BROADER REACH
Nanofabrication and instrumentation facilities take innovation beyond the laboratory
BREAKING MAJOR GROUND

Groundbreaking, the ceremonial kick-off to a building’s construction, usually involves several dignitaries lined up with shovels in hand and cameras at the ready.

When the College broke ground on Riddick Engineering Laboratories in 1949, Engineering Dean J. Harold Lampe took things a little further, taking a seat in the cab of a steam shovel being used to begin grading work for the project.

Completed in 1950 and first referred to simply as the Engineering Building Oval (EB Oval), will be the new Centennial Campus home of the Edward P. Fitts Department of Industrial and Systems Engineering; the Department of Civil, Construction, and Environmental Engineering; and the dean’s administrative offices.

It will be the College’s first building groundbreaking on Centennial Campus since a ceremony was held to mark the beginning of work on Engineering Building III on Feb. 27, 2008.

Learn more about the planning for EB Oval on page 32.

The College will hold another significant groundbreaking this spring, when it begins work on a building that is just as important to the future of NC State engineering as Riddick Engineering Laboratories was in the late 1940s.

Engineering Building Oval (EB Oval), will be the new Centennial Campus home of the Edward P. Fitts Department of Industrial and Systems Engineering; the Department of Civil, Construction, and Environmental Engineering; and the dean’s administrative offices.

DEAN Dr. Louis A. Martin-Vega

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Candice Wallace

ASSISTANT GRAPHIC DESIGNERS

Jacob Freidman, Sha Liao

CONTRIBUTING WRITERS

Brian Campbell, Lea Hart, Kathi McBlief, Matt Shipman, Larry Silverberg

IMAGES

410 Medical; Milad Abolhasani; Jingyan Dong; Clark Newsen; Frank Culberson; Julie Williams Dixon; Aleksandra Elber; Faith Furlough; Marc Hall; Lilian Hsiao; Aaron Isebel; Stock; Rebecca Kriksland; James Lester; Kenneth Martin; Alii Schuman; Special Collections Research Center, North Carolina State University Libraries; Tony Sigmon; Susanna Stevens; David Whitney; Chuck Wilson, Jr.; Yanqi Ye

OFFICE OF THE DEAN

College of Engineering

Campus Box 7901, NC State University

Raleigh, NC 27695-7901

919.515.2311

www.engr.ncsu.edu

NC STATE ENGINEERING FOUNDATION, INC.

Campus Box 7901, NC State University

Raleigh, NC 27695-7901

919.515.7458

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Questions for Suzanne S. Gordon

This spring, Suzanne S. Gordon will become the first woman to serve as president of the NC State Engineering Foundation Board of Directors. She holds bachelor’s degrees in computer science and mathematics and a master’s degree in statistics, all from NC State. She retired from SAS Institute in 2012 as chief information officer.

What goals do you have as president?
First, I would like to continue the great tradition of good leadership and support for the College. Second, I would like to see the Oval Building fully funded. Third, I would like to find out more about present programs like Women in Science and Engineering and where we can help them be more successful and recruit more women to engineering.

Why is it so important for you to give back to the College?
I have always been a giver. It is just so rewarding. My father taught us from an early age if you don’t give when you have a little you won’t give when you have a lot. I received a great education from NC State, and by participating on different boards, I continued to benefit and learn from others. It’s also good to have a network outside of the company you are working for. I have found that when my career had bumps the NC State people I was working with at the time helped me stay confident and motivated.

What is the board doing to get more alumni involved?
We are working to get young alumni more engaged so that it is just a continuous activity. You graduate, you serve on a young alumni group, you serve on your department board, you move to the Engineering Foundation Board. Young alumni, however, are frequently in the most intense part of their career so finding the balance between involving them and overwhelming them is the key. I would just reiterate to them how beneficial the network can be to their career and your self-confidence.

You enjoy speaking to groups about building a trusting atmosphere as a leader. Why is that important?
I always felt that way that trust was key to having a successful team, trust in each other and trust in the leader. A good book I read and recommend sums it up called The Speed of Trust by Stephen M. R. Covey. If you have trust, there are so many other problems you don’t have to deal with, so you can get things done much quicker.

You’re a pioneering woman in a STEM field. How can we encourage more girls and young women to take an interest in STEM?
(Former NC State) Chancellor Marye Anne Fox and I decided you have to start at an early age if you want to have a high school where you may have lost them, and they are already behind their male counterparts. So whatever we can do to expose young women to STEM early on is key. NC State Engineering has some very great summer programs. I would like to get the word out to more students like the Computer Science students about these programs.

FROM THE DEAN

Welcome to the spring 2018 NC State Engineering magazine.

As you read through this issue, I want you to think back on your days at NC State and how exciting it was to be a part of this University and the College of Engineering. For some of you, the memory may be of Ridcock, Broughton, Mann, Daniels or Burlington Labs. For others, the memories may be more recent and focus on the newer engineering buildings I, II and III on Centennial Campus. Whether you are among the most recent or the not-so-recent graduates, you are all part of something very special — the College of Engineering at NC State University.

Since the very first student, Walter J. Matthews, enrolled in mechanic arts engineering in October 1889, our students, faculty and staff have been an important force in the direction of our state, nation and world. For 128 years, we have worked together to develop new ideas, create new tools and technologies, and educate tomorrow’s engineers and computer scientists. As alumni of this College, you are a part of this great legacy — a legacy that is constantly evolving to meet the needs of society, to improve our lives and drive our economy.

Today our campus is a vibrant and exciting place. Our faculty members are among the best in the world, and through their hard work, we have achieved another important milestone — reaching more than $200 million in annual research expenditures. This puts us in an elite group of engineering colleges — among them are MIT, Texas A&M, Purdue, and Stanford — and ranked 10th in the nation in annual research expenditures.

Just as exciting is the public-private partnership that is coming together to construct Engineering Building Oval, our newest building on Centennial Campus. Thanks to more than 100 dedicated alumni and friends who have donated more than $31 million, we have surpassed the halfway mark in raising the $60 million in private funds needed to fully fund EB Oval. To add to the excitement, large earth-moving equipment crews recently began preparing the site for construction. And while this is also an important milestone, we continue to need financial support for this effort from our alumni and friends.

In this issue we share with you a sampling of other exciting news in your college, from flexible electronics, cancer treatments and new manufacturing processes for power electronics to international aid work in Sierra Leone and animal conservation efforts in Namibia. From our front door to around the globe, NC State’s students, faculty and staff apply Think and Do to improve our world and “engineer a better tomorrow” for us all.

If it has been a while since you’ve been to NC State, I invite you to come and visit. I know you will be inspired by what you find. In the meantime, please enjoy this issue of NC State Engineering, and thank you for your continued support.

Sincerely,

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

*Data from the American Society for Engineering Education
PACK POINTS

COLLEGE OF ENGINEERING PASSES $200 MILLION IN RESEARCH EXPENDITURES

The College leads or is heavily involved in 24 national centers, institutes and laboratories and leads two National Science Foundation Engineering Research Centers (ERC). NC State is one of only two schools in the United States currently leading two ERCs and one of only two schools to ever be awarded the lead role in three ERCs.

The Future Renewable Electric Energy Delivery and Management Systems Center (FREEDM) is developing a next-generation power grid that allows bi-directional flow and integrates renewable energy sources. The Nanosystems Engineering Research Center for Advanced Self-Powered Systems of Integrated Sensors and Technologies (ASSIST) is making wearable, self-powered health-monitoring systems.

The College and NC State are also:
- The lead institution in PowerAmerica, a National Manufacturing Innovation Institution (NMI) that is furthering the development of wide-bandgap semiconductor-based power electronics.
- The Southeast lead institution in the Clean Energy Smart Manufacturing Innovation Institute, an NMI that will advance national manufacturing across several industry sectors.
- A member of the Consortium for Advanced Simulation of Light Water Reactors, a Department of Energy hub working to improve the operation and safety of the current generation of light water nuclear reactors.
- Home of one of four National Security Administration Science of Security Lablets, which are conducting research on cybersecurity.
- A partner in the National Institute for Innovation in Manufacturing Biopharmaceuticals, an NMI that is working to accelerate U.S. innovation in biopharmaceuticals.
- The lead institution in the Consortium for Nanoproliferation Enabling Capabilities, a National Nuclear Security Administration effort to develop the next generation of technologies and leaders in the field of nuclear nonproliferation.

The College of Engineering at NC State posted more than $200 million in research expenditures in budget year 2016-17, placing NC State Engineering in elite company among engineering schools in the United States.

According to the American Society for Engineering Education (ASEE), only seven engineering schools posted more than $200 million in research spending in the previous year, fiscal 2015-16. Those schools were Massachusetts Institute of Technology, University of Michigan, Texas A&M University, Purdue University, University of Illinois at Urbana-Champaign, University of California-Berkeley and Stanford University.

NC State ranked 10th among engineering schools in research expenditures in the United States in 2015-16, according to ASEE, and seventh among public colleges of engineering. ASEE has not posted expenditure totals for 16-17.

RESEARCHERS HAVE DEVELOPED a technique that allows users to collect 100 times more spectrographic information per day from microfluidic devices, as compared to the previous industry standard. The novel technology has already led to a new discovery: the speed of mixing ingredients for quantum dots used in LEDs changes the color of light they emit — even when all other variables are identical.

“This challenge has led to an interest in continuous nanomanufacturing approaches that rely on precisely controlled microfluidic-based synthesis.”

DR. MILAD ABOHLASANI

Semiconductor nanocrystals are important structures used in a variety of applications, ranging from LED displays to solar cells. But producing nanocrystalline structures using chemical synthesis is tricky because what works well on a small scale can’t be directly scaled up — the physics don’t work,” says Dr. Milad Abolhasani, an assistant professor of chemical and biomolecular engineering and corresponding author of a paper based on this work.

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“This challenge has led to an interest in continuous nanomanufacturing approaches that rely on precisely controlled microfluidic-based synthesis,” Abolhasani says. “But testing all of the relevant variables to find the best combination for manufacturing a given structure takes an extremely long time due to the limitations of the existing monitoring technologies — so we decided to build a completely new platform.”

Currently, microfluidic monitoring technologies are fixed in place and monitor either absorption or fluorescence. Fluorescence data tells you what the crystal’s emission bandgap is — or what color of light it emits — which is important for LED applications. Absorption data tells you the crystal’s size and concentration, which is relevant for all applications, as well as its absorption bandgap — which is important for solar cell applications.

To monitor both fluorescence and absorption, you’d need two separate monitoring points. And, because the monitoring points are fixed in place, people would speed up or slow down the flow rate in the microfluidic channel to control the reaction time of the chemical synthesis: the faster the flow rate, the less reaction time a sample has before it hits the monitoring point. Working around the clock, this approach would allow a lab to collect about 300 data samples in 24 hours.

TECH INCREASES MICROFLUIDIC RESEARCH DATA OUTPUT 100-FOLD
CANCER IMMUNOTHERAPY USES MELANIN AGAINST MELANOMA

WORK IN BIOMEDICAL ENGINEERING has led to a melanin-enhanced cancer immunotherapy technique, applied via a transdermal patch, that can also serve as a vaccine, based on early experiments done in a mouse model.

“Melanin is a natural pigment that can efficiently transform absorbed sunlight energy into heat,” said Dr. Zhen Gu, corresponding author of a paper on the work and an associate professor in the UNC/NC State Joint Department of Biomedical Engineering. “We demonstrated that melanin, which is found at high levels in melanoma, can actually be used to help treat melanoma. We do this by shining near infrared (IR) light on a therapeutic skin patch, which promotes the systemic immune response that fights cancer.”

The new technique starts with a lysate — a tumor puree, made up of ruptured melanoma cells — that is used to fill an array of microneedles, embedded in a polymeric transdermal patch. By itself, the lysate is inactive and harmless. But when the patch is applied, the microneedles, which quickly raise the temperature of the skin where the patch is applied, then largely absorb the IR light onto the transdermal patch. The light is then largely absorbed by the melanin in the microneedles, effectively attracting and activating immune cells. The increased local heat causes a fever-like response that fights cancer. The local heat causes a fever-like environment in the skin and promotes the release of lysate from the microneedles, effectively attracting and activating immune cells. The increased temperature also contributes to the locally increased blood and lymphatic flow that facilitates the migration of immune cells. This increased immune response amplifies the ability of the body to remember — and respond to — the lysate, better protecting against incursions of melanoma.

The technique uses existing electrohydrodynamic printing technology, which is already used in many manufacturing processes that use functional inks. But instead of ink, Dong’s team uses molten metal alloys with melting points as low as 60 degrees Celsius. The researchers have demonstrated their technique using three different alloys, printing on four different substrates: one glass, one paper and two stretchable polymers.

“The technique uses existing electrohydrodynamic printing technology, which is already used in many manufacturing processes that use functional inks. But instead of ink, Dong’s team uses molten metal alloys with melting points as low as 60 degrees Celsius. The researchers have demonstrated their technique using three different alloys, printing on four different substrates: one glass, one paper and two stretchable polymers.”

“Flexible electronics hold promise for use in many fields, but there are significant manufacturing costs involved — which poses a challenge in making them practical for commercial use,” says Dr. Jingyan Dong, corresponding author of a paper on the work and an associate professor in the Edward P. Fitts Department of Industrial and Systems Engineering.

“Our approach should reduce cost and offer an efficient means of producing circuits with high resolution, making them viable for integrating into commercial devices.”

Researchers in the college have developed a new technique for directly printing metal circuits, creating flexible, stretchable electronics. The technique can use multiple metals and substrates and is compatible with existing manufacturing systems that employ direct printing technologies.

“This is direct printing,” Dr. Dong explains. “There is no mask, no etching and no molds, making the process much more straightforward.”

The researchers demonstrated the resilience of the printing technique by creating a high-density touch sensor, fitting a 400-pixel array into one square centimeter.

“We’ve demonstrated the resilience and functionality of our approach, and we’re open to working with the industry sector to implement the technique in manufacturing wearable sensors or other electronic devices,” Dr. Dong says.
ROUGH MICROPARTICLES CAN LEAD TO BIG PROBLEMS

NEW RESEARCH FROM NC STATE, Massachusetts Institute of Technology and the University of Michigan finds that the surface texture of microparticles in a liquid suspension can cause internal friction that significantly alters the suspension’s viscosity—effectively making the liquid thicker or thinner. The finding can help address problems for companies in fields from biopharmaceuticals to chemical manufacturing.

“We heard about problems companies were having with pumping suspensions and became curious about what was causing these problems,” says Dr. Lilian Hsiao, an assistant professor of chemical and biomolecular engineering at NC State and lead author of a paper on the topic. “We found that it was particle surface roughness.”

The research team at NC State and MIT found that adding energy to a suspension that contains rough particles can also cause the suspension to expand. This is because rough particles simply take up more space than smooth ones when tumbling in suspension. The end result is that putting more shear stress into the system can cause catastrophic clogging if the suspension expands too much.

For more than 30 years, the Dele Village Learning Center in Lower Allentown has provided an education for hundreds of children in the growing community outside Sierra Leone’s capital. And for years, the school has struggled to provide affordable clean water for its students and staff.

The school’s current rainwater catchment system is able to provide water for sanitation uses, but is only useful during the area’s six-month rainy season. Purchasing bagged water or well water from a nearby community was the only way to provide what was needed for drinking, cooking and washing.

It was a financial strain and became a burden to the school’s budget,” said John Merrill, a senior studying environmental engineering and a member of the NC State chapter of Engineers Without Borders (EWB). An NC State EWB team first traveled to Sierra Leone in 2011 to begin assessment for the project. Following discussions with the school, it was agreed that a mechanically drilled well would best provide a reliable, long-term water supply.

With volunteer assistance from Smith Gardner Inc., a Raleigh-based environmental engineering firm, the team gathered information on the aquifer and soil profiles at the site while building relationships with local government officials, members of the community and charitable agencies working in the region.

Once the travel ban was lifted, a team of five students and two mentors were able to return to Sierra Leone in December 2016 to oversee drilling of the well to a depth of 62 meters and installation of a hand pump, while assessing for the future distribution system. At the time they left, the well was providing clean water for the students and staff at the school, and school personnel had been fully trained on handpump operation and maintenance.

The NC State EWB team plans to return to Sierra Leone in May 2018 to install a solar-powered submersible pump, treatment system, storage tank, distribution lines and handwashing stations.

The second NC State EWB team working at the Dele School also plans to travel in May 2018 to install a solar photovoltaic and battery storage system that would provide clean, reliable electricity to students and staff and replace a noisy, expensive diesel generator.

Students Return to Sierra Leone to Finish What They Started
HAVE YOU EVER wanted to wirelessly charge your mobile device and watch Netflix at the same time? Researchers in the Department of Electrical and Computer Engineering (ECE) may have you covered.

They have developed a system that can simultaneously deliver watts of power and transmit data at rates high enough to stream video and charge the device and transmit data at rates high enough to simultaneously deliver watts of power — more than enough to power your tablet during video playback — the system was only 2.3 percent less efficient when also transmitting 3.39 megabytes of data per second. At 2 watts of power, the difference in efficiency was only 1.3 percent. The tests were conducted with the transmitter and receiver 16 centimeters, or 6.3 inches, apart, demonstrating the ability of their system to operate in longer-distance wireless power links.

“People thought that efficient wireless power transfer requires the use of narrow bandwidth transmitters and receivers, and that this, therefore, limited data transfer,” Ricketts says. “We’ve shown that you can configure a wide-bandwidth system with narrow-bandwidth components, giving you the best of both worlds.”

With this wider bandwidth, the NC State team realized that while efficient wireless power transfer links can be used as a communication link, adapting data-rate enhancement techniques, such as channel equalization, to further improve data rate and data signal quality. The researchers tested their system with and without data transfer. They found that when transferring almost 3 watts of power — more than enough to power your tablet during video playback — the system was only 2.3 percent less efficient when also transmitting 3.39 megabytes of data per second. At 2 watts of power, the difference in efficiency was only 1.3 percent. The tests were conducted with the transmitter and receiver 16 centimeters, or 6.3 inches, apart, demonstrating the ability of their system to operate in longer-distance wireless power links.

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NC STATE RESEARCHERS are rolling out a new manufacturing process and chip design for silicon carbide (SiC) power devices, which can be used to more efficiently regulate power in technologies that use electronics. The process, called PRESiCETM, was developed with support from the PowerAmerica Institute funded by the Department of Energy to make it easier for companies to enter the SiC marketplace and develop new products.

“PRESiCETM will allow more companies to get into the SiC market, because they won’t have to initially develop their own design and manufacturing process for power devices — an expensive, time-consuming engineering effort,” says Dr. Jay Baliga, Distinguished University Professor of Electrical and Computer Engineering and lead author of a paper on PRESiCETM. “The companies can instead use the PRESiCETM technology to develop their own products. That’s good for the companies, good for consumers and good for U.S. manufacturing.”

Power devices consist of a diode and transistor and are used to regulate the flow of power in electrical devices. For decades, electronics have used silicon-based power devices. In recent years, however, some companies have begun using SiC power devices, which have two key advantages.

First, SiC power devices are more efficient, because SiC transistors lose less power. Conventional silicon transistors lose 10 percent of their energy to waste heat. SiC transistors lose only 7 percent. This is not only more efficient but means that product designers need to do less to address cooling for the devices.

Second, SiC devices can also switch at a higher frequency. That means electronics incorporating SiC devices can have smaller capacitors and inductors — allowing designers to create smaller, lighter electronic products. But there’s a problem. Up to this point, companies that have developed manufacturing processes for creating SiC power devices have kept their processes proprietary — making it difficult for other companies to get into the field. This has limited the participation of other companies and kept the cost of SiC devices high.

The NC State researchers developed PRESiCETM to address this bottleneck, with the goal of lowering the barrier of entry to the field for companies and increasing innovation. The PRESiCETM team worked with a Texas-based foundry called X-Fab to implement the manufacturing process and have now qualified it — showing that it has the high yield and tight statistical distribution of electrical properties for SiC power devices necessary to make them attractive to industry. •
"We have more than a decade of experience in designing and developing educational games, and have a lot of data demonstrating their effectiveness," said Dr. James Lester, principal investigator on the grant and Distinguished Professor of Computer Science.

"Our new game, called Health Quest, will be aimed at middle school students," Lester said. "We want students from all backgrounds to know more about health-related careers — from clinical medicine and public health to molecular biology and pharmacology. And by working this educational content into an ongoing adventure, we can raise awareness in diverse audiences, help teachers achieve their educational goals and get students engaged by keeping them entertained and motivated."

The new program will build on the Crystal Island educational curriculum, a game-based initiative aimed at middle schoolers that Lester’s team rolled out in 2015.

"But whereas Crystal Island focused on microbiology and literacy, Health Quest will look at broader areas specific to health sciences, and relevant careers will be incorporated into the plot and gameplay," Lester said.

The project involves experts in K-12 education, game development, health sciences and public outreach programs.

"In addition to NC State, we’re collaborating closely with researchers and the Office of Diversity and Outreach at the University of California, San Francisco, as well as engaging others from Stanford, the North Carolina Museum of Natural Sciences and community-based afterschool programs," Lester said.

Internal communications, community outreach, governmental relations and educational outreach.

Prior to her career at Langley Research Center, Darden served as a mathematics instructor at Virginia State College and taught high school mathematics. During her time at NASA, she authored more than 57 technical papers and articles, primarily in the areas of sonic boom prediction, sonic boom minimization and supersonic wing design and is recognized as an international expert in these areas. She has received dozens of awards and honors including two NASA Medals, one for her work and leadership of the Sonic Boom Program, and the other for her active involvement in working with and encouraging students to pursue careers in math and science. In addition, she received the Black Engineer of the Year Outstanding Achievement in Government Award and the Women in Science and Engineering Lifetime Achievement Award.

She was recently included in the book, "Hidden Figures: The American Dream and the Untold Story of the Black Women Mathematicians Who Helped Win the Space Race" by Margot Shetterly. The book was adapted into the 20th Century Fox film "Hidden Figures," based on the NASA “human computers” who, as members of the segregated West Computers, contributed to the NASA Space Program in the early 1960s.

If the United States wants to remain a leader in health sciences, it needs to interest young people from diverse backgrounds in the field. With that in mind, a team of researchers, supported by a $1.3 million grant from National Institutes of Health, is developing an online adventure game designed to inspire future generations to pursue health-related careers.
Gu receives Young Investigator Award from Controlled Release Society

Dr. Zhen Gu, associate professor in the UNC/NC State Joint Department of Biomedical Engineering, has received the Young Investigator Award from the Controlled Release Society. The Controlled Release Society (CRS) is a not-for-profit organization devoted to the science and technology of controlled release, which encompasses scientific and technical efforts to regulate the spatial and temporal effects of agents in diverse areas including human and animal health as well as non-pharmaceutical areas such as agriculture, cosmetics and consumer products, and the environment. Gu has created dozens of technologies and techniques aimed at delivering the right drug to the right place at the right time to maximize the impact of therapeutic medications.

Williams named Fellow of Institute of Electrical and Electronics Engineers

Dr. Laurie Williams, professor and interim head of the Department of Computer Science, has been elected as a Fellow of the Institute of Electrical and Electronics Engineers (IEEE). The IEEE Fellow is one of the most prestigious honors of the IEEE, and is bestowed upon a very limited number of Senior Members who have contributed importantly to the advancement of application of engineering, science and technology bringing significant value to the society.

Bitzer named Fellow of National Academy of Inventors

Dr. Donald L. Bitzer, Distinguished University Research Professor of Computer Science, has been named a Fellow of the National Academy of Inventors. The academic inventors and innovators elected to the rank of NAI Fellow are named inventors on U.S. patents and were nominated by their peers for outstanding contributions to innovation in areas such as patents and licensing, innovative discovery and technology, significant impact on society, and support and enhancement of innovation.

Westmoreland wins AIChE Award for Excellence in Industrial Gases Technology

Dr. Phil Westmoreland, professor in the Department of Chemical and Biomolecular Engineering, was named the 2017 recipient of the American Institute of Chemical Engineers (AIChE) Institute Award for Excellence in Industrial Gases Technology. The award, sponsored by Praxair, Inc., recognizes an individual’s sustained excellence in contributing to the advancement of technology in the production, distribution and application of industrial gases. Westmoreland’s research focuses on reaction kinetics and reaction engineering. Results are obtained from using flame and pyrolysis experiments, molecular-beam mass spectrometry, computational quantum chemistry and reactive-flow modeling.

Zikry receives Robert Henry Thurston Lecture Award

Dr. Mohammed Zikry, the Zan Provest Smith Professor in the Department of Mechanical and Aerospace Engineering, has been named the recipient of the 2017 Robert Henry Thurston Lecture Award from the American Society of Mechanical Engineers (ASME). The award was established in 1925 in honor of Robert Henry Thurston, ASME’s first president and a leader in engineering and science. Zikry is known as an international leader and pioneer in micromechanics modeling, where he has developed formulations that account for microstructural effects, such as grain boundary orientations, size and distribution. His work and publications have led to the development of new three-dimensional dislocation-density-based crystalline constitutive formulations and computational schemes that account for microstructural effects, such as grain boundary orientations and distributions, grain-size and slip impedance and transmission at grain boundary interfaces in polycrystalline aggregates.

College bestows R.J. Reynolds Tobacco Company Award for Excellence on Velev

Dr. Orlin Velev, INVISTA Professor in the Department of Chemical and Biomolecular Engineering, is the thirty-third recipient of the R.J. Reynolds Tobacco Company Award for Excellence in Teaching, Research and Extension. Velev is an established research leader in colloid science and engineering. His work and publications have led to the development of new three-dimensional dislocation-density-based crystalline constitutive formulations and computational schemes that account for microstructural effects, such as grain boundary orientations and distributions, grain-size and slip impedance and transmission at grain boundary interfaces in polycrystalline aggregates.

Bitzer co-invented the flat plasma display panel in 1964. The technology was eventually applied to television screens, and millions of plasma TVs have been sold to the public since they were introduced in the 1980s. His work on the plasma display monitor earned him an Emmy Award in 2002. He also invented and co-developed Programmed Logic for Automated Teaching Operations, or PLATO, the first computer system to combine graphics and touch-screen displays.

Dr. Orlin Velev
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FEATURES
IN OUR LABS
THESE ARE THE SPACES THAT ENABLE
GROUNDBREAKING RESEARCH

TRANSPORTATION HUMAN FACTORS RESEARCH GROUP LABORATORY
EDWARD P. FITTS DEPARTMENT OF INDUSTRIAL AND SYSTEMS ENGINEERING

NC STATE RESEARCHERS have long
had access to driving simulators that
measure test subject response time,
level of distractedness and how they
prioritize assigned tasks.
But those simulators don’t move.
“They’re useful for getting some
general insights into driver visual
behavior and performance under
different roadway conditions and
stimulus conditions but, unfortunately,
the observations on steering behavior
and braking can deviate from what
occurs in the real world,” said Dr.
David Kaber, Distinguished Professor
in the Edward P. Fitts Department of
Industrial and Systems Engineering
(ISE).
A new simulator housed in ISE,
funded by the department and the NC
Department of Transportation (DOT),
the Department of Psychology and
NC State’s Institute for Transportation
Research and Education (ITRE), offers
a more realistic experience for test
subjects and more generalizable
research results. Beyond that, using
a moving simulator reduces the
potential for motion sickness some
participants feel in a static simulator
when their mind thinks their body
should be moving but it isn’t.
Sitting in a realistic car cab, the test
subject is surrounded by ultra-high-
definition television monitors, which
don’t exhibit time lag in presenting a
driving scene that is experienced with
projection systems.
“There’s no separation of the visuals
from the motion,” Kaber said. “It’s
really about very accurate simulation
of real vehicle behavior.”
Cameras measure all of a subject’s
physical movements, including how
they shift in the seat under certain
conditions and where their eyes go.

ISE HAS BEEN STUDYING
driver distractedness since 2005, starting
with tests of drivers using handheld
cell phones behind the wheel.
Then ISE researchers looked at how
distraction affected the capabilities
of drivers of different ages in dealing
with roadside hazards. They tested
drivers to see whether monetary
motivations (e.g., pay per shipment
delivery) during simulated driving
affected driving habits, specifically
risk-taking behaviors. The drivers
were compensated in different ways
to make for a realistic simulation
and safety margins varied with
compensation.
A lengthy study done for the DOT
examined whether increasing the
number of business logos presented
on “blue” highway signs, identifying
businesses located at a next exit,
would be more distracting to drivers
and cause a safety hazard. The
manner of driver use of logo signs
was found to be a major factor in an
absence of additional distraction.
As manufacturers add more and
more automation to vehicles with an
eye toward fully autonomous driving,
research in the field will gravitate
toward examining risks associated
with these systems, Kaber said. How
effective would a driver riding in a
semi-autonomous vehicle and reading
a book be if they needed to suddenly
take the wheel because of an accident
in the road?
“People during driving start to rely
more and more on the automation, and
they become complacent,” he said.
“Then when something bad happens,
they are less prepared than they
would be otherwise if they weren’t
relying on the automation. Future
research needs to map the design of
advanced vehicle automation to driver
behaviors in order to support safe and
effective vehicle control.”

ITRE AND THE DOT are using the new
simulator to model how drivers deal
with certain road configurations and
traffic signs and plan to use the data to
help design roadways.
Dr. Jing Feng, an assistant professor
in the Human Factors and Applied
Cognition Program within the
Department of Psychology, conducts
research on driver mind wandering,
automated driving, and aging and
driving. She is part of a collaborative
research effort with ISE and ITRE that
is examining attentional demands of
in-vehicle messaging systems, which
will become more common in new
vehicles and may subtract from driver
roadway awareness.
The simulator was designed with
an open cab rather than a closed one
that closely resembles being in a car.
The hope is that the set up will also
be used for simulations outside of
driving, including for pilots or utility
plant operators.
Engineering research is helping lead to cleaner tap water for North Carolina communities.

Surface water in the Cape Fear River basin serves as a source of drinking water for approximately 1.5 million North Carolinians. 1,4-DIOXANE

The U.S. Environmental Protection Agency (EPA) classifies 1,4-dioxane as a likely human carcinogen. Dioxane is an industrial solvent and a byproduct generated in the production of plastics, laundry detergents and shampoos. According to a national survey of drinking water quality, some of the highest concentrations of dioxane in the United States were found in North Carolina. Knappe and his group found high levels of 1,4-dioxane in large stretches of the Cape Fear River basin and estimated that more than 1 million of the 1.5 million people who use the river as a drinking water source are impacted by the water pollution.

To develop an analytical method for detecting dioxane in river water and to identify sources of dioxane, Knappe and his team applied for a National Science Foundation (NSF) RAPID Grant. Knappe and his collaborators published their findings in a 2016 paper in Environmental Science and Technology Letters. Following the publication of an article in the Wilmington Star News in June 2017, local officials, residents in impacted communities and state regulators took notice.

Within a few weeks, Chemours agreed to stop discharging GenX and related compounds into the river. Chemours also stated that the Fayetteville Works plant had been releasing GenX as a manufacturing by-product for 37 years. In November 2017, DEQ announced its intent to partially revoke Chemours’ permit to discharge process wastewater into the Cape Fear River. Now, fluorochemical concentrations in Wilmington-area drinking water have dropped by approximately 89 percent from the levels observed in June 2017. I am pleased that actions were taken quickly and that the level of fluorochemical pollution in the Cape Fear River and in the Wilmington area has decreased dramatically,” said Knappe. “But, it won’t erase 37 years of pollution.”

To determine potential health effects, Knappe is now part of a research team funded by the National Institute of Environmental Health Sciences that aims to study human exposure by measuring GenX concentrations in the blood and urine of Wilmington residents.

HOME FILTERS

Residents in communities impacted by emerging contaminants also wanted to know which home filtration options are effective. Home filters, such as pitcher filters, faucet filters, refrigerator filters and under-the-sink filters, are typically not tested for their ability to remove emerging contaminants.

To address this need, Knappe’s group examined the removal of dioxane, GenX and other fluorochemicals from tap water with a focus on commercially available systems but also creating a custom filter.

“For the cocktail of emerging contaminants present in tap water derived from the Cape Fear River, I have recommended that residents install under-sink reverse osmosis filters to treat the water for drinking and cooking,” Knappe said. Filters containing activated carbon were not effective for dioxane and their performance for fluorochemical removal was mixed. With recent funding from the NSF, the team is now working on developing new materials for removing fluorochemicals from tap water.
Work has begun on Engineering Building Oval, the College’s newest building on NC State’s Centennial Campus. The new home of the Department of Civil, Construction, and Environmental Engineering and the Edward P. Fitts Department of Industrial and Systems Engineering represents a new funding paradigm for the College and for NC State. While the project received $75 million from a statewide bond issue in March 2016, the College hopes to raise $60 million in private funds to complete the project. On these pages, you’ll learn more about the building, the alumni and friends who have pledged to help raise that money and how you can help.

**THE DONORS**

327 Alumni and friend donors

40 Cornerstone Society members

47 Dean’s Engineering Building Oval Club members

$31.8 million Private support raised

**WHERE YOU COME IN**

To learn more about how you can support EB Oval, contact Lora Bremer, executive director of major gifts and campaign planning for the NC State Engineering Foundation, at lora_bremer@ncsu.edu or 919.513.0983.
A life-saving idea receives funding, research collaboration from NC State

Before they started work on developing a medical device, the five women had a plan: to work together. Students in Dr. Andrew DiMeo’s senior design class in the UNC/NC State Joint Department of Biomedical Engineering (BME) fill out a survey early in the year-long class. The data gathered informs how students in the class will be divided into teams for the year.

Dr. Elizabeth Davenport, Alexandra Eller, Denise Witman, Laura Johnson and Ashley Hayes had connected during their sophomore year. So as their senior year began in fall 2010, they tried to figure out DiMeo’s algorithm to self-select their group.

“We kind of worked the system a little bit because we had worked well together all through undergrad,” Davenport, now a postdoctoral researcher at the University of Texas Southwestern Medical Center, said.

The team was assigned to shadow nurses and physicians at WakeMed Hospital in Raleigh, where they were introduced to Dr. Mark Piehl, a pediatric intensive care physician.

Piehl had identified a problem and had been thinking about solutions. Intravenous infusion, the standard method for giving a large amount of saline or other fluids by using a syringe to push it into bone marrow rather than a vein, is slow, inefficient and carries a number of risks. What if there were a better way?

“I thought, why don’t we take that concept of multiple strokes of a syringe and package it into something that’s easy to understand, easy to use and gets the job done quickly by one provider anywhere, whether it’s in a helicopter, an ambulance or in a hospital,” he said.
A WIN for NC State

The Wolfpack Investor Network launched in fall 2016 as a way for alumni to connect with NC State-affiliated startup companies as angel investors.

Beyond the financial support, these young companies gain access to alumni’s expertise and professional networks while WIN members receive promising investment opportunities that also support the NC State ecosystem.

Interested companies are screened by a selection committee before earning a chance to pitch to interested member investors. WIN staff then work with the company and investors to complete the investment.

WIN works in tandem with the Duke Angel Network and the Carolina Angel Network as the Triangle Venture Alliance (TVA).

Learn more about WIN at www.wolfpackinvestornetwork.com.

Piehl had been approached about working with senior design teams before but had felt that it was too busy. This time he decided to collaborate with the five women from the NC State Design team to develop a new device based on his concepts. With Piehl’s guidance and collaboration, the team set out to develop an initial prototype.

At the end of their senior year, the students presented a prototype of a device that would deliver the fluid faster and could be used by a single person instead of two.

As a result of the ideas generated from this collaboration and other work outside the University, Piehl founded a company called 410 Medical. The company ultimately developed and launched the LifeFlow® rapid infuser that includes some concepts from the original design. LifeFlow makes fluid delivery faster, simpler, and more controlled. The Food and Drug Administration has cleared the device for saline delivery, and it is being tested in hospitals around the country.

In 2017, 410 Medical became the first company to receive funding from Triangle Venture Alliance, a new investment alliance joining NC State’s Wolfpack Investor Network (see box above) and angel investor networks at Duke and UNC-Chapel Hill.

While the five students have moved on to careers in the medical device field and graduate studies, they say their senior design work provided valuable lessons that helped shape their careers and post-graduate studies and was an important experience.

“I was really proud of being able to work with women,” Hayes, now a research and design (R&D) engineer with medical device maker Cook Medical, said. Johnson is also an R&D engineer with Cook.

Based in part on the work that was done by Hayes and her teammates, a patent application was submitted in 2014. Per University policy, the students’ rights were assigned to NC State, but if the patent issues, both the students and the University will be compensated.

“I didn’t know when I was a senior that I would help develop a medical device that would go to market five years later,” said Eller, now a global product manager with Teleflex, an international medical device company.

A MEDICAL DEVICE “SWEET SPOT”

When the five students began talking to nurses at WakeMed about the existing method for intravenous infusion, they knew they’d been given an important problem to solve.

“Everybody jumped in and said ‘oh yes, it’s so hard,’” Witman, who now works for device maker Ottobock Healthcare as a marketing manager in its orthotics division, remembers. “You had two nurses doing a job that was not very efficient.”

The team surveyed WakeMed nurses and EMT technicians across the state. They conducted tests on pig legs, which provide a close model of the human tibia. They built a prototype using SolidWorks design software and a 3D printer.

Each year, DiMeo has senior design students shadow medical professionals and question them about their problems and needs. The students then conceptualize, prototype and test devices that offer solutions.

DiMeo, an associate professor of the practice in the department, says the class “sweet spot” is creating fairly simple, high-volume, single-use devices. Teams from senior design have developed a rapid chiling device that cools saline during the infusion process to induce therapeutic hypothermia, a communication platform for patients with disabilities and a urinary catheter that reduces the risk of patient infection.

In most cases, DiMeo said, the great ideas that come out of his course end with graduation. Most students, armed with a valuable degree from a rigorous engineering program, have graduate school or the opportunity for a great first job in industry on their mind.

“Somebody has got to keep the torch alive,” he said. “Unfortunately, most often nobody does it.”

BARRIERS TO ENTRY

The LifeFlow rapid infuser resembles a laser gun from a science-fiction movie. A single front line clinician can infuse 500 milliliters of fluid into a patient in 2.5 minutes.

It’s a simple solution to a complex and important problem, which begs the question of why it hadn’t been done before.

“That’s the hallmark of a great idea,” said Galen Robertson, 410 Medical’s chief operating officer. “It’s simple, and it works.”

Piehl identified a tendency among medical professionals to assume that the tools available are the best that they could be. And there are several barriers to producing a new medical device, which Piehl discovered when he tried to push the idea forward.

After the five women presented their work and graduated, Piehl let the idea sit for about a year, undecided on how to move it forward. Eventually, he mentioned it to an acquaintance with experience in medical device development who offered help and encouragement. Piehl founded 410 Medical in 2013. Less than 12 months after hiring its first employee, the company had submitted its rapid infuser to the FDA for clearance.

LifeFlow is being used in more than 20 hospitals around the country and will soon be tested in ambulances. 410 Medical, based in the Research Triangle Park, has 14 employees. Piehl works part-time as the company’s chief medical officer and part time as a practicing physician.

Robertson, who brought 15 years of medical device operations and research experience with him to the company, said it’s very unusual for a practicing physician to found a medical device company. The barriers to entry are often too high.

Piehl identified the work put in by those five BME seniors as an important turning point that helped turn an idea into a life-saving product.

“The work required to develop the initial prototype was daunting. The NC State team was instrumental in getting there.”

FROM LEFT, DR. ELIZABETH DAVENPORT, ASHLEY HAYES, ALEXANDRA ELLEN, DENISE WITMAN AND LAURA JOHNSON IN 2011.
VETERANS AND ACTIVE DUTY MEMBERS of the armed services arrive as students in the College of Engineering with life experiences often unlike many of their peers.

Some have deployed to Iraq and Afghanistan, others have hands-on experience in roles such as aircraft mechanics, and at least one recently had the responsibility of managing more than 200 subordinates. This group brings a unique perspective to campus. They’re a little older than the average undergraduate, and they bring a sense of order, respect for others and duty from their military life.

DEVON HARRIS

Devon Harris learned important lessons about responsibility, prioritization and professionalism during his time in the U.S. Marine Corps. It’s something he’s carried forward with him as a student in the College of Engineering, where he knows to treat professors with respect, work hard to accomplish his goals and make time for what’s important.

It was a few months after the Sept. 11, 2001, terrorist attacks when Harris enlisted in the United States Marine Corps. He served as an F-18 mechanic and ejection seat mechanic before being medically discharged in 2012.

Harris immediately pursued college opportunities, starting classes at Wake Technical Community College just four months after leaving the Marines. With an associate degree from Wake Tech, he enrolled at NC State in the summer of 2016.

“I was always interested in engineering and the STEM fields,” Harris said. “My M.O.S. [Military occupational specialty] really solidified in my heart that this was something I’d really be good at and something I’d enjoy doing.”

He chose mechanical engineering for its broad engineering focus, but Harris said he’s not sure yet what he wants to do when he graduates.

For now, he’s focused on working hard in what he calls a challenging program. Like others who have come from the military to the University, he’s balancing a family — with a wife and two kids at home — a mortgage and the responsibilities that come with home ownership, while pursuing his degree.

Harris called his transition to academics at NC State, “seamless,” but said he still searches for the structure and camaraderie he found in the Marines.

NC State’s Student Veterans Association has helped. Though he said he’s only been to a few meetings, Harris feels comfortable and at ease with like-minded individuals.

“It provides a space for veterans to be their uncensored selves without fear of offending sensitivities,” he said. “You have all races, genders, ages — but all with the same mind-set; they’re laid-back but still disciplined.”

“It’s a way for other veterans who might be at the University to know that they have some place that they can go and feel comfortable and welcome and deal with any issues,” he said.

TIM MOORE

Some might look at Tim Moore’s life and think it’s pretty hectic. He’s enlisted in the Army, has a wife and two children, and is working toward his Master of Science in operations research on a thesis track. But to Moore, who left a command position with the Army where he was responsible for 275 people, life now seems less complicated.

In fact, ask him about the best part of his graduate school experience, and he’ll say it’s the freedom to spend more time with his wife and kids. He received a scholarship option through the Army allowing him to serve locally for two years while pursuing his degree. Upon graduation, Moore’s scholarship stipulates he spend two to three years teaching at the United States Military Academy, but he’s fine with that as he plans to stay in the Army for 20 years.

Moore selected NC State for its reputation and its proximity to his family in Virginia. He reached out to a friend who was a year ahead at NC State who answered his questions prior to applying. The transition was made even easier for him thanks to NC State’s Veterans Association.

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DEVON HARRIS

From SOLDIER to STUDENT

Veterans and active duty members of the military are making the transition to college life.
“It was beneficial to me — I can imagine it would be even more beneficial to a younger soldier who was transitioning to academic and civilian life.”

TIM MOORE

“Like the military, you want to be a part of something bigger than yourself. Joining a sport at a big university gives you that opportunity.”

ALYSSIA HARDY

“For all the hard work and dedication she’s put into her engineering degree, she’s equally dedicated to the cheerleading team. She practices three hours a day, three days per week, and attends numerous athletic events, from basketball to gymnastics to football.”

“Despite being comfortable in aviation, I have more of an interest in the space industry — it’s still somewhat unfamiliar to me and very exciting.”

A senior pursuing his Bachelor of Science in aerospace engineering, Pollard said he’d like to obtain a graduate degree. He’s considering rocket design and propulsion systems, but said his options are open.

The workload has been challenging, but he expected this.

“I’m a problem solver and more often than not if something is very difficult, I can make it through it, I’ve loved it,” he said. “So far I’m very pleased with the education I’ve received at NC State.”

I then decided to take back control of my future, and use my GI Bill to pursue a degree that relates to my passion and the 10-year career I had in the Air Force.”

RYAN POLLARD

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RYAN POLLARD
THE NC STATE NANOFACTURATION FACILITY (NNF) and the Analytical Instrumentation Facility (AIF) provide the kind of core shared resources that help make a research-intensive university like NC State create innovation. NNF is a Class 100/Class 1000 cleanroom that provides semiconductor processing capabilities, while the AIF is NC State’s primary shared facility providing access to major analytical and materials characterization instrumentation like scanning electron microscopes and X-ray units. While both facilities are part of the College of Engineering and are used regularly by students and faculty members in the College, they also provide important capabilities to researchers in textiles, physics, chemistry and other programs on campus. NNF and AIF are two of five such research centers identified by NC State as vital Shared Core Research Facilities that are central to the University’s mission.

“Facilities like NNF and AIF are set up so that there is one facility where all professors in the University, all students and post docs, can go to share the equipment and not have to shoulder the burden of maintenance, infrastructure and tool upkeep,” said NNF Director of Operations Dr. Philip Barletta. “It also serves as a melting pot where researchers from a number of disciplines and backgrounds can work together, share ideas and inspire each other.”

Along with on-campus users, the two centers are made available to clients in business and at other academic institutions. Growing that client base is a revitalized focus for NNF, which has recently upgraded its equipment and space and has grown the size and expertise of its staff, thanks to new investments from the Department of Electrical and Computer Engineering (ECE), the College of Engineering and the University. Barletta, hired in 2017, is NNF’s first full-time director. At the same time, leaders of both AIF and NNF are working to expand access to their centers, transforming them into resources that are broad in scope and global in reach.

“It’s not just about having such facilities that are available for use,” said Dr. Jacob Jones, AIF director and professor in the Department of Materials Science and Engineering. “It’s about reaching out and promoting these state-of-the-art capabilities to global researchers.”

A WIDE RANGE OF CLIENTS

NNF possesses a full range of micro- and nano-fabrication capabilities, including photo and electron beam lithography, wet and dry etch, chemical vapor deposition, vacuum metallization, rapid thermal anneal and various characterization tools. The center is capable of processing on a broad range of substrates such as semiconductors, ceramics, plastics and glass with sizes from small pieces to six-inch wafers.

For clients that range in size from small start-ups to large international companies, NNF offers vital capabilities that would be cost-prohibitive to have in-house. Their projects include micro-electro-mechanical machines for sensing, microfluidics for biomedical applications and non-silicon-based microelectronics.

Of 107 individual users of NNF’s facilities during the 2016-17 fiscal year, 15 were from outside NC State. That’s a number Barletta hopes to increase.

AIF offers users state-of-the-art scanning and transmission electron microscopes, X-ray scattering and spectroscopy instruments, mass spectrometry, scanning probe and Raman microscopy, nanoindentation and extensive sample preparation facilities. Its advanced capabilities include chemically sensitive atomic-scale imaging, extreme-resolution SEM of insulating and soft materials, in-situ high-temperature and electric-field-dependent X-ray diffraction and cryogenic SEM of biological and soft materials.

In addition to the several hundred NC State researchers served by AIF during fiscal 2016-17, the center served 127 external government, industrial and academic researchers, or 25 percent of all AIF lab-use hours during that period. AIF has created a Corporate Affiliates Program to help strengthen ties to outside academic and business clients. Through financial support of the center, members of the program receive increased access to the AIF’s services and expertise.

AIF and NNF are also part of a National Science Foundation-supported National Nanotechnology Coordinated Infrastructure (NNCI). The local site in the NNCI, the Research Triangle Nanotechnology Network (RTNN), has many programs geared toward serving outside clients. For example, RTNN’s Kickstarter program provides facility access to members of the nanotechnology and greater scientific communities who would otherwise not have the financial resources to use RTNN facilities.

BEYOND THE LAB

ECE offers two classes that take place in NNF — one undergraduate level and one graduate level — in which students learn to make transistors. Education is also central to the mission of AIF. During 2016-17, the facility offered training workshops and short courses on topics including vacuum technology, surface analysis and sample preparation.

For the two centers, the next step is to further expand their reach to those outside the Research Triangle area of North Carolina and outside of technical fields.

Through RTNN — an NC State-led initiative designed to provide public access to University facilities, tools and expertise within all disciplines of nanoscale science, engineering and technology — faculty members in the College of Engineering, Duke University and UNC-Chapel Hill are offering a free online course called Nanotechnology: A Maker’s Course.

The course, available through the Coursera online platform, opens a wealth of opportunities for students, entrepreneurs and business people to learn about and use machinery involved in making high-tech products and studying materials on a molecular scale.

In the first few months after the course was released, it had seen more than 10,000 visitors and several thousand students were enrolled. The creators hope to have tens of thousands enrolled students annually.

“We’ve got a large swath of wonderful resources here at NC State that are available to the world,” Jones said.
In late February, contractors began site work for Engineering Building Oval, the College of Engineering’s newest academic and research building. The future home of the Department of Civil, Construction, and Environmental Engineering; the Edward P. Fitts Department of Industrial and Systems Engineering; and the dean’s administration marks the next step in the unification of the College on Centennial Campus. EB Oval is scheduled to open to students and faculty members in June 2020.

A NEW WAY TO BUILD
EB Oval represents a first-of-its-kind infrastructure project for NC State, using a public-private partnership to fund the construction of an academic building. The $154 million project received $75 million from the people of North Carolina through the 2016 bond referendum. The NC Legislature provided $2 million, and the University will provide $17 million, leaving the remaining $60 million to be raised from private donors. So far, the College has raised $31.8 million.

“We are very grateful to the more than 300 people who have stepped forward to help us reach our funding goal for EB Oval,” said Dr. Louis A. Martin-Vega, dean of the College. “We reached out to our alumni and friends, and they have really come through for us.”

With a little more than $28 million left to raise, the College continues to need the help of its alumni and friends. To aid the fundraising effort, the NC State Engineering Foundation (NCSEF) has developed a portfolio of giving opportunities for donors.

The Cornerstone Society comprises the lead donors who give $100,000 or more to the project and offers donors naming rights in EB Oval as well as in other engineering buildings. Dean Martin-Vega and his wife, Maggie, made a leadership gift to initiate the Dean’s Engineering Building Oval Club (DEBOC) for donors who want to give between $50,000 and $100,000 over five years. To encourage participation by the College’s young alumni, the Dean’s Young Alumni Oval Club was established for donors who have graduated within the last 15 years and pledge $25,000 over five years. Donors in all three societies will receive permanent recognition of their gift inside the building.

“There are many different ways in which you can contribute,” Martin-Vega said. “We are excited that so many of our alumni and friends have already contributed and encourage others to help us reach our goal.”

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**FOUNDATIONS**

**BREAKING NEW GROUND**

The College begins work on a new building as fundraising continues

**SINCE ITS ESTABLISHMENT** in the mid-1980s, Centennial Campus has represented the bold future of NC State University and the College of Engineering. Over the last 15 years, the campus has experienced rapid growth. One of the most exciting areas on the campus is the Engineering Complex on the Oval.

In the early 2000s engineering buildings I, II and III started the College’s move from main campus to Centennial and sparked new energy into the faculty, staff and students. Over the last 10 years, the College has moved up in the U.S. News and World Report graduate rankings to 12th among public engineering colleges, the annual research expenditures have doubled to more than $200 million and our faculty members and students have created more than 40 new startups and spinoff companies.

In late February, contractors began site work for Engineering Building Oval, the College of Engineering’s newest academic and research building. The future home of the Department of Civil, Construction, and Environmental Engineering; the Edward P. Fitts Department of Industrial and Systems Engineering; and the dean’s administration marks the next step in the unification of the College on Centennial Campus. EB Oval is scheduled to open to students and faculty members in June 2020.

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**KEEP TRACK OF OUR PROGRESS**

You can watch work being done at the EB Oval site by checking out our webcam at camera.ehps.ncsu.edu/eboval.html.

**GET INVOLVED**

Learn how you can support the College’s work on EB Oval by contacting Lora Bremer, executive director of major gifts and campaign planning with the NC State Engineering Foundation, at lora_bremer@ncsu.edu or 919.513.0983.

**Connect NC Bond**

**Total Philanthropy still needed**

**Design budget**

**Private support** (as of 2/21/18)

**Investing in EB Oval is an investment in the future of engineering at NC State**

**$28,196,424**

**$31,803,576**

**$2 million**

**$75 million**

**$17 million**

**Connect NC Bond**

**Total Philanthropy still needed**

**Design budget**

**Private support** (as of 2/21/18)

**$31,803,576**

**$17 million**

**$75 million**

**NC State support**

 Foundations

Investing in EB Oval is an investment in the future of engineering at NC State
AARON ISBELL

When Aaron Isbell visited NC State’s campus for the first time, he felt he could easily transition from his magnet high school in Gastonia, NC, to the University.

“I selected NC State for the engineering reputation, and the fact I could see myself easily interacting with people,” said Isbell, a 2007 graduate with a bachelor’s in computer science.

During his time as a student, Isbell held the position of technical intern with the analytics software company SAS Institute, which led to a full-time position after graduation as an individual contributor. After a few years, he was given the opportunity to build a team to deliver support and IT services to SAS hosting customers. After 11 years at SAS, Isbell is now a senior solution consultant with ServiceNow—an enterprise cloud software company—where he is responsible for supporting pre-sales activities for major accounts in the US South region.

Isbell’s connection to the College continued post-graduation, as he participated in several alumni panels, attended student events such as E-Day (Engineering Day) hosted by the Engineering Council and served as chair on the engineering young alumni council.

“The innovative ideas that are coming out of the College, especially from the students, are inspiring,” said Isbell. “I like to make engaging relationships and help how I can.”

Isbell recalls a phone call from Angela Martin with the Engineering Foundation asking for his help in sharing his skills and engaging with students by giving his time rather than his money. But, Isbell said, “some things can’t happen without money.”

As the first member of the Dean’s Young Alumni Oval Club, Isbell and his wife, Dr. Lauren Isbell, saw an opportunity to continue making engaging relationships.

“When you think about your experiences on a college campus, you make the most transitions in a short amount of time, places you spend a lot of your time at stay with you,” said Isbell. “During my time at NC State, I was always in Harrellton, the library and Centennial Campus. It’s important for students to have nice places where they can not only make memories but can also innovate. It’s so much more than a building.”

David Whitley had an interest in all things electronic from an early age.

“Whether it was the very first Atari game system, the first electronic calculator that my father brought home from work or my very first computer (a Radio Shack TRS-80), it completely fascinated me how these devices worked,” said Whitley, a 1992 graduate with a bachelor’s degree in electrical engineering.

Through a recruiting event held by Eta Kappa Nu electrical and computer engineering honor society, where Whitley served as recording secretary, he was offered a job as a consultant for Andersen Consulting (now Accenture).

It was here he worked with software development as a programmer on large-scale custom applications development programs.

Whitley left Andersen Consulting in the late 1990s and worked at several different start-up companies that led to “fantastic technical and business experience — a real-life MBA.”

For the past 12 years, he has worked with private-equity software companies as the software development leader responsible for product development.

Thinking back on his time at NC State and how it affected his career, Whitley thought back to two main questions, why and how.

“My engineering degree has been fundamental to everything that I’ve achieved in my career. As an engineer, answering the two questions of “Why?” and “How?” faceted engineering and for solving problems,” said Whitley.

“Being exposed to many different facets of the engineering field helped me to develop the confidence that I am able to learn anything. It also opened my mind to many different answers or possibilities, and that there may not always be one right answer.”

Early in 2017, Whitley and his wife, Karen, funded the David and Karen Whitley Engineering Scholarship and did not have plans of contributing toward the EB Oval.

But after hearing Dean Louis Martin-Vega speak at a lunch event in Atlanta, the Whitleys felt the dean’s message really spoke to them and they wanted to be part of this once-in-a-lifetime opportunity.

“All of my professional success is completely attributable to the knowledge, experience and life-changing events which happened while at NC State. To be able to give back to my beloved university, after it has afforded me so much, is beyond satisfying for us both.”

CHAUC WILSON JR.

Chuck Wilson grew up in construction; the first office of his father’s business was out of the family home.

“I started working with my father at a young age, mostly due to the fact that my mother wanted me out of the house” laughed Wilson, a 1965 graduate with a bachelor’s in civil engineering.

After graduation, Wilson enrolled in graduate school.

“Alumni share why they donated toward the new Engineering Building Oval

“I give to the College of Engineering because of what they do for the community and how they prepare students for future success.”

CHUCK WILSON

For Wilson, NC State was his only choice. “I spoke with a rep from MIT. Even though I could get in to MIT, I didn’t think seriously about going anywhere else but NC State.”

When his father passed away in 1995, Wilson and his mother set up an endowed scholarship in his father’s name, the Charles T. Wilson Sr. Scholarship. Chuck Wilson and his wife, Jean, have also endowed program funds for the C.T. Wilson Construction AGC Student Chapter – the same student chapter of which Wilson’s father was a founding member.

“Chuck and his wife, Jean, have also contributed toward EB Oval. ‘I am really impressed with Dean Louie and the amazing job he is doing for the College of Engineering,’ said Wilson. ‘I give to the College of Engineering because of what they do for the community and how they prepare students for future success.”

“IT’S MORE THAN A BUILDING”
Engineering graduates return for homecoming

LEN HABAS, immediate past president of the NC State Engineering Foundation, received several nods of agreement from the faces in the audience.

Opening the College’s 2017 homecoming weekend, engineering graduates are invited to a Friday lunch and presentation to catch up with classmates and see the progress the College has made and the cooperative atmosphere that the College strives for.

After hearing from Habas, the audience met CHRISTINA HAMMOCK KOCH. An NC State electrical engineering bachelor’s and master’s alumna, Koch is a NASA astronaut from the class of 2013 currently assigned to the International Space Station (ISS) Crew Operations Branch. As an astronaut, she has gone through wilderness survival school and military flight school. She has trained in a weightless environment, has become fluent in Russian and has served as a capsule communicator (the crew member back on Earth talking to astronauts in space).

Training for a spot on the ISS or even a trip to Mars has been rigorous, Koch said, and has included learning how to eat in a weightless environment and how to fix a space toilet. A six-hour simulated spacewalk provided a particularly memorable challenge in a life that’s been full of them.

“This by far is the most mentally and physically challenging task,” she said.

Next, RAHUL KATHARD and MICHELLE LISHNER of the NC State student chapter of Engineers Without Borders (EWB) gave the audience a peek inside the group’s work improving the lives of people in Sierra Leone and Guatemala.

The non-profit, humanitarian organization has 17,000 members impacting 3.1 million people around the world. The group is focused on sustainable development through community-led change. EWB volunteers work on infrastructure projects that local residents have identified as a need and that they can take ownership of.

At NC State, EWB volunteers are working on water supply and renewable energy projects for a school in Sierra Leone and a water supply project for a remote community in central Guatemala.

Dean Louis Martin-Vega wrapped up the program with an overview presentation on the current state of the College. As he ticked off achievements in rankings, research expenditures, growth and faculty hiring, the theme of collaboration Habas talked about shone through.

“Those two students won’t finish their engineering degree. ‘It’s not that way anymore,’” Habas told the audience of engineering alumni and their family members. “Now it’s a collaboration among the students, the faculty and the University as a whole.”

Each year during the University’s homecoming weekend, engineering graduates are invited to a Friday lunch and presentation to catch up with classmates and see the progress the College has made and the cooperative atmosphere that the College strives for.

Hassan, Icenhour receive DEA awards

The College bestowed the Distinguished Engineering Alumnus award on DR. BASIL HASSAN and DR. ALAN S. ICIENHOUR.

Dr. Louis A. Martin-Vega, dean of the College, recognized Hassan and Icenhour at a banquet on Nov. 1. Hassan earned his bachelor’s (1968), master’s (1990) and doctoral (1993) degrees in aerospace engineering from NC State. Upon completing his doctoral degree, he joined Smanda National Laboratories in Albuquerque, New Mexico, and has held a variety of management and staff positions, overseeing all aspects of engineering sciences research, development and applications work. Currently, he holds the title of senior manager of the Thermal, Fluid, and Aero Sciences Group. He helped support NASA to determine the cause of the Space Shuttle Columbia accident in 2003 and was part of the team to support the shutdown of the Deepwater Horizon Oil Well after the explosion and spill in 2010.

He is a Fellow of the American Institute of Aeronautics and Astronautics, including serving on its Board of Directors from 2008-17, where he held the roles of director and vice president. He has also served on review boards for the National Academies, NASA, and Air Force Office of Scientific Research. He currently serves on the NC State Mechanical and Aerospace Engineering Educational Advisory Board and has served on similar boards for New Mexico State University, Texas A&M University, University of Texas at Austin and University of New Mexico.

Icenhour earned his bachelor’s degree in nuclear engineering in 1986 from NC State. He also holds M.S. and Ph.D. degrees in nuclear engineering from the University of Tennessee, where he is an adjunct professor of nuclear engineering. He was a commissioned officer in the U.S. Navy on a nuclear-powered submarine and continued his service with the Navy as a reservist until retiring in 2010 at the rank of captain. He joined the Oak Ridge National Laboratory in 1980, serving in various roles, including principal investigator, research group leader, director of three research divisions and his current role as associate laboratory director for the Nuclear Science and Engineering Directorate.

He has more than 30 years of experience in nuclear reactor operations and R&D on topics such as enrichment, radiochemical processing, radiosotope production and applications, nuclear fuels, radiation effects on materials, radioactive waste management and nuclear security. He was elected a Fellow of the American Nuclear Society and chairs the NC State Nuclear Engineering Department Advisory Committee.

Under the leadership of the late Dean Ralph Fadum, the Distinguished Engineering Alumnus Award was established by the faculty of the College of Engineering at NC State in 1966 to honor engineering graduates who have been recognized for outstanding achievements in one or more of the following categories:

▪ Planning and direction of engineering work
▪ Fostering professional development of young engineers
▪ Contributing to knowledge in the field of engineering
▪ Bringing, in other ways, distinction to the University through engineering achievement. ▪
ALUMNI PARTICIPATION MATTERS!

Q: Bob gives $25 to the College of Engineering. Susie gives $2,500. Whose gift is more important?

A: Both gifts are equally important!

When it comes to national rankings, U.S. News & World Report considers a wide range of factors, including the alumni participation rate, or the percentage of alumni who make an annual gift to NC State. This means that your gift to the College of Engineering — no matter the amount — directly impacts our national ranking.

Want to see NC State move up the list? Make your annual gift to the College of Engineering today.

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

DR. TONY SIGMON, founder and corporate president of Collegiate Capital Management headquartered in Raleigh; his wife, Nancy; their children, and children’s spouses have donated to NC State with a gift of land, a donation at the Cornerstone Level to the College of Engineering’s EB Oval Initiative and the gift of a life insurance policy to the College of Engineering and the greater University.

Pack loyalty prompted them to make the generous gifts.

Sigmon and his family are enthusiastic Wolfpackers. Sigmon received his bachelor’s, master’s and doctoral degrees in engineering science and mechanics from the College in 1974, 1975 and 1977, respectively. Both of his children, their spouses and his stepdaughter also graduated from NC State, and his stepdaughter’s husband is currently in the Goodnight Scholars Program at NC State.

He has three grandchildren being primed for the Pack. A grandson’s t-shirt displaying the words, “Raised by a Pack of Wolves,” could be a family motto.

An entrepreneur at heart, Sigmon started his company in 1994 after working as an engineer at RTI International for 12 years and receiving his M.B.A. from Duke University. His allegiance to NC State has never wavered.

His colleague Grant Walker (B.A. economics and accounting ’91) is chief investment officer and corporate vice president of Collegiate Capital Management and a “proud NC State graduate (who) has been a 20-year trusted partner in growing our business,” Sigmon said.

His two children and one son-in-law also hold positions in the company and, of course, are NC State graduates. His son, Daniel Sigmon (B.S. textiles management ’08), is vice president of investment management at the then Department of Engineering, a professor emeritus in the Department of Mechanical and Aerospace Engineering, equally helpful to him.

Explaining the family decision to invest in the College, Sigmon said, “I think NC State changed the trajectory of all of our lives. I think it’s a debt in some respects that we would like to repay. Certainly, what we were taught there has helped us in so many ways to work through problems to arrive at a solution. So, it really has affected us professionally as well as personally.”

Sigmon added, “I’m sure, as with all of our fellow alumni, our classroom experiences were only part of the texture added to our lives by our years at NC State. Our lives are continually enriched by our relationships with the University.”

ALUMNI PARTICIPATION FOR OUR PEER INSTITUTIONS

(2017 U.S. News & World Report data)

NC STATE - 11.5%
TEXAS A&M - 17.4%
GEORGIA TECH - 23.8%
VA TECH - 11.2%

A Wolfpack family gives back
Alumna continues her support of the College

When RASHIDA HODGE established a scholarship in the College of Engineering, she didn’t name it after herself. Her recent pledge to help fund construction of the newest engineering building on NC State’s Centennial Campus includes naming rights for a foyer in Engineering Building Oval. She won’t put her name on that, either.

Hodge, who earned B.S. and M.S. degrees in industrial engineering from NC State, says that these gifts aren’t about her. Instead, she’s motivated to further the mission of the university that helped launch her career and to inspire women engineers and show African-American engineers that they have the skill set to have that earning potential to make that kind of contribution.

“I wanted to show women engineers and show African-American engineers that they have the skill set to have that earning potential to make that kind of contribution.”

RASHIDA HODGE

When she endowed the Real Hope for her daughter, Rashida. Karen Hodge, who eventually earned her degree and is now retired, still lives in her daughter’s native U.S. Virgin Islands.

“My mom is such a badass of my life,” Hodge said. “I named it after my mother because she gave up what she wanted so that I could have what I have.”

Rashida Hodge didn’t know much about North Carolina, or NC State, when she arrived in Raleigh in 1998. She had picked up an interest in industrial engineering after attending a summer program at the University of Illinois at Urbana-Champaign. A fateful call to an advisor in the industrial engineering department at NC State to talk about her options helped make her decision. It was a good one, she says.

While working on her master’s degree, she completed an internship at IBM and began working full time for the company in 2002 as a development and research program manager. Along the way, she earned an MBA from Duke University and has been climbing to new positions of importance at IBM ever since.

Hodge recently moved to California, but she is an active member of the NC State Engineering Foundation Board of Directors and as a chairman of a university-wide capital campaign.

Now, the Culbersons have donated to the College to help fund construction of Engineering Building Oval, NC State’s newest planned engineering research and instruction facility on Centennial Campus.

The Siler City, NC, native identified the foyer will bear Karen Hodge’s name. When EB Oval is completed in 2020, “They’ve given me four so far,” he said. “I’m sure they’ll give me more.”

Since he left campus in 1960 with a bachelor’s degree in chemical engineering, NC State has called on FRANK CULBERSON many times for help.

He has always responded.

Culberson and his wife, DORIS, have donated to the College of Engineering to fund scholarships and named professorships. He has served on the NC State Engineering Foundation Board of Directors and as a chairman of a university-wide capital campaign.

Culberson is a past president of the NC State Engineering Foundation and served four years as director of the NC State Achieve! fundraising campaign. He is now the College’s chairman for the University’s current Think and Do the Extraordinary campaign, which aims to raise $1.6 billion for the NC State endowment.

Frank and Doris Culberson name atrium in Engineering Building I

Since he left campus in 1960 with a bachelor’s degree in chemical engineering, NC State has called on Frank Culberson many times for help. He has always responded.

Culberson and his wife, Doris, have donated to the College of Engineering to fund scholarships and named professorships. He has served on the NC State Engineering Foundation Board of Directors and as a chairman of a university-wide capital campaign.

Now, the Culbersons have donated to the College to help fund construction of Engineering Building Oval, NC State’s newest planned engineering research and instruction facility on Centennial Campus. The atrium in Engineering Building I, home of Culberson’s department of Chemical and Biomolecular Engineering (CBE), was dedicated as the Frank and Doris Culberson Atrium in November.

After graduation, Culberson worked with the Shell Oil Company/Shell Chemical Company and the Pace Chemical Company. He then joined and later led Rimkus Consulting Group, Inc., a forensic consulting company that performs engineering and business assessments concerning accidents, injuries and structural and mechanical failures.

The Culbersons established the S. Frank and Doris Culberson Academic Enhancement Fund to fund student scholarships and have endowed two professorships in CBE.

Culberson is a past president of the NC State Engineering Foundation and served four years as director of the NC State Achieve! fundraising campaign. He is now the College’s chairman for the University’s current Think and Do the Extraordinary campaign, which aims to raise $1.6 billion for the NC State endowment.

The Siler City, NC, native identified a need to help the College raise the funds necessary to complete EB Oval early on. The College has pledged to raise $80 million in private money to help fund construction of the building, which will be the new home of the Department of Civil, Construction, and Environmental Engineering (CCEE) and the Edward P. Fitts Department of Industrial and Systems Engineering.

As a member and later president of the Engineering Foundation Board of Directors, Culberson made several visits to the College’s nine academic departments. He was struck by comparing Mann Hall, built in 1964 and the current home for CCEE, to the College’s three engineering buildings on Centennial Campus.

“NC State is special,” he said. “They have the contrast between Mann and the kind of buildings you have on Centennial,” he said. “The facilities are amazing over there.”

Moving more of the College to Centennial will bring tremendous benefits, Culberson said, including in recruiting students and faculty members. Having the entire College together, instead of split on two campuses, will make it even stronger.

Culberson, a 2002 Distinguished Engineering Alumnus, entered what he refers to as semi-retirement from his most recent position with Rimkus as chairman of the board on July 31, 2017. On a recent weekday morning, Frank Culberson was on a golfing trip in Pittsburgh. But his work helping the College was never far from his mind.

During a conversation about his commitment to the EB Oval project, he mentioned how much he enjoys going with members of the Engineering Foundation staff to visit alumni in the Dallas and Houston areas. He had with him a list of people to call to talk about the campaign for EB Oval.

“They’ve given me four so far,” he said. “I’m sure they’ll give me more.”
Foundations

Praxair continues to be a champion for the College

Each year, the Taste of Engineering program ties engineering disciplines to food. It gives undecided female first-year students and others a chance to learn about the College’s academic departments and to network with fellow students and faculty members.

And every year, Dr. Laura Bottomley, director of the Women in Engineering (WIE) program that hosts the event, works with the College’s development staff to find private funding to pay for it. “Sometimes I was just going on faith that I was going to get the money,” Bottomley said.

WIE and the College’s Minority Engineering Programs (MEP) rely on donations from alumni and businesses for support, as well as writing proposals and applying for grants. They have no bigger champion than Praxair, one of the world’s leading industrial gas producers and a proud sponsor of NC State since 2013.

Praxair and NC State have collaborated on sustainability efforts, graduate research symposiums and Ph.D. recruitment weekends, as well as scholarship funding. The company and the College share a strategic commitment to providing educational opportunities for future STEM generations to address the growing need for available talent in STEM.

“As one of our target schools, our relationship with NC State continues to be a bright spot for Praxair,” Esneault said. “We are honored to be a source of support for these talented students. One of the greatest rewards for us is networking with them, and we are continually impressed by their high quality and enthusiasm to learn.”

In addition to Praxair’s contributions, Steve Angel, its chairman and CEO and a 1977 NC State civil engineering graduate, chose the innovation lounge because he believed it could produce some of the world’s next great innovators. “EB Oval will provide an outstanding academic environment designed to help students prepare for successful careers in STEM-related fields.”

Lisa Esneault

A gift from a father-daughter team of NC State graduates is providing opportunities in science, technology, engineering and math (STEM) to a North Carolina elementary school.

Tom Coffey is a 1963 civil engineering construction option graduate of NC State. His daughter Susanna Stevens graduated from NC State in 1989 with a degree in economics and finance and lives in Wilmington, NC.

Stevens became connected with Amy Oots, principal at Mary C. Williams Elementary School in Wilmington, NC. “Many of Amy’s children are in families that haven’t gone to college,” Stevens said.

She has worked for North Carolina school that would increase access to STEM curriculum. That’s where Dr. Laura Bottomley came in.

Bottomley leads the College’s Women in Engineering program and the Engineering Place, its K-20 engineering education outreach program. With financial support from Coffey and Stevens, Bottomley and a team from The Engineering Place have visited Williams Elementary twice to begin work with teachers on an integrated STEM curriculum that incorporates not just science and math but also social studies and language arts using engineering as a platform.

“It’s STEM-plus, if you will,” Bottomley said. “The Engineering Place team is developing activities for each grade level that ask students to read, comprehend math, record data, learn about culture and interpret maps.”

It’s the first time The Engineering Place has written lesson plans that integrate so many areas. Bottomley hopes the kits can be adapted for other schools across the state.

Steven’s work for North Carolina-based analytics and data firm SAS Institute in 24 years, wants to encourage more young women to seek degrees and careers in STEM.

In thinking about a way to give back, she hoped to encourage her alma mater to do more to support the people of North Carolina.

Coffey, who has endowed scholarships for the men’s and women’s golf teams at NC State and for civil engineering students at the undergraduate and graduate levels, saw another opportunity to make a difference.

“These types of programs that get young people involved in technical areas excite me,” he said. “It’s where they need to be into the future.”

STEVEN’S LEFT, AND COFFEY

Father and daughter help bring STEM support to North Carolina school

With one first-grade kit, students learn about festivals of lights native to different cultures around the world and are given a string of battery-powered lights to decorate with. The students learn about culture and geography but also engineering as they discover how the lights work.

As Bottomley points out, it’s not enough to just hand kits to overworked teachers. To make the project a success, the NC State team needed to develop the curriculum and instructions that go along with it.

It’s STEM-plus, if you will.”

Dr. Laura Bottomley

SHE’S THE FIRST TIME...
Ways to give to the NC State Engineering Foundation

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

Endowment: An endowment is a fund held in perpetuity that supports a specific purpose. Most endowments held by the Engineering Foundation are either

Opportunities include the planned Engineering Oval building and other engineering buildings on Centennial Campus.

In-Kind Gifts: These are gifts of goods or services to the College at a discount or no cost.

Special Gifts: These gifts are directed to unique projects, centers or initiatives as directed and approved by the dean of engineering.

for scholarships or endowed faculty positions.

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

Capital Gifts: These gifts go toward “bricks and mortar” projects. Donors are given “naming opportunities.”

NC STATE ENGINEERING FOUNDATION, INC.

FOUNDRY STAFF

Brian E. Campbell
Assistant Dean for Development and Alumni Relations
pcampbell@ncsu.edu | 919.515.7200

Lisa Brown
Executive Director of Major Gifts and Campaign Planning
lisa_brown@ncsu.edu | 919.515.3088

Erica Fuller
Associate Director of Development and Alumni Engagement
e fuller@ncsu.edu | 919.515.8958

Ben Hughes
Senior Development Advisor
bhughes@ncsu.edu | 919.515.9974

Bruce Grealy
Director of Development
bgrealy@ncsu.edu | 919.515.9417

Kerrie Kramer
Director of Development
kkramer@ncsu.edu | 919.515.1338

Angela S. Martin
Assistant Director of Annual Giving and Project Development
amartin@ncsu.edu | 919.515.1714

Lincoln Smith
Director of Development and Alumni Relations
lsmith@ncsu.edu | 919.515.7233

Michael Walsh
Senior Director of Development
mwalsh@ncsu.edu | 919.515.9175

Carol S. Browne
Lead Event and Dollar Relations Coordinator
cbrowne@ncsu.edu | 919.515.9395

Shawnda Hill
Senior Director of Development
shrill@ncsu.edu | 919.515.7557

Cindy Konkel
Administrative Support Associate
cdkonkel@ncsu.edu | 919.515.9417

Karen Whitten
Assistant Director of Alumni Engagement
kwhitten@ncsu.edu | 919.515.7770

DEPARTMENT REPRESENTATIVES

Kenneth M. Tate
Department of Computer Science
tate@ncsu.edu | 919.515.4322

Russ D’Oliveira
Department of Chemical and Biomolecular Engineering
doliveira@ncsu.edu | 919.515.2071

A NEW STUDY-ABROAD PROGRAM within the College gives students a chance to further their knowledge of unmanned aerial vehicle (UAV) technology while helping to protect some of the world’s most majestic animals.

Dr. Larry Silverberg, professor in the Department of Mechanical and Aerospace Engineering, founded the Namibia Wildlife Aerial Observatory (WAO) Project to help protect rhinos, elephants, giraffes and other large African wildlife species using emerging aerial technologies.

UAVs can help rangers in African conservation parks keep an eye on poachers, and they can be used to assess erosion damage to riverbeds, monitor controlled burns, keep an accurate census of park animals and survey land.

And aerial video footage and still photographs taken on the African plains can be used to help tell the story of conservation efforts and the uphill battle these efforts face.

NC State is working with three Namibian partners: Naankuse, a private wildlife sanctuary; the Namibia Ministry of Environment and Tourism, which manages the country’s national parks; and the Namibia University of Science and Technology.

Much of the groundwork for the Namibia WAO Project will be performed by field units of eight to 12 undergraduate students, predominantly engineering and wildlife majors, who will spend a fall semester in Namibia as part of the study-abroad experience. Each field unit, under the on-site direction of a pair of trained graduate students, works on both a technical objective and a wildlife mission.

During the project’s initial visit to Namibia, in fall 2017, a field unit of 10 undergraduate students studied the reactions of animal wildlife to UAVs. This information will inform how the WAO system will be deployed.

In coming years, the teams will assess vertical takeoff and landing UAVs that fly longer and quieter, and test autonomous battery exchange stations and wireless networks that more efficiently stream data into the cloud.

In 2018, the program is being opened to students and instructors from Europe and other countries, Silverberg said. The program revolves around the desire of students to tackle a global problem and gain practical experience in solving on-the-ground problems, all while making progress toward their degrees.

“The project exemplifies the best aspects of the research community as a whole, of NC State’s research community in particular and the power of our students,” Silverberg said. “It shows how global partners can come together and help solve an important, real-world problem.”
JOIN THE CLUBS

Donors who support the College’s Engineering Building Oval project receive recognition and exclusive benefits as part of their important gift. To learn more about how you can support EB Oval and about membership in these groups, contact Lora Bremer, executive director of major gifts and campaign planning with the NC State Engineering Foundation, at 919.513.0983 or lora_bremer@ncsu.edu.

**Cornerstone Society**

*For gifts beginning at $100,000*

As a member of this exclusive society, you will have your name permanently associated with the space of your choosing, and your gift will be recognized in a central location in EB Oval along with a special recognition biography and photo. In addition, as a Cornerstone Society member, you will receive regular insider updates on the construction and information on the research and education that EB Oval will house and will be invited to exclusive events, including the groundbreaking ceremony, hard hat tours of the space and the dedication of the new building.

**Dean’s EB Oval Club**

*For gifts of $50,000 to $100,000*

Your gift gives you the honor of membership in this exclusive group of visionaries. As a member of the Dean’s EB Oval Club, you will receive permanent recognition with a donor profile in a central location in EB Oval and regular insider updates about the progress of the construction and information about the education and research that will be conducted in the classrooms and labs. Club members are also invited to exclusive events, including the groundbreaking ceremony, hard hat tours of the space and the dedication of the new building.

**Dean’s Young Alumni Oval Club**

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

Young alumni who are members of the Dean’s Young Alumni Oval Club will receive permanent recognition with a donor profile in a central location in EB Oval and regular insider updates about the progress of the construction. Members also receive insider information about the education and research that will be conducted in the classrooms and labs. Club members will be invited to exclusive events, including the groundbreaking ceremony, hard hat tours of the space and the dedication of the new building.