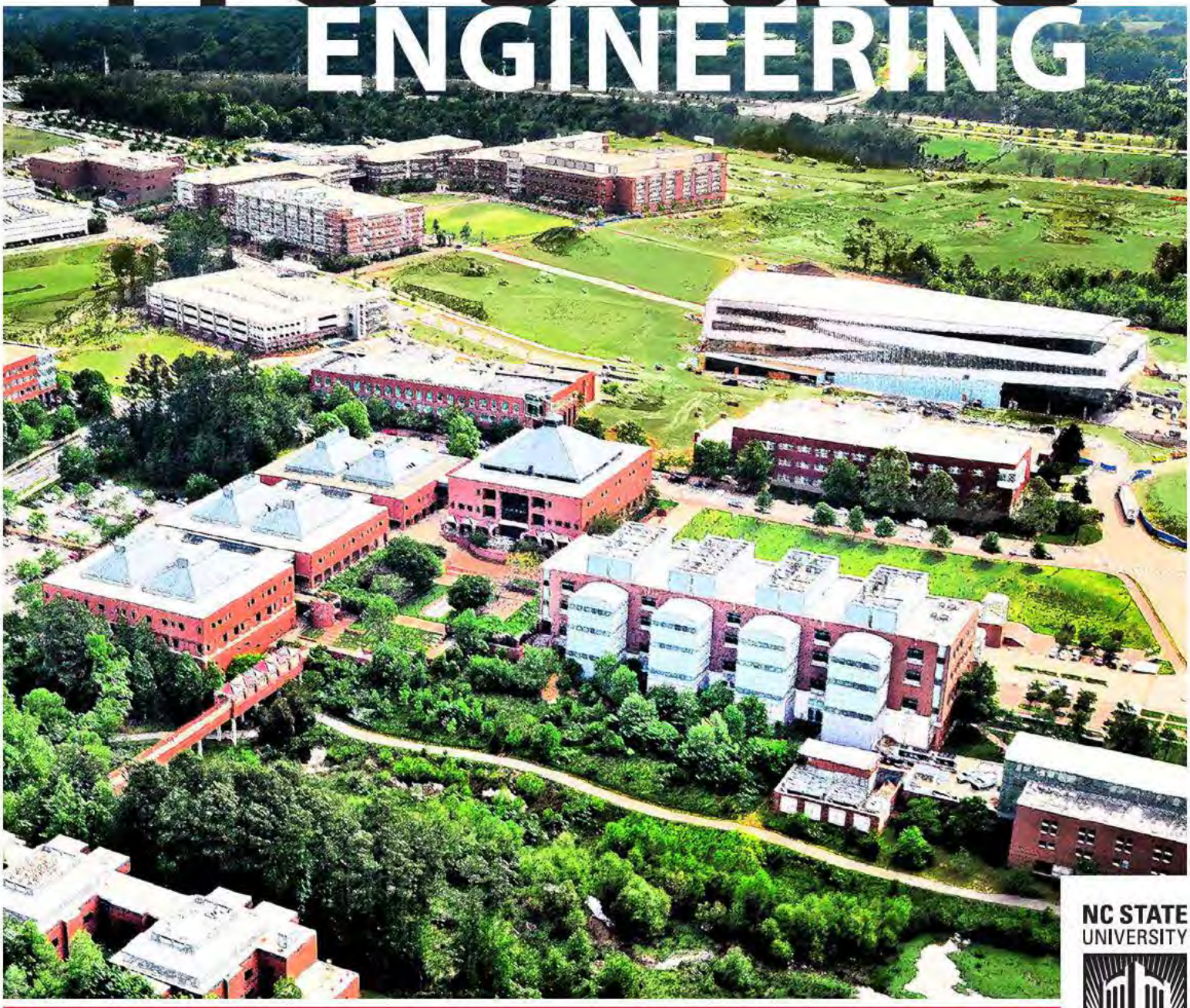
FALL/WINTER **2013**

# nc state ENGINEERING



NC STATE UNIVERSITY

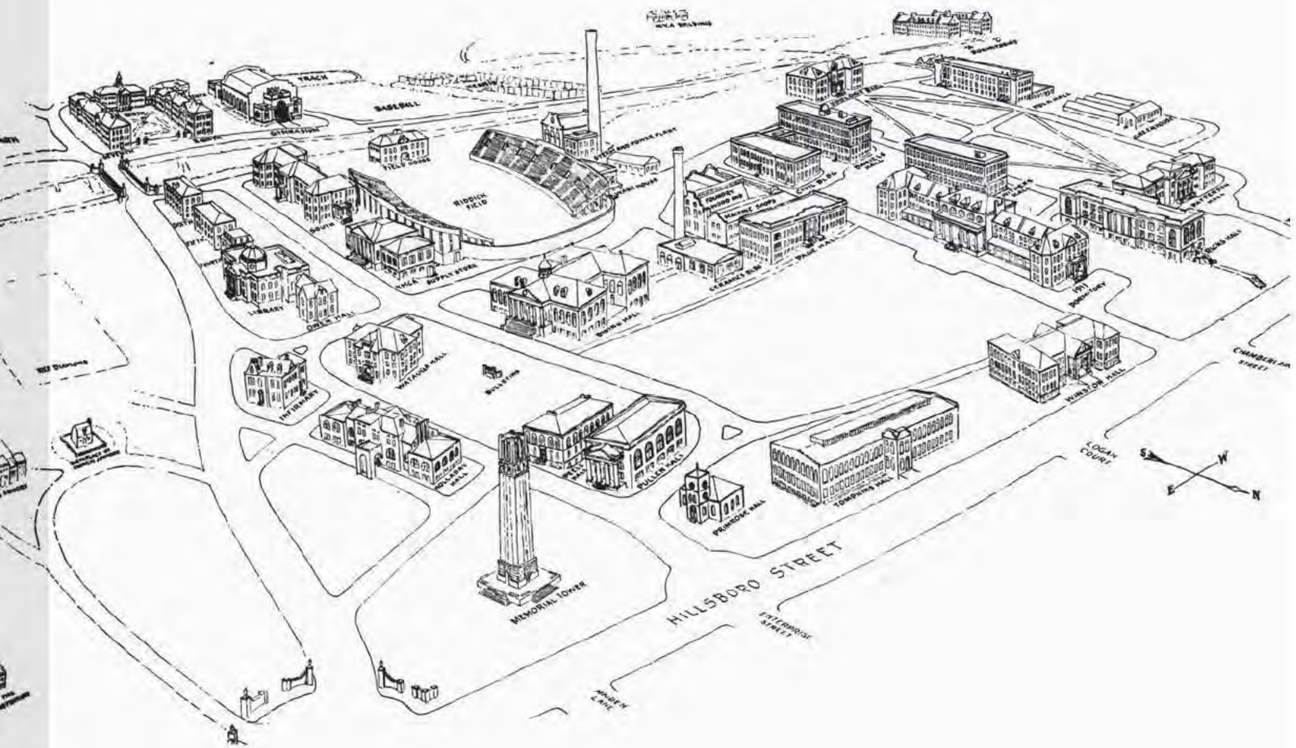
COLLEGE OF ENGINEERING

## CENTENNIAL CAMPUS TODAY

NC State's campus of the future is here

**ENGINEERS POWER THE STATE'S ECONOMY**

**RESEARCH LEADS TO A BETTER AUTOMOBILE**




**THE 1939 BIRD'S-EYE VIEW**

Today's NC State campus — spread out over 2,000 acres — is a fascinating blend of old and new. There are modern parts — the new engineering buildings figure prominently on Centennial Campus — and older parts, which began going up on the south side of Hillsborough Street in the late 1800s.

This map, a bird's-eye view that omits trees and landscaping, is from 1939. NC State was already 52 years old at that point, and what was once just a single building, Holladay Hall, had become a bonafide campus.

Most prominent is the Memorial Belltower, completed in 1937 to honor the NC State alumni killed during World War I. The blank space in the center of the drawing is the Court of North Carolina. Its western edge is flanked by Page Hall, which contained the mechanical engineering department at the time, and Winston Hall, which was built in 1910 and was the first building on campus devoted primarily to engineering activities.

Riddick Field, named for Wallace Carl Riddick, a former university president and the first dean of the School of Engineering, dominates the top portion of the image (Riddick also served as football coach for a time).

Page 20 has another bird's-eye view, only this time it's of Centennial Campus and the year is 2013.

nc state ENGINEERING FALL/WINTER 2013

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## FEATURES



## DEPARTMENTS






ON THE COVER: Centennial Campus offers a unique combination of industry, teaching and research. Now, NC State students are living on the state-of-the-art campus. See page 20 for a look at Centennial Campus today.

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## *Did you know?*

NC State engineering and physics alumna Christina Hammock (shown in background photo at a remote science lab in Greenland) was one of eight candidates selected to join NASA's Astronaut Class of 2013, but did you know the recent cohort is comprised of four women — the highest percentage of female astronaut candidates ever selected for a class? Following a year-and-a-half search, the group was selected from the second largest number of applications ever received by NASA — more than 6,100. Hammock began training at NASA's Johnson Space Center in Houston in August.

# FROM THE DEAN

Louis A. Martin-Vega

The national dialogue on higher education in the past few years has focused on the value of a college degree. Many discussions emphasize the cost of tuition. In North Carolina, our public higher education system, the University of North Carolina, has benefitted significantly from the support of the people of the state for more than a century. This public support built one of the most highly regarded university systems in the nation and kept tuition costs well below the national average for North Carolina citizens. The result: a highly educated workforce that has created an environment where business and industry thrive.

As the flagship engineering and technology university in the UNC system, NC State plays a key role in producing that workforce as well as in educating the founders of those businesses that create jobs in communities across the state.

In this issue of *NC State Engineering*, we examine a number of ways that our college and university boost the economy of North Carolina and the nation. You will meet alumni who build businesses and create jobs, researchers who are working to improve the global ability to produce food and students who invent new products to bring to the marketplace. These are just a few examples of how NC State's College of Engineering plays an essential role in the success of the economy of our state and nation.

This Fall/Winter issue of *NC State Engineering* includes a very special invitation to our alumni and friends to attend the 2nd Annual College of Engineering Homecoming Celebration. This year our event will be held in the brand new James B. Hunt Jr. Library on NC State's Centennial Campus. The very popular engineering mini-camp for kids will return, and alumni can learn more about the future of 3-D printing technology, meet student entrepreneurs and hear from our provost on the future of higher education at NC State. I look forward to seeing you at this celebration.

We greatly appreciate your continued engagement and support. I hope you will find time to visit our campus and learn more about your college.

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

## ACC deans come together at NC State

Each year, the engineering deans from the Atlantic Coast Conference universities set aside their playing field rivalries and come together to discuss issues and trends in engineering higher education.

This year, Dean Louis A. Martin-Vega hosted the deans at NC State. Attendees included the engineering deans from Clemson, Duke, Florida State/FAMU, Georgia Tech, Maryland, Miami, Pittsburgh, Syracuse, Virginia and Virginia Tech.

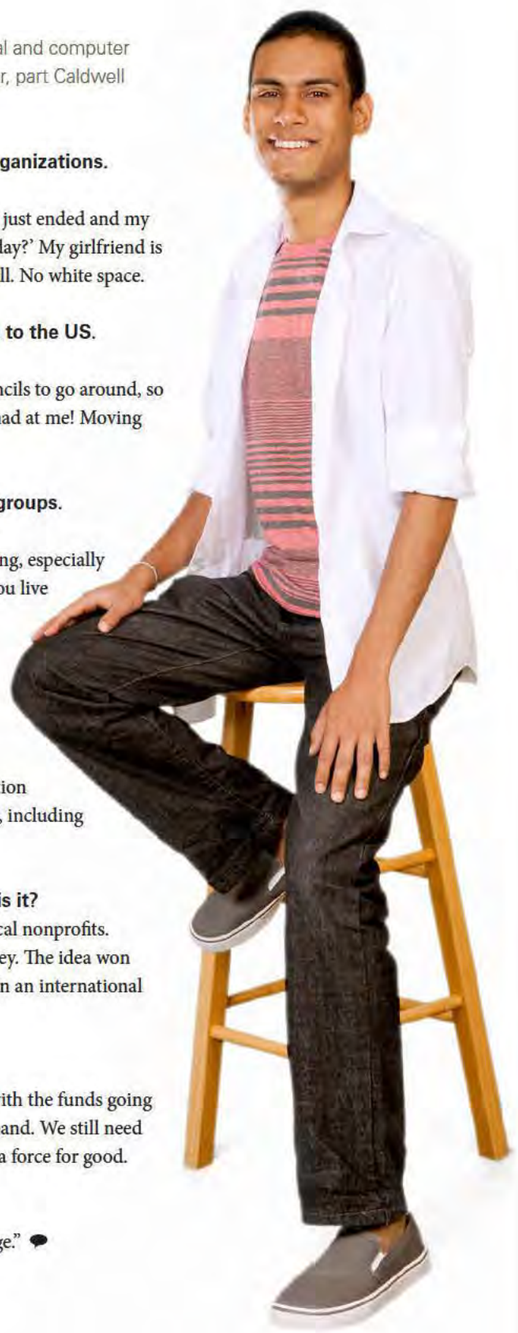
The meeting was held on NC State's Centennial Campus in the university's new high-tech James B. Hunt Jr. Library and in Engineering Building II. Discussion topics covered Massive Open Online Courses and educating the public on how an engineering education prepares graduates to address the grand challenges of society in areas such as sustainability, health, security and joy of living.

The group was also invited to tour and learn more about the two National Science Foundation Engineering Research Centers — ASSIST and FREEDM — led by NC State engineering faculty. ▪

ACC deans gather at NC State, (front row from left) Dean Louis Martin-Vega, NC State; Dean Martine LaBerge, Clemson; Dean Laura Steinberg, Syracuse; Assoc. Dean Christine Grant, NC State; Dean Gary May, GaTech; (back row from left) Dean James Aylor, U of Virginia; Dean Richard Benson, Va Tech; Dean Yaw Yeboah, Florida State/FAMU; Dean Tom Katsouleas, Duke; Dean Darryll Pines, U of Maryland; Dean Gerald Holder, U of Pittsburgh; Dean James Tien, U of Miami.

# Q&A

## with SHREYE SAXENA



Even when Shreye Saxena rests, he wants to do something. The junior electrical and computer engineering major is part Engineers' Council president, part nonprofit co-founder, part Caldwell Fellow, part researcher and all-around campus dynamo.

**Looking at your resumé, you've been involved with 12 different campus organizations. How do you manage it all?**
It's actually normal to me. This week (week of May 13) is the scariest because exams just ended and my summer internship hasn't started yet. So I go to bed thinking, 'What have I done today?' My girlfriend is the same way. Sometimes we put up both our Google calendars and everything is full. No white space.

**Backing up a bit, you were 6 years old when your family moved from India to the US. How did your life change?**
Fitting in was tough sometimes. In schools in India, there are fewer crayons and pencils to go around, so everybody shared. But here, when I tried to use other kids' stuff, they kept getting mad at me! Moving here helped me learn ways to break down barriers between people.

**You came to NC State and immediately became involved with all sorts of groups. Let's start with the Engineers' Council. What are your goals as president?**
We have lots of goals. One is for the College to be more involved with student housing, especially the Entrepreneurs' Village and other new housing on Centennial Campus. Where you live is where you build your life.

**You've also found time for undergraduate research.**
As a freshman, I helped test power semiconductors for the smart grid at the FREEDM Systems Center. The University Honors Program then brought me to RiboLab, a joint project between computer science and biology that develops computer models of protein synthesis. The models identify errors in genetic translation and make fixing them possible. This work has many incredible medical applications, including developing vaccines and treating cancer.

**You're co-founder of a nonprofit startup called Pennies for Progress. What is it?**
We partner with business so one penny from each retail transaction goes to fund local nonprofits. That way, nonprofits can spend more time helping people and less time raising money. The idea won first place in the UNC system Social Business Competition, and now we're finalists in an international competition.

**Then what?**
We'd like to pilot the idea through NC State's Campus Enterprises retail locations, with the funds going to the Hillsborough Street Community Services Corporation. After that, we can expand. We still need to tackle some remaining technical challenges, but we're close to making the penny a force for good.

**What's the origin of your first name?**
"Shreye" is an Indian name. It means "the auspiciousness that comes from knowledge."






## Solved with a twist

A new product developed by NC State engineering students in the Engineering Entrepreneurs Program will make getting the last dab of peanut butter a breeze. Jar~with~a~Twist, which works like a deodorant stick, twisting on the bottom and moving the container contents to the top, provides a full-jar effect even when the jar is empty. *Good Morning America* was the latest to report on the product.

The team anticipates the additional cost of the jar to be just three cents per unit compared to normal jars. They spent six months prototyping and testing the product, which began with 3-D printing. Though a patent is still pending, consumers may soon be rid of "peanut butter knuckles" at lunch-time.

Other media outlets featuring the new jar included *International Business Times*, *Slate.com*, *MSN Now* and the *Huffington Post*. ▪

## Researchers build 3-D structures out of liquid metal

*Nature* magazine featured the three-dimensional (3-D) printing technology and techniques developed by NC State engineers to create free-standing structures made of liquid metal at room temperature.

The research team, led by Dr. Michael Dickey, assistant professor of chemical and biomolecular engineering, found that a liquid metal alloy of gallium and indium reacts to the oxygen in the air at room temperature to form a "skin" that allows the liquid metal structures to retain their shapes.

Dickey's team is currently exploring how to further develop these techniques, as well as how to use them in various electronics applications and in conjunction with established 3-D printing technologies.

The technology was also featured in media outlets such as the *New York Times*, *BBC*, *Popular Science* and *New Scientist*. ▪

## Creating biofuels out of carbon dioxide

*Science Daily* featured research conducted by a team of engineers that was published in the *Proceedings of the National Academy of Sciences* that may soon lead to the creation of biofuels from the carbon dioxide in the Earth's atmosphere.

Dr. Robert Kelly, Alcoa Professor of Chemical and Biomolecular Engineering at NC State, and a team of researchers used a microorganism called *Pyrococcus furiosus* — "rushing fireball" — that feeds on carbohydrates in super-heated ocean waters near geothermal vents. They manipulated the genetic makeup of the *P. furiosus*, creating a microorganism that feeds on carbon dioxide at lower temperatures.

Kelly and his colleagues then created a chemical reaction in the manipulated *P. furiosus* using hydrogen gas to incorporate carbon dioxide into 3-hydroxyproprionic acid — a common industrial chemical. The team could, with other genetic manipulations of *P. furiosus*, create fuel from carbon dioxide. When burned, this fuel would come out as carbon neutral, releasing the same amount of carbon used to create it and lessening the impact on the environment. ▪

From left: Dr. James Tuck, Dr. Joel Ducoste, Dr. Terri Long, and Dr. Cranos Williams.

## A single challenge, a suite of experts

Feeding the expanding global population poses a formidable challenge, so NC State has pulled together a multi-disciplinary team of researchers with expertise in everything from plant genetics to electrical and computer engineering to come up with answers.

NC State has received an INSPIRE grant from the National Science Foundation to better understand how plants respond to various stresses, such as a lack of essential nutrients. In particular, the project investigates how a plant called *Arabidopsis thaliana* responds when deprived of iron, which is essential to the plant's biological processes. A more significant goal of the project is to improve understanding of specific proteins ("transcription factors") that control how a plant responds to environmental conditions.

The team includes Dr. Cranos Williams, lead investigator of the project and assistant professor of electrical and computer engineering; Dr. Joel Ducoste, professor of civil, construction, and environmental engineering; Dr. James Tuck, assistant professor of electrical and computer engineering; and Dr. Terri Long, assistant professor of plant biology. Long will help the team use information from the study to create and test a prototype model that predicts plant responses to stress.

"Ultimately, we want to create models that can help us determine the best practices for breeding plants with increased nutritional value and the best agricultural practices for different conditions — ranging from how growers should respond to stresses related to climate change or new plant diseases to farming on marginal crop land," Williams said.

Williams and Ducoste bring extensive experience modeling complex biological systems and cellular processes; Tuck will streamline computation for quicker, more efficient calculations.

By sharing expertise in computer modeling, plant biology, genetics, biological systems and high-speed computing, the researchers hope to shed light on issues related to the most fundamental of real-world problems: ensuring that the human population has enough good food to eat. ▪

## A new insulin delivery system

Any diabetic knows that insulin injections are no fun. They can be painful, and it's often difficult to determine how much insulin is needed to keep blood-sugar levels from peaking or bottoming out.

But new research led by an NC State engineer could change that.

The researchers have developed a network of nanoscale particles that can be injected into the body and release insulin when blood-sugar levels rise. In preliminary tests on mice, the new treatment maintained normal glucose levels for more than a week.

The multi-institutional research team, led by Dr. Zhen Gu, assistant professor in the Joint NC State-UNC Department of Biomedical Engineering, is currently in discussions to move the technology into clinical trials for use in humans. The research is aimed at Type 1 and advanced Type 2 diabetics.

Here's how it works. The researchers' nano-network is composed of a synthetic nanoparticle mixture that includes a solid core of insulin and glucose-sensing elements. The injectable mixture is structured in a way that allows the insulin to be released when it is exposed to high blood-sugar levels, which brings those levels under control.

But before the injection, each of the nanoparticles is given a positively or negatively charged biocompatible coating. As the particles mix, they're attracted to each other to form a network that holds them together. Both the nano-network and the coatings are porous, allowing blood — and blood sugar — to reach the nanoparticle cores and trigger the release of appropriate amounts of insulin.

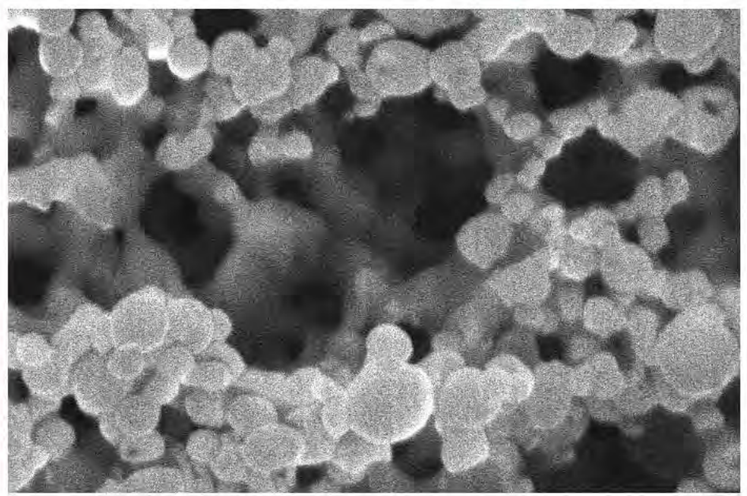
"This technology effectively creates a synthetic 'closed-loop' system that mimics the activity of the pancreas in a healthy person, releasing insulin in response to glucose level changes," Gu said.

That means fewer injections — and Gu continues to deliver great news for diabetics.

His recent work led to a drug delivery technique in which a "smart" sponge expands and contracts in response to blood sugar levels to release insulin as needed. This technique could also be used for targeted drug delivery to cancer cells.

The work has garnered national and international attention.

"I'm proud to be part of a creative and energetic team that's working to improve lives," Gu said. ▪



## Plugging in with the North Carolina Solar Center

The North Carolina Solar Center at NC State is championing the use of alternative transportation fuels, advanced vehicle technology and eco-friendly driving techniques in North Carolina.

The call-to-action begins with an explanation of hybrid cars, flex-fuel vehicles and biodiesel — terms that have become increasingly important as consumers focus on ways to protect the environment and their pockets.

Hybrid cars use two or more energy sources to stay on the road — an electric battery and gasoline, for example; flex-fuel cars run on gasoline mixed with up to 85 percent ethanol; and biodiesel is an alternative diesel fuel that can be made of either vegetable oil or animal fat.

Another option: plug-in vehicles — cars that can be charged via a household electrical outlet or a charging station.

"The cost of electricity used to charge a plug-in hybrid or all-electric vehicle is 75 percent less than the cost of normal gasoline," said Anne Tazewell, the Solar Center's Clean Transportation Program manager.

The state has nearly 700 plug-in vehicles, and there are more than 200 charging stations available across North Carolina. There are more than 10 charging stations on NC State's campus.

A movement in support of alternative driving methods is nothing new for the Solar Center, whose past initiatives include reducing truck idling emissions, hosting annual educational conferences about the benefits of cleaner air, and supporting the installation of E85 and B20 fueling stations in North Carolina's counties. E85 is a blend of 85 percent ethanol and 15 percent gasoline. B20 is a blend of 20 percent biodiesel and 80 percent petroleum diesel.

"Nineteen pounds of carbon dioxide is emitted for every gallon of gasoline you use," Tazewell said.

When ethanol and biodiesel are burned, however, the amount of carbon dioxide released is less than the amount of carbon dioxide captured when crops, such as corn and soy beans, are grown to produce the alternative fuel.

Educating the public about their options to lessen the impact on the environment is paired with similar teaching on ways to reduce the number of gas station stops. Eco-driving — techniques aimed at improving fuel economy — is a great start. Ensuring tires have proper air pressure and avoiding hard breaking are among some of the tips highlighted in the series of workshops offered by the Solar Center. Eco-driving can save drivers between 5 and 20 percent of fuel costs, according to Tazewell.

The Solar Center hopes its efforts to promote alternative driving and shine light on fuel options will show dividends. The Solar Center also offers grants to business owners and government entities across the state that want to provide charging stations and other technologies that can help reduce transportation-related emissions.

"North Carolina is a leader in advancing clean transportation options that promote energy diversity and enhance our environment and economy," Tazewell said. "We hope to see more incentives to increase these benefits to the state." ▪

## New and improved: www.engr.ncsu.edu

This summer, the College of Engineering's website underwent a transformation. Designed by NC State's Web Communications, the new website — www.engr.ncsu.edu — is more visually appealing and falls right in line with NC State's iconic brand. Thanks to responsive design, website visitors can now view content on multiple screen sizes and devices, including smartphones and tablets.

New additions to the home page include features about students, alumni and faculty, as well as a Twitter feed linked to @NCStateEngr. Main navigation is streamlined, topic-oriented and easy to navigate. We also have provided a pull-down menu and quick navigational links to Web pages specific to future and current students, alumni and friends, and faculty and staff.

And we're not finished.

The College of Engineering's website is a living document. Watch the website evolve with updates and new content. ▪


## Living and learning

NC State students have more space to live, work and play thanks to the new apartment complex on Centennial Campus and the latest living-and-learning village on main campus.

Wolf Ridge at Centennial, which opened in August after phase one of construction, provides housing to upper-class undergraduates and graduate students, regardless of their major. Located directly across from the state-of-the-art James B. Hunt Jr. Library, the new space meets the needs of a growing Centennial Campus where nearly two-thirds of the College of Engineering is located. Wolf Ridge offers on-site dining at On the Oval Culinary Creations, a fitness center, green spaces, efficient appliances and other amenities. Phase two of construction will be complete in Fall 2014.

The new Engineering Village, a living-and-learning space created specifically for first-year engineering and computer science students, offers students personal, professional and leadership development opportunities as well as ways to engage with the university. The Engineering Village is housed in Metcalf Hall on NC State's main campus. ▪

## Behind the fur, then and now: NC State engineers as Mr. Wuf

When NC State engineering student Cory Taylor signed up for his new job on campus, there was a unique requirement: complete silence.

That's because he's Mr. Wuf — NC State's enthusiastic mascot who is often joined by Ms. Wuf doing cartwheels, shaking hands with adoring fans and representing NC State at everything from private events to bowl games. No words necessary, only presence.

Dr. Julian Willoughby was in Taylor's shoes from 2004 to 2006, when he graduated with a bachelor's degree in chemical engineering. He later earned an MD and a master of public health degree from UNC-Chapel Hill. He's now a resident physician at Carolinas Healthcare System.

(Inset) From left: Dr. Julian Willoughby and Cory Taylor

### THE START

***Dr. Julian Willoughby:*** My interest in being Mr. Wuf was accidental. I lived across the hall from a current Mr. Wuf during my freshman year, and he suggested I check out the opportunity.

Tryouts were three days — Friday through Sunday. I put on the costume Friday night and quickly realized the suit was an excuse to show different sides of my personality.

***Cory Taylor:*** I was a mascot in high school — Mr. Patriot. My guidance counselor was a big NC State fan and noticed I impersonated Mr. Wuf pretty well. I tried out the last weeks of my senior year of high school and began at NC State Fall 2012.

### THE SUIT

***JW:*** Mr. Wuf's feet look fluffy and comfortable, but they don't have much stability. My feet always had calluses.

***CT:*** There's one word to describe the suit: hot. The only time I'm not burning up is when the crowd is freezing in the stands. The cold games are my favorite.

### THE TIME

***JW:*** Being Mr. Wuf was a fun obligation. The commitment was hard to manage, but the outlet kept me grounded and balanced. We were always in demand.

***CT:*** School is a priority, and it's incredibly challenging to balance. NC State provides study hours to help us stay on top of schoolwork. Between school, Mr. Wuf and my part-time job, my days stay full.

### THE CHALLENGE

***JW:*** It was tough managing the heat. I was also a bit worried about handling my rheumatoid arthritis and challenging my body as Mr. Wuf.

***CT:*** It's our job to keep the idea of Mr. Wuf alive; therefore, we can't talk. You think you're making sense through your movements, but it's more difficult to convey ideas.

### THE DEGREE

***JW:*** I was diagnosed at 9 years old with rheumatoid arthritis, a chronic inflammatory disorder that affects the small joints in your hands and feet. I was dealing with medical problems in the beginning of my sophomore year and switched from computer engineering to chemical engineering. I made the decision after learning the cool things happening with chemical engineering, including nanotechnology and its promise in the medical field.

The time management skills and discipline I used to complete my NC State engineering degree helped in medical school.

***CT:*** This past summer, I interned as an engineering assistant at the North Carolina Department of Transportation; I'm thinking of majoring in civil engineering. I get a great engineering education while receiving the chance to travel and watch NC State play other teams. I will carry the opportunity for the rest of my life.

### THE MEMORIES

***JW:*** I flew to Hollywood to film a commercial with Lee Corso of ESPN's *College GameDay*. It was an amazing experience.

***CT:*** I was Mr. Wuf during NC State's regional baseball game in June. The team later advanced to the university's first appearance at the College World Series since 1968. ▪

## Super heroes on display

Captain America's shield. Iron Man's powered exoskeleton. Spider-Man's web. Materials science is everywhere, including in the hands of classic comic book characters who've defied the odds with the help of out-of-this-world materials.

For NC State engineer Dr. Suveen Mathaudhu, adjunct professor of materials science and engineering, his goal is to share the comic book connection with the public through his latest venture — co-curator of a new exhibit at the ToonSeum in Pittsburgh. The exhibit, "COMIC-Tanium: The Super Materials of the Super Heroes," is scheduled to open at the end of the year.

Mathaudhu, an avid comic book reader and program manager in the materials science division of the US Army Research Office, garnered media attention with his article in *JOM*, a member journal for the Minerals, Metals and Materials Society (TMS). TMS sponsored the exhibit at the ToonSeum.

As co-curator, Mathaudhu wants onlookers to get an in-depth look at materials science and engineering through original comic art, movie props and educational displays.


JOM, Vol. 64, No. 1, 2012
DOI: 10.1007/s11837-012-0256-x



Figure 1. A wonder of materials science in the form of his indestructible shield defined the character of Captain America. (Image reprinted with permission: The Origin of Captain America, "The Hero That Was" Issue #109, Jan. 69 © TM Marvel and its subsidiaries. All Rights Reserved.)

Granted, in some circles, superhero comics are not considered high culture. For the millions who will be flocking to local movie theaters this summer to catch the big-screen adventures of the Avengers, Spider-man or Batman, they are simply entertaining stories told with bigger-than-life characters and special effects. On a more resonant level, however, these fantastic sagas have woven together a mythology for the modern age, tracing society's perception of and relationship with scientific advancement. Both brilliant and mighty, the heroes and villains of these tales echo ancient themes and struggles, told within the context of extreme scientific possibility.

It's also frequently the materials science involved that defines these characters and the parameters of their power. And, while some scientific descriptions might seem to push the boundaries of plausibility, Suveen N. Mathaudhu, program manager, Synthesis and Processing of Materials, U.S. Army Research Office, notes that advanced processing and characterization technologies, coupled with computational materials design tools and strategies, have closed the gap between comic fiction and science reality. "There really is very little reason that we should not be able to microstructurally engineer whatever materials we want for the future," he said.

As a case in point, Mathaudhu recently issued a request for white papers based on the theme of "the making of Captain America's shield." Captain America burst upon a frightened and war-torn world from the pages of his self-titled Marvel comic book in 1941, ready and eager to vanquish the Axis powers with superior strength and skills gained from an experimental "super soldier serum."

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"We eventually plan to have a traveling exhibit," Mathaudhu said. "We also hope to line up movie releases with the super heroes featured."

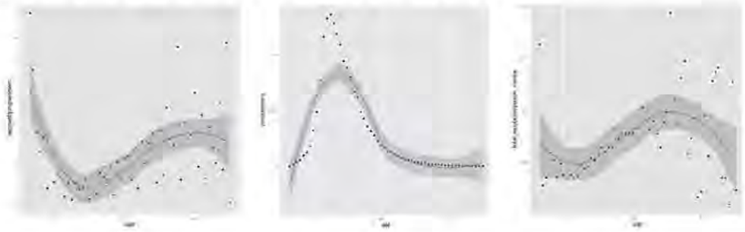
There are four intertwined aspects of materials science: processing, structure, properties and performance. Before new advances, understanding these aspects took decades — work didn't begin until after a new material was discovered.

But that's changing, and researchers can look to Iron Man's Tony Stark, who uses reverse engineering, as an example. Reverse engineering takes place when researchers create new materials by defining performance characteristics first, searching for the proper atomic structure next and finally synthesizing a new material. In other words, think of a material, then figure out how to make a new element.

Mathaudhu hopes the mix of science and comics invites many to attend.

"Schools can even plan field trips to see the exhibit," Mathaudhu said. "Science and comics appeal to all ages." ▪

## Older is wiser: Study shows software developers' skills improve over time



A new study from NC State indicates that the knowledge and skills of programmers actually improve over time — and that older programmers know as much (or more) than their younger peers when it comes to recent software platforms.

"We wanted to explore these perceptions of veteran programmers as being out of step with emerging technologies and see if we could determine whether older programmers are actually keeping up with changes in the field," said Dr. Emerson Murphy-Hill, assistant professor of computer science at NC State and co-author of a paper on the research.

Researchers studied profiles of more than 80,000 programmers on a site called StackOverflow, an online community that allows users to ask and answer programming questions. For the first part, researchers compared the age of users with their reputation scores (a high reputation score likely indicates a robust understanding of programming issues). They found that an individual's reputation score increases with age, at least into the user's 40s.

Researchers then studied the number of different subjects users discussed, which reflects the breadth of user programming interests. Researchers found there is a sharp decline in the number of subjects users weighed in on between the ages of 15 and 30 — but that the range of subjects increased steadily through the programmers' 30s and into their early 50s.

Finally, researchers evaluated the knowledge of programmers 37 and older compared to programmers younger than 37 regarding technologies less than 10 years old. For two smartphone operating systems, iOS and Windows Phone 7, veteran programmers had a significant edge in knowledge over younger programmers. For other technologies, there was no statistically significant difference between older and younger programmers.

"The data doesn't support the bias against older programmers — if anything, just the opposite," Murphy-Hill said. ▪

## Bitzer inducted into National Inventors Hall of Fame

NC State computer scientist Dr. Donald L. Bitzer, who helped develop the technology behind plasma-screen televisions, has been inducted into the National Inventors Hall of Fame. Bitzer is Distinguished University Research Professor of Computer Science at NC State.

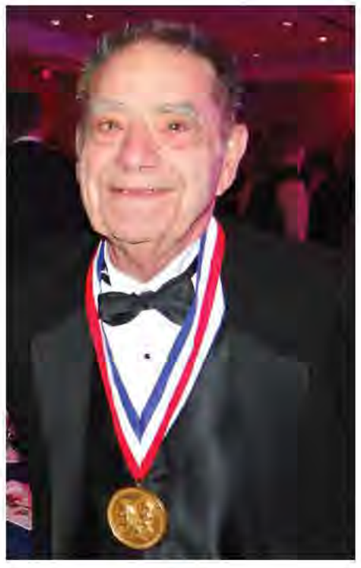
The Hall of Fame, which was founded in 1973, honors inventors whose innovations and entrepreneurial endeavors have changed the world. Its membership includes inventors such as Thomas Edison, Wilbur and Orville Wright, Alexander Graham Bell and Steve Jobs.

Bitzer co-invented the flat plasma display panel in 1964, intending the technology to be an educational aid allowing students to work in front of computers for longer periods of time, since plasma screens do not flicker. The technology was eventually applied to television screens, and millions of plasma TVs have been sold to the public since their introduction in the 1990s.

Bitzer is also known as the "Father of PLATO," or Programmed Logic for Automatic Teaching Operations, the first computer system to combine graphics and touch-screen displays. His work on the technology began around 1960; descendant systems still operate today.

In 2002, Bitzer received an Emmy Award from the National Academy of Television Arts and Sciences for his work advancing television technology. He has been a member of the National Academy of Engineering since 1974.

He joined the faculty at NC State in 1989. ▪



## Introducing Dr. Frances Ligler

Dr. Frances Ligler is new to the College of Engineering at NC State, but she's far from being a novice. A pioneer in the fields of biosensors and microfluidics, Ligler's seminal concepts in biosensing and transfer to industrial products, including the development of detection systems for biological agents, led to being elected to the National Academy of Engineering in 2005. She was recognized with the Presidential Rank Awards of Distinguished Senior Professional and of Meritorious Senior Professional in 2003 and 2012, respectively.

Recently, Ligler was named the inaugural Lampe Distinguished Professor of Biomedical Engineering at NC State — home to the National Science Foundation ASSIST Engineering Research Center and bioengineering initiatives in multiple departments. She brings 28 years of experience gained at the US Naval Research Laboratory in Washington, DC, as Senior Scientist for Biosensors and Biomaterials. Ligler holds patents that have led to 11 commercial biosensor products — devices that use biological materials to monitor the presence of chemicals in a substance.

Currently Ligler is working to rebuild an organ system in three dimensions to learn more about how the component cells develop and function.

Her research —body-on-chip applications in microfluidic systems — fits well with the tissue regeneration work happening at NC State. The colleges of Engineering, Textiles and Veterinary Medicine, as well the university's Joint Biomedical Engineering Department with UNC-Chapel Hill's School of Medicine, are working in the innovative field. Researchers in the Edward P. Fitts Department of Industrial and Systems Engineering are also involved.

The well-established interdepartmental relationships were selling points for Ligler, who envisions expanding the collaboration across the colleges.

"Work with biosensors and biomaterials is very interdisciplinary," Ligler said. "Anyone has the potential to jump between fields — from chemistry to engineering — and have ideas to create high-impact products."

Ligler hopes to work with a team of faculty and students during the lab-to-market process. As biosensors become smaller and more user-friendly, she would like to see the devices created more efficiently and at lower costs. The combination of biomaterials and nanotechnology will open new opportunities for tissue regeneration and analytical methods.

"I've seen incredible inventions by undergraduates in the bioengineering area," Ligler said. "I'm at the give-back stage of my career, and I'm excited to help others grow."

Ligler holds a D. Phil. in biochemistry and a higher doctorate, the D.Sc., for her contributions to the field of biosensors, all from Oxford University. ▪

## College rises in world rankings

A newly released ranking places NC State's College of Engineering 27th in the world, a two-spot jump from last year's position.

The Shanghai ranking, more formally known as the Academic Ranking of World Universities, serves as a prestigious international scorecard of universities. Unlike the better known ranking of "Best Colleges" marketed by *U.S. News & World Report*, the Shanghai ranking does not include subjective measures of an institution's reputation. Instead, the metrics include the number of highly cited researchers and the number of articles published in the journals *Nature* and *Science*, among other indicators.

The Center for World-Class Universities at Shanghai Jiao Tong University has published a list of the world's top 500 universities since 2003. In recent years, the Center has identified the top 200 universities in specific fields, such as engineering, social sciences, economics and business, and medicine.

NC State is up from previous years. The College of Engineering was ranked 32nd in 2010, 30th in 2011 and 29th last year. Overall, NC State ranks among the top 200 world universities for 2013; the university debuted on the list in 2003 at No. 99. ▪






## That makes 13

NC State is now home to 13 National Academy of Engineering (NAE) members, adding two members to its faculty in 2013.

Dr. Frances Ligler, who has been an NAE member since 2005, recently joined the faculty as the Lampe Distinguished Professor of Biomedical Engineering. Dr. Carl Koch, whose induction was announced in February, is Kobe Steel Distinguished Professor in the Department of Materials Science and Engineering.

Election to the NAE is considered one of the highest professional distinctions in the field of engineering. ▪

## Martin-Vega named chair of ASEE Engineering Deans Council Executive Board

Dr. Louis A. Martin-Vega, dean of the College of Engineering, has been elected chair of the American Society for Engineering Education (ASEE) Engineering Deans Council Executive Board for the 2013-15 term. He is also serving as the Council's Public Policy Committee chair.

The Engineering Deans Council is the leadership organization of the nation's deans of engineering, and its members represent more than 90 percent of all US engineering deans. The Council's objectives include advocating and providing a vision for engineering education and research; serving as a resource to its constituents and the public at large; and articulating and influencing US public policy on engineering education and research.

Martin-Vega has been dean of engineering at NC State since 2006. ▪




## Four researchers receive NSF CAREER Awards

The College of Engineering can add four more faculty to its list of National Science Foundation (NSF) CAREER Award winners. The award, which has been granted to 58 of the College's faculty since 2000, is among the highest given by NSF to young faculty in science and engineering. Congratulations to this year's recipients.

Dr. William Enck, assistant professor of computer science, aims to improve the security of modern consumer operating systems, such as Android, iOS and Windows 8, by developing a holistic view of data.

Dr. Fanxing Li, assistant professor of chemical and biomolecular engineering, is developing more effective redox catalysts for tar removal in biomass gasification, a process that converts biological material, or biomass, into synthesis gas, electricity or liquid fuels.

Dr. Emerson Murphy-Hill, assistant professor of computer science, aims to increase the frequency and effectiveness of social tool learning — the sharing of tools such as memory debuggers and performance analyzers between software developers — so developers are more aware of these helpful programs and applications.

Dr. Gregory Reeves, assistant professor of chemical and biomolecular engineering, will study how genetic expression in fruit flies remains robust despite "noise," or random variability, and feedback interactions with other signaling pathways. ▪

## Kuznetsov receives Humboldt Research Award

Dr. Andrey V. Kuznetsov, a professor in the Department of Mechanical and Aerospace Engineering, has received the Humboldt Research Award from the Alexander von Humboldt Foundation in Germany for his research on transport in various thermofluid and biological systems.

As an award recipient, Kuznetsov will continue his research at the Institute of Thermo-Fluid Dynamics in the Hamburg University of Technology. His work includes modeling transport of micron-sized vesicles propelled by molecular motors inside neural cells. ▪

# Success Beyond the HEADLINES

NC State engineering alumni boost North Carolina's economy, one start-up at a time.

When you write the story of how the College of Engineering makes entrepreneurship and job creation happen, Cree often gets the headlines. After all, the successful LED lighting company based in Durham, NC, was co-founded by NC State engineering alumni.

Cree is just one example, though. The work being done by NC State engineers is making an impact across North Carolina, and it's creating jobs for the state's residents.

Here are just a few NC State engineers who are making a difference for North Carolina's economy.

## *Sepideh* Asefnia

President and Founder
**SEPI Engineering & Construction**
Charlotte, Raleigh and Wilmington, NC

In May 2001, Sepideh (Sepi) Asefnia became the new owner of an executive office chair, a typewriter and a credenza — recently auctioned furniture that would soon fill a bonus room in her Raleigh home.

Next, she began a five-month stint working from home on the beginnings of SEPI Engineering & Construction, known today as a full-service civil engineering, surveying, planning and construction management firm. The planning came nearly a decade after Asefnia received her bachelor's degree in civil engineering in 1993; she received a bachelor's degree in agricultural engineering in 1985.

Today, 12 years after hiring her first two employees in Raleigh, Asefnia leads nearly 150 employees at North Carolina offices in Charlotte, Wilmington and Raleigh, where the company is headquartered.

Diversifying sector clients has helped the company flourish. From transportation engineering to land development to disaster relief and environmental planning and permitting, Asefnia's NC State engineering degree prepared her to explore and succeed in a variety of sectors.

"The fundamental strength of NC State's engineering program was phenomenal," Asefnia said. "It's always rewarding to meet fellow alumni in my field as I research new business options."

A 2006 North Carolina Small Business Person of the Year, Asefnia leads a company that has been named to *The Zweig Letter*'s 2013 "Hot Firm" list and the *Triangle Business Journal*'s "Fast 50" list. The firm recently received the *Triangle Business Journal*'s Leader in Diversity Award.


## *Edward P.* Fitts

Founder and Former Chairman and CEO
**Dopaco, Inc.**

Kinston, NC, welcomed a new establishment in 1993. NC State industrial engineering alumnus Ed Fitts signed the lease.

New to the neighborhood was Pennsylvania-based Dopaco, Inc., a paperboard packaging company that Fitts founded in 1979 after leading a management team that purchased the company from Sonoco Products Company. Fitts, a 1961 graduate, began at Sonoco as a junior engineer and eventually became vice president of paperboard packaging; he was with Sonoco for 18 years.

Kinston was a great location for Fitts, who served as chairman and CEO of the company until 2007. The eastern North Carolina town was close to Interstate 95, adding convenience for transporting the company's products.

The company had also been given 25 acres in an industrial park in Kinston.

"We found a home in Kinston," said Fitts, a 2001 Distinguished Engineering Alumnus. "We employed great people and generated revenue for the community."

The Kinston location employed hundreds of North Carolinians under Fitts and produced the environmentally friendly packages that fast-food chains like McDonald's use today. During Fitts' 27-year tenure, Dopaco's employment grew from 115 employees to more than 1,500 employees across nine plants. In 2011, the company was acquired by Pactiv.

"My NC State engineering degree was the cornerstone of my whole career," Fitts said. "I wouldn't trade my degree with any university in the country."

In 2005, Fitts made a generous endowment gift to establish the Edward P. Fitts Department of Industrial and Systems Engineering — the first named academic department at NC State.

# Herb McKim Jr. & Dr. Michael Creed

Herb McKim Jr., President and COO (not pictured)
Dr. Michael Creed, Chairman and CEO (shown above, center)
**McKim & Creed**
Florida, Georgia, Michigan, North Carolina, Texas and Virginia

Though McKim & Creed has its headquarters on NC State's Centennial Campus, the number of company trucks traveling North Carolina highways illustrates the company's statewide influence in engineering, surveying and mapping.

Founded in Wilmington, NC, in 1978 by NC State alumni, McKim & Creed has been involved in numerous projects across the state, including the North Carolina Veterans Park — the first state park dedicated to veterans from all branches of the armed services.

Co-founders Herb McKim Jr. and Dr. Michael Creed received bachelor's degrees in civil engineering in 1973 and master's degrees in 1975 and 1984, respectively.

In 2008, the company headquarters moved to Raleigh, just as the recession started. To stay one step ahead, the duo explored new markets, such as energy, and took advantage of technology advancements like LiDAR — a remote sensing technology. Today, about half of McKim & Creed's 400 employees are in North Carolina.

"I have a great sense of pride that we relocated our corporate headquarters to NC State's Centennial Campus," Creed said. "This campus, like the new James B. Hunt Jr. Library, is an excellent example of the forward thinking that epitomizes NC State's College of Engineering. I am proud of the association I've had with the university for the last 40 years."

# Barbara Mulkey

Founder and Chair of the Board of Directors
**Mulkey Engineers & Consultants**
Columbus and Roswell, Ga.; Charlotte and Raleigh, NC; and Newberry, SC

A signature street in Raleigh needed a facelift. NC State's Main Campus Drive needed to accommodate a growing Centennial Campus, and the streets near the NASCAR Hall of Fame needed to handle increased traffic.

Civil engineering alumna Barbara Mulkey knew the right team for the job — Mulkey Engineers & Consultants — the engineering and consulting firm she founded in 1993. The company has since worked on an impressive list of projects, including the Green Square Complex, home to the Nature Research Center and the headquarters for the NC Department of Environment and Natural Resources.

Headquartered in Raleigh with locations in two other states, the majority of the firm's 130 employees are in North Carolina.

"We have NC State's Centennial Campus and Research Triangle Park minutes from our headquarters," Mulkey said. "What that says is that businesses in North Carolina will always be rubbing shoulders with the latest innovations and ideas that will shape our future."

A Distinguished Engineering Alumna, Mulkey received bachelor's and master's degrees in civil engineering in 1977 and 1984, respectively. She also serves on the university's Board of Trustees.

"The College of Engineering provided me with the beginnings of my business and a network that exists to this day," Mulkey said. "Many of my colleagues and clients are former NC State students or professors."

# Steve and Raymond von Drehle

President and Chairman, respectively
**von Drehle Corporation**
Natchez, Miss.; Hickory, Cordova and Maiden, NC; Las Vegas, Nev.; and Memphis, Tenn.

Steve von Drehle (left) joined his father's company in 1983 as the fifth employee — four were family members, including his older brother Raymond.

Today, the brothers run von Drehle Corporation — a world-class toilet paper and towel dispenser manufacturing company that's been around since 1974. Headquartered in Hickory, NC, von Drehle products can be found in thousands of locations, including the Pentagon.

Von Drehle began by selling paper and packaging products to janitorial supply houses. Steve and Raymond, who graduated from NC State with furniture manufacturing and management degrees in 1981 and 1976, respectively, decided to focus the company's efforts on manufacturing.

"A critical skill I learned at NC State was the ability to analyze a project from a financial standpoint," von Drehle said. "I also learned human resources policies, enabling me to develop our most important asset — our people."

The company owns converting facilities in three states. They also have a mill in Cordova, NC, and a new mill will soon open in Mississippi. Approximately 225 of the company's employees work in NC.

"Hickory is home, and the work environment in North Carolina is good," von Drehle said. "The quality of people we can hire is strong."

# Scot Wingo

CEO, Chairman of the Board, and Co-founder
**ChannelAdvisor**
Research Triangle Park, NC; New York, NY; and Seattle, Wash.
International: Richmond Victoria, Australia; Berlin, Germany; Limerick, Ireland; and London, United Kingdom

Scot Wingo came to NC State to earn a master's degree in computer engineering. He graduated in 1992, inspired by Engineering Entrepreneurs Program founder Dr. Thomas Miller to think about computer engineering in a different way.

Since then, the 2008 Distinguished Engineering Alumnus has helped change the face of online shopping as co-founder and CEO of ChannelAdvisor. The company, founded in 2001, is a leading provider of cloud-based e-commerce solutions, giving retailers the best technology and strategic services to advertise and sell their products across online channels such as Amazon and Google.

With more than 2,000 clients around the world and offices as far away as Australia, the location of the company's headquarters in the Research Triangle Park area often surprises people.

"North Carolina is a great place to be in business," Wingo said. "The local universities provide access to the best minds, and the Raleigh-Durham area is ideal for recruiting and retaining top talent."

ChannelAdvisor has roughly 480 employees worldwide; about 300 are located in the RTP area. Recently named one of the best places to work by the *Triangle Business Journal* for the third consecutive year, the company has created hundreds of jobs over the last decade.

"NC State's graduate program has made a significant impact on my career because I had the opportunity to collaborate with other engineers and develop my interpersonal skills," Wingo said. "Dr. Miller was the first person to encourage me to think about the business side of things, something that has been instrumental to my entrepreneurial accomplishments." ▪

### ENGINEERING BUILDING II

**Opened:** 2005

**What's inside:** Computer Science, Electrical and Computer Engineering

**Fun fact:** Emmy award winner and National Inventors Hall of Fame inductee Dr. Donald Bitzer, co-inventor of the flat plasma display panel, has an office here.

### ENGINEERING BUILDING III

**Opened:** 2010

**What's inside:** Biomedical Engineering, CASL, Mechanical and Aerospace Engineering and the Rehabilitation Engineering Laboratory

**Fun fact:** The facility has the first "green" roof on Centennial Campus.

### WOLF RIDGE AT CENTENNIAL

**Opened:** 2013

**What's inside:** Apartment living for upper-class and graduate students.

**Fun fact:** Wolf Ridge is the first student housing built on Centennial Campus.

### BIOMANUFACTURING TRAINING AND EDUCATION CENTER

**Opened:** 2007

**What's Inside:** More than $12.5 million of industry-standard equipment

**Fun Fact:** The 82,500-gross-square-foot center, the largest of its kind in the US and the world, features a simulated cGMP pilot plant facility where skilled professionals train for the biomanufacturing industry.

### JAMES B. HUNT JR. LIBRARY

**Opened:** 2013

**What's inside:** 100 group study rooms and technology-equipped spaces, including the Game Lab, which features a 21-foot-wide, high- definition video wall

**Fun fact:** Visitors love the robot-driven bookBot automated book delivery system that holds up to 2 million volumes.

### KEYSTONE SCIENCE CENTER

**Opened:** 2010

**What's inside:** 72,000 sq.ft. Class "A" laboratory and office building suitable for both wet and electric lab users

**Fun fact:** The center is home to the NSF FREEDM Systems Center, one of two NSF Engineering Research Centers on Centennial Campus.

### ENGINEERING BUILDING I

**Opened:** 2004

**What's inside:** Chemical and Biomolecular Engineering, Materials Science and Engineering

**Fun fact:** EB I is a very big home for very small structures — researchers create nanodots, develop nanofibers, and find new ways to use nanotechnology.

# CENTENNIAL CAMPUS *today*

Since land was first allocated for a new campus in 1984, the dream of a "technopolis" that brings together academics, research, government and industry has been realized in NC State's Centennial Campus. Today, Centennial is home to more than two-thirds of the College of Engineering and is nationally recognized as a model for the 21st century. Centennial's newest additions – Wolf Ridge at Centennial student apartments and the world-class James B. Hunt Jr. Library – give students a place to live, study and play.

### MONTEITH ENGINEERING RESEARCH CENTER

**Opened:** 1996

**What's inside:** The NSF ASSIST Center and state-of-the-art laboratories

**Fun fact:** Renamed in 2005 to honor Dr. Larry K. Monteith, chancellor emeritus and former dean of engineering at NC State, MRC houses the FEI Titan electron microscope, which can enlarge images to more than 15 million times their actual size.

### CONSTRUCTED FACILITIES LABORATORY

**Opened:** 1996

**What's inside:** 20,000 sq.ft. research complex with student and faculty offices, state-of-the-art laboratories, and equipment

**Fun fact:** Contains some of the largest testing equipment in the nation. Distinguished for its capacity to test large to full-scale structural systems under a wide variety of environmental conditions.

# *Maybe* YOU CAN *have it all*

An NC State engineer has linked marketing and engineering in ways that could transform manufacturing and design. The result: better products for all of us.

The people who designed your car didn't work for GM, Ford or Toyota.

Sure, a giant automobile company employing thousands of people that came up with the drawings built the engine, installed the stereo and applied the paint. But before all that happened, those companies contacted real people. Through surveys of thousands of potential consumers, companies gather preferences for seat fabrics (cloth or leather?), wheels (steel, alloy or chrome?) and a host of other customizable features. The results inform the design.

But putting all that data to use is time-consuming and expensive. Dr. Scott Ferguson has improved that process by creating better starting points for all that data-crunching. His approach is already influencing product design at one of the world's largest automakers.

"We're taking advances in marketing and advances in engineering optimization and mashing them together," said Ferguson, an assistant professor of mechanical and aerospace engineering.

Ferguson's work, which is supported by General Motors and the National Science Foundation, seeks to integrate the work of marketers and engineers. With the help of several graduate students in NC State's System Design Optimization Laboratory, he is translating marketing data into engineering knowledge that can guide the design and manufacturing processes for many of the products we use every day.

## The old way

Understanding Ferguson's process involves understanding the roles of the engineers and the marketers. The engineering side of a company focuses on minimizing structural stress, maximizing efficiency and other design-related issues. For a carmaker, that point of view informs the selection of materials, physical dimensions such as wheelbase or overall width, or the height of the seat cushions.

These technical details are important, but customers aren't necessarily aware of them when they're kicking the tires in a showroom.

"When you talk to people about a car, no one cares how long or wide it is," Ferguson said. "They want to know about fuel economy. They want to know, 'Can I get the stroller in the trunk?'"

Car manufacturers aim to answer these questions in ways consumers like, not only to improve customer satisfaction but also to improve market share and (ideally) make the company more profitable.

But not all consumers like the same things. To gauge their numerous and diverse preferences, companies use market researchers to prepare consumer surveys. By asking potential customers dozens of questions about what they like and what they don't like, companies accumulate a wealth of data that helps them design and build their products.

All that information, coupled with recent advances in computing power for processing it, have the potential to reveal new insights into how consumers think and what they want.

But getting to those insights can take awhile. Translating marketing survey responses into actual product lines has traditionally meant feeding the computer huge volumes of product feature combinations. This heavyweight modeling uses algorithms that are enormously complex and computationally expensive.

If a product line has 60 available features — and there are no restrictions on possible combinations — it has more than one million trillion possible feature combinations. That's 1,000,000,000,000,000,000.

"There's been lots of work in marketing on developing models, but not as much on product optimization. They don't usually focus on the complexity associated with searching for solutions," Ferguson said. "That's the bridge we're trying to build."

Companies could start by running random combinations of features through their computers to see how closely they matched up with the consumer preference data, but that practice can produce ridiculous designs — a two-door coupe with monster-truck-sized tires, for example — that no one would ever want to buy. The computers can improve on these designs by running longer — but in highly competitive industries, where working efficiently helps beat the competition, the amount of time that the computers can be allowed to run is limited.

"Using conventional methods, these simulations can take weeks to run, but we can do them over the weekend," Ferguson said. "Our solutions were better, too."

## A better way to search

But what if there was a better starting point? Ferguson's team developed a search process that, in effect, starts the product-design race closer to the finish line.

In one study conducted by Ferguson's team, a group of consumers were asked to choose their favorite from a set of several vehicles with different interior features. Feature preferences were estimated from everyone's responses. The team created a product optimizer that used an algorithm to wade through a number of products at multiple price points to find good starting points.

The results were products that more closely aligned with what people actually want in almost every measurable way. The products, Ferguson's team found, were potentially more profitable for the company and would produce bigger market shares.

And his results were produced in days, not weeks, and at much less expense.

"Consumers have to like something before they want to buy it," Ferguson said. "But until now, we haven't had a way to capture what each customer actually liked about the product."

GM liked what they saw. Ferguson's ideas have been adopted into their feature packaging process.

## "Almost" what you want

Now Ferguson is going further. He's working on a way to help companies give consumers customized variety in their products — a potentially expensive undertaking — in a way that helps the company's bottom line.

The work involves finding the sweet spot between the consumer's exact preferences and what they're willing to settle for, a gulf called the "sacrifice gap." Someone buying a car, for example, may be dead set on a convertible with all the luxury options, but when it comes time to buy, she'll settle for a coupe with a sunroof. The work involves thinking about "customization" a little differently than many consumers are used to hearing.

Dr. Scott Ferguson and PhD student Garrett Foster discuss results obtained from their latest simulation.

"Custom-designed" is thrown around quite a bit in company advertisements, but these engineers take a different view.

"It's really just personalization," said Alex Belt, a graduate student in the lab. "From an engineering standpoint, slapping a new color on a product doesn't make much difference. What's more interesting is to change how that product works."

Ferguson's group is trying to understand how companies can take advantage of that sacrifice gap to guide their product design decisions. By finding ways to design products that give consumers just enough to prompt a purchase, companies can satisfy customers without offering so many features and design choices that it hurts their profits.

Ferguson's work in this area is funded by an NSF CAREER Award, one of the top honors young faculty in science and engineering can receive.

So, given all this work into how companies and consumers think, has Ferguson the shopper learned from Ferguson the researcher?

A little, he said.

"I'd like to think it's made me a more informed consumer," Ferguson said. "By doing this work, you start to understand why some decisions were made." ▪

# YEAR ONE

## NSF ASSIST CENTER

With the addition of ASSIST, the College became the only engineering school in the nation leading two prestigious NSF Engineering Research Centers.

Dr. Veena Misra (left), the ASSIST Center's director, and Dr. John Muth, the deputy director, discuss the center's research.

The National Science Foundation established the Nanosystems Engineering Research Center for Advanced Self-Powered Systems of Integrated Sensors and Technologies (ASSIST) in Fall 2012 with NC State's College of Engineering as the lead institution. That award made the College the only engineering college in the nation to lead two prestigious NSF Engineering Research Centers. This summer, ASSIST Center held its first post-award site visit, providing an overview of the research conducted during the center's first year.

ASSIST's primary goal is to develop and employ nano-enabled energy harvesting, energy storage, nanodevices and sensors to create innovative battery-free, body-powered and wearable health monitoring systems. Essentially, center researchers have come together to use nanotechnology to improve global health by monitoring an individual's environmental and health information, allowing doctors to correlate patients' health with environmental stimuli. If successful, the technologies developed by ASSIST would revolutionize health monitoring and delivery, improving personal health on a global scale.

Center research is divided into five thrust areas: Energy Harvesting and Storage, Low-Power Nanoelectronics, Wearable Nanosensors, Integrated Sensor Node Design and Prototyping, and Systems Testbeds. ASSIST Center work is conducted by researchers at NC State and partner institutions across the US and the world. Partners include Florida International University, Pennsylvania State University and the University of Virginia. Critical research is also being carried out at UNC-Chapel Hill and at University of Michigan. ASSIST has global partnerships established with the University of Adelaide (Australia) and Korean Advanced Institute of Science and Tokyo Institute of Technology.

New advances in energy harvesting and storage include developments in thermoelectrics, using heat from the body to develop power. Researchers have developed novel methods for producing flexible and wearable thermoelectrics along with nano-enabled heat sinks to maximize the power available from the human body. The team has also been able to demonstrate a substantial increase in the amount of power harvested from piezoelectric systems. These developments are important for powering the sensors and wireless transfer of information from the devices. In the area of computation and communication, the ASSIST team has demonstrated ultra-low-power devices, chips and radios with high functionality.

Center researchers are working to develop low-power wearable sensor technologies that have bioelectric and biochemical skin interfaces with multifunctional capabilities and very low impact on the skin. Advancements have been made in three-dimensional structures made out of liquid metal and liquid metal wires. These developments will help ASSIST create the wiring for flexible, wearable devices.

The ASSIST Center is headquartered in the Monteith Research Center on NC State's Centennial Campus. In addition to the initial five-year, $18.5-million grant from NSF, funding comes from ASSIST Center member companies that participate in research and provide a platform for moving research developments from the laboratory to commercial applications. ▪

ASSIST.NCSU.EDU



# YEAR FIVE

## NSF FREEDM SYSTEMS CENTER

FREEDM's "smart transformers" were among MIT *Technology Review*'s 2011 list of the world's 10 most important emerging technologies.

For more than a century, electric utilities have generated and distributed power to customers over long distances through an aging power grid — but only in one direction. In 2008, a new National Science Foundation (NSF) Engineering Research Center on NC State's Centennial Campus began work to upgrade the "grid" and enable bi-directional power flow.

The Future Renewable Electric Energy Delivery and Management Systems Center (FREEDM) is led by NC State and headquartered in the Keystone Science Center. Faculty, students and other collaborators from seven partner education institutions around the world are represented. Formed with an initial five-year, $18.5-million grant from NSF, the center aims to develop technology to revolutionize the nation's power grid and speed renewable electric-energy technologies into every home and business.

The FREEDM Center draws upon vast expertise at NC State, including, from left: Seth Crossno, industry liaison; Rogelio Sullivan, managing director; Dr. Alex Huang, center director; and Dr. Ewan Pritchard, associate director.

In June, FREEDM conducted its fifth annual site visit for NSF. Visitors observed demonstrations of center-developed technology, ranging from direct current (DC) power distribution — on display in a mock home located in the laboratory — to a wind-turbine emulator that replicates the generation of wind energy onto the 1-MegaWatt micro-grid that powers FREEDM's headquarters.

Visitors also received updates on the center's broad, hands-on education activities that have consistently been ranked highly during site visits. The education programs have grown in scope, and in 2011, a $3.4 million grant from the US Department of Energy launched NC State's Professional Science Master's Degree Program in Electric Power Systems Engineering. The program is the first of its kind in the nation. Educating a diverse group of students is among the center's top priorities.

"NSF was impressed with NC State's progress," said Rogelio Sullivan, FREEDM's managing director.

FREEDM researchers shared accomplishments and in-progress technology commercialization activities, including the Generation II solid-state transformer (SST) —"smart transformer" — a fourth of the size of the Generation I version that was named to MIT *Technology Review*'s 2011 list of the world's 10 most important emerging technologies. The communication and power management capabilities of the SST enable functions not available in traditional distribution transformers.

Since 2008, FREEDM has led dozens of projects to improve energy storage systems, integrate renewable generation more effectively and explore DC power distribution. Researchers also created an ultra-fast fault detection, isolation and restoration system.

The work couldn't be accomplished without industry support. The center's 51 industry members, ranging from Duke Energy to Ford Motor Company, offer internships to students, donate scientific equipment, provide a pathway for technology commercialization and help to guide the research.

FREEDM researchers are already planning for sustainability beyond NSF's 10-year funding. They are also looking for additional research and development opportunities that will complement the center's core program.

"Creating engineering innovations in energy and electric power will remain key to ensuring economic growth, a healthy environment and a robust and adaptable electric infrastructure," Sullivan said. "NC State is a recognized leader in these fields." ▪

FREEDM.NCSU.EDU

# WORLD -TRAVELERS, WORLD -CHANGERS

Each year, NC State engineers come face-to-face with the dynamic global marketplace through international opportunities and programs offered by the university.

NC State engineers are crossing international borders to get a first-hand look at how using their skills abroad can save lives, enforce standards and improve efficiency. From study and research opportunities to service-related work and internships, NC State engineers can show stamp-filled passports and gain perspective on engineering outside the classroom. The result: a world-changing engineer, technically equipped and culturally aware.

From one-month stays to semesters abroad, hear from some of our globally minded engineers.




## Sean Echevarria

**DESTINATIONS:** Shanghai, Hangzhou and Beijing, China
**MAJOR:** Mechanical Engineering with a Business Administration minor
**DURATION:** May 13 – June 19, 2013

Sean Echevarria had one final assignment before he could claim his alumnus status: a study abroad trip to China to complete the last requirements of his business administration minor.

Echevarria participated in an accelerated program offered through NC State's Poole College of Management. Instead of a traditional 17-week program, students are able to complete the nine credit hours in one month.

The team followed a jam-packed schedule, taking classes at Shanghai University Monday through Saturday, from 8 am to noon, with the exception of two free weekends. The students traveled to Hangzhou and Beijing and visited attractions such as the Great Wall of China, one of the Seven Wonders of the World. Another component of the program included visiting corporate entities in China to observe business practices and automation techniques.

"Although I finished my business administration minor during this study abroad experience, I felt like I was also part of an engineering corporate visit," Echevarria said.

He and his classmates toured the facilities of SF Express, an international logistics firm similar to UPS in the United States, and Shanghai International Port, the world's busiest port, boasting a lot size of 1.55 million square meters.

Echevarria took as many notes as he could, since he had been busy with his own business deal before arriving to China. He and his teammates from the Engineering Entrepreneurs Program had recently filed for a patent for their first product — Jar~with~a~Twist — which is aimed at creating an easy-to-open jar to address the common problem that occurs when peanut butter and similar condiments get stuck at the bottom of the container. The team's product is now officially pending a patent, and the company is looking to expand.

Echevarria's top international business tip is respect the culture, first and foremost.

## Jessica Rose

**DESTINATION:** Czech Republic
**MAJOR:** Industrial Engineering with an International Studies minor
**DURATION:** May 17 – June 30, 2013

The Czech term "Ano" means "Yes."

But for a traveler whose first language is English, the common saying, "Uh, no" sounds similar.

Industrial engineer Jessica Rose knows the possible consequences of miscommunication in her field — the difference between the production of a surplus or a shortage. Rose wants to be prepared to address these kinds of challenges, ultimately saving time and money for her clients.

"The market today is such a global one," Rose said. "I think it's very useful to interact with people from different cultures and understand the differences and similarities."

Rose loves to travel and has taken advantage of many international opportunities offered by NC State, including a trip to Guatemala as part of Alternative Service Break. Next up was the Czech Republic, home to the Prague Institute.

A registered entity in the Republic, the Prague Institute is an official branch of NC State and the first overseas facility of the UNC system. Here, Rose took global systems engineering and operations management as well as a course on world population and food prospects.

Rose and her classmates toured the original Budweiser factory and the Skoda Car Plant, which is known for its ultra-clean and super-efficient appeal. The plant has been called one of the most modern car factories in the world.

"Eighty percent of the work there was automated," Rose said. "The factory had a lot of robots doing the work and fewer people working on the assembly line."

Outside the classroom, Rose learned to balance school responsibilities with the unique opportunity to live in the Czech Republic for a little more than a month. She traveled every weekend.

"Let's sit down and focus on our homework first," Rose said. "Then, we can go exploring later. That was our motivation."

## Senior Design, Biomedical Engineering Team

**DESTINATION:** Ethiopia
**MAJOR:** Biomedical Engineering
**DURATION:** May 13 – June 19, 2013

Look around. Immerse yourself in a clinical setting. Identify at least 30 medical problems that need solving.

The challenge presented to Andrew Miller and his biomedical engineering senior design team helped identify a common problem plaguing many hospitals in developing nations: a lack of oxygen supply equipment. Soon, the team would address the issue face-to-face in the second most populated country in Africa — Ethiopia.

"We began our journey with one goal in mind: to change lives," Miller said.

The team planned out a portable, affordable oxygen delivery system. Their larger goal was to boost available oxygen supplies for hospitals in developing countries by 40 percent.

The project was developed under standards that mimic the Food and Drug Administration's quality guidelines under which students will work when they enter industry or graduate school.

When they arrived at a local hospital in Addis Ababa, Ethiopia, doctors explained that oxygen equipment was in such short supply that they had to turn away many patients. To combat this problem, Miller's team applied the principles of pressure swing adsorption concentrator technology, a technique that removes nitrogen from the air to concentrate oxygen levels.

Their project taught them an important lesson: Designing equipment for a global market is completely different than creating products for domestic consumers, Miller said. Great designs must account for not only the technical challenges but also incorporate social, economic and cultural influences. The experience offered the opportunity to gain insight into the country's culture and the daily lives of its residents — as well as their severely limited resources.

"While in Ethiopia, we were not designing an oxygen concentrator for hospitals," Miller said. "We were designing for something much more significant: people's lives."

## Maria Withrow

**DESTINATION:** Germany
**MAJORS:** Mechanical Engineering and German
**DURATION:** January 7 – July 22, 2013

For Maria Withrow, taking the next round of mechanical engineering courses came with a twist: She'd be studying in a different country, adapting to life in a new time zone and learning from instructors who taught solely in German — the most widely spoken language in the European Union.

But before Withrow dove in to kinematics, thermodynamics and fluids at the Technical University of Berlin, the dual-degree major in mechanical engineering and German had an opportunity to put her skills to the test at an internship with Davis-Standard, an international engineering company near Dusseldorf, Germany. During the first three months of her journey, Withrow worked roughly 35 hours per week, putting her more than 10 years of German-speaking skills into action.

"Although I've been learning German since kindergarten, some words are still confusing," Withrow said. "Particularly the scientific terms."

Withrow's first assignment was to use AutoCAD — drafting, modeling and architectural drawing software — to render a 3-D drawing of complex machinery parts, which included a casing that would be used to protect a machine's exterior as it rolled up finished sheets of plastic. She had a chance to build on her technical skills while understanding universal standards for engineers.

"I've learned so much about being a global engineer," Withrow said. "I was reminded that even in a different language, each engineer has the same responsibilities to uphold, including ensuring the safety of your clients and consumers."

While in Germany, Withrow took advantage of the ease of traveling from country to country within Europe. Withrow experienced a whirlwind tour of Paris, France, capturing the sights of the Eiffel Tower; skied across the German Alps; and explored Spain, Poland, the Czech Republic and other destinations.

Among many unique experiences in Germany, Withrow will certainly remember her birthday.

"I'm a triplet," she said. "I'd never celebrated a birthday without my brother and sister."

## Sending engineers abroad

NC State industrial engineering alumnus Ralph Edwards knows the impact of a study abroad experience — it gave him the confidence to work and travel around the world, leading to a career in international real estate investment.

Now, he's giving back to the university that gave him the chance to travel to Italy, the site of his first international work experience. Edwards has established a Global Engineering Learning Experience Fund to support top engineering and computer science students who will study abroad, intern, research or engage in service-learning projects. The gift has already supported five students, including two who are featured in the article.

During the summer of 1960, Edwards spent two months in northern Italy working for Olivetti, the leading Italian designer and manufacturer of typewriters, early computers and other award-winning business products. He spent another month exploring Italy, taking in the country's architecture, history and culture. Dr. Clifton Anderson, who was head of the department at the time, played a key role in coordinating the internship opportunity.

"I had a career-changing life experience when I had the opportunity to work abroad," said Edwards, who graduated from NC State in 1961 and the Harvard Business School in 1967. "Today, the advantages of international travel and work are recognized by employers, and I would like to help students have that experience while they're in school."

Edwards is managing partner of EBS Property Investments, LLC, in Atlanta, Ga.

# IRWIN HOLMES WAS FIRST


NC State's first African-American graduate, an electrical engineering major, was an important figure on campus at the dawn of the Civil Rights Movement.





The NC State tennis team was hungry, Irwin Holmes included.

The squad had just finished up a series of matches against UNC in Chapel Hill, and they'd stopped to eat in a local diner before heading back to Raleigh. They sat down and ordered their food.

A few minutes later, the owner entered the dining room. He pulled the coach aside and said he wouldn't serve the team until Holmes — the team's lone African-American — left the diner. And then an interesting thing happened.

"The rest of the guys said, 'No way, we're all going,'" Holmes remembered. "So they've got all this cooked food back there, and we all got up and left."

Until 1960, when Irwin Holmes walked out of NC State with a bachelor's degree in electrical engineering, the university had never had an African-American graduate. He endured much during his time at NC State — a professor who gave him lousy grades for good work, cheap hits on the intramural football field, countless looks and behind-his-back whispers — but nevertheless he looks back on those years as a mostly positive experience.

A theme runs through many of his stories. For every difficult incident, there is another one in which his fellow students stuck up for him.

"In almost every case, if the guy on your side knew you, race was not an issue," Holmes said. "And that's true in real life. When you have a real friend, you forget race."

Holmes grew up in Durham, NC, at a time when segregation was a way of life in the South. He was a top high-school student and athlete, starring in several varsity sports and graduating third in his class.

He wanted to become an engineer and applied to NC A&T and Howard University, both historically African-American institutions. But he was also attracted to the top engineering program at all-white NC State, so in the wake of a US Supreme Court ruling that said African-Americans had a legal right to attend UNC-system schools, he applied.

That got people's attention.

"I was not trying to break the color barrier," Holmes said. "But when I applied to NC State, that's what came out in the newspapers all over the state. Everyone was so happy about it that I really didn't have a choice."

Holmes was one of four black students to enroll at NC State in 1956. He immediately became involved in many aspects of campus life, including becoming the first African-American to play on a Wolfpack athletic team when he joined the varsity tennis squad. During his senior year, he served as co-captain.

But he experienced plenty of unsettling moments. Holmes had always been a good student, so he was puzzled when, during a class on contemporary civilization, his pop quizzes kept coming back with C's on them. During one discussion about race and integration, another student mentioned that Holmes would be the university's first African-American graduate.

Not so fast, the professor said. He'll need to get his grades up first.

But he's a top student, the other student said. How could he not graduate?

The professor had been called out. Holmes got A's the rest of the class.

The athletic fields also produced their share of trying moments. During the final seconds of an intramural basketball game, Holmes was dribbling out the clock when a player on the other team's bench jumped up and slugged him from behind. No technical foul was called.

Another time, after executing a good block on the intramural football field, another player illegally leveled him as he ran out for a pass. His teammates, unwilling to accept the cheap hit, later returned the favor.

Overall, Holmes felt that most students and faculty were ambivalent about the African-American students' presence on campus, at least at first.

"But by my junior year," Holmes remembered, "most of the campus was cheering me on to graduate. We had proven we had the academic credentials to be there."

After graduation, Holmes went on to earn a master's degree in electrical engineering from Drexel University. He then worked for several companies before landing at IBM. He spent 19 years there and contributed to several high-profile computer projects.

Today, Holmes is retired and lives in Durham with his wife, Meredythe. His legacy has been recognized at NC State, where the Irwin Holmes and Black Alumni Society Conference Room on Centennial Campus was named in his honor.

Much has changed in the 53 years since his graduation, including the creation of initiatives like the College's Minority Engineering Programs. NC State is ranked third nationwide in the number of African Americans who graduate with bachelor's degrees in engineering each year.

But more work remains, and Holmes is teaming with the NC State Engineering Foundation and other alumni to explore new ways to support minority engineering students' education as well as their college experience. He wants to encourage others to do the same.

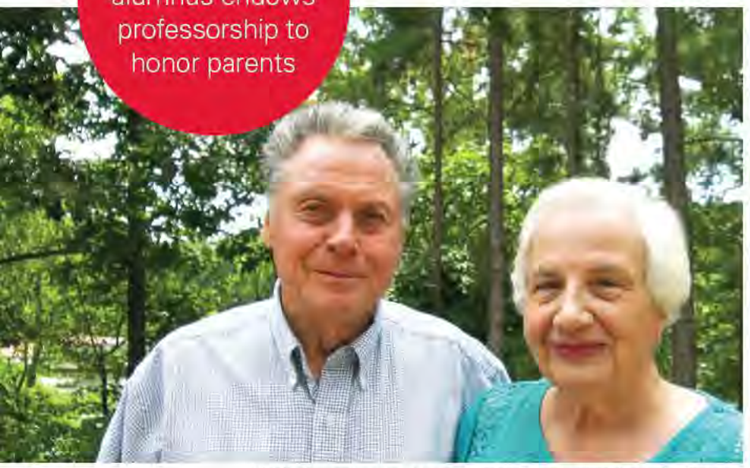
"I received a great education here," Holmes said. "I want other students to have the same opportunities I did." ▪

## Support the initiative

Help more minority engineering students succeed at NC State. To contribute, contact Tasha Martin at the NC State Engineering Foundation at 919.513.7557 or tasha_martin@ncsu.edu.

# RAISED *on* EDUCATION

NC State engineering alumnus endows professorship to honor parents



NC State engineering alumnus John Freeman and his wife, Dolores.

Walter and Ida Freeman began their lives as newlyweds during an uncertain time in United States history — the depths of the Great Depression. Walter began to grow apples, developing Freeman Orchards in Hendersonville, NC, which still exists today; Ida established a hand-woven rug business.

NC State engineering alumnus John Freeman remembers his parents' hard work, as well as the sacrifices they made to support their children's education.

"I had three siblings, and each of us went to college," said Freeman, a 1957 ceramic engineering graduate. "Throughout our time, we weren't pressured to support ourselves. This was very exemplary of my parents."

Recently, John and his wife, Dolores, pledged to establish the Walter and Ida Freeman Distinguished Professorship in the Department of Materials Science and Engineering at NC State. The Department of Ceramic Engineering was formed in 1924 — a precursor to today's Department of Materials Science and Engineering, which is led by Dr. Justin Schwartz, Kobe Steel Distinguished Professor.

"I'm impressed with how strongly Dr. Schwartz promotes materials science and engineering," said Freeman, whose daughter Karen Freeman Bisi is also a graduate of the department. "He's making a great deal of progress, and I'm motivated to support his efforts while permanently honoring my parents."

Professorships help to attract or retain renowned researchers. Additional funds also allow professors to hire talented graduate students and purchase equipment, among other benefits.

Freeman is a registered professional engineer in North Carolina and the president and general manager of Cer-Met, Inc., a Charlotte, NC, wholesale company that manufactures and installs refractories and other high-temperature materials. He credits professors in the ceramic engineering curriculum for taking an interest in student success and sharing their experience in the ceramic industry. Professors W.C. Hackler, George Harrell and Wurth Kriegel are among those who Freeman remembers well.

"Professor Harrell made it a point to take students on field trips to a number of the ceramic companies around the state," Freeman said. "I saw real-world application firsthand."

Freeman's journey to becoming his own boss began with a company known as Harbison-Walker Refractories Company in Pittsburgh, which at the time was known for being among the nation's largest producer of the most technically advanced refractories — heat-resistant materials that make up the linings of high-temperature structures such as furnaces and reactors. He worked for the company for about 12 years, ascending to the rank of applications engineer and gaining experience in refractories applications.

Next, Freeman sought to satisfy his interest in installing refractories, as he had been visiting sites and supervising installation during his time with Harbison-Walker. He particularly liked the idea of establishing a company in the south, and in 1972, Freeman returned to Charlotte. Here, he started Cer-Met, Inc., which has now been a flourishing business for a little more than four decades.

Freeman had great resources: unwavering support from his parents, a scholarship from the Brick and Tile Manufacturers Association and a degree from one of the best colleges of engineering in the nation.

"An NC State engineering degree is a great starting point for all kinds of entrepreneurial ventures," Freeman said. "Everyone should give back when they're able, and I think NC State is a very deserving partner." ▪



NC State engineering alumnus Glenn Futrell and his wife, Phyllis.

# STRONG FOUNDATION

A civil engineering alumnus establishes a professorship to recognize the program that put his career on the fast track

An NC State engineering degree helps graduates land jobs.

Glenn Futrell holds two — a bachelor's and master's in civil engineering — and the technical training he gained at NC State helped him secure his first job at an engineering and testing company in Charlotte. Years later, his degrees led to entrepreneurship.

Recently, he and his wife, Phyllis, pledged to establish the Glenn E. and Phyllis J. Futrell Distinguished Professorship in Civil, Construction, and Environmental Engineering. For Futrell, the gift is a way of giving back to the university that provided the fundamental problem-solving skills needed to run a successful business. He credits his wife, Phyllis, whose support was instrumental while he earned his degrees.

The gift is also evidence of Futrell's understanding that top-notch researchers need support. Professorships provide funding for professional development activities, such as conference travel, and the gifts also provide financial assistance for research materials.

"It's really important to have additional funds to supplement professors," Futrell said. "Professorships help to attract the best."

Futrell received his first degree from NC State in 1963 and graduated with his master's degree in 1965. He launched Soil & Material Engineers, now known as S&ME, in Raleigh in 1973. Futrell, a registered professional engineer, served as president of the environmental engineering firm from 1973 to 1987.

Under his leadership, the company received numerous accolades, including being featured on the cover of *Engineering News Record* in 1986 as one of the most successful engineering firms in the United States. The same year, S&ME had become the fifth largest geotechnical engineering company in the nation. Today, the company has 25 offices across nine states; its headquarters remain in Raleigh.

A 1999 Distinguished Engineering Alumnus, Futrell is former president of the NC State Engineering Foundation Board of Directors. He also endowed the Glenn Elliott Futrell Scholarship in 1997 to support students pursuing a civil engineering degree at NC State.

Today, Futrell is president of Weaver's Pond Development Company, a family-owned business in Zebulon, NC. The family has been in real estate development for 30 years and has worked on well-recognized projects, including Pirate's Cove, a prestigious resort development on the Outer Banks of North Carolina.

Futrell is grateful that his NC State engineering degrees have kept him working in the field for 50 years.

"I can never do enough for the university that did so much for me," Futrell said. "My NC State engineering degree taught me the critical skills needed to successfully manage a business." ▪

## Making a distinction

When NC State engineer Dr. Carl Koch received a package from Washington, DC, in 2013, he was prepared to review a stack of proposals. Instead, he was informed of his election to the National Academy of Engineering (NAE) — one of the loftiest achievements in the engineering profession.

Koch, who is Kobe Steel Distinguished Professor in the Department of Materials Science and Engineering, credits his distinguished professorship for enhancing his reputation and increasing his visibility in the engineering community. He was among three faculty to receive the professorship in 2008; a portion remained for the incoming department head.

"Many NAE members have endowed chairs," Koch said. "Distinguished professorships boost the reputation of the College and its researchers."

Koch, whose career spans more than 50 years, is well-known for his achievements in research on amorphous and nanostructured materials. His professorship has supported enrichment experiences, such as travel to professional society meetings, and living expenses for international graduate students working in Koch's laboratory as part of collaborative research with international faculty.

# MEET THE DEAN'S CIRCLE

From recent graduates to distinguished faculty, the Dean's Circle is filled with donors who have a variety of backgrounds, as well as motivations for supporting one of the nation's top engineering and computer science schools.

The Dean's Circle is the College of Engineering's signature annual giving fund, and joining means making an annual gift to the College of $1,000 or more. Gifts help fund scholarships and fellowships, which help attract and retain top students. Donors also support the College's departments and programs.

Meet some of the College's supporters.

## Elin Gabriel

Chemical engineering alumna Elin Gabriel knows the job-placing impact of an NC State engineering degree — she hit the ground running after graduating in 1985, starting in the semiconductor industry and later ascending to executive management levels in operations, quality and global supply chains. She was appointed chief operating officer at Alvogen, a multinational pharmaceutical company, in 2010.

A supporter of the NCSU Libraries and a Dean's Circle member since 2009, Gabriel wants future students to have access to the same quality education that helped boost her career. Mention the new James B. Hunt Jr. Library on Centennial Campus and Gabriel recalls the hours spent studying in the D. H. Hill Library.

"I value my NC State engineering degree," Gabriel said. "I encourage alumni to give back if they feel the same."

## Aaron Isbell

Aaron Isbell graduated in 2007 with a bachelor's degree in computer science. Since then, he's been determined to explore different ways of giving back — time, resources and financial support. He recently transitioned to the third option by making his first gift to the Dean's Circle.

Now, he wants his peers to know they can do the same.

"I've tried to experience all the ways to give," said Isbell, an IT manager at SAS, the software company in Cary, NC. "Engage with the College, and see the impact of your generosity."

As chair of the College's Young Alumni Council, which formed last fall, Isbell hopes to provide opportunities for young alumni to give back, including volunteering at recruiting events or NC State's Engineers' Day (E-Day).

## Dr. Paul Zia

Dr. Paul Zia joined NC State in 1961. He is a member of the National Academy of Engineering and Distinguished University Professor Emeritus of Civil, Construction, and Environmental Engineering at NC State. During his decades-long tenure, Zia has seen the College from different perspectives, beginning long before the move to Centennial Campus.

"It's been exciting to see the university's transformation into a first-class research university," said Zia, who also contributes to the NCSU Libraries. "I've seen the impact of private contributions, especially on my department."

Zia is referring to the Department of Civil, Construction, and Environmental Engineering, which he also supports by helping with field trips, research assistantships and other opportunities for students.

"From alumni to faculty and staff, we should all have excitement about the growth and stature of our university," Zia said. ▪



# DEAN'S CIRCLE MEMBERS 2012-13

NC STATE UNIVERSITY

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Deborah B. Young, '77
Paul Z. and Dora L. Zia

More information:
Visit **www.engr.ncsu.edu/foundation/deanscircle**
or contact Angela Stallings at angela_stallings@ncsu.edu or 919.513.1714.

The 2012-13 Dean's Circle recognizes individuals and corporations that made unrestricted gifts of $1,000 or more to the College of Engineering and its departments between July 1, 2012, and June 30, 2013. For alumni up to 10 years after graduation, gifts of $250 or more qualify for recognition in the Dean's Circle. Those with company matching gifts are recognized for the combined total of their gift. We apologize for any omissions or errors. If you have a correction, or would like to know how to become a Dean's Circle member, please contact Angela Stallings at angela_stallings@ncsu.edu or 919.513.1714.

# donor stories

## PLANNED GIFT SUPPORTS FACULTY

Dr. Lawrence A. Twisdale Jr.

Dr. Lawrence A. Twisdale Jr. (CE '69, '70) and his wife, Frances, have established the Lawrence and Frances Twisdale Charitable Remainder Unitrust through the NC State Engineering Foundation. The endowment will provide faculty support in the Department of Civil, Construction, and Environmental Engineering and the Poole College of Management. A large portion of the endowment will be used to fund the Lawrence A. Twisdale Jr. Distinguished Professorship in Civil, Construction, and Environmental Engineering.

"I am passionate about NC State and want to see the department excel," Twisdale said. "With this gift, our objectives were to help attract and retain distinguished faculty. A distinguished professor can obtain funded research, attract top students, publish scholarly works and enhance our academic recognition. The endowment maintains the principal of the gift, and a portion of the earnings will fund faculty each year."

Twisdale is an executive vice president and board member of Applied Research Associates (ARA), Inc., an international research and engineering firm. He founded the ARA Raleigh office in 1982, and it now has more than 175 employees. ▪

## PLANNED GIFT TO SUPPORT STUDENTS IN NORTH CAROLINA

Jerry Yarborough

NC State engineering alumnus Jerry Yarborough has made a planned gift to support future students and military veterans in North Carolina. Yarborough has made a bequest, which is a giving option that allows donors to include the College of Engineering in a will or trust. The gift will establish the Jerry K. Yarborough Endowed Scholarship in Engineering.

A native of Edenton, NC, Yarborough graduated from NC State in 1967 with a bachelor's degree in nuclear engineering. He remembers the financial struggle to attend school and wants to help talented high school students in the state receive a top-notch engineering education.

"I grew up in rural eastern North Carolina, and I still have a special affinity for the state and NC State's role in the technical education of its young students," Yarborough said. "I see myself 50 years ago."

Following graduation, Yarborough went on to serve 20 years in the US Navy Civil Engineer Corps, including time on reserve. He later added master's degrees in accounting and business administration and held management positions in various finance offices in Colorado. ▪



## CORPORATE DONORS TO THE NC STATE ENGINEERING FOUNDATION, FISCAL YEAR 2012-13

**$200,000+**
Duke Energy Foundation
Progress Energy Foundation
IBM
ABB

**$100,000 – $199,999**
Extreme Networks
Clancy & Theys Construction Company
Eaton Corporation
GKN Driveline North America, Inc.
BD

**$50,000 – $99,999**
Agilent Technologies
Cree, Inc.
RTI International
Tekelec
Cisco Systems
Unilever Research & Development
Triangle Community Foundation, Inc.
EMC Corporation
BioSono, Inc.

**$20,000 – $49,999**
LORD Corporation
Qualcomm Incorporated
Exxon Mobil Corporation
Fidelity Charitable Gift Fund
Fidelity Investments
Stewart Engineering, Inc.
John Deere Foundation
IBM International Foundation
Mentor Graphics
FDH Engineering, Inc.
CRSI Foundation
Norfolk Southern Foundation
SAS Institute, Inc.
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Deutsche Bank
Huntington Ingalls Industries
John Deere & Company
Sirtex Medical, Inc.
NC Propane Gas Association, Inc.
Fluor Enterprises, Inc.
ImagineOptix Corporation

## GIVE RIGHT

Ensure your gift reaches the students and programs you want to support. Make your check payable to "NC State Engineering Foundation, Inc." and send it to this address:

Martin Baucom
Associate Executive Director of Development and College Relations
NC State Engineering Foundation
Campus Box 7901
Raleigh, NC 27695-7901

Or give online at **www.engr.ncsu.edu/foundation**.

## New NC State Engineering Foundation staff

Angela Stallings

### Meet Angela Stallings

Angela Stallings joined the Foundation staff as assistant director of development and alumni engagement in May. Her responsibilities include engaging with alumni for the Dean's Circle, the College of Engineering's signature annual giving fund, and serving as a liaison for the Young Alumni Council. Stallings previously worked at Duke University's Fuqua School of Business as assistant director of donor relations. She graduated in 2008 with a bachelor's degree in political science from the University of North Carolina at Chapel Hill.

*"I have an affinity for higher education," Stallings said. "I love what I am able to do here because it is vital to NC State's success."* ▪

## Foundation Year in Review

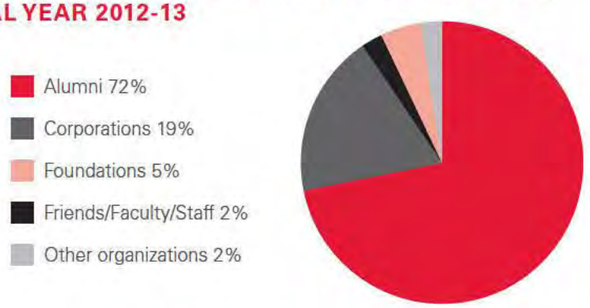
Alumni, friends and corporate partners make long-term investments in the College of Engineering.

The NC State Engineering Foundation raised more than $17.4 million in private gifts and new commitments in fiscal year 2012-13 to support educational experiences and groundbreaking research being conducted by students and faculty in the College of Engineering. That is 51 percent more than was raised the previous fiscal year. The charts below illustrate the sources and uses of that private support.

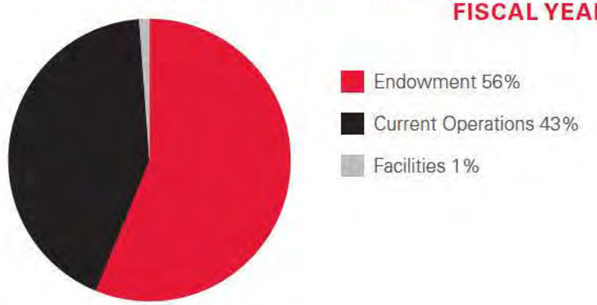
Our priority remains raising gifts to build the College's endowment. More than $9.8 million of new commitments booked last year were to endowment. Those gifts are the most important and enduring investments donors can make in the College, and they have a profound impact on our ability to attract and retain people — the students and faculty who define the College. The principal of an endowment gift is invested while its annual income is used to support the donor's purpose. Gift agreements are tailored to achieve the kind of impact a donor desires. As the principal grows over time, so too does that capacity for students and faculty to pursue their dreams. The permanence of endowments provides us the opportunity to recognize the donors whose philanthropy makes such wonderful impact. Naming recognition not only preserves legacy for the donor, but also sets an important leadership standard for others.

As engineers, those dreams involve solving big challenges, so the generosity of donors and every new endowment that is established plays a unique role in inspiring education and research that will advance society. On behalf of the students, faculty and staff, the Foundation expresses its sincere thanks to all who continue to give so generously. ▪

### GIFTS AND NEW COMMITMENTS BY GIFT SOURCE, FISCAL YEAR 2012-13




### GIFTS AND NEW COMMITMENTS BY GIFT USE, FISCAL YEAR 2012-13




# BY THE NUMBERS

A LOOK AT SOME OF THE FIGURES THAT SHAPE THE COLLEGE OF ENGINEERING

**3**

**Consecutive years NC State's undergraduate video game design program has been ranked in the TOP 15 NATIONWIDE by *The Princeton Review*.**

**1**

Ranking for NC State's Engineering Online as the nation's top online graduate engineering program for veterans and active-duty military in *U.S. News & World Report*.

**13**

College faculty who are members of the National Academy of Engineering, one of the field's loftiest professional distinctions.

**4**

Raleigh's ranking among the nation's best cities for entrepreneurs by *Forbes*. More than 1,000 students have passed through NC State's Engineering Entrepreneurs Program since 1993.

**85 MILLION+**

Dollars in the College's endowment, which generates income that funds new opportunities each year in perpetuity. Building the endowment helps the College create programs of distinction and recruit and retain the best students and faculty.

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