FALL/WINTER **2012**

nc state ENGINEERING

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NC State is now the nation's only university leading two active NSF Engineering Research Centers

RISING FACULTY STARS

PROBLEM-SOLVING SENIOR PROJECTS

NC STATE UNIVERSITY

125 YEARS

ADVICE FROM AMELIA

Katharine Stinson's barrier-breaking engineering career started in 1932 on the dusty runway of her hometown airstrip.

Legendary flyer Amelia Earhart (above right) had touched down at the old Raleigh Municipal Airport, and the 15-year-old Stinson stole a moment with her idol to share her dream of becoming a pilot. But pilots didn't make much money in those days, and Earhart suggested another occupation.

"Don't become a pilot, become an engineer," Stinson recalled her saying.

Stinson (above left) took the advice. But when she applied to NC State a few years later, she hit a roadblock: Women weren't allowed to study engineering at the university.

Stinson persisted, convincing the dean of engineering to let her transfer in as a junior and then enrolling at nearby Meredith College.

Just one year and a whopping 48 credit hours later, she marched back to NC State. She graduated in 1941 with a BS in mechanical engineering with an aeronautics option, becoming the first woman to leave the university with an engineering degree.

Stinson spent the next 32 years with the US Civil Aeronautics Administration (now the Federal Aviation Administration) making key contributions to aircraft safety. She even served on an advisory committee under President Lyndon Johnson.

But Stinson never forgot her NC State roots, and the university never forgot her. She became the first woman to serve on the Alumni Association Board of Directors and earn recognition as a Distinguished Engineering Alumna.

To give other women similar opportunities, she established the Katharine Stinson Scholarships for Women in Engineering in 1987.

Engineer or pilot? Looks like she made the right choice.

contents

nc state ENGINEERING FALL/WINTER 2012

FEATURES

DEPARTMENTS

ON THE COVER: Dr. Veena Misra, center left, director of the new NSF ASSIST Nanosystems Engineering Research Center led by NC State, discusses ASSIST research with Dr. John Muth, the center's deputy director. See page 22 to learn how ASSIST could reshape health care.

DEAN **Dr. Louis A. Martin-Vega**

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Did you know?

Did you know that robots will retrieve books at the new James B. Hunt Jr. Library on Centennial Campus? After users request books online, a robotic crane fetches them from tightly packed shelving hidden behind the library walls. The "bookBot" system will include the engineering collections when the library opens in 2013.

FROM THE DEAN

Louis A. Martin-Vega

I am very proud to share with you that we begin this academic year celebrating NC State's new National Science Foundation Nanosystems Engineering Research Center led by our own Dr. Veena Misra. The award of the Advanced Self-Powered Systems of Integrated Sensors and Technologies (ASSIST) Center, along with our existing NSF ERC for Future Renewable Electric Energy Delivery and Management (FREEDM) Systems, marks NC State's College of Engineering as the only engineering college in the nation currently leading two active NSF ERCs. This is truly a remarkable achievement that speaks to the exceptional quality of our faculty and College.

We have had another outstanding year in research with total expenditures estimated to exceed $155 million in 2011-12. We are also proud of our three new 2012 NSF Career Award winners. Their efforts, together with those of our existing stellar faculty and the more than 40 new faculty members we have welcomed in the last two years, will ensure the continued growth of our research programs. Our students, working alongside some of the finest engineering faculty in the world, are clearly significant beneficiaries of these research efforts.

In the following pages you will learn about the innovative, problem-solving projects developed by our graduating seniors in their capstone design courses, meet some of our outstanding young faculty members, and learn about some of the many companies that got their start in our college. We also take a moment to congratulate our alumnus Dr. Hesham Kandil, who recently was named prime minister of Egypt.

In closing, I'd like to invite you to our first alumni Homecoming celebration on Friday, November 2. You'll be able to reconnect with your classmates and home department, as well as learn more about your college. The Homecoming event will be held in conjunction with NC State's 125th anniversary celebration. I appreciate your continued support and look forward to seeing you at Homecoming.

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

Welcoming 15 new faculty

The College continues to boost its faculty ranks, with 15 new faculty members in seven departments joining NC State for 2012-13.

The new faces add to the dozens of new faculty added by the College over the past five years, a brisk pace of hiring that helps the College handle student enrollment growth and places additional emphasis on research.

Both the College and the university are committed to boosting faculty resources. Generous professorship gifts from engineering alumni have created new opportunities to bring outstanding faculty to NC State.

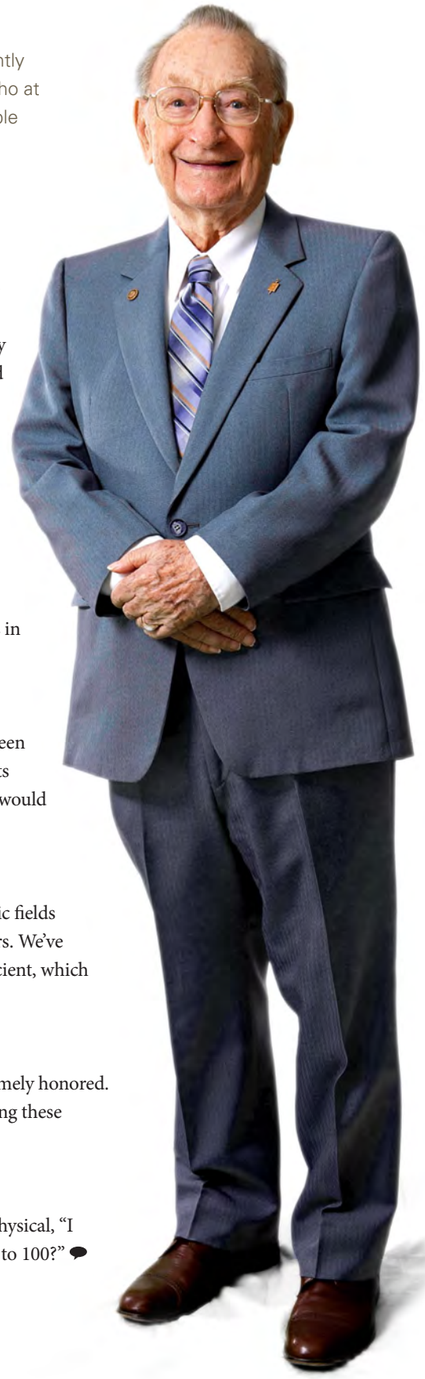
One way of gauging new faculty members' success is by the awards they win. Since 2000, 52 young College faculty members have won National Science Foundation CAREER Awards, among the top honors given by the federal agency to early-career faculty in science and engineering.

Check back a few years from now. Members of this group of 15 may join them. ▪

Q & A

Questions for HANS CONRAD

Dr. Hans Conrad, professor emeritus of materials science and engineering, recently received the 2012 ASM Gold Medal, one of his field's highest honors. Conrad, who at 90 is one of the world's oldest active researchers, talks about his most memorable projects, his current research on ceramics, and why he keeps on working.



What was your childhood like?
I was born in Germany, but we emigrated to Michigan in 1926 and later settled near Pittsburgh. My parents got me erector, chemistry and physics sets — things that stimulated an interest in science and engineering. I enjoyed sports and played on the varsity basketball team in high school, but I was best at math and science. Sometimes when my sophomore geometry teacher wasn't prepared for class, he'd say, "All right, Conrad," and have me teach.

What have been some of your most memorable projects?
Out of college at Alcoa I helped develop a new alloy to strengthen the wing struts of planes. I discovered after World War II that it was needed to carry the atom bomb to Japan. Later, at Aerospace Corporation, I joined a project that developed equipment for the Dyna-Soar, which was the forerunner to the space shuttle. I've also worked on the development of the laser, a method of "cold welding" in space, and titanium alloys for the B-1 bomber. My theoretical work has focused on explaining how atomic defects in materials affect their processing and properties.

Describe your typical day.
In the mornings, I do my reading and writing. Then I have lunch with my wife; we've been married 68 years. I spend the afternoon in the lab. This past semester, I had five students and one postdoctoral fellow working with me. I work for no pay and give any money I would normally make to my students.

Talk about your recent ceramics research.
I have a grant from the National Science Foundation to understand the effects of electric fields on ceramics, which are found in everything from body armor to ball bearings to sensors. We've discovered that using these fields makes the ceramics manufacturing process more efficient, which reduces costs and pollution. Now we need to figure out why this happens.

What was your reaction to winning the ASM Gold Medal?
Winning an award like this makes you feel that your work is worthwhile, and I'm extremely honored. I formally retired 20 years ago, but I wanted to keep working on new theories and solving these puzzles because they give me so much satisfaction. I just love it.

When will you stop working?
When I feel like I can no longer contribute, I'll stop. I said to my doctor at my annual physical, "I hope you're going to keep me going to 100 years old." He said, "Why are you limiting it to 100?"

A leader in Egypt

News outlets around the world took notice when Dr. Hesham Kandil, a water and irrigation minister who received his PhD in biological and agricultural engineering with a minor in water resources from NC State in 1993, was named prime minister of Egypt in July.

At NC State, Kandil was a graduate student under Dr. Wayne Skaggs, William Neal Reynolds Professor and Distinguished University Professor of Biological and Agricultural Engineering. Kandil's dissertation was an extension of the DRAINMOD computer simulation model of water drainage that Skaggs developed.

Kandil's addition to the DRAINMOD predicts soil salinity and its effect on crop yields on irrigated arid lands — a big issue in parts of the world like Egypt.

Skaggs remembers Kandil as "very bright" and "absolutely honest," as well as someone who "will work as hard as he can to do his very best to benefit the people of Egypt. I am very proud of him. The job he now has is enormous."

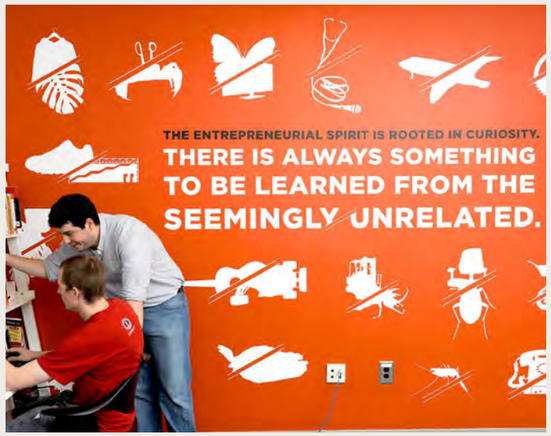
Kandil's ascendance to prime minister marked the second time in less than a year that an NC State engineering alumnus took a leadership position in an Arab country. In October, Abdurrahim El-Keib, who earned his PhD in electrical engineering from NC State in 1984, was named prime minister of Libya. ▪

Among the best in gaming

NC State's undergraduate video game design program has been recognized as one of the best for the second year in a row.

The rankings published by the *Princeton Review* salute the 32 best video game design undergraduate programs in the US and Canada. NC State was given an "Honorable Mention" for the second consecutive year.

The list was based on a survey of administrators at institutions offering game design coursework or degrees. The survey covered everything from academics and faculty credentials to graduates' employment and career achievements. Selection criteria included the quality of the curriculum, faculty, facilities and infrastructure. ▪

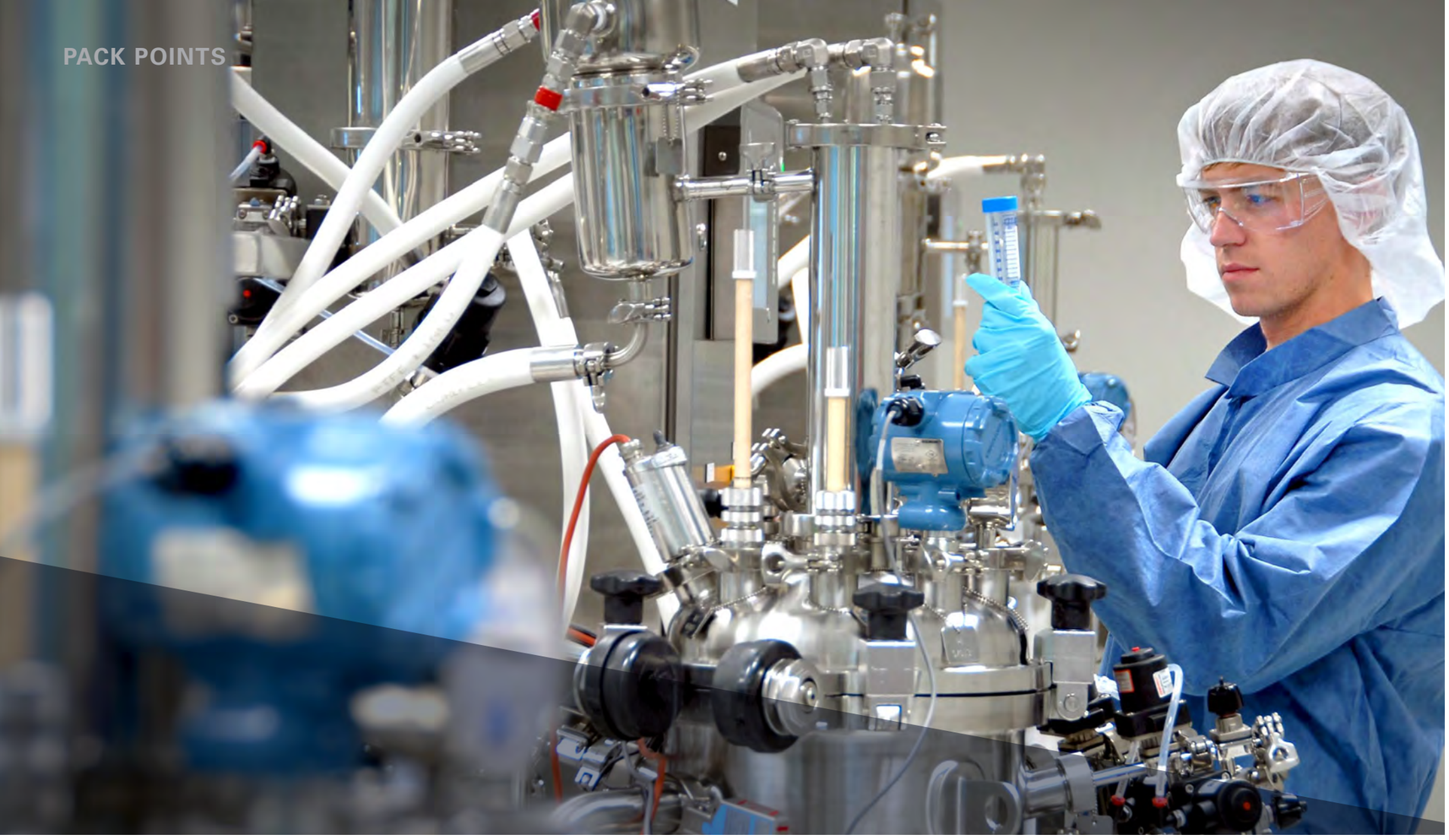


A Garage for entrepreneurs

The News & Observer and WRAL-TV ran lengthy stories recently on the Garage, the student entrepreneurs' space on Centennial Campus that opened in 2010.

The N&O noted that those using the Garage "have cross-pollinated in the kind of 'beneficial collisions' of students with different backgrounds and interests that the Garage was, in part, created to foster."

"A lot of people thought we'd see only engineering students in the Garage," Dr. Tom Miller, executive director of the NC State Entrepreneurship Initiative and McPherson Family Distinguished Professor of Engineering Entrepreneurship, told the N&O, "but it really has attracted students from across the university, and they help each other learn." ▪



BTEC goes international

NC State has joined forces with a French university to provide biomanufacturing training, education and process services in the US and Europe. The alliance aims to foster the continued success of the biomanufacturing industry.

The new organization, BTEC International, is the result of a partnership between NC State's Golden LEAF Biomanufacturing Training and Education Center (BTEC) and Strasbourg University's European Aseptic and Sterile Environment Training Center (EASE). The partnership was developed with Alsace Biovalley, an international cluster of public and private health and life sciences organizations.

Biomanufacturing typically refers to the production of biopharmaceuticals — medical drugs produced through biotechnology. Examples include vaccines, monoclonal antibodies and proteins for medicinal use.

The overall impact of the biopharmaceutical industry on the US economy exceeds $917 billion annually. This translates into 674,000 direct jobs and 3.4 million indirect and induced jobs.

Plans call for the enterprise to become a knowledge hub of regulatory affairs expertise pertaining to both the US Food and Drug Administration and the European Medicines Agency.

BTEC International will develop and provide hands-on biomanufacturing training and regulatory-affairs courses at the Golden LEAF BTEC facility on NC State's Centennial Campus, and at the EASE headquarters in Strasbourg, France. The initiative will also work with researchers, corporations, governments and international organizations to create innovative technologies to advance the biomanufacturing industry.

"We are delighted to launch this initiative with EASE. By joining forces and integrating new member centers, the BTEC International network will bring a critical value to companies in participating regions," said Dr. Ruben Carbonell, director of BTEC and Frank Hawkins Kenan Distinguished Professor of Chemical Engineering at NC State.

BTEC International plans to expand its membership and become a collaborative network of training centers. The goal, Carbonell said, is to bring biomanufacturing companies into closer, mutually supportive relationships. BTEC International members will work together to develop partnerships, increase the international content of curricula and organize short courses and seminars.

"The end result is improved employability and enhanced skills," Carbonell said. ▪

Silver and stretchable

Researchers from NC State have developed highly conductive and elastic conductors made from silver nanoscale wires (nanowires). These elastic conductors can be used to develop stretchable electronic devices.

Stretchable circuitry would be able to do many things that its rigid counterpart cannot. For example, an electronic "skin" could help robots pick up delicate objects without breaking them, and stretchable displays and antennas could make cell phones and other electronic devices stretch and compress without affecting their performance.

But the first step toward making such applications possible is to produce conductors that are elastic and able to effectively and reliably transmit electric signals regardless of whether they are deformed.

Dr. Yong Zhu, an assistant professor of mechanical and aerospace engineering at NC State, and Feng Xu, a PhD student in Zhu's lab, have developed such elastic conductors using silver nanowires.

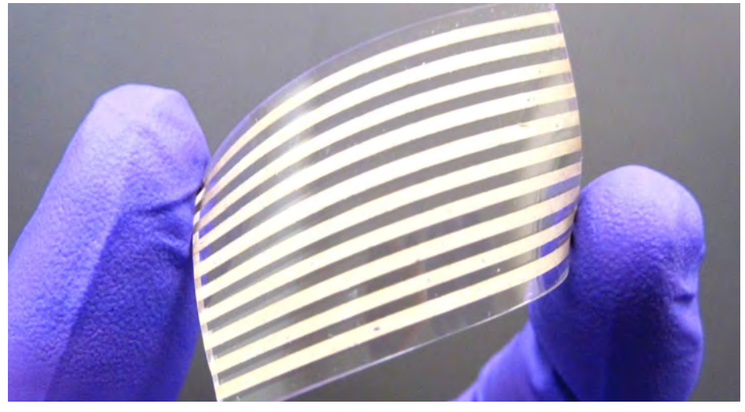
Silver has very high electric conductivity, meaning that it can transfer electricity efficiently. And the new technique developed at NC State embeds highly conductive silver nanowires in a polymer that can withstand significant stretching without adversely affecting the material's conductivity. This makes it attractive as a component for use in stretchable electronic devices.

"The fabrication approach is very simple," Xu said. Silver nanowires are placed on a silicon plate. A liquid polymer is poured over the silicon substrate. The polymer is then exposed to high heat, which turns the polymer from a liquid into an elastic solid. Because the polymer flows around the silver nanowires when it is in liquid form, the nanowires are trapped in the polymer when it becomes solid. The polymer can then be peeled off the silicon plate.

When the nanowire-embedded polymer is stretched and relaxed, the surface of the polymer containing nanowires buckles. The end result is that the composite is flat on the side that contains no nanowires, but wavy on the side that contains silver nanowires.

After the nanowire-embedded surface has buckled, the material can be stretched up to 50 percent of its elongation, or tensile strain, without affecting the conductivity of the silver nanowires. This is because the buckled shape of the material allows the nanowires to stay in a fixed position relative to each other, even as the polymer is being stretched.

The research was supported by the National Science Foundation. ▪



A 'lablet' for cyber systems security

NC State is one of three universities receiving an initial $2.5 million grant from the US National Security Agency (NSA) to stimulate the creation of a more scientific basis for the design and analysis of trusted systems.

Leading the NC State "Science of Security" Lablet are Dr. Laurie Williams, professor of computer science, and Dr. Michael Rappa, director of the Institute of Advanced Analytics and Distinguished University Professor of computer science. Lablets are also being established at the University of Illinois at Urbana-Champaign and Carnegie Mellon University.

It is widely understood that critical cyber systems must inspire trust and confidence, protect the privacy and integrity of data resources, and perform reliably. To tackle the ongoing challenges of securing tomorrow's systems, the NSA concluded that a collaborative community of researchers from government, industry and academia is a must.

To that end, the NSA grant has seeded academic "lablets" focused on the development of a Science of Security (SoS) and a broad, self-sustaining community effort to advance it. A major goal is the creation of a unified body of knowledge and analytics methods and tools that can serve as the basis of a trust engineering discipline, curriculum, and rigorous design methodologies.

The results of SoS lablet research are to be extensively documented and widely distributed through the use of a new, network-based collaboration environment. The intention is for that environment to be the primary resource for learning about ongoing work in security science, and to be a place to participate with others in advancing the state of the art.

The NC State lablet, which will be housed in the College of Engineering's Institute for Next Generation IT Systems, will contribute broadly to the development of security science while leveraging NC State's expertise and experience in analytics, including the extensive expertise available in the NC State Institute of Advanced Analytics. ▪

New technologies = lower emissions

New research from NC State shows that federal requirements governing diesel engines of new tractor trailer trucks have resulted in major cuts in emissions of particulate matter (PM) and nitrogen oxides (NOx) — pollutants that have significant human health and environmental impacts.

"These requirements for new emission control technologies have increased costs for truck owners and operators, and we wanted to know whether there was any real benefit," said Dr. Chris Frey, professor of civil, construction, and environmental engineering at NC State and co-author of a paper describing the research. "We found that there is a huge reduction in both PM and NOx emissions."

Frey and PhD student Gurdas Sandhu, the paper's lead author, used a portable emissions measurement system to sample exhaust from diesel trucks while those trucks were being used on roads and highways.

The emission requirements apply only to new trucks, meaning that trucks purchased in 2010 and trucks purchased in 1999 were subject to different emission requirements.

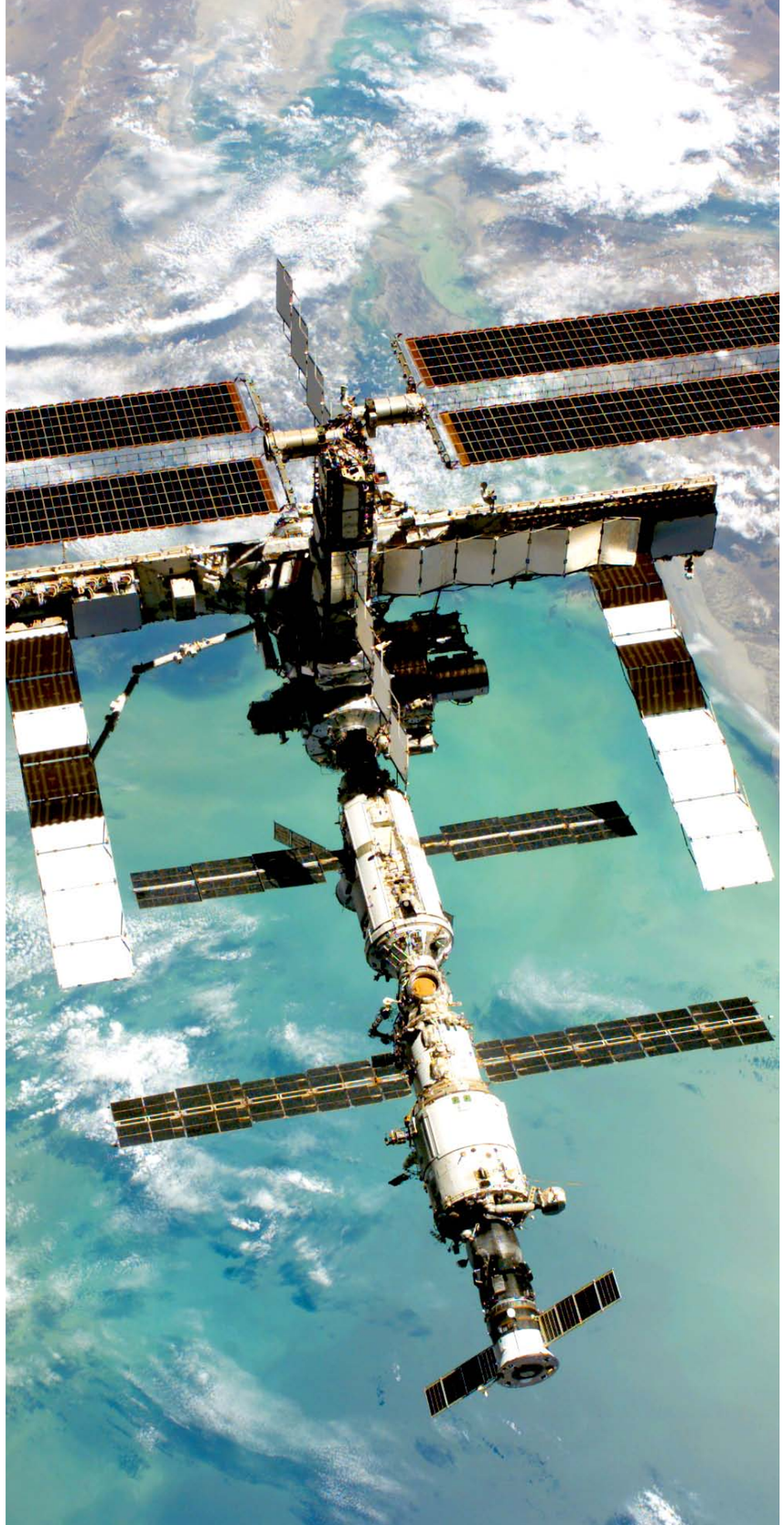
Frey and Sandhu found that a truck in compliance with 1999 standards emitted 110 grams of NOx per gallon of fuel used and 0.22 grams of PM per gallon of fuel used. NOx is a significant contributor to low-level ozone, which adversely impacts respiratory health. PM also adversely impacts respiratory health and, because it is largely made up of black carbon, also contributes to global climate change.

Trucks in compliance with newer standards had far lower emissions. For example, a 2010 truck emitted 2 grams of NOx per gallon of fuel — a decrease of 98 percent. The PM emissions were 95 percent lower.

The reductions stem from the implementation of exhaust gas recirculation and selective catalytic reduction technologies, as well as installing diesel particulate filters into the tail pipes of diesel trucks.

"While these technologies are a significant investment for truck owners, this study shows that they are achieving a remarkable drop in emissions of contaminants that have meaningful health and environmental consequences," Frey said.

The research was supported by the NC Department of Transportation and the National Science Foundation. ▪



Across the Twitterverse

Two NASA astronauts discussed their adventures in space before a packed room of NC State students during an on-campus Twitter Town Hall hosted by the College of Engineering in April.

Astronauts Nancy Currie and Bill McArthur spoke at NC State as part of Destination Station, NASA's national awareness campaign that communicates the work of the International Space Station (ISS), an inhabitable space station that also serves as a laboratory for experiments. The station was launched in 1998 and involves the US and 14 other countries.

McArthur and Currie answered questions posed from the audience and through Twitter. The questions touched on topics ranging from life in space to the future of space travel.

"When will we put a human being on Mars?" one questioner asked.

The astronauts' answer, summarized for Twitter: "We are still developing technology to try and do this and it has a lot to do with funding. But it is doable."

McArthur, a veteran of four space flights, also shared his experience as commander and ISS science officer with the Expedition 12 crew, which docked with the ISS in 2005 and became the first two-person crew to conduct a spacewalk in both Russian and US spacesuits. The audience laughed as he described everyday activities that became more difficult in a zero gravity environment, such as the challenges associated with brushing his teeth.

Currie, who is serving as a visiting adjunct professor at NC State's Edward P. Fitts Department of Industrial and Systems Engineering during 2012, is principal engineer for the NASA Engineering and Safety Center. The center tests, analyzes and assesses NASA's high-risk projects. She has been on four space shuttle missions and has accrued 1,000 hours in space.

When asked for advice for students interested in working in space, Currie said education was important.

"It is best to get as much of a technical background as you can," she said. ▪

Rock and (not) roll

New research from NC State shows that a wind-driven "tumbleweed" Mars rover would be capable of moving across rocky Martian terrain – findings that could also help the National Aeronautics and Space Administration (NASA) design the best possible vehicle.

"There is quite a bit of interest within NASA to pursue the tumbleweed rover design, but one of the questions regarding the concept is how it might perform on the rocky surface of Mars," said Dr. Andre Mazzoleni, an associate professor of mechanical and aerospace engineering at NC State and co-author of a paper describing the research. "We set out to address that question."

Mazzoleni and Dr. Alexandre Hartl, an adjunct professor of mechanical and aerospace engineering and lead author of the paper, developed a computer model to determine how varying the diameter and mass of a tumbleweed rover would affect its speed and ability to avoid getting stuck in Martian rock fields.

These fields are common on the surface of Mars, which averages one rock per square meter.

"We found that, as anticipated, the larger the diameter, and the lower the overall weight, the better the rover performs," Mazzoleni said. More importantly, the study found that a tumbleweed rover would need to have a diameter of at least six meters in order to achieve an acceptable level of performance – meaning the rover could move through rock fields without getting stuck.

Using the model, the researchers also found that tumbleweed rovers, which would be wind-blown across the landscape, are more likely to bounce than roll across the rocky surface. Mars has approximately three-eighths of Earth's gravity.

Tumbleweed rovers are attractive because they can cover much larger distances, and handle rougher terrain, than the rovers that have already been sent to Mars. Mazzoleni's group has also tested prototype rovers along the North Carolina coast (see photo).

"This model is a tool NASA can use to assess the viability of different designs before devoting the time and expense necessary to build prototypes," Mazzoleni said.

The research was supported in part by North Carolina Space Grant and NASA. ▪

New to the faculty? Learn from the best

Before the fall semester began, each new NC State engineering faculty member got the chance to spend four days learning from two legends of engineering education.

Great way to start, right?

Each August, recently hired NC State engineering faculty can attend an orientation workshop run by Drs. Richard Felder and Rebecca Brent. The husband-and-wife team has spent more than two decades preparing engineering and science faculty to excel at their jobs.

During that time, Felder and Brent have led more than 300 teaching and faculty development workshops on six continents and racked up dozens of education awards for their work.

"Very few new faculty members are prepared for the headaches that come with managing a research program and teaching a full slate of classes," Felder said. "We want to help them be as effective as they can be, as quickly as possible."

Felder, Hoechst Celanese Professor Emeritus of Chemical Engineering at NC State, and Brent, a former East Carolina University education professor who is now president of the consulting firm Education Designs, Inc., bring an unconventional approach to their work.

They encourage faculty to understand different learning styles and engage students in class — a teaching model called "active learning" — and they practice what they preach.

At each NC State orientation, for example, faculty don't just sit and listen. Instead, Felder and Brent intersperse short presentations with activities and breaks that offer plenty of networking opportunities.

Discussion topics include creating learning objectives for courses, planning multidisciplinary research projects, reviewing and critiquing funding proposals, and brainstorming solutions to common research- and teaching-related problems.

Between 2000 and 2011, 257 faculty from the colleges of Engineering and Physical and Mathematical Sciences attended the orientation, and the vast majority graded the workshop as "excellent" on evaluations.

Sounds like Felder and Brent got an "A". ▪

Champion of change

President Barack Obama recognized Sina Bahram, an NC State PhD student in the Department of Computer Science, as a "Champion of Change" at a White House ceremony in May.

The award recognizes leaders making significant efforts to make science, technology, engineering, and mathematics (STEM) accessible to the disabled.

Bahram, who also earned his undergraduate and master's degrees at NC State, conducts research on improving interaction between people and the technology they use.

This field of study has special meaning for Bahram, who is blind.

Bahram's goal is to give users with functional limitations or specific needs better access to information. He has developed a prototype system called Touch It, Key It, Speak It (TIKISI) that allows computer users to access graphical information in an "eyes free" fashion. TIKISI can already be employed to help blind users interact with Google Maps, and more applications are under development.

"When I was a child I made a conscious decision to have a positive outlook on life," Bahram said. "That attitude has served me well. And when I began working on my PhD, I realized I had an opportunity to affect the kinds of changes I wished existed when I was younger and struggling to learn STEM topics. With TIKISI, I'm hoping to give low-income and under-privileged people access to these educational tools. This technology works with a smart phone or a tablet – you don't need expensive, proprietary technologies that can be an obstacle for the disadvantaged."

Bahram attributes much of his success to the support he's received at NC State. He is grateful to his professors for the many hours they have spent working with him outside of class.

"I wouldn't choose to be part of any other university," he said. ▪

A new high for international admissions

There are more new international undergraduate students in the College of Engineering this fall than ever before.

More than 65 new first-year students from outside the United States enrolled in the College for the Fall 2012 semester, according to admissions figures. Last year, 31 new international students enrolled in the College for the fall semester. Total international undergraduate enrollment was 127 for the Fall 2011 semester and 193 for the Spring 2012 semester.

The increase mirrors a university-wide surge in international admissions. Most of those new arrivals are engineering students.

Bringing more international students to campus is a priority for NC State. The university's 2011-2020 Strategic Plan, endorsed by the Board of Trustees last year, advocates enrolling more out-of-state and international students to increase geographic diversity and broaden students' perspectives. ▪

Tuning up for wireless power transfer

NC State engineers have developed a new way to fine-tune wireless power transfer (WPT) receivers, making the systems more efficient and functional. WPT systems hold promise for charging electric vehicles, electronic devices and other technologies.

Researchers have shown that it is possible to transmit power wirelessly by using magnetic resonance. Even minor changes in how the transmitter or receiver is tuned, however, can result in faulty power transmission.

A new prototype developed at NC State addresses the problem by automatically — and precisely — re-tuning the receivers in WPT systems. The researchers, Dr. Srdjan Lukic, assistant professor of electrical and computer engineering, and PhD student Zeljko Pantic, focused on receivers because methods already exist that allow researchers to use electronics to precisely tune the transmitters.

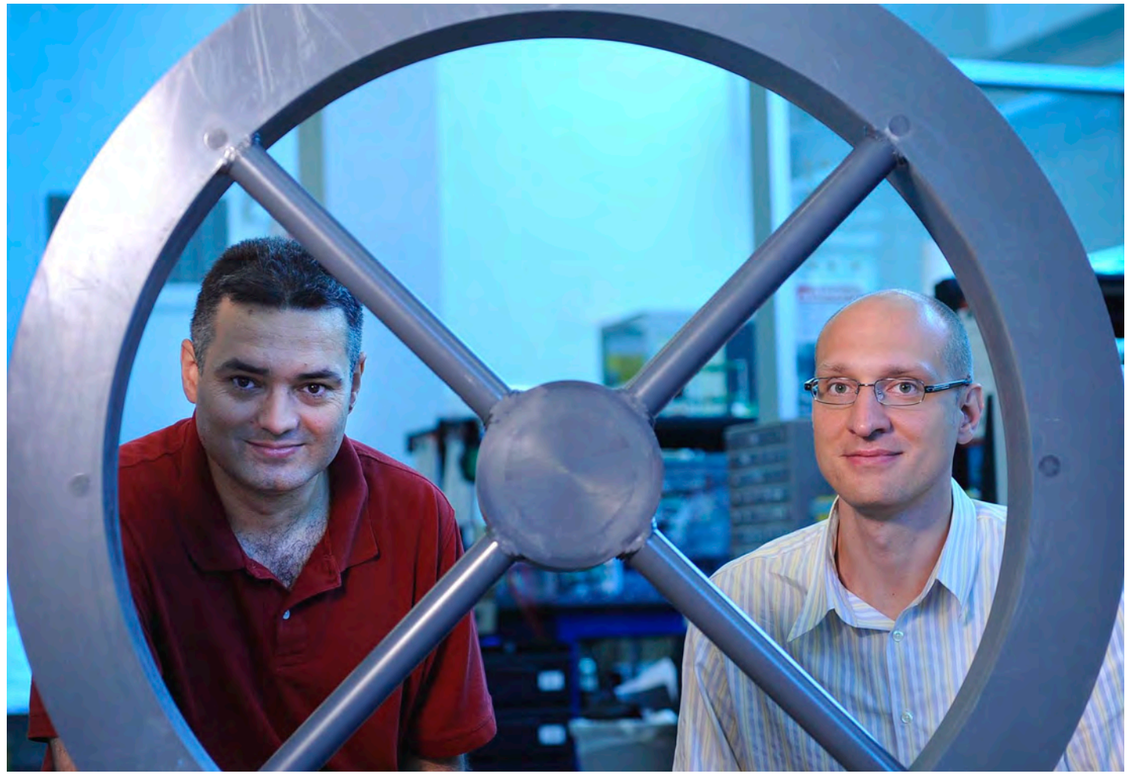
WPT systems work by transmitting magnetic waves on a specific frequency from a transmitter to a receiver. These magnetic waves interact with a coil in the receiver to induce an electric current. If the coil is tuned so that its resonant frequency matches the frequency of the magnetic waves, the current it produces is amplified. However, if the receiver and the transmitter are out of tune, the system becomes inefficient and doesn't transfer much power. The receiver coil still picks up a trace amount of current, but it is not amplified.

This is a problem because many factors can affect the tuning of a receiver or transmitter, such as temperature or proximity to other magnetic objects. In other words, a hot summer day could wreak havoc on the tuning of a receiver.

Lukic and Pantic, who co-authored a paper on the research, developed a prototype that incorporates additional circuitry into the receiver that does two things: it injects small amounts of reactive power into the receiver coil to maintain its original resonant frequency; and, if the transmitter's tuning changes, the prototype can read the trace amount of current being transmitted and adjust the receiver's tuning accordingly.

The research was supported by the Advanced Transportation Energy Center at NC State.

"The next step is to try incorporating this work into technology that can be used to wirelessly charge electric vehicles," Lukic said. ▪



A visit from the chancellor

Chancellor Randy Woodson was treated to a tour of NC State's newest engineering building and several of its laboratories in April.

The College of Engineering hosted the chancellor for the tour of Engineering Building III, which opened in 2010 and houses the Department of Mechanical and Aerospace Engineering and the Joint NC State-UNC Department of Biomedical Engineering. The tour was part of the chancellor's annual visit to the College.

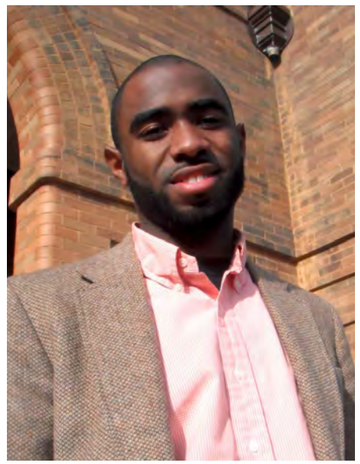
Woodson, accompanied by Dr. Louis A. Martin-Vega, dean of the College of Engineering, visited the Biomedical Microfabrication Laboratory, where researchers use ultraviolet lithography equipment to design, fabricate and test microfabricated sensors and devices. The chancellor also toured the Electromechanics Research Laboratory, where he operated a robotic heart catheter and learned about the lab's medical and engine research. Then it was on to the building's subsonic wind tunnel and flight research lab.

Woodson also visited the NC State facilities of the Consortium for Advanced Simulation of Light Water Reactors, a $122 million multi-institution research initiative that is using computer models to develop innovative new approaches to nuclear power that will result in safer, more cost-effective energy. NC State plays a leading role in the new center.

Near the end of the tour, Woodson toured the Human Physiology of Wearable Robotics (PoWeR) Lab, where researchers study the science and physiology of wearable robotics. Research conducted in the lab could significantly improve the lives of people with disabilities, aging baby-boomers and soldiers on the battlefield.

Finally, Woodson met with NC State's Aerial Robotics Club, where he used a computer to fly a simulated unmanned aerial vehicle over Centennial Campus. ▪

Student wins first place for 'Stay With It' video



Nehemiah Mabry, a doctoral student in civil engineering at NC State, won the grand prize for a video he created for the national "Stay With It" engineering competition.

The two-minute video, which follows Mabry through a day studying, attending class and meeting with professors, was named the best among the 12 finalists for the prize. Mabry will receive a $2,500 college bookstore credit and an Ultrabook computer.

Check out Mabry's video online at ow.ly/aKGip (URL is case-sensitive).

Stay With It is a national initiative designed to help students keep working toward their engineering degrees. The contest asked engineering students to explain how they would do it.

"I'm here because I don't just want to have the next big thing," Mabry says in the video. "I want to create it."

The award for Mabry followed the launch of the national Stay With It campaign on the National Day of Engineering on March 14. About 160 NC State engineering students celebrated the launch at an event at Witherspoon Cinema.

The Stay With It initiative is sponsored by the President's Council on Jobs and Competitiveness in partnership with Intel, MTV and Facebook. ▪

DeSimone elected to National Academy of Sciences

Dr. Joseph DeSimone has been elected to the National Academy of Sciences (NAS), one of the highest honors that a US scientist or engineer can receive. DeSimone is William R. Kenan Jr. Professor of Chemical Engineering at NC State and Chancellor's Eminent Professor of Chemistry at UNC-Chapel Hill.

DeSimone has more than 280 publications and 130 patents. His current work in nanomedicine includes developing a nanoparticle vaccine for prostate cancer and creating particles that mimic red blood cells. ▪

Irving receives NSF CAREER Award

Dr. Douglas L. Irving, assistant professor of materials science and engineering at NC State, has received a Faculty Early Career Development Award from the National Science Foundation (NSF). The award, known as the NSF CAREER Award, is one of the highest honors given by NSF to young faculty in science and engineering.

Irving is the College's 52nd NSF CAREER Award winner since 2000. ▪

Felder wins ASEE Lifetime Achievement Award

Dr. Richard M. Felder, Hoechst Celanese Professor Emeritus of Chemical Engineering at NC State, is the inaugural winner of the Lifetime Achievement Award in Engineering Education from the American Society for Engineering Education (ASEE).

Felder has authored and co-authored more than 300 papers on engineering and science education and chemical process engineering. He has also co-directed the National Effective Teaching Institute under the auspices of ASEE since 1991. ▪

Narayan receives Holladay Medal

The NC State Board of Trustees awarded the Alexander Quarles Holladay Medal for Excellence this spring to Dr. Jagdish "Jay" Narayan in recognition of his outstanding career at the university, including his research in novel materials and groundbreaking contributions in materials science. The Holladay Medal is the highest honor bestowed on a faculty member by the trustees and the university.

Narayan is the John C.C. Fan Family Distinguished Chair Professor of Materials Science and Engineering at NC State. He has received 35 patents and published more than 500 papers in archival journals. ▪

Three NC State engineers honored by IIE

Three NC State industrial engineers have been honored with some of the loftiest professional recognitions awarded by the Institute of Industrial Engineers (IIE).

Dr. Louis A. Martin-Vega, dean of the College, was honored with IIE's highest and most esteemed honor, the Frank and Lillian Gilbreth Industrial Engineering Award. Recipients are recognized for their distinguished national and international contributions to the welfare of mankind in the field of industrial engineering.

Dr. Jerome Lavelle, associate dean of academic affairs in the College, was given IIE's Fellow Award, which recognizes outstanding leaders who have made significant, nationally recognized contributions to industrial engineering. A Fellow is the highest classification of IIE membership; no more than 20 can be named each year.

Dr. Ola Harrysson, associate professor in the Edward P. Fitts Department of Industrial and Systems Engineering, received IIE's award for Technical Innovation in Industrial Engineering, which honors pioneering technical contributions to the field. His groundbreaking health care work in osseointegration, a process that fuses a prosthetic limb directly to bone, has drawn international attention. ▪

DESIGNING SENIORS

INVENT SOMETHING IMPORTANT.

That's the challenge put to NC State engineering seniors who spend their final year of college immersed in a senior design project. These students tackle critical problems in areas such as energy, global health and security.

From a new system that helps consumers save energy to an electricity-based approach to killing HIV in breast milk, see how NC State engineering students take their senior projects from the classroom to the real world.

Fighting HIV, one volt at a time
Biomedical Engineering

Shake the virus away.

That's what four biomedical engineering students dream of telling HIV-infected mothers each time they prepare a milk bottle for their babies. The students have created a disease-thwarting baby bottle that, when shaken, allows milk to pass through an electric current that deactivates HIV.

Without preventative measures, there's a one-in-three chance that these mothers will spread the deadly virus to their babies through their breast milk, adding to the more than 30 million people living with HIV across the globe.

"Withhold nutrition, or possibly give your child HIV?" said one of the NC State students, Michael McKnight. "It's a tough decision for moms to make."

The students came up with their idea after discovering a promising patent that indicated that HIV could be deactivated in blood if the virus was exposed to an electric current. So, with help from researchers in NC State's College of Veterinary Medicine, the students took the findings a couple steps further. They began working on a way to apply electricity to breast milk and designed an hourglass-shaped baby bottle that's easy for mothers and children to use.

The students' ultimate goal was to kill the HIV without removing the milk's nutritional value. They also kept in mind that many mothers in low-resource communities lack access to milk banks, reinforcing the need for a device that can be used at home.

Mothers would follow these simple steps: Dispense milk into the bottle, screw on the lid that holds the electrode-lined core, and shake the bottle for 10 minutes. The electricity that's generated deactivates the virus. A battery or a hand-cranked generator can work as an energy source, and the lid can be replaced with a regular baby bottle top for feeding.

With the help of NC State's veterinary experts and local companies offering prototype advice, the team hopes to continue its research and apply for a patent.

The ultimate goal: Commercialize the device while keeping costs low, ensuring that mothers everywhere can safely get their children the nutrition they need.

The right radiation
Nuclear Engineering

Each year, border patrol agents handle millions of cargo containers entering the US through scores of ports lining its borders.

The top priority: Making sure radioactive materials that could be used as weapons aren't waived through security.

Twelve NC State students wanted to help. Their creation is a system that applies current radiation detection technologies in a new way.

The new system serves two purposes. First, it can help agents fight a radiation-hiding technique called "masking," in which a harmless radioactive material, like fertilizer, conceals a more dangerous import, like uranium, that could be used to build nuclear weapons. Second, it keeps border agents from having to conduct lengthy weapons searches that turn up nothing but kitty litter.

To build their system, the students used an advanced detection method known as coincidence spectrometry to combine the strengths of two radiation detection tools — plastic scintillator detectors and more expensive sodium iodide detectors. The former are good at detecting radiation but provide little detail to inspectors. The latter provide more detail but are smaller and less sensitive.

After conducting tests with each type of detector — pitting a harmless bag of fertilizer (the "masking" agent) against a material called cobalt-60 that can be used in so-called "dirty bombs" — the team knew its system worked. It picked up the fertilizer and cobalt-60 separately.

"We're trying to make commerce flow better while also keeping Americans safe," said teammate Benjamin Bingham.

National security-focused projects like this can be found throughout the department's senior design program, and the commitment to keeping the nation safe will continue after the students graduate. The ongoing work prepares NC State engineers to tackle a grand challenge: preventing nuclear terror.

Spotting waste, saving money
Electrical and Computer Engineering

Computers. Air conditioning. Lighting.

We love these modern conveniences, but they come with a cost. In 2010, North Carolinians' residential electricity bills averaged $125 per month.

Four NC State students want you to enjoy these comforts without getting "sticker shock." They invented Granular Systems, a wirelessly distributed power sensor network system that allows consumers to identify how much energy they're using, which appliances are using the most energy, and ways to cut down the waste.

"We wanted to educate users, help them improve efficiency and enable control and automation of their homes," team leader Dreier Carr said.

Armed with its "smart outlet" invention, the Granular Systems team is now eyeing an even larger energy consumer: the industrial and manufacturing sectors. North Carolina ranks fourth in the nation in its total manufacturing output, and companies' power-eating machines can result in a massive power bill that offers little explanation as to who or what is using the power.

Here's the idea: Power outlets will be retrofitted with Granular Systems hardware, which sends minute-by-minute updates to an Internet-based system. Customers can track their energy use through an easy-to-understand online interface that breaks down

each machine's usage. Over time, businesses can figure out how to run their operations more efficiently and determine which equipment needs to be updated or replaced.

This past spring, the concept took top prize in the Design and Prototype Challenge in NC State's Lulu eGames, a university-wide competition for students with innovative ideas. The group has filed for a provisional patent and is partnering with Sustainable Industrial Solutions in Durham, NC, to test out the technology this fall.

"We're solving a problem that a lot of people don't even know that they have," Carr said.

Lightweight reconnaissance
Mechanical and Aerospace Engineering

This airplane doesn't need a long runway.

It has a wingspan only slightly wider than a yardstick, weighs slightly less than half a pound and is powered by a motor the size of a baby's fist.

It may also be the next way to quickly transport surveillance equipment used by farmers to watch over crops as well as firefighters and rescue workers needing an extra set of eyes during search-and-rescue missions. The plane can carry approximately three times its weight.

"It's mobile and easy to launch," said Patrick Leser, who led the student team that developed the plane. "You can even catch it out of the air."

Leser led one of the two groups enrolled in the bioflight option of the department's senior design course, which challenges students to incorporate a bird-like feature into the design of a small unmanned aircraft. Leser's team chose passive-surface flaps, which mimic how parts of a bird's feathers help the creature use shorter distances to take off and land.

The plane's wings are hollow and made of a lightweight fiberglass-covered foam. Each piece can be packed in an innovative, backpack-style carrying case lined with energy-harvesting solar panels. The aircraft can be assembled by two people in less than three minutes.

Last spring, after completing more than 100 hours of wind-tunnel testing and 25 successful test flights, the team's creation placed first in the American Institute of Aeronautics and Astronautics Southeast Regional Competition.

Ultimately, team members hope their design will serve as a model for future seniors, including those enrolled in a new course that teaches students to build inexpensive aerospace prototypes that could later be adopted and produced by industry. The team members were chosen to mentor students taking the course.

"Using hollow wings was something we came up with on our own," Leser said. "Many of the aspects of the design had never been done before, so it was up to us to figure out which methods worked best. We really had a great team." ▪

FILLING THE FAST 15

NC State engineering has always been a business builder. So when the university's Office of Technology Transfer rolled out its inaugural NC State Fast 15, a group of the most compelling new business ventures produced by faculty and students, it was no surprise that most came from the College of Engineering.

A 25-year NC State success story

The roots of Cree, a powerhouse in the growing LED lighting industry, date to 1983, when a group of graduate students and young faculty were investigating silicon carbide in an NC State materials science and engineering lab. By 1987, the researchers had devised a way to grow silicon carbide crystals and use them in ways that could be used for lighting. So they founded Cree.

In 1989, Cree introduced the world's first blue light-emitting diode (LED), a landmark that paved the way for billboards and large video screens to produce full-color displays. Today, Cree's energy-efficient LED lights and lighting components brighten spaces all over the world. The Durham, NC-based company now employs more than 5,000 workers and is among the world's top LED manufacturers.

Cree turned 25 years old this year. Talk about a success story.

CERTALGO

Certalgo is developing a device that cools saline for inducing therapeutic hypothermia in patients suffering from heart attacks, heat stroke and serious concussions. The device doesn't need refrigeration or electricity, meaning the live-saving hypothermia treatment can be used practically anywhere.

IMAGINEOPTIX

ImagineOptix is a development and licensing company commercializing revolutionary new optical films and components based on technology developed at NC State. Its films are enabling next-generation products including projector phones, efficient mobile displays, telecommunication switches and other devices.

KATHAROS

Katharos is developing a filter that removes certain blood phosphates during dialysis treatment, extending the lives of those with chronic kidney disease and reducing the need for associated medications. The system should also reduce related heart and bone disease complications.

KNOWIT

Knowit is an online platform that enables users to share what they learn with friends and followers. Users can organize what they read, watch, write, and experience into a portfolio, and then use it to get a job or internship.

ORYX BIO

Oryx Bio has developed a unique combination of compounds and filtration devices that provides faster, cheaper and better ways to separate and purify protein antibodies and vaccines. The company bought the College of Engineering spinout Ligamar earlier this year.

POLYMER BRAILLE

Polymer Braille is building an electronic reading device for the blind that converts pages into multiple lines of Braille dots that rise up through the screen. This advancement could increase Braille literacy, a key for employment for the blind.

SPARKMOTO

SPARKmoto has developed an intelligent, electric supercharger with big performance advantages over traditional turbos and superchargers. The company is focusing on motorcycles, but it wants to expand to all-terrain vehicles and autos.

VAPORPULSE

VaporPulse Technologies is commercializing an advanced coating method that will be used for defense and commercial applications. The company's first product, SunEvade, provides twice the UV protection of uncoated fabrics and protects them from fading in the sun.

XANOFI

Xanofi produces nanofibers for filters and medical uses through a unique, liquid-based process that holds great potential for numerous markets. Its technology — called XanoShear — creates a significant production advantage over current electrospinning and meltblowing methods.

The Next Class

The 2013 Fast 15 class was announced as this magazine went to press. The College is well-represented; most of the start-up companies and projects were founded by NC State engineers and computer scientists or were based on College research.

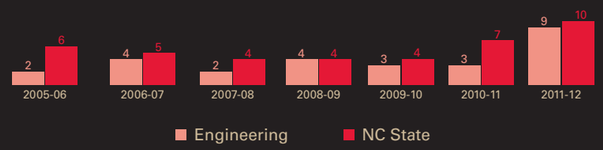
CellSentry
Certalgo*
Granular Systems
GridBridge
Koyr Engineering
mAssured Technology
Offline Media
RiboScan Technologies
VaporPulse*
Zone Five Software

* Holdover from 2012 class

More information at research.ncsu.edu/ott.

Startup State

NC State has spawned 40 startups since 2005, and the College of Engineering has played a role in two-thirds of them.



Note: The engineering totals include startups from NC State's Entrepreneurship Initiative.

Health ASSIST

A new NC State-led National Science Foundation Nanosystems Engineering Research Center could transform the way we think about health care.

What makes a 10-year-old asthmatic girl cough?

It could be an allergy to the family dog. Or high pollen counts. Or smoke from the old factory she passes on the way to school.

For worried parents, solving this health puzzle would be much easier if there were a reliable way to monitor what's happening in their daughter's body in real time. They could track when symptoms appear and when they go away. Eventually, they could steer her away from environments that make her sick.

Researchers at the new National Science Foundation (NSF) Nanosystems Engineering Research Center for Advanced Self-Powered Systems of Integrated Sensors and Technologies (ASSIST) are working on ways to make this happen. The center, headquartered at NC State with additional faculty and facilities at three partner institutions, is using the tiniest of materials to develop self-powered health monitoring sensors and devices.

These devices could be worn on the chest like a patch, on the wrist like a watch, as a cap that fits over a tooth, or in other ways, depending on the biological system that's being monitored. Wireless health monitoring is already a fast-growing industry, but the self-powered technology being developed by ASSIST means that changing and recharging batteries on these devices could be a thing of the past.

"Currently there are many devices out there that monitor health in different ways," said Dr. Veena Misra, the center's director and professor of electrical and computer engineering at NC State. "What's unique about our technologies is the fact that they are powered by the human body, so they don't require battery charging."

These devices could transform health care by improving the way doctors, patients and researchers gather and interpret important health data. Armed with uninterrupted streams of heart rate readings, oxygen levels, carbon monoxide concentrations, and other data, sick people could better manage chronic diseases, and healthy people could make even better decisions to keep themselves fit.

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

On a larger scale, data gleaned from research studies employing these devices could prove invaluable to lawmakers crafting environmental policy. And if people using the devices make better decisions about where and how healthfully they live, national health care costs, which topped $2.5 trillion in 2010, could come down.

The ASSIST Center, one of three recently announced Nanosystems Engineering Research Centers, will be supported by an initial five-year, $18.5 million NSF grant that will fund the center's research, education and outreach programs. Additional support will come from industry partners that will bring the center's research to the marketplace. About 30 companies and agencies have already signed up.

The new center is headquartered on NC State's Centennial Campus in the Larry K. Monteith Engineering Research Center. Just down the road is the NSF FREEDM Systems Center, another Engineering Research Center led by the university. With the addition of ASSIST, NC State holds the distinction of being the only university in the country currently leading two active NSF Engineering Research Centers, among the largest and most prestigious grants made by the engineering directorate of the federal agency.

A new way to monitor

People have used electronic devices for years to monitor their health. Sporting goods stores are filled with wristwatches that track heart rates and count calories burned. Diabetics can use wireless monitors to track their blood sugar levels.

But these devices run on batteries that will inevitably run out. When that happens, the device stops collecting data, and the hassle of replacing and recharging those batteries means the device might not start up again for awhile. The result: Important new information about a person's health could be lost.

At ASSIST, researchers see room for improvement. Their strategy: Go small.

By using nanomaterials — a nanowire is thousands of times thinner than a human hair — ASSIST researchers want to make sensing systems that operate on the tiniest amounts of power. Some of these materials are thermoelectric and piezoelectric, meaning they use body heat and body motion, respectively, as power sources.

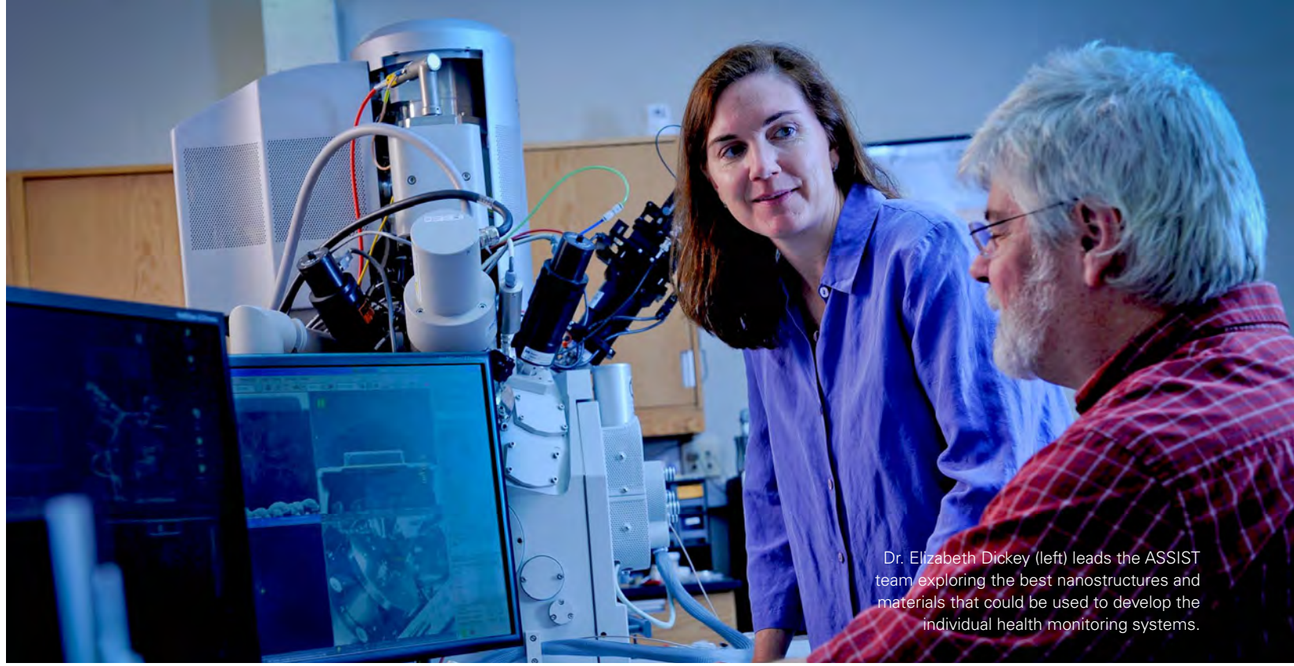
That means the batteries in ASSIST's nanosensors and nanodevices won't need charging. And ultimately, as the technology becomes more advanced, these systems won't need batteries at all.

Two types of tracking

ASSIST researchers see their sensors and devices doing two jobs.

The first, called exposure tracking, is aimed at people who want to monitor the environment around them while simultaneously monitoring their bodies' responses to that environment. This information could be used to find links between personal health and exposure to harmful environmental conditions.

A person with asthma, for example, could wear a wristband with a sensor that picks up ozone levels and harmful pollutants and then wirelessly transmits that information to a doctor. The technology should gather enough uninterrupted data to help patients, doctors and scientists make direct correlations between health and environmental exposure, a breakthrough that's eluded the scientific community for centuries.



Dr. Elizabeth Dickey (left) leads the ASSIST team exploring the best nanostructures and materials that could be used to develop the individual health monitoring systems.

The second type of tracking, called wellness tracking, is aimed at helping people improve the way they monitor their own health. The center's minimally-invasive technologies will provide users with data on several different health indicators, such as heart and respiration rates, and what emerges should be a much clearer picture of a person's overall health.

A person experiencing stress, for example, could learn much from the real-time information provided by these systems.

"If your heart rate goes up, why did it go up? If you're feeling upset, why are you upset?" said Dr. John Muth, an NC State professor of electrical and computer engineering and the center's

Two ERCs, one campus

NC State is the only university in the country currently leading two active NSF Engineering Research Centers, the ASSIST Center and the FREEDM Systems Center. An ERC is one of the largest and most prestigious awards granted by NSF.

About ASSIST

Mission
Empower personal and environmental health monitoring by using advances in nanotechnology to create energy harvesting, battery-free and ultra-low-power nanosensors and devices.

Lead Institution
NC State University

Director
Dr. Veena Misra, Professor of Electrical and Computer Engineering at NC State

Partner Institutions
Florida International University
Pennsylvania State University
University of Virginia

Affiliated Institutions
University of Michigan
University of North Carolina at Chapel Hill
University of Adelaide (Australia)
Korea Advanced Institute of Science and Technology
Tokyo Institute of Technology

Headquarters
The Larry K. Monteith Engineering Research Center
NC State University Centennial Campus

About FREEDM

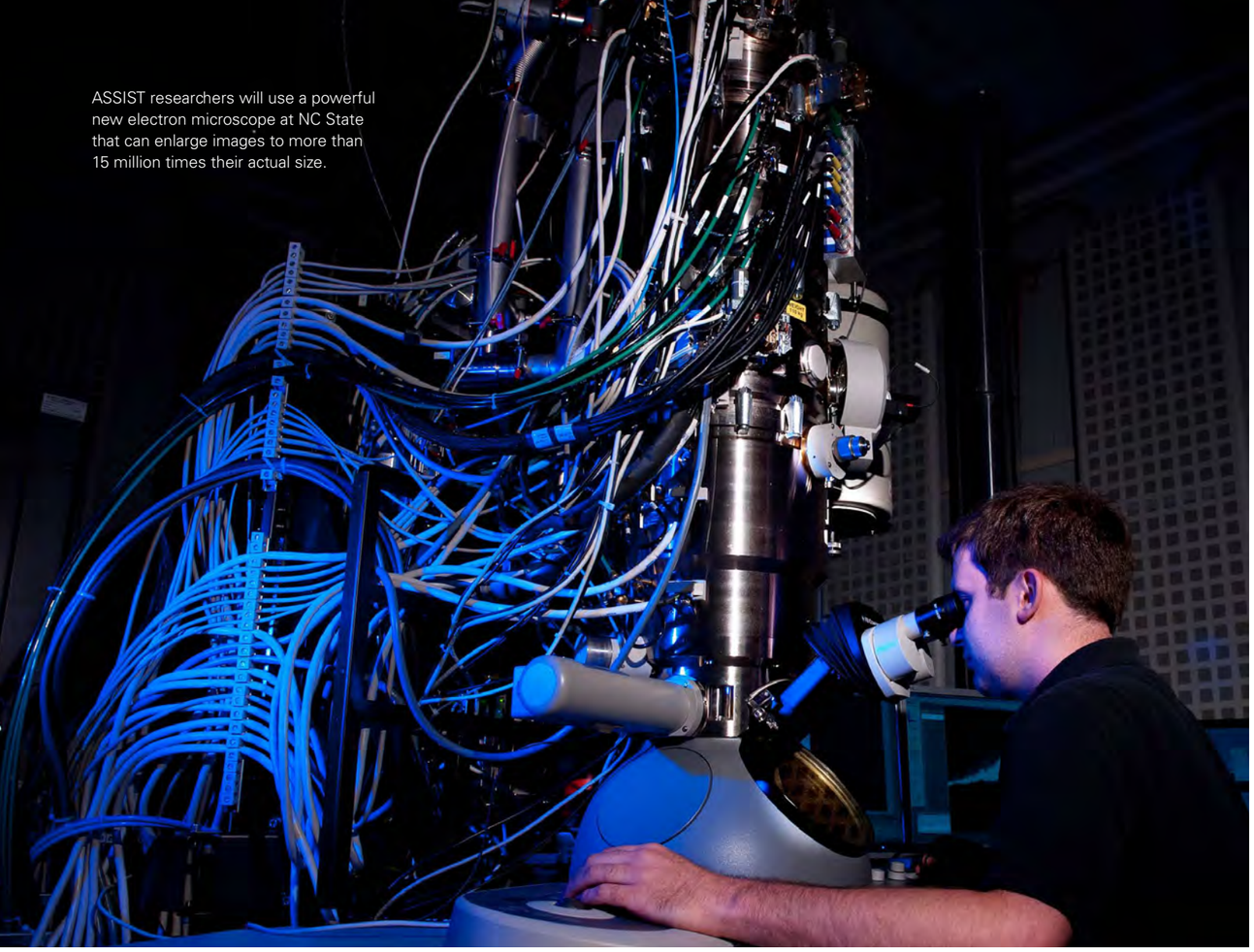
Mission
Develop technology to revolutionize the nation's power grid and speed renewable electric-energy technologies into every home and business.

Lead Institution
NC State University

Director
Dr. Alex Huang, Progress Energy Distinguished Professor of Electrical and Computer Engineering at NC State

Partner Institutions
Arizona State University
Florida A&M University
Florida State University
Missouri University of Science & Technology
RWTH Aachen University (Germany)
Swiss Federal Institute of Technology, Zurich
University of Auckland (New Zealand)

Headquarters
Keystone Science Center
NC State University Centennial Campus



ASSIST researchers will use a powerful new electron microscope at NC State that can enlarge images to more than 15 million times their actual size.

deputy director. "Your body has all of these responses to the little things that are happening as you go about your daily routine and interact with your immediate environment. These devices will help people measure and understand an individual's response to different stressors."

Athletes and fitness aficionados are already monitoring their health in increasing numbers — more than 80 million wearable fitness devices will reach shelves by 2016, according to a 2011 report from ABI Research. Popularity is also growing for systems that monitor heart rates, blood pressure levels and other health information in people with chronic diseases. The US market for such systems, which was $3.9 billion in 2007, is expected to reach $20.9 billion in 2016, according to a July report from the marketing firm Kalorama Information.

Data from these devices can be transmitted to a smartphone app, allowing users to get easily digestible health information and, if they want, share that information with their doctors.

But the dependence on batteries is holding back advancements in monitoring technologies. ASSIST researchers want to change that.

By developing technologies that are self-powered and hassle-free, health monitoring can extend beyond fitness devotees and people with chronic diseases to a much larger group of people who just want to improve their own health.

Partners in academia and industry

Developing efficient ways to harness energy from the human body, as well as the sensors and antennae to detect and transmit health data in real-time, requires expertise from across the nanotechnology spectrum. The center's researchers include experts in everything from environmental sensing to low-powered nanoelectronics to materials science and engineering.

"Key work on building these self-powered sensing systems is going on at different ASSIST partner schools," Misra said.

The center includes three partner institutions — Penn State, the University of Virginia and Florida International University. Also involved are UNC-Chapel Hill, the University of Michigan and universities in Australia, Japan and South Korea.

At NC State, Dr. Elizabeth Dickey, a professor of materials science and engineering, will lead the team exploring the best nanostructures and materials that could be used to develop the individual health monitoring systems.

Dickey and other researchers will take advantage of equipment in NC State's high-tech Nanofabrication Facility and Analytical Instrumentation Facility, the latter of which houses a powerful new electron microscope that can enlarge images to more than 15 million times their actual size at resolutions up to two-billionths of an inch.

"From our perspective, structure, properties and performance are interrelated," Dickey said. "With these powerful research tools, we have a better understanding of the connection."

The ASSIST Center will also draw on the expertise of industry partners that will help guide the center's work, speeding innovations developed at the center to the marketplace.

Among the partners is Rex Healthcare, the Triangle-based health care system.

"Rex Healthcare is excited to become a member of the ASSIST Center," said Rex Healthcare President David Strong. "A collaborative partnership between Rex and the ASSIST team brings together scientific, engineering and medical expertise to develop devices that have the potential to revolutionize individualized medicine."

Other partners include companies and agencies involved in microdevices, software development, bioengineering and health care. Phononic Devices, a startup that makes thermoelectric devices, and Texas Instruments, the large chip manufacturer, are among them.

"Texas Instruments is very excited about the research and commercialization prospects for the ASSIST ERC," said Dr. R. Allen Bowling, manager of research and consortia for analog technology development at the company. "Progress in integrated sensor technologies, including ultra-low power systems and self-powered systems, will enable a great leap forward in the application of electronics for enhanced healthcare and security."

"We're going to work hand-in-hand with industry to create these technologies," Misra said. "And that's going to help spawn new companies, new markets and new jobs."

The future of nanotechnology

Educating students is a big part of the center's mission.

The center will offer an undergraduate concentration and a graduate master's certificate program in nanotechnology, as well as a personalized professional-development program for graduate students.

"This is an investment for the future," said Dr. Mehmet Ozturk, a professor of electrical and computer engineering at NC State who directs the center's education and diversity programs. "We'll be developing a culture that will influence not only the years during the center's existence, but the next 20 to 30 years."

In addition, the center has partnered with 11 middle and high schools in North Carolina, Virginia, Florida and Pennsylvania to develop outreach activities that bring nanosystems engineering into the classroom. Students in partner high schools will get the chance to be involved in ASSIST research.

Some day, perhaps, they'll be wearing the devices they helped create.

"The self-powered technologies that we're creating will add a completely new genre of sensors to the market," Misra said. "These devices should last for a very long time." ▪

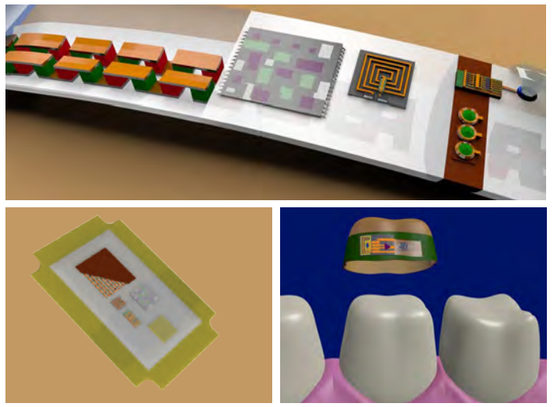
An ERC history

The ASSIST Center will be the third NSF Engineering Research Center (ERC) led by NC State since the ERC program was established in 1985.

[1988] Advanced Electronic Materials Processing ERC

[2008] FREEDM Systems ERC (active)

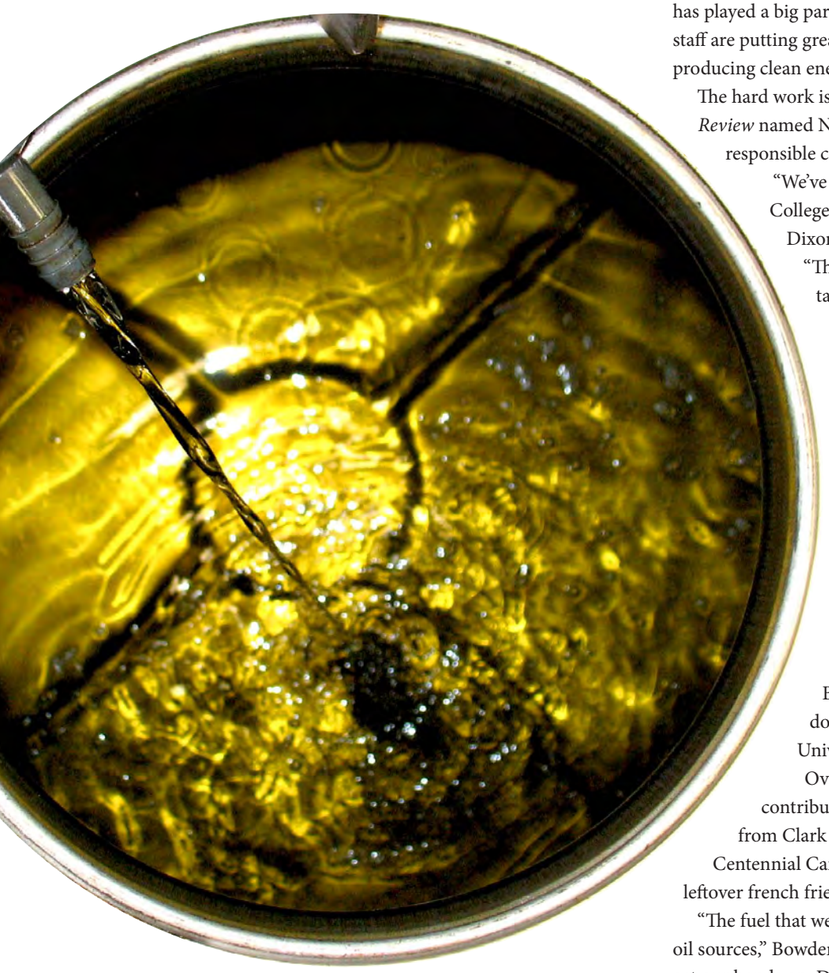
[2012] ASSIST Nanosystems ERC (active)



Devices developed at ASSIST could be worn on the wrist like a watch, on the chest like a patch, or as a cap that fits over a tooth.

ENGINEERING GREEN ON CAMPUS

College of Engineering students, faculty and staff help make NC State one of the nation's greenest campuses.



Above, finished biodiesel produced by the BRIC club. Opposite page, Marshall Bowden (left) and Nick Venuti disassemble an old pump assembly at NC State's biodiesel pilot plant.

Two years ago. That was the last time Marshall Bowden visited a gas station to fill up the tank in his Volkswagen Jetta.

Since then, he's been running the car on biodiesel made on campus by engineering students just like him.

NC State has earned a national reputation in recent years as one of the greenest campuses around, and the College of Engineering has played a big part in that transformation. Students, faculty and staff are putting greater emphasis on recycling, conservation and producing clean energy.

The hard work is paying off. Earlier this year, the *Princeton Review* named NC State one of the most environmentally responsible colleges in the US and Canada.

"We've seen tremendous contributions from the College of Engineering and its students," said Tracy Dixon, director of NC State's Sustainability Office. "They really see the value in supporting our sustainability efforts."

Students like Bowden, who studied chemical engineering before graduating earlier this year, have helped. In 2009, he became involved with NC State's biodiesel pilot plant, which converts used fryer oil into biodiesel fuel.

Soon after, he co-founded the Biofuel Research and Implementation Club (BRIC) with fellow chemical engineering student Nick Venuti. Among BRIC's activities is the production of biodiesel, an alternative diesel fuel that's made primarily from waste vegetable oils and animal fats.

To keep its efforts campus-centered, BRIC recycles waste vegetable and fryer oil — donated from nearby eateries, including NC State University Dining — for fuel production.

Over the past year, University Dining has contributed approximately 450 gallons of waste fryer oil from Clark Dining Hall and the new Innovation Cafe on Centennial Campus. It's raw stuff. BRIC needs to filter out the leftover french fries before they start making the fuel.

"The fuel that we make comes from a variety of waste vegetable oil sources," Bowden said. "We use pretty much whatever we can get our hands on. Donations continue to help us out tremendously."

BRIC has pushed to have student-made biodiesel blends used in school machinery. The NC State Dairy Extension volunteered to test the fuel and has successfully used a five-to-10 percent biodiesel blend in its farming equipment.

And to remove any doubts about the quality of the biodiesel, BRIC members test it on their own cars and mechanical equipment.

"My Jetta TDI has been using BRIC biodiesel for the last two years without any fuel-related problems," Bowden said. "[And] local farmers have used it in tractors and equipment without any issues."

BRIC isn't the only group driving sustainability efforts at NC State. Other engineering students are enlisting their green thumbs to campus projects.

In April 2011, electrical and computer engineering student Kyle Barth helped develop a community garden in the University Honors Village. The idea for the garden had previously won a student government sustainability competition and was funded with a $500 grant.

Barth and the other members of NC State's Quad Sustainability Committee used the grant to help build a plot for the garden and buy all the necessary tools and seeds. Once the garden was completed, the committee became responsible for maintaining it. That meant planting, harvesting, weeding and watering.

"We wanted to show that it doesn't take much to build and take care of a nice little garden that produces vegetables that are easily harvested and used," Barth said.

Engineering students are also thinking about ways to keep still-usable items out of landfills. Azariah Barrow, an aerospace engineering major and a former chair of the Inter-Residence Council (IRC) Sustainability Committee, helped organize a "Residence Hall Swap Shop."

In April, with the end of the semester looming, the mock yard sale was set up for students to buy, sell and trade miscellaneous unwanted or outgrown items such as Nerf guns and DVDs. The IRC also gave away unused promotional gear such as pens and cups. The idea behind the swap shop, Barrow said, was to give students a reason to recycle and reuse instead of throwing things away.

With that same goal in mind, Barrow and other engineering students were involved in the "Reusable Regatta," which focused on building boats and rafts out of reused and recycled items.

Like other students working to keep NC State green, Barrow wants to make sure the resources available today are around for future generations to enjoy.

"It's all about making the most of what you have," Barrow said. "We want to represent the best of Raleigh and our school." ▪

Sustainability Recognized

Thanks in part to its engineering students and faculty, NC State has earned recognition as one of the greenest schools around.

One of the most environmentally responsible colleges in the US and Canada
Princeton Review
2012

Bicycle Friendly University
League of American Bicyclists
2012

No. 4 among the Southeast's Coolest Schools
(green university rankings)
Blue Ridge Outdoors magazine
2010

RISING *stars*

NC State has some of the finest young engineering and computer science minds in the country. But don't take our word for it; ask the National Science Foundation.

Since 2000, 52 College of Engineering faculty have received NSF CAREER Awards, one of the nation's top honors for early-career faculty members. Plenty of others have also become leading authorities in their fields, racking up awards and mentoring top graduate students.

These pages celebrate just a few of the many faculty members who have distinguished themselves — and NC State — early in their careers.

Michael Escuti

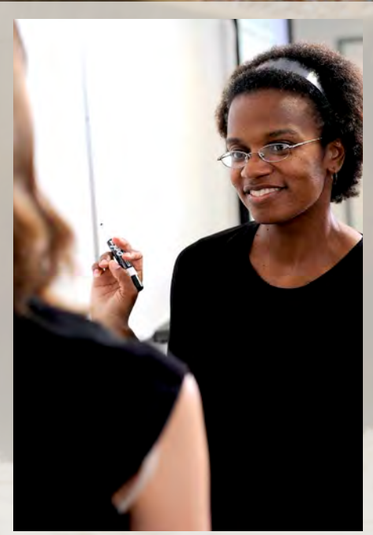
Associate Professor
Electrical and Computer Engineering

Michael Escuti has developed a liquid crystal hologram that makes projectors and displays in smartphones, tablets and TVs more energy-efficient. The hologram formats light — called polarization conversion — twice as efficiently as current methods. He's also used the technology to develop a better way to steer laser beams. His work earned him the 2011 Presidential Early Career Award for Scientists and Engineers. "I aim to realize beauty and understanding in my corner of science, and then engineer both for a meaningful impact."

Xuxian Jiang

Associate Professor
Computer Science

Xuxian Jiang studies how malware attacks computers — including smartphones. His most recent undertaking is the Android Malware Genome Project at NC State, which collects data on more than 1,200 malware on the increasingly popular Android operating system. More than 130 companies and universities have learned more about protecting their systems by downloading the helpful data he's compiled — all free of charge. "All my research, insight and inspirations come from real-world needs."



Julie Ivy

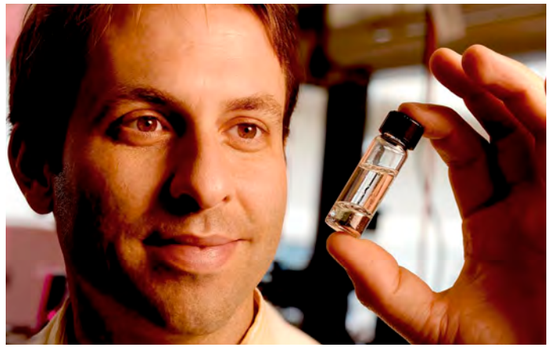
Associate Professor
Industrial and Systems Engineering

Julie Ivy uses advanced mathematical models to develop strategies that help doctors, nurses and hospital administrators care for patients more efficiently. Her calculations create what-if scenarios that can be used to test new treatment strategies or emergency-response systems without putting patients at risk. These models can help identify the best breast cancer screening policies or determine the number of nurses needed to vaccinate thousands in an epidemic. "I love the math, but I really love the possibility of improving people's lives."

Sankar Arumugam

Associate Professor
Civil, Construction, and Environmental Engineering

In developing countries, managing water resources and preparing for droughts and floods is important to ensure future water sustainability. Sankar Arumugam uses climate data to develop strategies to help water managers do just that. His simulations provide a glimpse into the future, predicting how climate change will affect long-term temperatures and precipitation totals. Armed with that knowledge, water managers can make good decisions that keep water safe and accessible. "We're very focused on ensuring water and ecological sustainability under future climate change."



Michael Dickey

Assistant Professor
Chemical and Biomolecular Engineering

Picture an antenna. Now imagine that it stretches like a rubber band. Michael Dickey and his research group have discovered how to manipulate a liquid metal to create stretchable antennas that can be tuned — through stretching — to change their frequencies. The new antennas hold promise in flexible electronics, biomedical devices and military applications. “We began developing the stretchable antennas because the idea was so compelling. We’re now able to put them in places we couldn’t before.”

Albena Ivanisevic

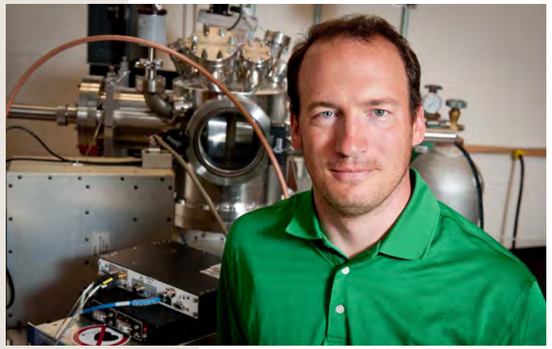
Associate Professor
Materials Science and Engineering
and Biomedical Engineering

In diabetic patients, scar tissue can form on the surface layer of the retina, causing damage to the eye and even blindness if left untreated. Albena Ivanisevic is using a new microscopy technique to better understand the properties and surface characteristics of scarred eye tissue. The study is one of the first to use an atomic force imaging technique to learn more about the composition of human eye tissues. “This could be used for research into additional treatments for the condition.”

Bill Hunt

Associate Professor and Extension Specialist
Biological and Agricultural Engineering

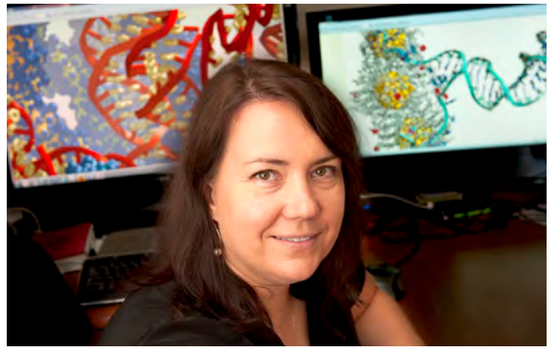
Bill Hunt is finding better ways to treat harmful storm-water runoff before it reaches bodies of water. His work includes everything from designing plant-laden green roofs to harvesting rainwater to developing permeable pavement that allows water to pass through it. The State of North Carolina, with Hunt’s help, recently adopted standards that allow such pavement to become more widely used. “Every time the state adjusts design guidelines per NC State research, I view that as a huge success.”



Steve Shannon

Associate Professor
Nuclear Engineering

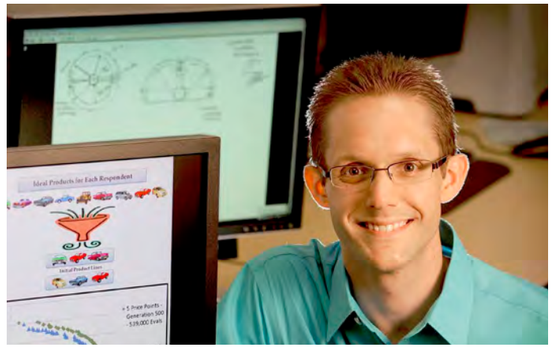
Steve Shannon works with plasmas, ionized gases that have applications from fluorescent light bulbs to fusion energy. He was the first to develop a new method to create plasmas at normal atmospheric pressure, opening up their potential for a wide range of applications, including wound treatment, disinfection, and surface treatments for manufacturing. He’s also working with NC State civil engineers to use plasma in water treatment. “I wish everybody had a job that is as fun as mine.”



Yaroslava Yingling

Assistant Professor
Materials Science and Engineering

Yaroslava Yingling wants to understand how to better control properties of DNA-based materials. Yingling and her team recently discovered a way to use tiny gold nanoparticles to decorate, bend or even “unzip” a DNA helix. The discovery could prove helpful for medical applications such as gene therapy and DNA-based electronics, which use DNA as a template for creating nanoelectronic circuits. “We can tailor the nanoparticles to maintain or challenge the structural integrity of the DNA.”



Scott Ferguson

Assistant Professor
Mechanical and Aerospace Engineering

Scott Ferguson wants product manufacturers to give consumers “almost” what they want. His research is based on strategically targeting product attributes that should be made customizable. Ferguson wants to help manufacturers make the necessary tradeoff decisions that allow buyers to add these finishing touches. “Consumers want some control over what’s in their new car or MP3 player. This work helps guide the product architecture decisions to make it possible.”

5 more to watch

Expect big things from these young faculty members in the coming years.

Kristy Elizabeth Boyer

Assistant Professor
Computer Science

Kristy Boyer is developing models to help computers better understand human dialogue. The results could improve the way humans learn through computers.

Aranya Chakrabortty

Assistant Professor
Electrical and Computer Engineering

Aranya Chakrabortty is developing new ways to model, track and control the ever-changing behavior of large electric power grids to prevent blackouts and other catastrophes.

James LeBeau

Assistant Professor
Materials Science and Engineering

James LeBeau uses powerful electron microscopes to gather new information about the atoms in advanced materials that influence how modern electronic devices work.

Gregory Sawicki

Assistant Professor
Biomedical Engineering

Gregory Sawicki studies human locomotion to develop lower-limb robotic devices that help both healthy and disabled people move more easily.

Emily Zechman

Assistant Professor
Civil, Construction, and Environmental Engineering

Emily Zechman develops models to help urban water supply and infrastructure managers adapt to changing demands and protect public health in environmental emergencies.

YOUNG ALUMNI

INTRODUCING the Young Alumni Council

A new group of recent graduates wants to reconnect their peers with the College.

Rashida Hodge decided to give back to NC State sooner rather than later.

As a student, scholarships had allowed her to focus on schoolwork without worrying about debt. So, shortly after graduation, she established her own scholarship. It's already funded awards for three students, and she wants to keep contributing to it until it's fully endowed.

"I didn't want to wait until I was comfortable," said Hodge, who earned bachelor's and master's degrees in industrial engineering from NC State in 2002 and 2003, respectively. "I'm just a big fan of giving back to the community that invested in me."

In that spirit, Hodge and some of her peers have started a new group to encourage others to give back to NC State. The Young Alumni Council (YAC), which formed this spring, is a cadre of recent graduates who want to mobilize young alumni into a giant support force for the College.

Convincing more young alumni to contribute financially is among the group's goals, but it also just wants to get more recent graduates involved with College activities and each other.

"A rising tide lifts all ships," said Jay Dawkins, a YAC member and a 2010 civil engineering graduate. "Our personal destinies are not independent of NC State. If we do something to improve the reputation of the College, we improve our own lives."

The YAC's nine members hail from different backgrounds and fields, so they bring a variety of perspectives to the group. The chair, Aaron Isbell, a 2007 computer science graduate, runs the young professionals group at SAS, the software company in Cary, NC.

"The College needs its young alumni to stay connected and get involved," Isbell said. "That could mean participating in Engineers Week. Or if a student gets an internship, maybe there's an NC State engineering grad working at that company who can be a mentor."

Young Alumni Council members include (from left to right) Aaron Isbell, Josh Hames, Jay Dawkins and Rashida Hodge.

The group's early activities have been devoted to better understanding the College's young alumni base, including collecting data on how alumni interact with NC State now.

Later this fall, the group will use that data to craft a proposal aimed at boosting young alumni participation. Developing regional groups of recent graduates is among its ideas.

"From early discussions, it's pretty clear that people are passionate about this College, but they may not be engaged with it right now," Isbell said.

The new group will work alongside the NC State Engineering Foundation, which partners with alumni and friends to secure private financial support for the College. Electrical engineering alumnus Robin Manning, who chairs the College Relations Committee on the Foundation's Board of Directors, said the new group can help young alumni develop a habit of involvement.

"The more people who are involved, the more they can do to support the College," Manning said. "We need that energy and vitality that young alumni bring to connect the larger alumni base with the student population."

Hodge, who grew up in the US Virgin Islands, didn't know what to expect when she arrived at NC State in 1998. What she found was a welcoming community, and she wants to help other NC State engineering students find that community, too.

"Growing up, my mom always told me that to be successful, you have to have skills and capabilities, but you also need to know that you're standing on the shoulders of giants," Hodge said. "I want to help someone be successful. I want to be a giant for them." ▪

Get Involved

Attend Homecoming
The College holds its first Homecoming celebration Nov. 2.
engr.ncsu.edu/alumni/homecoming

Help out at E-Week and E-Day
Critique resumes and give mock interviews during these annual on-campus celebrations of engineering.
Contact Daniel Pietrzak at **dapietrz@ncsu.edu**.

Organize a regional alumni event
Bring together NC State engineering alumni in your area.
alumni.ncsu.edu

Recruit top students
Help host recruiting events in Raleigh, Charlotte and other North Carolina cities each fall, sharing your NC State experiences with prospective students.
Contact Martin Baucom at **mabaucom@ncsu.edu**.

Give
NC State needs more alumni to give each year. Your private financial contributions benefit students and boost the value of your degree. Alumni giving rates are considered in national rankings of engineering schools. **engr.ncsu.edu/foundation**

Connect with the YAC
The Young Alumni Council wants your help.
Contact Aaron Isbell at **aaron.isbell@sas.com**.

Get Social

Keep up with the College of Engineering on social media.

facebook.com/ncstateengineering **@NCStateEngr**

Matthew Meares (left), along with his father, Robert, have continued a family tradition of Dean's Circle giving.

A Tradition of Giving

Supporting the Dean's Circle is a family affair for these NC State engineering graduates.

Alumnus Merlin Meares started something special when he made his first gift to NC State in 1952: A family tradition of investing in the future.

Today, Meares' son, Robert, and grandson, Matthew, have followed the example set by the elder Meares, who passed away in August. They have been consistent members of the Dean's Circle, the College of Engineering's signature annual giving fund.

Dean's Circle donors help fund the scholarships and fellowships needed to recruit and retain the brightest students and support the College's departments and programs. Joining means making an annual gift to the College of $1,000 or more.

"My family has had a huge influence on my giving," said Matthew Meares, who graduated in 2000 with dual degrees in mechanical engineering and French. "Supporting education has always been the most important thing."

Dean's Circle gifts help NC State compete with other engineering schools for the best students. Donors can help supplement scholarship packages for top-performing students or support innovative programs in the College's academic departments.

"I think of the Dean's Circle as a way to strengthen the school year after year," said Robert Meares, a 1974 electrical engineering alumnus. He made his first gift to the College the year after he graduated and has been a Dean's Circle member for more than a decade.

To thank Dean's Circle donors, the College invites them to the Leadership Dinner held each fall and recognizes them in these pages and on its website. The Foundation also provides donors with yearly updates on how their support has helped the College.

"I feel like I should give back," said Matthew Meares, a Dean's Circle member since 2008. "My NC State engineering education launched my career and allowed me to pursue my interests."

Today Matthew is director of project finance at Amonix, a designer and manufacturer of concentrated solar power systems. He is also an alumnus of the Benjamin Franklin Scholars Program, which combines degrees from the College of Engineering and the College of Humanities and Social Sciences to create boundary-crossing graduates in the mold of its namesake.

Robert Meares, who endowed a scholarship in the College with his wife, Peggy, in 2003, has worked at IBM for nearly 40 years. He is credited with developing the customer ID cards that help grocery store shoppers take advantage of discounts and other membership perks.

Merlin Meares, a 1947 mechanical engineering alumnus, joined the Dean's Circle in 1988. He served on the NC State Alumni Association Board of Directors, the Campaign for Excellence steering committee, and the Board of Directors of the Wolfpack Club. In 1999 Merlin Meares received the Watauga Medal, the university's highest non-academic honor. He also received the Menscer Cup in recognition of his lifelong contributions to the university.

"My dad was 17 when he showed up at NC State," Robert Meares said. "This university was a huge part of his life." ▪

Dean's Circle Members 2011-12

SUPPORT THE DEAN'S CIRCLE

Learn more about membership in the College of Engineering's leadership giving society at **www.engr.ncsu.edu/foundation/deanscircle**.

To make a donation, please contact Daniel Pietrzak at 919.513.1714.

LAMPE SOCIETY ($10,000+)
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Edward P. Fitts, '61
Brian D. Garrett, '72
J. Alan Justice, '64
Thomas R. McPherson Jr., '76, '77
Timothy E. Scronce, '87
S. Ed White, '78
James G. Wilson, '67

FADUM SOCIETY ($5,000 – $9,999)
Larry A. Bowman, '73
Mark Cagley
Carlos D. Gutierrez, '60
Leonard Habas, '66
Jacob T. Hooks, '78
Ross W. Lampe Jr., '77
Peter M. Lehrer, '63
M. A. McDuffie, '48
William C. Miatke, '06
Carl S. Stutts, '68
Robert G. Wright, '68

VAN LEER SOCIETY ($2,500 – $4,999)
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Stephen F. Angel, '77
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Ashok S. Bhatnagar, '79
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Jeffrey R. Garwood, '84
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Mack W. Bailey, '73
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William Y. Barkley, '75
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Gene Moore
Kenneth D. Nelson, '79
Larry D. Nixon, '64
Johnny F. Norris Jr., '71
Jeffrey T. Oakes, '74
William E. "Jack" Ogburn Jr., '56
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Daniel W. Perry, '77
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Terry N. Phillips, '63, '66
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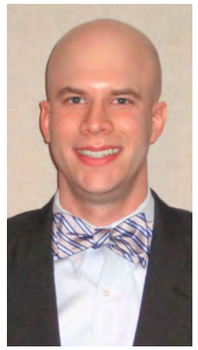
donor stories

TEACHING GENEROSITY, LEADING BY EXAMPLE

K. Linga and Ratnaveni Murty

Keith E. Gubbins



Robert Bradley

Lisa G. Bullard

NC State engineering and computer science faculty lead by example — and that includes more than just teaching and conducting research.

Many faculty are generous supporters of the programs, people and departments that define the College. The recent gifts listed below enhance academic programs and create a scholarship and a prominent lecture series. One gift speaks to the power of inspiration: It was initiated by an alumnus in honor of his former professor.

Dr. K. Linga Murty, a professor of nuclear engineering and materials science and engineering at NC State, has established a $25,000 scholarship endowment with his wife, **Ratnaveni**, to benefit undergraduate students enrolled in either nuclear engineering or materials science and engineering at NC State.

Murty, a leading researcher in nuclear materials and fuels, joined the NC State faculty in 1981. He and his wife have a son and daughter who attended the university.

Dr. Keith E. Gubbins, the W.H. Clark Distinguished University Professor in the Department of Chemical and Biomolecular Engineering at NC State, has made a lead gift of $10,000 to fund the Keith E. Gubbins Lecture Series, which will help bring in some of the field's top scholars to deliver lectures. The department wants to raise $100,000 for the lecture series and will help with the fundraising efforts.

Gubbins is a National Academy of Engineering member and has received dozens of national and international honors during his 50-year teaching and research career. He joined the NC State faculty in 1998.

Alumni and friends of the Department of Chemical and Biomolecular Engineering at NC State have contributed close to $35,000 to create an endowment in honor of **Dr. Lisa G. Bullard**, a teaching professor and director of undergraduate studies in the department.

Robert Bradley, a 2009 alumnus and reservoir engineer at ExxonMobil, first pitched the gift idea as a way to thank Bullard for her tireless efforts as an advisor and mentor. The Dr. Lisa G. Bullard Undergraduate Enhancement Fund will be used to support undergraduate activities such as the freshman welcome dinner and the senior banquet.

Bullard joined the faculty in 2000 and has received numerous teaching accolades. ▪

ALUMNUS ENDOWS UNDERGRADUATE SCHOLARSHIP

Robert Womack

NC State engineering alumnus Robert Womack and his wife, Judith, have established a scholarship endowment to encourage young leaders from western North Carolina to pursue an engineering or computer science degree in the College of Engineering.

The gift establishes the Robert R. and Judith H. Womack Scholarship. First preference for the award will be given to students attending western North Carolina high schools who have demonstrated superior leadership qualities. Robert and Judith Womack grew up in Macon County, NC.

Robert Womack earned his bachelor's degree in mechanical engineering with an aeronautical option from NC State in 1959. He later went on to serve as chairman, chief executive officer or president of four New York Stock Exchange companies, including Zurn Industries. Womack was named a 2011 Distinguished Engineering Alumnus by the College.

The Womacks have also been generous supporters of the university's Chancellor's Circle as well as the College's Dean's Circle. ▪

HOMECOMING WITH THE COLLEGE OF ENGINEERING

Friday, November 2, 2012
11:30 a.m. — 5:30 p.m.
NC State Centennial Campus

Engineering at NC State turned 125 years old this year, and we want to celebrate with you on Homecoming weekend.

You can tour new facilities on our world-class Centennial Campus, hear from students and faculty on their latest accomplishments, and catch up with other engineering alumni at a BBQ dinner. We'll also have an engineering camp for kids, so be sure to bring the whole family. Then stick around for the weekend to watch the Wolfpack football team take on Virginia.

The College wants to make this an annual event that brings alumni back to campus each fall. Join us on Nov. 2 and help start something special.

Register at engr.ncsu.edu/alumni/homecoming.

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

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

A plan for giving

NC State supporters can include the College in their long-term financial planning.

When civil engineering alumnus Johnie H. Jones passed away last fall at the age of 82, the College of Engineering mourned the loss of a distinguished alumnus and a man who deeply loved NC State.

But Jones' ties to the College remain strong thanks to planned giving, a charitable option that allows alumni and friends to include the College in their long-term financial planning.

Jones chose to leave an endowment of about $285,000 to the College in his will. The endowment, designated as the Johnie Jones Enhancement Fund, will help support College activities and programs, laying the groundwork for the next generation of engineers and computer scientists.

Johnie H. Jones

"Johnie made the decision to invest in the College's future many years ago," said Linda Jones, the widow of Johnie Jones. "I can tell you he would be very pleased that this gift will be used to support talented students."

Johnie Jones was a longtime member of the Dean's Circle and served as president of the Board of Directors of the NC State Engineering Foundation. After graduating in 1953, he served in the US Navy Civil Engineer Corps and later joined his grandfather's J.A. Jones Construction Company. Jones spent his entire career with the company and retired as chairman and CEO. He was named a Distinguished Engineering Alumnus by the College in 1994.

Jones chose to make his gift a bequest, but supporters may also establish a charitable remainder trust, a charitable lead trust or a charitable gift annuity. An explanation of each option is below.

- **Bequest**
  Include a gift to the NC State Engineering Foundation as part of a will or trust. Donors receive an estate tax deduction.
- **Charitable Gift Annuity**
  Make a gift, and the Foundation provides a fixed income for the donor or a loved one annually for life.
- **Charitable Remainder Trust**
  There are two types of charitable remainder trusts: the unitrust and the annuity trust. The former creates constant life income for the donor or a loved one, but the amount varies based on the annual value of the trust. The latter provides a fixed income for life.
- **Charitable Lead Trust**
  Pass property and other assets on to your family and support our mission.

For more information, visit engr.ncsu.edu/foundation/ways-to-give or contact Martin Baucom at mabaucom@ncsu.edu or 919.515.7458. ▪

BY THE NUMBERS

A look at some of the figures that shape the College of Engineering

72

Number of students in NC State's first freshman class. They arrived on campus in 1889, two years after the university's founding. Today NC State has more than 34,000 students, including more than 9,400 in the College of Engineering.

2

Active National Science Foundation Engineering Research Centers currently led by NC State, the nation's only university to hold that distinction.

68

Engineering student organizations in the College. From the Underwater Robotics Club to Engineers Without Borders, there's something for every student.

1,227

Acres on NC State's Centennial Campus, home to most of the College and more than 60 government, industry and non-profit partners.

$155.8 million

Early estimate of the College's research expenditures for 2011-12. This important indicator of research activity has jumped 50 percent over the past five years.

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College of Engineering Homecoming Celebration
Friday, November 2, 2012
11:30 a.m. – 5:30 p.m.

Join College of Engineering alumni and friends on Homecoming Weekend as we celebrate NC State's 125th Anniversary

- **Reconnect with your department**
- **Enroll your kids in Engineering Mini-Camp**
- **Learn about new research**
- **Reminisce with friends at a BBQ dinner**

Register at engr.ncsu.edu/alumni/homecoming

NC STATE UNIVERSITY
College of Engineering
125 YEARS