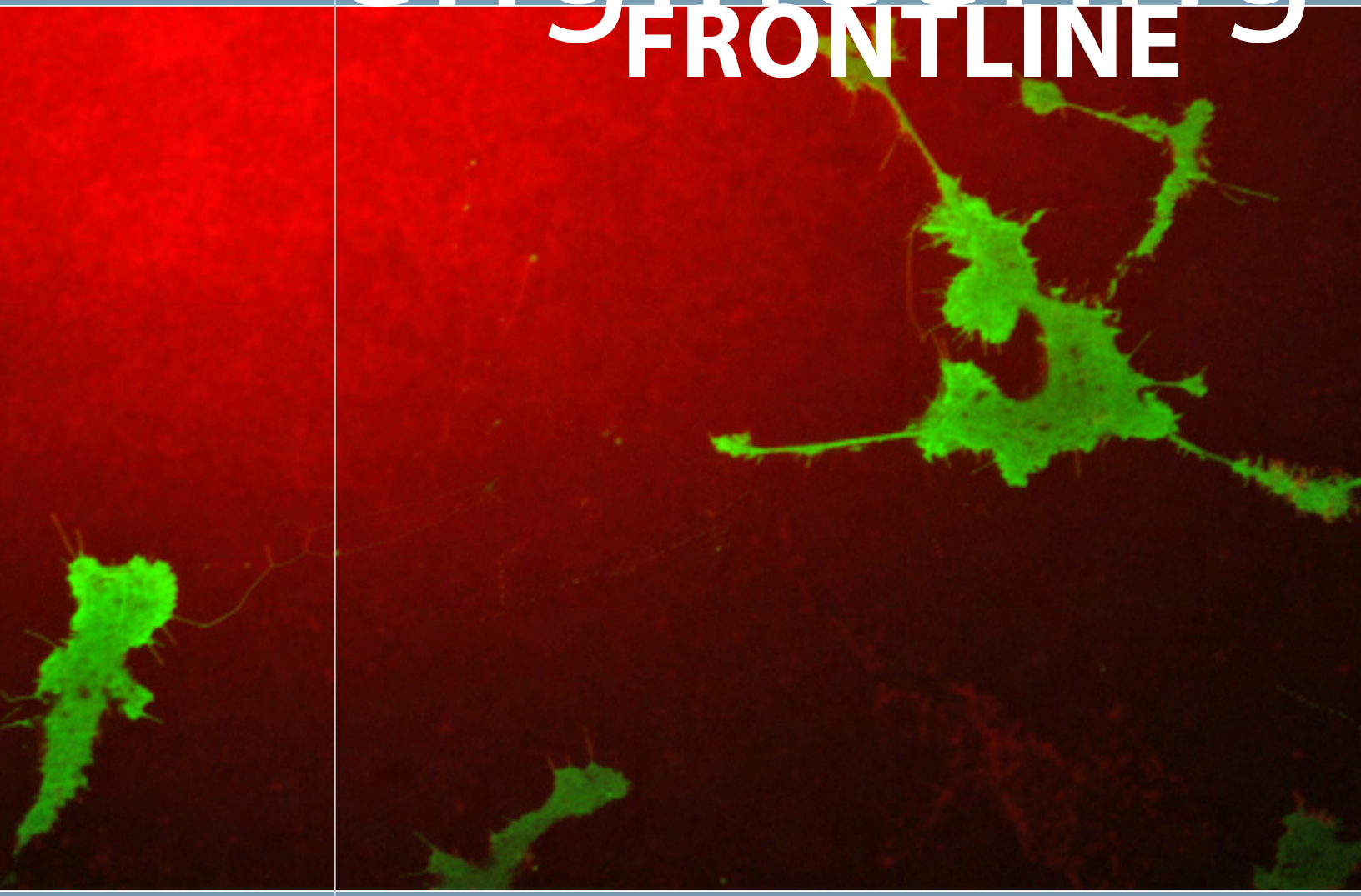
THE COLLEGE OF ENGINEERING

NC STATE UNIVERSITY

January 2007

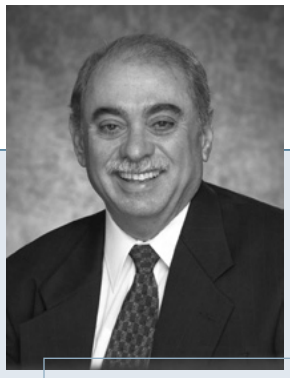
engineering FRONTLINE



Engineering Without Borders

• NC State Engineering Foundation Inc. Annual Report 2005-06

From the Dean of Engineering



Louis A. Martin-Vega

As the new dean of the College of Engineering at NC State University, this is my first open letter to you, our more than 47,000 alumni, friends and supporters, and I am extremely pleased to have this opportunity to address you.

First, let me offer special thanks to Nino Masnari for his vision and leadership as dean of engineering at NC State for the past 10 years. Under his leadership, the College grew tremendously in academic, research and extension programs, number and quality of faculty and students, programs for minorities and women, national recognition and funding, including a $10 million endowment to name the Edward P. Fitts Department of Industrial and Systems Engineering. With unwavering resolve, Nino led the College in its move to Centennial Campus, leaving an outstanding legacy.

We want to build upon these great strides as the College moves into a new era, and we are fortunate to have extraordinary people, facilities and resources to do so. One of my top priorities is to see the College of Engineering at NC State become one of the foremost engineering colleges in the nation. The long-term goal is to reach a level of achievement and recognition that will place us among the global leaders in engineering education, research and extension.

To achieve this goal, we face major challenges. These include a substantial increase in the number of outstanding faculty and doubling our PhD production and research activity. We clearly need the support of alumni, friends, faculty, staff, students, industrial supporters, legislators and advisory boards to achieve our goals. This support can come in a variety of forms, ranging from significant naming and endowment opportunities to support for scholarship and fellowship programs. Joining the Dean's Circle increases the impact of your contributions as they are channeled to the areas of greatest need.

Another way to help is by spreading the word about the great things going on in our college. An underlying theme we have adopted for our college is to assure that the "E" in Engineering stands for "excitement." One way to illustrate this is by sharing with you how the research, education and extension activities in our college go well beyond traditional borders of engineering. We trust that you will find the activities documented in this publication both engaging and representative of the excitement and broad impact embedded in the NC State engineering experience.

Following a kickoff event in Raleigh on November 30th, we began a series of trips across the state and nation to meet with alumni and friends and share the goals and aspirations we have for the College. We are excited about these events and look forward to meeting with as many of you as possible and hearing your ideas about the future of the College of Engineering. I also encourage our alumni to get together and let us know about your upcoming events.

Finally, I want you to know how delighted I am to have joined the College as your new dean. The opportunity to lead such an outstanding College of Engineering is indeed a privilege that I hold in the highest regard. Our ultimate objective is to provide our students and faculty with an environment where they can experience the breadth and excitement of engineering, and in so doing help define the future of engineering itself and make all our graduates leaders in engineering a better tomorrow. I am very grateful for your support and assure you of my commitment to build upon our already strong foundation and make you even more proud of being alumni, friends and supporters of the College of Engineering at NC State University.

— Louis A. Martin-Vega
Dean, College of Engineering

Engineering Frontline

Engineering Frontline, created for alumni and friends of the College of Engineering at North Carolina State University, comprises news from the College of Engineering and the NC State Engineering Foundation annual report. *Engineering Frontline* appears annually in hard copy, with updates coming throughout the year as *Engineering Frontline–Online*. Keep up with all the latest activities of the College of Engineering at **www.engr.ncsu.edu**.

Editorial board

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Upcoming Events

College of Engineering Career Fair,
McKimmon Center
February 15, 2007

College of Engineering
Endowment Dinner
March 29, 2007

Engineering Open House
April 14, 2007

NC State Engineering Foundation
Board Meeting
April 27, 2007

Change of Address?

Alumni, you can update your contact information online at

www.engr.ncsu.edu/ncef/registration

or send address corrections to

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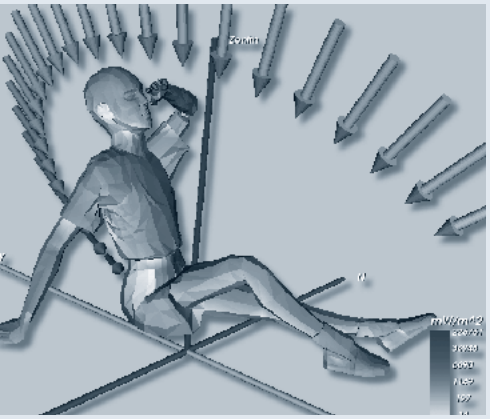

content

ABOVE: The winning project, SunRay, has 3-D visualization capabilities. *(Graphic: NC State SunRay Team)*

OPPOSITE: Engineering Building II, which opened in fall 2005, is the new home of the Department of Computer Science and the Department of Electrical and Computer Engineering. *(Photo: Cameron Triggs Photography)*

ON THE COVER: Real-time imaging of fluorescent probes is used to study patterns of signaling within living cells *(see story on page 16)*. This research is representative of the numerous involvements NC State's College of Engineering has with other institutions and enterprises across the nation and throughout the world, typifying our theme of engineering without borders. In this story, chemical and biomolecular engineer Jason Haugh works on a team of 40 researchers from 23 institutions collaborating on research to better understand wound healing and cancer progression. Supporting this valuable research is a grant renewal of $35.7 million from National Institutes of Health. *(Image courtesy Jason Haugh)*

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Latest News

Features — Engineering Without Borders

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Martin-Vega named Dean of Engineering

Dr. Louis A. Martin-Vega, professor and dean at the University of South Florida's College of Engineering, became dean of the College of Engineering at North Carolina State University on August 7, 2006. Martin-Vega succeeds Dr. Nino A. Masnari, Distinguished Professor of Electrical and Computer Engineering, who had served as dean since 1996.

Provost Larry A. Nielson stated, "We're proud to have Louis Martin-Vega join NC State as dean of the College of Engineering. His dynamic skills will lead the college to even greater heights as a training ground for the next generation of engineers and as a place where cutting-edge research provides real-world solutions to problems."

The College of Engineering, NC State's largest college, with more than 5,500 undergraduates and 1,800 graduate students, ranks fourth among all US engineering colleges in the number of bachelor's degrees awarded and sixth in total degrees awarded.

Martin-Vega was dean of engineering at the University of South Florida from 2001 to 2006. Previously Martin-Vega served as acting head of the Engineering Directorate at the National Science Foundation (NSF), overseeing a $440 million budget supporting research and education programs. He also served as director of NSF's Division of Design, Manufacture and Industrial Innovation for two years.

Prior to his NSF service, Martin-Vega was a professor at Lehigh University and chair of the Department of Industrial and Manufacturing Systems Engineering. He was also the Lockheed Professor in the College of Engineering at the Florida Institute of Technology and held tenured faculty positions at the University of Florida, where he served as director of the Center for Electronics Manufacturing, and the University of Puerto Rico, Mayaguez. His research and teaching interests are manufacturing systems, logistics and distribution, operations management, and production and service systems.

Martin-Vega is a fellow of the Institute of Industrial Engineers (IIE) and the Society of Manufacturing Engineers. He is also a member of the National Engineering Deans Council and the Pan American Academy of Engineering. He is a registered professional engineer in Florida and Puerto Rico and is currently President-elect of the Institute of Industrial Engineers (IIE).

Martin-Vega received the Albert Holtzman Distinguished Educator Award from IIE in 1999 and a Hispanic Engineer National Achievement Award (HENACC) in 2000. He has also received a number of outstanding faculty awards that include the College of Engineering Teacher of the Year Award from University of Florida in 1986. He has authored or co-authored several manuscripts, book chapters and book reviews, as well as dozens of scientific and technical publications.

Martin-Vega, a native of New York, received his bachelor's degree in industrial engineering from the University of Puerto Rico in 1969. He earned a master's degree in operations research from New York University in 1971 and a master's in systems engineering from the University of Florida in 1973. He received his Ph.D. in industrial and systems engineering from the University of Florida in 1975.

Engineering on the move

The plan to move the entire College of Engineering to Centennial Campus is well underway. The Engineering Graduate Research Center opened in 1997 and was renamed the Larry K. Monteith Engineering Research Center in 2005. This complex, which includes the Constructed Facilities Laboratory, represents 136,507 gross square feet of additional space for the College. The College continues to occupy space in Research I, II, and IV; Partners I; and the Flex Building.

- Engineering Building I, with 152,499 gross square feet of space, opened in 2004 and is the new home of Chemical and Biomolecular Engineering and Materials Science and Engineering.
- Engineering Building II, with 202,376 gross square feet of space, is the new home of Computer Science and Electrical and Computer Engineering. It was completed in fall 2005.
- Engineering Building III, the future home to Mechanical and Aerospace Engineering and Biomedical Engineering, received $8.7 million from the Legislature in 2005 for planning and $61 million in funding in 2006 for construction. Plans call for 200,000 gross square feet of space.
- EBIV, which will house the Edward P. Fitts Department of Industrial and Systems Engineering, and EBV, which will house Civil, Construction, and Environmental Engineering and Nuclear Engineering, have not yet received funding and are in the conceptual stages.

Computer Science and Design collaborate to form Design Tech

The Department of Computer Science and the College of Design at NC State University have joined forces to form Design Tech, an interactive visual design hothouse that will conduct research that combines computer science and design. Research areas include artificial intelligence, visualization, graphics and computer games, as well as graphic, visual and interaction design. Projects include cinematic camera control for games, automated tours through scientific data, swarm-based visualizations of news feeds and intelligence telemetries and PDA-based navigation tools.

The National Science Foundation (NSF) has provided NC State with $268,000 to support 10 undergraduate students during a 12-week research program to be held each summer for three years as part of their NSF Research Experience for Undergraduates (REU) program. Participants are recruited nationally and will receive a stipend for room and board while they participate in the program. Dr. Ben Watson, associate professor of computer science, is the principal investigator for the project and serves as director of Design Tech.

For more information, visit **designtech.ncsu.edu**.

NC State, IBM announce Services Science program

In January 2006, NC State University and IBM announced a new curriculum initiative in Services Sciences, Management and Engineering (SSME). The new academic initiative is designed to prepare graduate students for careers in the evolving multidisciplinary field of services management. NC State will be the first research university in the US to launch a master's-level curriculum initiative in SSME, which was created in collaboration with IBM through its Academic Initiative program. For more information visit **www.ssme.ncsu.edu/new**.

Engineering students help "Stop Hunger Now"

Senior design projects help global food aid program

Each day more than 30,000 people die of starvation around the world. It is a crisis highlighted during World Refugee Day and in the national and international media. While the causes vary, the short-term solution is the same — send food aid to the areas hardest hit. It is a monumental task requiring countless hours of work by volunteers and aid workers.

At North Carolina State University, a group of students in the Edward P. Fitts Department of Industrial and Systems Engineering used their industrial engineering skills to help a global food aid organization improve its process for preparing and shipping meals to more than 55 countries in crisis. The students, all seniors completing their capstone design course, worked with Stop Hunger Now to improve its Raleigh warehouse operation. The projects were coordinated through the Engineers Without Borders chapter at NC State.

"The projects actually started as a result of efforts by one of our students, Kate Hensley, who was working with the university's Engineers Without Borders chapter," said Clarence Smith, assistant head of the department and project design course instructor. "Unfortunately she wasn't able to work with this first set of projects, but she was able to coordinate the senior design students' projects with the needs of Stop Hunger Now."

The students formed three design teams, each with a specific task assigned. Team 1 studied the warehouse layout and developed a new layout for storage and production and to improve the flow of materials from delivery of raw goods to finished product ready to ship. Team 2 focused on the supply chain functions, and Team 3 created an inventory control and management database. Dr. Michael Kay, associate professor of industrial and systems engineering at NC State, served as project adviser.

After the students assessed the operation and the areas needing the most improvement, they worked through the semester to find workable solutions. At the end of the semester the teams presented their recommendations to Chad Stutsman, program director for Operation Sharehouse, the food distribution arm of Stop Hunger Now. The students' reports helped Stutsman improve the organization and flow of materials at the Raleigh facility. The inventory control and management database will be used in the Raleigh facility and at the Charlotte and new South Hill, Va., facilities, which opened in July 2006.

"The students' projects helped organize the warehouse and programs in a way that I can adapt to future growth," said Stutsman. "I used most of the recommendations in the warehouse, and the database was very well done. It will be used in all of our current facilities and in the planned facility in Mississippi. I'm very grateful to the NC State students for their hard work on this project." ■

Members of NC State's Engineers Without Borders work to improve conditions in other countries

In spite of the technological advances of the 20th and 21st centuries, millions of people around the world continue to live in poverty, lacking even the most basic necessities. At North Carolina State University, engineering students are using their skills to change the lives of impoverished people in other countries. The students are all members of the NC State chapter of Engineers Without Borders, an international humanitarian organization that uses the talents of engineers to address the problems of poverty around the world.

Officially recognized in 2005, the NC State chapter has grown to more than 50 members. The chapter is interdisciplinary, with members from engineering as well as the humanities and management, all eager to use their talents to help meet the needs of people in developing countries.

In spring 2006 students in the industrial engineering senior design class used their senior design projects to help Stop Hunger Now. *(See story at left.)*

In fall 2006 the students worked on projects in Sierra Leone and Bolivia. Working with LemonAid Fund, a non-governmental organization that strives to eradicate poverty and support universal primary education, NC State EWB students set up a water sanitation project and used solar panels or wind turbines to power utilities for a school in Lower Allentown, Sierra Leone.

EWB members are also working with Save the Children – Canada on a project to help improve conditions in schools in Cochabamba, Bolivia. Members planned to travel to Cochabamba to assess water supply and treatment options with the community, perform hygiene education and conduct ethnographic surveys.

While the focus of the Engineers Without Borders is primarily on bringing engineering expertise to impoverished areas in other countries, the NC State chapter also volunteers closer to home. In fall 2006 members tutored students in math and science at A.B. Combs Elementary School in Raleigh while continuing to work at Operation Sharehouse.

For more information about the NC State chapter of Engineers Without Borders, visit **www.ncsu.edu/stud_orgs/ewb**.

Assembling food packages for Stop Hunger Now's Operation Sharehouse is just one of several projects of the NC State chapter of Engineers Without Borders (EWB) this year. EWB member Akeem Robinson and chapter president Troy Gould, both chemical engineering students, worked with other members to aid villages in Bolivia and Sierra Leone. *(Photo: Daniel Kim)*

NC State, Shaw University, Wake County Schools team up for RAMP-UP

Family Math Night is a popular draw for this program supported by NSF and GE

RAMP-UP fellows are ready for Family Math Night at Bugg Creative Arts and Science Elementary Magnet School. Left to right are Kate Caldwell, NC State graduate student in mechanical and aerospace engineering; Matthew Lewis, NC State doctoral student in chemistry; Denice Young, NC State graduate student in materials science; Mike Geci, NC State senior in mechanical engineering; Tania Coleman, Shaw sophomore in math education; Travis Williams, NC State graduate student in electrical and computer engineering; and Tenea Miller, NC State junior in biological engineering. *(Photos: Kathi McBlief)*

It was family math and science fair night at Bugg Creative Arts and Science Elementary Magnet School in Raleigh. Some parents and students had gathered to admire student science projects, and others to participate in Family Math Night.

Running the Family Math Night events were Liz Parry, project director of RAMP-UP, a program at NC State University officially known as Recognizing Accelerated Math Potential in Underrepresented People, and a crew of RAMP-UP fellows who are college students from NC State University and Shaw University. Parry and her crew all sported bright red polo shirts stenciled with the white RAMP-UP logo. Armed with bins of hands-on math activities, the crew spread out to several classrooms to set up and facilitate grade-appropriate activity stations. Fellows, students and parents settled in for an hour of fun and learning.

RAMP-UP is a five-year, $2.5 million grant project funded by the National Science Foundation's GK-12 Program and the GE Foundation. The program partners NC State's colleges of Engineering and Education and Shaw's Department of Natural Sciences and Mathematics with the Wake County Public School System to increase the number and diversity of students who enroll and succeed in higher level math courses.

NC State's Dr. Laura Bottomley, the director of Women in Engineering and Outreach for the College of Engineering, and Dr. Karen Hollebrands, assistant professor of mathematics education in the College of Education, are the principal investigators for the project. Dr. James Nelson, professor of natural sciences and math, is the lead collaborator at Shaw University.

RAMP-UP fellow Tania Coleman helps fifth grader Alice Adebari with a Family Math Night activity.

NC State and Shaw students are the cornerstone of the program. Approximately 40 graduates and undergraduates who are studying engineering, computer science, mathematics and education are placed in eight Wake County schools (five elementary schools, two middle schools and one high school) to act as resources and to collaborate with teachers to create "hands-on" activities that foster enthusiasm for mathematics among K-12 students.

Jaimi Neuf, fourth grade teacher at Bugg Elementary, is excited about the RAMP-UP program. "The kids get excited about working with college students, which gets translated into getting excited about math. The [RAMP-UP] fellows are very prepared. We teach, and the fellows reinforce the concepts. The kids now want to know how to get into Math Club — it's considered cool. Parents are very supportive, too."

For Parry, who directs the fellows, RAMP-UP is her "passion." "I absolutely love what I'm doing. I tell people I would do this for free, but I don't have to, which is really nice," she said.

Family Math Night is a new tool among many that RAMP-UP uses to tap the math and science potential of students who may be left behind. The goal of Family Math Night is to reach children through their parents. According to Parry, parents' attitudes, especially those of mothers, have a tremendous impact on their children's views toward math and science. If the parents do not have confidence in their own math and science skills, then their children tend to lack confidence as well.

"Parents are really key," Parry continued. "In North Carolina," she explained, "children are tested in third grade to determine if they are academically gifted. The academically gifted children are then on track to take algebra by eighth grade and calculus by twelfth." According to Parry, the children who are not deemed academically gifted are at a disadvantage unless they have strong advocates. Parry said, "Parents can be that advocate. Part of our mission is to educate them about doing that."

On Family Math Nights, Parry and her fellows take six bins, marked K through 5, to the elementary schools. Each bin contains five activities tied to the math curriculum of the grade. The fellows explain the rules of the activities, and the parents and children participate in the activities together. Activities range from kindergarten patterning exercises, such as stringing a necklace with items to match a drawn card, to fifth grade percentage exercises, such as fishing items from a bowl of water and then determining the percentage of what was caught.

Family Math Nights are extremely popular. When Parry held a Family Math Night at Willow Spring Elementary School, 400 parents showed up. "It was the largest parent event in the school's history," Parry said.

For the children, part of the attraction of Family Math Night and other RAMP-UP activities is interacting with the college students. One of Parry's NC State students, Travis Williams, an African-American who is working toward his master's degree in electrical and computer engineering, tutors four African-American students each week.

No one can deny that RAMP-UP is a positive influence in the schools. Sometimes the benefit is profound. A fellow from Shaw collaborated with one math teacher to teach Algebra I to students who were not supposed to be ready for that level of math, yet the entire class passed the end-of-course exam.

At other times, the effects are subtle but equally powerful. Ann Thiani's daughter, Stephanie, is in fifth grade at Bugg Elementary and "loves" the RAMP-UP fellows. Thiani said of her daughter, "She is a bright girl and an excellent student, but before [RAMP-UP] she talked about becoming a dancer, a lawyer or a doctor. Now she talks about engineering. It has opened up a new world for her."

For Parry and the fellows of the RAMP-UP program, opening up new worlds is their goal and passion. ■

Engineer develops better device for people with Parkinson's Disease

NC State and UNC-Chapel Hill work together to improve safety and comfort of neuroprosthetics

Parkinson's disease (PD) is one of several neurological disorders with symptoms such as tremor, rigidity, stiffness, slowed movement and walking problems. In some cases these disorders do not respond to medications. However, the patients can still benefit from a surgical procedure known as deep brain stimulation (DBS). DBS uses a surgically implanted, battery-operated medical device called a neurostimulator to deliver electrical stimulation to targeted areas in the brain that control movement, blocking the abnormal nerve signals that cause tremor and PD symptoms.

The stimulation devices that are currently in use are based on cardiac pacemakers that have been modified for use in the brain. While these devices provide adequate stimulus for symptom relief, they are so bulky that they have to be implanted in the upper chest area and connected to the head with a long cable that is placed under the skin. Statistical research conducted at the Johns Hopkins University has shown that the subcutaneous cable is the main source of patient discomfort and system malfunction.

Using a combination of novel microstimulation methodologies and low-power circuit design techniques, Dr. Maysam Ghovanloo, assistant professor of electrical and computer engineering at North Carolina State University, is creating a device that eliminates the long, subcutaneous cable between the stimulator and its electrodes and delivers a better-controlled train of electrical impulses for stimulating the brain. The small-sized, low-power, head-mounted deep brain stimulation system will reduce patient morbidity and mechanical failures while improving the safety, efficacy and efficiency of stimulation delivery as well as patient comfort.

Dr. Maysam Ghovanloo and graduate student Gautham Krishnamurth test circuitry designed to improve deep brain stimulation in Parkinson's patients. *(Photo: Jennifer Weston)*

"Significant advancements in electronics, computing, microfabrication, wireless communications, biocompatible materials and neurosciences have made possible the development of a new generation of neuroprosthetic devices that are aimed at restoring sensory, motor and cognitive functions lost through injury or disease. This research takes advantage of these technologies to develop state-of-the-art implantable microelectronic devices," says Ghovanloo.

Current DBS devices are susceptible to failures, including breaks in the lead wires, migration of the subcutaneous wire and shifting of the stimulation electrodes. Studies of DBS patients have shown that the long wires and connectors attached to the chest-implanted devices are the primary cause of mechanical failure.

Ghovanloo's more efficient head-mounted design reduces the possibility of these problems because the stimulator will be small enough to be placed under the scalp inside a cap that will be located directly above the place where the electrodes enter the skull. The head-mounted device does not require long subcutaneous wires, and the smaller stimulation device and rechargeable battery eliminate the current bulky chest-implanted device.

One key component of the new device is a novel switched-capacitor-based stimulation (SCS) circuitry, developed by Ghovanloo, that gives better control over the electrical charge delivered to the neural tissue. Existing devices either provide high power efficiency through voltage-controlled pulses for longer battery life with very little control over the injected current or provide good control over the stimulus current with greater power consumption, resulting in shorter battery life. The SCS circuitry, on the other hand, provides both good control over the injected charge into the neural tissue and reduced power consumption.

To evaluate his experimental device designs, Ghovanloo is collaborating with Dr. Oleg Favorov, associate professor of biomedical engineering in the joint Department of Biomedical Engineering at NC State and the University of North Carolina at Chapel Hill (UNC-CH), and Dr. Richard W. Murrow and Dr. Mark Tommerdahl, both of the Department of Neurology at UNC-CH. The study compares the different stimulation delivery methods, including the SCS-based circuitry developed by Ghovanloo. Once the optimum circuitry, stimulus waveforms and range of stimulus parameters are determined, miniaturized, fully integrated system-on-a-chip (SoC) prototypes of the head-mounted device can be built and tested.

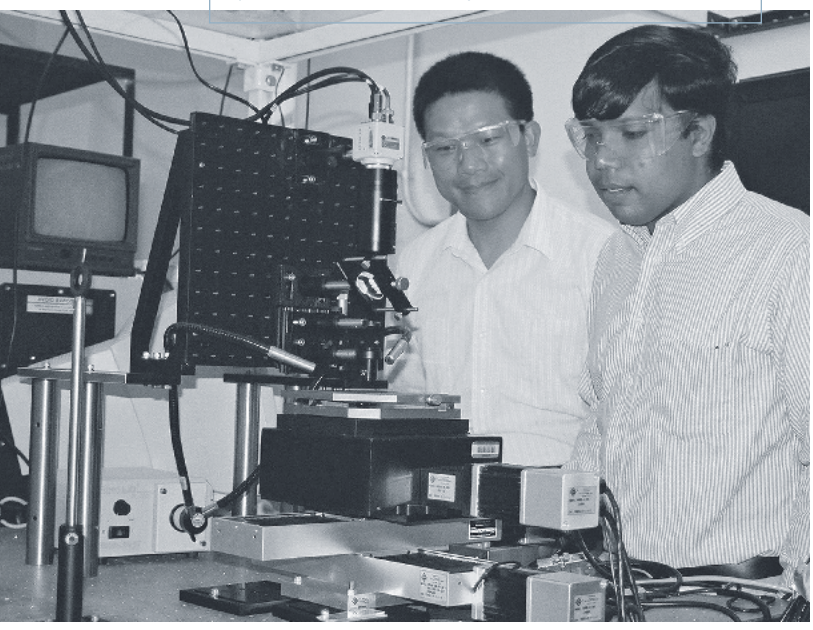
Ghovanloo's research into implantable microelectronic devices (IMDs) for the treatment of neurological disorders such as Parkinson's disease, essential tremor and dystonia can be applied to a variety of other diseases, disorders and disabilities.

"Developing new technologies to better and more effectively aid people with disabilities is one of the major challenges that scientists and engineers aspire to undertake in the 21st century," says Ghovanloo. "These devices can be designed to address many other nerve-related problems, including hearing loss, blindness and paralysis. While these applications are still in the early stages, they are very promising for the future." ■

New process revolutionizes micro medical devices

NC State, UNC-Chapel Hill and German researchers open door to a new dimension in customization and mass production of tiny medical devices for drug delivery

Using this micropositioning system to manipulate a laser, Dr. Yuan-Shin Lee and Dr. Roger Narayan are able to create a three-dimensional microstructure such as a microneedle. *(Photo: Jennifer Weston)*

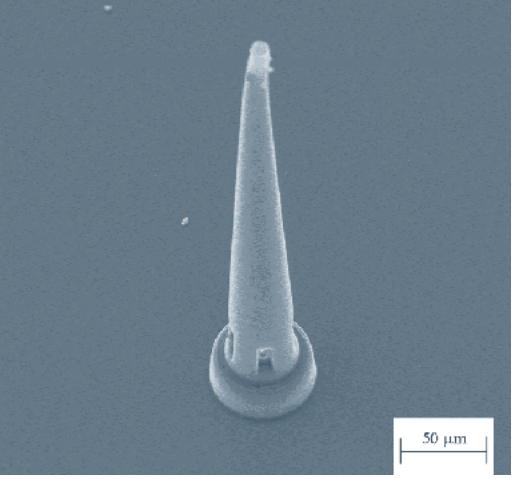


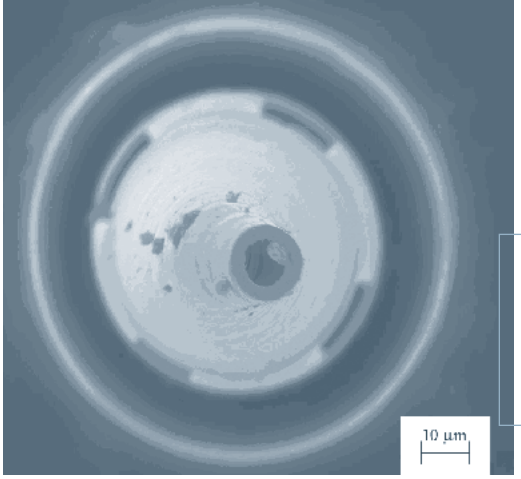
Imagine a world in which tiny devices can cure diseases and correct defects in the human body. That's the goal of research being conducted by engineering researchers at North Carolina State University and the University of North Carolina at Chapel Hill (UNC-CH). They are designing novel applications of microstructures and nanostructures to create medical devices that may one day revolutionize human medicine.

Dr. Roger Narayan, associate professor of biomedical engineering in the joint Department of Biomedical Engineering at NC State and UNC-CH, in collaboration with researchers at Laser Zentrum Hannover in Germany, developed a two photon polymerization (2PIP) process to produce three-dimensional microstructured medical devices using Ormocer®, an organic-inorganic hybrid material currently used in dentistry. The process opens new possibilities for micro and nano devices that are customized for specific biomedical purposes.

Once the new process was developed, the researchers contacted Dr. Yuan-Shin Lee, professor of industrial and systems engineering at NC State, who is internationally recognized as a pioneer in the field of computational design and manufacturing. Lee's modeling work uses computer-aided molecular modeling and molecular design to create optimal specifications for each tiny device according to its specific use. He has developed a new modeling and design process that allows the researchers to test the limits of the hybrid materials by varying the structure of the devices and changing the elasticity along a greater range.

"Modeling at the molecular level represents a new dimension of modeling and analysis," said Lee. "Since the physical properties of materials at the microscale are very different from the physical properties at the macroscale, we must





The two photon induced polymerization (2PIP) process can produce these microneedles (left and below) using Ormocer®. *(Images: courtesy Roger Narayan)*

design a modeling process that is highly specific. Using molecular modeling and computer-aided molecular design, we can manipulate the material properties to optimize performance."

Currently the team is working to design and produce microneedles with a variety of specifications and modeling the penetration of the needles in skin to improve geometry and design. The designs are being tested and validated in the Biomechanics Laboratory at NC State with the help of Dr. Peter Mente, assistant professor of biomedical engineering.

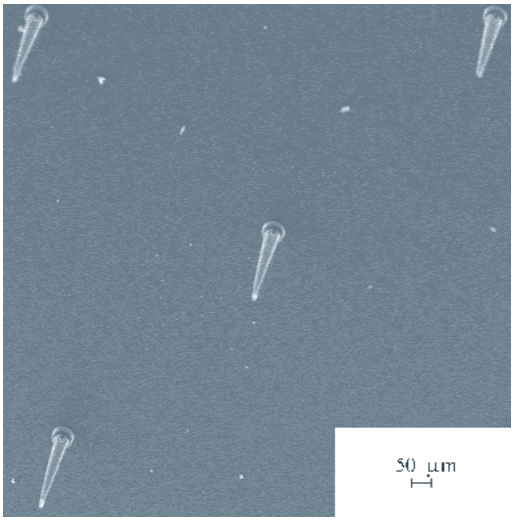
"The conventional microneedles are not mass producible," says Narayan. "What we are able to do is produce needles with unique geometrics tailored with optimal skin penetration and fracture resistance properties. Our goal is to be able to customize and mass-produce these microneedles. Dr. Lee's modeling work will help us find the most efficient and effective way to manufacture the devices using this new laser technique."

In the 2PIP process, laser pulses are delivered in femtosecond (one millionth of a nanosecond) pulses to break chemical bonds on photoinitiator molecules. These molecules react with the Ormocer® monomers to create radicalized polymolecules. (Monomers are single molecules that have the ability to combine with similar molecules in a process called polymerization.) The lasers are manipulated in three dimensions using a micropositioning system to create a three-dimensional microstructure such as a microneedle. This new process opens the doors for the development of nano and micro devices that will have a wide variety of applications from painless injections to orthopedic, prosthetic and cardiovascular devices.

"What initially attracted me to this type of research is the possibility that we may someday have tiny machines that can function within the human body to repair and heal the body," said Lee. "There is beauty in the machine that can do what your hands cannot do and see what your eyes cannot see. This is the direction I see that engineering should go."

Lee's vision of a micromachine that heals or helps the human body may not be that far-fetched. He and Narayan already envision that their modeling and fabrication process may one day develop a tiny device that can reside in the body of a diabetic and not only monitor blood sugar levels but also deliver proper doses of insulin. The device would combine the microneedles they are currently designing with a microelectromechanical system (MEMS) and a nanosensor that remains viable in the human body. Essentially the diabetic would no longer have to prick a finger, inject insulin or wear an external insulin pump. Materials with antimicrobial properties may be incorporated so that the risk of infection, a serious concern for diabetics, would be all but eliminated.

"The tiny system that can go inside the body and make repairs will probably not be developed in my lifetime," says Lee. "But it is satisfying to know that we are working in that direction." ■



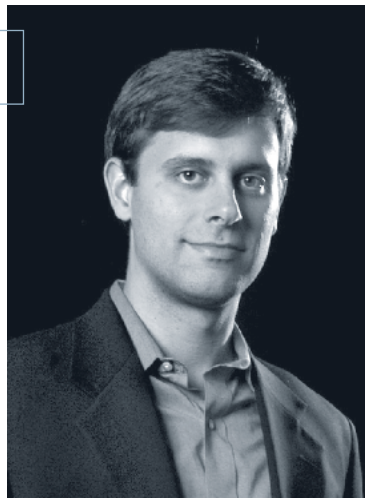
Chemical engineer Jason Haugh is part of a 40-member consortium studying cell migration

Process is key to understanding cancer progression and tissue regeneration

A North Carolina State University chemical engineer is working with researchers from 23 institutions in a collaborative effort to understand cell migration. The Cell Migration Consortium, funded through a "glue" grant from the National Institutes of Health (NIH), was formed to study the molecular basis for cell movement, a process that is key to understanding cancer progression and tissue regeneration.

The 40-member team of researchers has recently received a $35.7 million grant renewal from the NIH to continue this work. The team is organized into multidisciplinary working groups (initiatives) that investigate the different aspects of cell migration and is in the process of developing new biological tools, chemicals, technologies and data to improve understanding of how and why cells move.

Jason Haugh



Dr. Jason Haugh, associate professor of chemical and biomolecular engineering at NC State, is working with the modeling initiative. This group is developing mathematical descriptions of the chemical and mechanical processes that govern cell migration, in close collaboration with biologists within and outside the consortium. Other groups include the discovery initiative, which is identifying the functions of major genes and proteins involved in cell migration, and the structure initiative, which studies how adhesion proteins assemble to form biologically active, multiprotein machines.

Haugh's role in the consortium is to model intracellular signaling elicited by combinations of distinct cell migration stimuli, driven in part by experiments in his laboratory. Simply put, he is modeling how a cell responds to changes in its environment. He has already characterized and modeled the cellular response stimulated by platelet-derived growth factor (PDGF) and other factors released during wound healing.

Using real-time imaging of fluorescent probes in living cells, Haugh can directly compare the observed patterns of signaling within the cells to the models he has developed. This approach allows Haugh to study how signaling mechanisms are regulated and organized in response to a variety of cell migration cues.

Haugh's research combined with the other research projects conducted within the consortium will greatly improve the understanding of cell migration and provide other scientists with new tools for studying the cell migration process. ■

Researchers study FROG problem in sewers

NC State, Purdue, Southern Illinois and Town of Cary team up on this two-year project

Dr. Joel Ducoste leads the FROG project from NC State University. *(Photo: courtesy Joel Ducoste)*

There is a FROG problem in the sewer systems. No, it's not the croaking kind but the slick, matted kind.

The accumulation of fat, roots, oil and grease (FROG) in sanitary sewer collection systems can lead to sanitary sewer overflows (SSOs). Ongoing sewer system maintenance by public utilities is required to prevent wastewater overflows that end up in creeks and rivers. Better ways of removing FROG during a pretreatment stage can help reduce maintenance costs.

THE TEAM'S MULTIFACETED APPROACH TO TACKLING THESE ISSUES INCLUDES SURVEYS, FIELD AND LAB WORK, PILOT-SCALE TESTING AND COMPUTER SIMULATIONS.

Dr. Joel J. Ducoste, associate professor of civil, construction, and environmental engineering, and a multidisciplinary team have received funding from the Water Environment Research Foundation to study aspects of FROG pretreatment. In particular, they will investigate ways to improve grease interceptor performance, analyze the surface chemistry of pipe surfaces to determine if one surface over another favors fat, oil and grease (FOG) accumulation and study treatments designed to reduce the regrowth of roots in pipes.

Joining Ducoste, who is leading the two-year project, are Dr. Kevin M. Keener, associate professor of food science at Purdue University; Dr. John W. Groninger, associate professor of silviculture in the Department of Forestry at Southern Illinois University; Leon Holt, utility pretreatment Town of Cary; and Barbara Oslund, senior engineer at Solutions-IES in Raleigh.

The primary focus of the FROG project deals with two types of blockages that cause SSOs. Ducoste said, "According to the EPA [US Environmental Protection Agency], blockages make up at least 40 percent of sanitary sewer overflows." The first type of blockage is caused by food-related wastes, FOG, that get into the sewer systems from food preparation and cleaning activities at food service establishments and, to a lesser degree, at private residences. The second is caused by plants, particularly tree roots that have penetrated sewer pipes through cracks. Root hairs combined with hardened fat create dense mats that build up in the pipes and eventually constrict or block wastewater flow. The team's multifaceted approach to tackling these issues includes surveys, field and lab work, pilot-scale testing and computer simulations.

Motorsports brings math and physics to life for elementary, middle and high school students

New math and science curriculum developed at NC State appeals to young NASCAR enthusiasts

The issue of improving math and science education has recently moved to the forefront of national debate with leaders calling for more funding for math and science education. It has long been acknowledged that keeping students interested in math and science is a challenge for teachers, who must compete with videogames and iPods for students' attention.

One *U.S. News and World Report* article, "Did Bush Do The Math?," cites a recent study that shows that close to half of all 17-year-olds in America do not have the basic math skills needed to hold a production associate's job in the automobile industry.

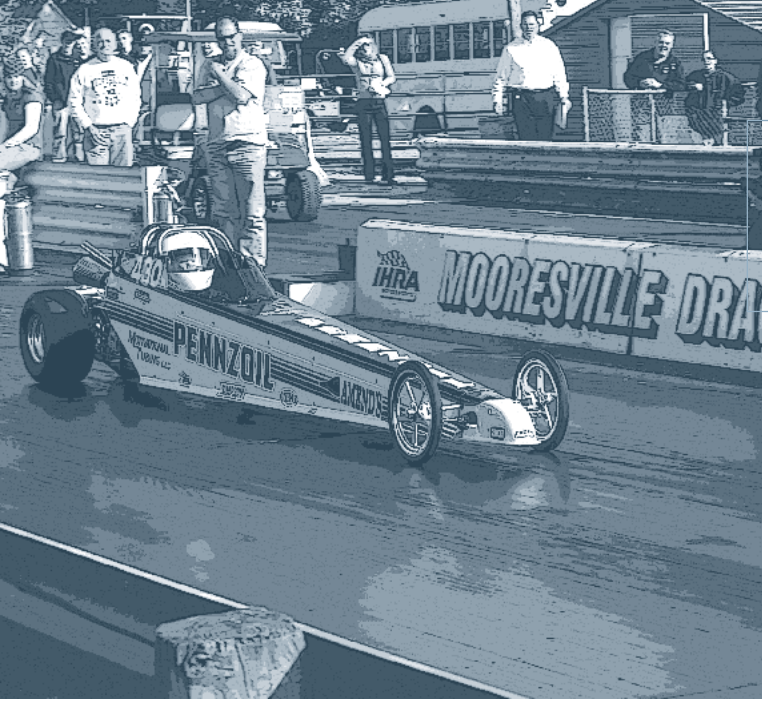
At North Carolina State University, Dr. Eric Klang, associate professor of mechanical and aerospace engineering, and Dr. Ed Maxa, associate professor and 4-H youth development extension leader, have joined forces to create a math and science curriculum that has no trouble holding the attention of students of all ages.

Drawing on the roar and excitement of motorsports, Klang, faculty advisor for the Wolfpack Motorsports team, has partnered with the national and North Carolina 4-H programs to develop a prototype math and science curriculum that teaches students the principles of math and physics. "On Track for Learning" is designed as an education tool that follows students from elementary grades through high school.

"This project has been a great collaboration between engineers and the 4-H program," says Klang. "Engineers have the math and physics background, and 4-H provides the curriculum development expertise. The result is a first-rate curriculum that is hands-on and exciting for students."

Based on national math and science standards, the prototype curriculum brings the two disciplines together by emphasizing experiential learning through motorsports-related experiments. According to Klang, the program would dovetail with an undergraduate and graduate program in automotive engineering, giving students incentive to pursue a college degree.

Physics is fun when taught at a motor speedway using race cars. These middle school students learned how friction is important to the motion of a race car. *(Photos: Cheryl Heeter)*



Middle school students learn about friction, aerodynamics and elapsed time as they apply to a dragster during the On Track for Learning event held at Mooresville Dragstrip.

The lessons in the curriculum include "Friction: Friend or Foe?" and "Energy Conversion: Form-Shifter." In the lesson on friction, students study the forces that govern the performance of a racecar and learn how friction is a key factor in the motion of the car. The lesson then also gives common examples of friction that people encounter in daily life, such as the friction between shoes and sidewalk. The full curriculum is broken into four categories: matter, motion, force and energy.

"This is a unique program that will address many of the current deficiencies in math and science education at the K through 12 level," says Klang. "With more funding for developing and expanding the curriculum, we could have a unified curriculum for all grades."

Work has already begun with middle school students and teachers. The first On Track for Learning event, which was held in fall 2005 at the Mooresville Dragstrip, involved approximately 50 fifth graders from a Statesville charter school. The event was organized by John Moloney, manager of Penske Technology Group, based on the education program developed by Klang and Maxa. The students learned about friction, aerodynamics, and elapsed time and velocity as they apply to a dragster. The students met National Hot Rod Association (NHRA) driver Tisha Wilson, a high school student who competes in NHRA events. Wilson demonstrated her driving skills in her NHRA dragster.

"The event was a great success," says Klang. "The students were able to apply the lessons from the curriculum and watch the principles of physics at work on the racetrack." ■

NC State University holds first automotive industry workshop in North Carolina

NASCAR is just one of North Carolina's important connections to the automotive industry. At NC State University more than 60 faculty members conduct research related to the automotive and transportation industries. With research projects that cover every aspect of the industry from design of the fabric on the seats to the design of the roads, experts at NC State work on advances that improve the way America travels.

Industry and government leaders joined NC State researchers on the university campus in spring 2006 for the first Automotive Industry Workshop to explore the most challenging issues facing the automotive industry and ways to collaborate to address those issues. Participants learned about the research capabilities of NC State in automotive and transportation technologies, identified challenges related to global competitiveness and the environment and discussed ways to address the challenges. The event was sponsored by the College of Engineering, the College of Textiles and the Office of Research and Graduate Studies.

Speakers and panelists included Richard Dell, director of the Advanced Vehicle Research Center; Cindy Williams, director of technology management at General Motors R&D; Don Graunstadt, CEO of Lotus Engineering Inc. North America; Simon Cobb, director of project planning at Lotus Engineering; Dr. Fred Gallash, Gallash Consulting; and Dr. Robert McMahan, senior advisor to the Governor, Science and Technology, State of North Carolina.

Breakout groups were led by faculty members from the colleges of Design, Engineering and Textiles. Key leaders from every aspect of the industry were represented at the workshop, including Automotive Textile Solutions, General Motors, Duke Power, Foard Systems Design, Insight Technologies, Lord Corporation, Nomaco, Omnisys Corporation, RTI International, Southern Research Institute, 3TEX and Walbridge Aldinger. State leaders from the NC Department of Commerce were also present.

The automotive and transportation research resources available at NC State could play a key role in attracting the automotive industry to North Carolina. Organizers are exploring the possibility of making the workshop an annual event.

Virtual Computing Lab brings next-generation computing to North Carolina

NC State provides resources for global grid computing demonstrations

North Carolina State University and the College of Engineering continue to be at the forefront of technology with advancements in powerful computing environments. The Virtual Computing Lab (VCL) is a first-of-its-kind computing environment that allows students and professors to access powerful computer software and hardware remotely from their desktop and laptop computers. The VCL is also part of a collaboration among other universities and industries that is developing the next-generation Internet that will allow global sharing of computer resources and technology through grid computing.

Developed by the Department of Computer Science and Office of Information Technology and Engineering Computer Services (ITECS) in the College of Engineering and the university's Information Technology Division (ITD), in partnership with companies like SAS and IBM, the VCL was first tested by small groups of engineering students at NC State in 2004. The testing and expansion to a wider group of students has continued. In fall 2006 the entire NC State student body was able to access the VCL through the NC State portal, and students at the University of North Carolina at Chapel Hill have been added.

The College of Engineering ITECS team developed the management software that makes the VCL possible. "The team wrote more than 40,000 lines of code that make it possible for users to schedule, reserve and access computing resources through the VCL," says Aaron Peeler, computer science/engineering program manager for IT Advanced Academic Computing Initiatives.

Recently the VCL participated in an MCNC demonstration of global grid computing that represents the future of high-end, international computing. The demonstration proved for the first time that a software application in one country was able to reserve, manage and monitor computing and network resources across both countries — Japan and the U.S. The demonstration is a milestone toward the development of a "global grid" of networked, interoperable resources. Another global demonstration is planned in November. The VCL will provide computing resources for that demonstration as well.

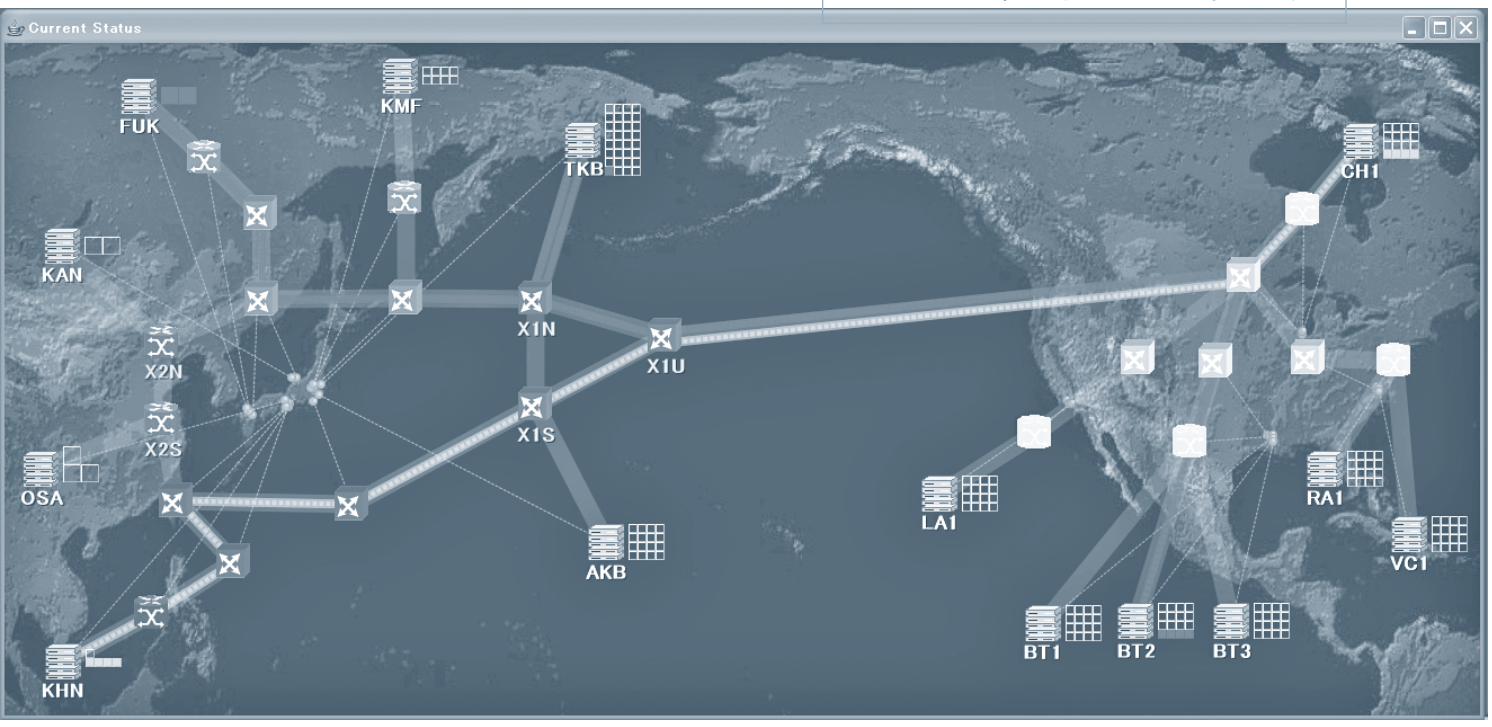
Dr. Mladen Vouk, associate vice provost for technology and professor and head of the Department of Computer Science at NC State, coordinated the effort that led to the creation of the VCL. Using the skills of the computer science and ITECS departments in the College of Engineering and the resources of the university's ITD office, the VCL was born.

"NC State continues to be a leader in computing technology," says Vouk. "The development of the Virtual Computing Lab allows students at NC State to become familiar with high-performance computing capabilities that would otherwise be inaccessible due to the high cost of the hardware and software they can run."

The VCL will eventually bring the capabilities of supercomputers to the entire University of North Carolina system and will allow students and teachers at public schools in rural North Carolina to access computer resources to improve elementary and secondary education opportunities.

"This is a great educational opportunity for North Carolina's K through 12 students," said Vouk. "The VCL is the answer to the shortage of computer access for rural students because with the VCL the students and teachers can log in to a central computer located hundreds of miles away and access state-of-the-art computer software." ■

The Virtual Computing Lab participated in an MCNC demonstration of global grid computing that proved for the first time that a software application in the US was able to use computing and network resources in the US and Japan. *(Photo: courtesy MCNC)*



STUDENT

spotlight

Robert Moorefield chooses to Teach for America

NC State graduate Robert Moorefield is a first-year member of the Teach for America teaching corps. *(Photo: Kathi McBlief)*

NC State graduate Robert (Robby) Moorefield (ChE, TC '06) has a college resume guaranteed to catch the attention of top companies in the textile and chemical process industries. Instead of seeking positions with such companies, Moorefield has chosen to use his skills and abilities to educate students through Teach for America.

Teach for America is a national corps of recent college graduates with strong leadership skills and scholastic abilities who have committed two years to teach in public schools with a low economic base. Teach for America is highly selective. Of the record 19,000 teaching corps applicants in 2006, approximately 17 percent gained admission. Moorefield was one of those accepted.

Certainly, he fits their profile. While at NC State as a Park Scholar, Moorefield received numerous awards that recognize his leadership skills and scholastic achievements, including the College of Engineering Senior Leadership Award, the Leader of the Pack Award, the Mulkey/General Hugh Shelton Leadership Award and an Honors Undergraduate Research Award. He also earned a Visionary Leadership Certificate through NC State's Center for Student Leadership and was a member of Phi Kappa Phi, Tau Beta Pi, Omega Chi Epsilon, the Order of Omega and the Order of the Thirty and Three. He served as president of Phi Gamma Delta Fraternity and treasurer of the Interfraternity Executive Council. In addition, he was the founder of a grief support group for young people and the coordinator of human concern for the Catholic Campus Ministry.

"Teaching is something I've always wanted to do," Moorefield said. "My mom is in education. She works for an assessment center for students who have learning disabilities. Many of my high school teachers encouraged me to teach."

Moorefield also was drawn to a career in his field of chemical engineering. A summer internship in a textile and chemical manufacturing company helped solidify his decision to teach, at least in the short term, because service is important to him. "I loved my internship," Moorefield said. "I still go back and visit. I have a close connection with the people there. But, right now, I feel like I need to be helping people more. Teach for America's two-year commitment is a perfect opportunity for me to try out teaching."

Teach for America has 25 teaching regions. Moorefield chose to teach in the Eastern North Carolina region. In summer 2006 he participated in six weeks of intense training. Often he went to bed by 2:00 a.m. and rose by 5:00 a.m. "But, after my first week, I knew I absolutely loved it," Moorefield said. "It's all about the kids."

At the end of his training, Moorefield learned that he would be teaching science to eighth graders at Henderson Middle School. "I am looking forward to forming relationships with the students, with the parents and with any other influencers in their lives. I want to really inspire the kids, to motivate them to achieve. The kids I taught this summer were really smart, and for whatever reason they just aren't achieving — but they can."

With Moorefield as the teacher, achievement is surely within the students' reach. ■

Student teams take first place in international competitions

Computer Science students win international competition — *again!*

First place winners in the IEEE Computer Society International Design Competition include (l to r) mentor Robert Fornaro, Blake Lucas, Josiah Gore, mentor John Streicher, Eric Helms, Hunter Davis and mentor Margaret Heil. *(Photo: IEEE Computer Society)*

The Computer Science Senior Design Team at NC State took first place among 133 entries from 28 countries in the 2006 IEEE Computer Society International Design Competition (CSIDC). The win makes NC State the only university to garner back-to-back wins in consecutive years and the only university in the US ever to win the international competition.

Sponsored by Microsoft Corp., the 2006 CSIDC theme was "Preserving, Protecting and Enhancing the Environment." Teams were judged on how they represented the contest theme and how thoroughly they covered the topics of software engineering.

NC State's team created "Sunray," which uses ray-tracing combined with a numerical model of solar radiation to calculate UV exposure for an arbitrary 3-D model, in particular a graphic representation of a human form *(see graphic, page 5)*. The SunRay system collects atmospheric data from a pyranometer to provide real-time input to model calculation. SunRay is a research tool that provides detailed simulated solar exposure data that is accurate and easy for a scientist to use. The goal of the tool is to assist the scientific community so that it can more effectively provide a convincing rationale to encourage the need for societal and environmental changes. ■

"Hungry Like the Wolf" ISE seniors topped 60 other teams

"Hungry Like the Wolf," the student team of 2006 graduating seniors in the Edward P. Fitts Department of Industrial and Systems Engineering (ISE), earned first place at the 2006 IIE/Rockwell Software Student Simulation Competition. Dr. Stephen D. Roberts, ISE professor, served as faculty advisor to the team. The first place award included plaques and $2,500. The Rockwell Simulation competition provides students a chance to experience the power of computer simulation while gaining practical problem-solving experience using the Rockwell Arena Simulation Software. Sixty-one teams from around the world were assigned a case study (defined by the IIE Society of Health Systems) typical of problems encountered in healthcare today. Only five teams were selected to present their findings to a panel of judges.

NC State's "Hungry Like the Wolf" team included John Telford, Kusha Kamarei and Andrew White. At far right is David Sturrock, Manager, Simulation Products for Rockwell Automation. *(Photo: courtesy IIE)*

Judging is based on how well the team analyzed not only the original problem but also a "critical" problem extension, how valid and logical their assumptions were and the quality of their presentation. "Hungry Like the Wolf" is the first NC State team to win the top prize. ■

FACULTY

spotlight

For alumnus Clarence Smith, building relationships is the key to college success

Clarence Smith is a three-time recipient of the George H. Blessis Outstanding Undergraduate Advisor Award. *(Photo: Amy Craig)*

Ask graduates from the Edward P. Fitts Department of Industrial and Systems Engineering what they remember most about their department, and more than likely you'll hear the same name — Clarence Smith. A three-time winner of the George H. Blessis Outstanding Undergraduate Advisor Award, Smith (IE '69) has taken the art of advising to a higher level, one that helps students develop the skills they need to succeed both in college and in their careers.

"Advising goes beyond just having the answer or signing a form," says Smith. "It's building a relationship to mentor the student and nurture that student's experience. It may be the one activity on campus where a student, on a continuing basis, can interact with a concerned adult who is not a parent to help them achieve a meaningful learning experience."

An industrial engineering graduate from NC State and a Fellow of the Institute of Industrial Engineers (IIE), Smith has been a consistent and important advocate for students in the department for 28 years. His eight years of experience working for Goodyear Tire and Rubber prior to joining the NC State faculty coupled with his extensive knowledge of the university are an invaluable asset for the college and the students. His personable style and warm demeanor have welcomed countless entering freshmen, making them feel much at ease, and his wisdom has benefited many students working through the challenges of college and preparing for a career. A natural "people person," Smith guides students through both the academic and personal growth processes that occur during the college years.

His commitment to the students in industrial engineering has made him the "go to" person when it comes to advising questions and solutions in the College of Engineering. In addition to numerous letters of gratitude from students and alumni, Smith also receives letters from parents. One family wrote, "It's true — you can count the important people in your life on one hand. You would be considered number one as the constant person [our daughter] turned to for reliable and true answers. In speaking about you, she was always saying, 'I'll talk to Clarence about it,' and we eventually found ourselves saying, 'Talk to Clarence about it before you decide.' It is certainly a tribute to you."

As advisor for the senior design course in the department, Smith has helped students learn more than just industrial engineering principles. His students have used their skills to help improve the lives of others through interesting, real-world projects. *(See related story, p.8.)*

The projects, like Smith himself, help the students experience the importance of using what you know to help others — a trademark of Smith's own career.

"There are many heroes in the academic world that get recognized for their widely visible contributions, but many heroes go about doing their business in invisible ways," says Dr. Stephen Roberts, professor of industrial and systems engineering and former head of the department. "Clarence Smith is one of these. His work is somewhat invisible, unless you are someone who has crossed his path. His impact is manifold and influences how you live your life and what you do, especially as an industrial engineer." ■

Paul Zia honored for lifetime achievement

A giant in the profession of civil engineering — Paul Zia, Distinguished University Professor Emeritus — was honored by 160 attendees at the American Concrete Institute's (ACI) spring convention in Charlotte in March 2006. The ACI hosted Zia's symposium, "A Celebration of Achievement and a Life Devoted to Engineering," which included invited talks by prominent professionals from industry, government, consulting and academia.

"All I had to do was pick up the phone and mention this was for Paul Zia, and these folks agreed immediately to speak," said Roberto Nunez, lecturer and senior extension specialist, who helped organize the event. Larry Monteith, NC State University Chancellor Emeritus, was among 12 who spoke to honor Zia.

"As one of his many graduate students, I have had the privilege to work with Prof. Zia since 1971. I have been treated, like most of his graduate students, as a member of his family," said Sami Rizkalla, Distinguished Professor and Director of the CFL, who co-organized the event.

Paul Zia

Zia joined the NC State faculty in 1961. His career spans more than 50 years of research, education and applied engineering. He has served as president of ACI, was the founding chair of the Carolinas Chapter and continues to be actively involved with ACI committees. Zia is a fellow of ACI, ASCE and the Prestressed Concrete Institute. He served as head of the civil engineering department at NC State for nine years. He has supervised 45 MS students and 22 PhD students, garnered more than 30 honors and awards, received funding for more than 30 sponsored research projects and coauthored numerous publications, including approximately 100 journal and proceedings papers, two edited books, two engineering bulletins and chapters in three major structural engineering reference books and 24 research reports.

A member of the National Academy of Engineering, Zia said that he was honored to be recognized and that he enjoys the ACI so much because it is purely a technical organization. One of the highlights of the celebration was the gathering of so many familiar faces. "It was really nice to see nearly 60 of my former students there," Zia remarked, smiling. ■

ALUMNI IN THE

frontline

Harris Strong shaped artist's career with engineer's touch

Renown for his decorative art, especially for his fine hand-painted ceramic wall hangings, NC State University alumnus Harris G. Strong (ChE '47) has spent his life "doing what he wanted to do." From owning his own bicycle repair shop at age 14 to running a highly successful pottery business throughout his adult life, Strong forged his own path with his artistic and engineering talents.

Born in Waukesha, Wis., Strong, 86, grew up wanting to be an artist. His aunt, Henrietta (Brownie) Strong, was his mentor. She owned a successful greeting card business and had so much faith in Strong she offered to pay for his college education when his father would not.

"She paid the tuition, and she gave me a weekly allowance," Strong said. "That was a tremendous help to me. She was a great help all my life."

But when it came time to go to college, Strong struggled with the practicality of leading an artist's life. "The only thing worse than an unemployed artist," Strong quipped, "is an unemployed poet, which was my second choice."

In 1961 Strong and Donald Deskey received the International Design Award from the American Institute of Decorators for this 30-foot, free-standing ceramic wall in the Waldorf-Astoria hotel in New York. *(Photo: courtesy Harris Strong)*

A solution soon presented itself when Strong had the opportunity to see some design work of his aunt's friend, Simon Lissim, a well-known artist. Strong said, "He had designed some pieces for Lenox pottery, and I saw them and was very impressed. I thought, 'Gee, studying ceramics may be a way of backing into the art field.'"

Strong came to NC State in 1939 to study ceramic engineering and soon changed his major to chemical engineering because he wanted to study the chemistry of glazes. While he was at NC State, he was a columnist and an associate editor for the *Wataugan*, a literary magazine published by students. He wrote stories and poems, many of which were rich with double entendre. "Some of them were a little raunchy, I think," Strong chuckled.

As with many men of his era, he interrupted his college education to join the military during World War II. "I left college in my junior year to go into the army because I felt very strongly about that war. It was the only war I ever felt strongly about."

During the his tour of duty, Strong worked in signal intelligence directly for General Douglas MacArthur in the South Pacific. After the war and upon finishing his degree at NC State, Strong took ceramic art courses at New York University. Strong said, "I had good technical information; I had good ideas. But I needed that art, and I had a great professor there, Ruth Canfield."

Although Strong soon took a job as an engineer at Kelby Pottery in Brooklyn, he aspired to start a business. Robert Krasner, chief designer at Kelby, and Strong formed a company on Wall Street in a fourth floor walkup. "It was after the war, and we were lucky to find anything," Strong explained. "Robert did a great deal of the designing; I did

ChE alumnus Harris Strong spent his whole life doing what he wanted to do. *(Photo: Cheryl Hall)*

some. I developed the glazes, [clay] bodies and techniques. I was particularly good at glaze chemistry." Their company, the Potters of Wall Street, quickly outgrew its space, so the partners moved to a much larger space in Brooklyn and hired more employees. They did quite well, but the business had to be sold when Krasner chose to start an envelope business. After Potters of Wall Street closed, Strong worked for a time at American Art Industries doing design, art work, chemistry and merchandising, but he soon felt the pull to be on his own again.

One day his wife saw an ad for a pottery for sale in the Bronx. "It was a weird building in the back of a German sausage-making store," Strong recalled. "Every time they smoked sausages, the whole place filled with smoke." He operated his pottery, Harris G. Strong, Inc., from that building for a while but eventually moved a couple of blocks away. Strong's decorative pieces sold well, and the company grew to 39 employees. In 1961 Strong with Donald Deskey received the International Design Award from the American Institute of Decorators for a 30-foot-long, free-standing ceramic wall in the Waldorf-Astoria hotel in New York.

In 1970 Strong moved his business to Trenton, Maine. There the working space expanded to 37,000 square feet, employees grew to 47 and their product line included printmaking, engravings, paintings, photography and woodcuts.

"I got into every phase of manufacturing," Strong said. "I had scientific knowledge and an approach that allowed me to do things no one else could do. My ceramic tiles and plaques were successful because many others in the business were making pie plates. We developed new techniques and textures. I even devised a method of packaging for shipping that was fantastic. We had less than one-tenth of one percent breakage. I engineered every process."

Demand for his decorative art kept growing. At its height his business had showrooms in New York, Chicago, High Point and Tokyo, as well as distribution centers in Canada and the Caribbean and representation in the Middle East. Strong traveled a great deal, and some of the moldings he designed were manufactured in Belgium, Holland and Germany.

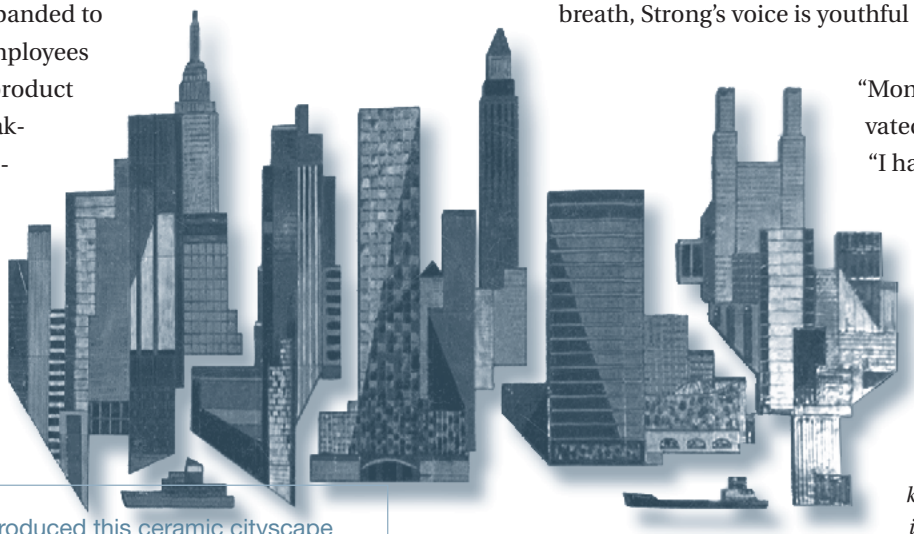
Strong gives much credit to his employees. "We had a number of good artists, mat cutters and frame makers. One of my former employees came to see me about a year ago and said, 'This was the best job I ever had because you were open to every suggestion. You don't usually get that in a job.'" Strong said, "I gave so much latitude to the other artists because I respected them. We were a close-knit group."

About five years ago Strong closed the business in Trenton and opened the Strong Art and Craft Gallery. Recently diagnosed with asbestos-related lung cancer, probably as a consequence of working with asbestos-lined kilns, Strong had to close his gallery. He now resides in Ellsworth, Maine, and has two adult sons, Matthew and Andre.

Despite his years and his illness, which can leave him short of breath, Strong's voice is youthful and rich with laughter.

"Money was not what motivated me," Strong said. "I have had a wonderful life." ■

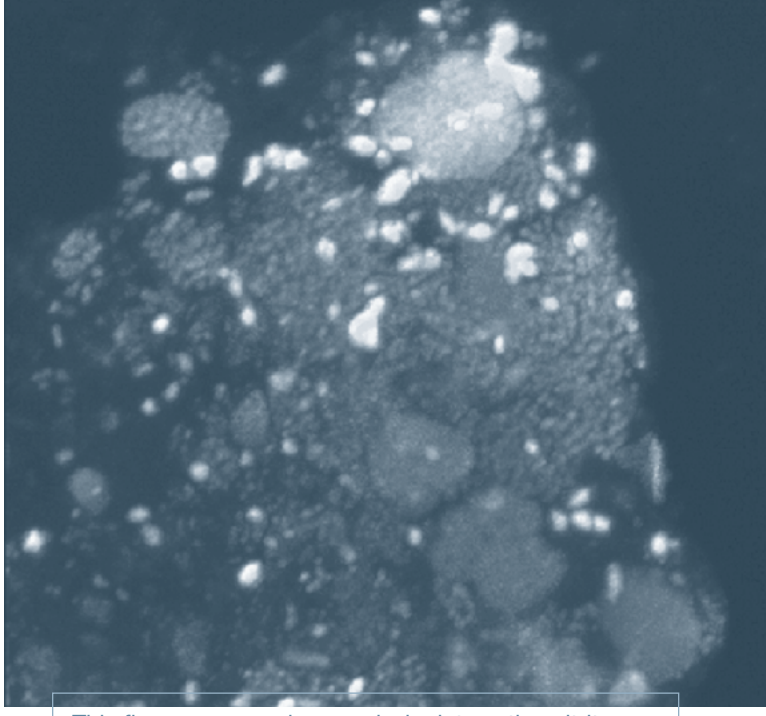
Editor's Note: Harris Strong passed away October 8, 2006. He lived long enough to see a copy of this story and was pleased to know it would appear in this issue.



Harris G. Strong, Inc. produced this ceramic cityscape for a Western Electric building in Westchester County, New York, in the 1960s. *(Photo: courtesy Harris Strong)*

RESEARCH update

Environmental engineers use gene probing to improve wastewater treatment



This fluorescence micrograph depicts active nitrite-reducing bacteria (white cells) in activated sludge, along with nitrite-oxidizing bacteria. *(Photo: Cesar Mota)*

Municipal and industrial wastewater has to be effectively treated to remove organic and nutrient pollutants before discharge to streams and rivers. Using leading-edge technology, environmental engineers at NC State University are improving our understanding of how microorganisms can be influenced to increase the performance of wastewater treatment plants.

One major role for microorganisms is the multi-step conversion of harmful ammonia nitrogen to harmless nitrogen gas. According to Francis de los Reyes III, associate professor of civil, construction, and environmental engineering, treatment plants typically supply large amounts of oxygen to allow microorganisms to convert ammonia to nitrite, then nitrite to nitrate. Nitrate is then converted to nitrogen gas by denitrifying bacteria. However, de los Reyes says less oxygen is required if the process is circumvented by bacteria that use nitrite instead of nitrate. Determining the identity and function of these nitrite-reducing bacteria is a challenge.

De los Reyes and NC State PhD student Cesar Mota are studying this problem using a gene probing method that targets the messenger RNA of nitrite-reducing bacteria. Using a technique called mRNA-FISH (Fluorescence In Situ Hybridization), they are able to fluorescently tag active nitrite reducers in wastewater bioreactors. This technique targets the functional nitrite reductase gene, and helps them identify bacteria responsible for nitrite conversion.

"Targeting functional genes is a big leap in this research area. In previous methods, you had to know the identity of the organism before you can tag it. Now, you can target the gene and ask the question of which bacteria are performing the function," said de los Reyes. "We are now extending the method to allow separation of the fluorescently labeled cells and subsequent identification of the species involved. Once the organisms are identified, we can then track them and see which factors can be used to influence their growth, and ultimately, reactor performance."

The new method, called SmRFF (Sequential mRNA FISH-Flow cytometry), also allows the researchers to spatially relate the different groups of organisms involved in the nitrogen conversions. Already, the researchers are seeing some interesting results, including some preliminary data showing that some ammonia oxidizing bacteria are also nitrite-reducers.

"The finding is significant, since it means we can potentially run treatment plants with 60 percent less oxygen," said de los Reyes. "The process will be best for wastewater with high nitrogen and low carbon, since you can also save potentially up to 100 percent of the carbon requirements."

The current research is funded from a four-year National Science Foundation (NSF) Microbial Interactions and Processes grant. Future applications of this work include targeting other functional genes important in environmental cleanup. "We can potentially use the new method to identify and quantify the microorganisms involved in cleaning up groundwater contaminated sites, or specific pollutants," said de los Reyes. "Very few engineers are using molecular methods in this way." ■

EXTENSION update

Herb Eckerlin helps industries "Save Energy Now"

This mechanical and aerospace engineer has been helping industry conserve energy since 1992

The recent increase in the cost of energy has both consumers and industry looking for ways to conserve. President George W. Bush has called for energy conservation through improved technologies and better efficiency.

At North Carolina State University, Dr. Herbert M. Eckerlin, professor of mechanical and aerospace engineering, has been teaching industries how to use energy more efficiently since 1992 through the NC State University Industrial Assessment Center (IAC), one of 26 university-based centers across the nation that are supported by the US Department of Energy (USDOE) for the purpose of helping industry find ways to operate more efficiently. Eckerlin, who is a national authority on boiler and steam systems, and his students have visited 25 industrial plants each year to test equipment and make recommendations for improved efficiency and energy conservation.

The two main goals of the program are to provide energy conservation and cost reduction assessments to small- to medium-sized manufacturers and to educate the next generation of energy managers. Advanced undergraduate and graduate students from the Department of Mechanical and Aerospace Engineering at NC State University along with experienced faculty conduct a one-day assessment of the facility. Data on plant operations and energy costs are collected and analyzed to determine potential conservation measures. These measures are compiled into a technical report detailing the recommended action, the potential savings, the estimated cost of implementation and simple payback period.

As part of the new USDOE Save Energy Now initiative, Eckerlin has delivered four workshops this year. Co-sponsored by the State Energy Office of North Carolina and the USDOE Save Energy Now initiative, the workshops focus on providing plant personnel with practical methods for identifying and implementing energy-saving methods in their boiler and steam facilities.

Boilers are one of the major energy expenses in industry. For example, one tire plant that Eckerlin recently visited has an annual natural gas bill of $3.5 million. Reducing the energy consumption by even a small fraction would have a major impact on the plant's expenses.

BOILERS ARE ONE OF THE MAJOR ENERGY EXPENSES IN INDUSTRY. ONE TIRE PLANT THAT ECKERLIN RECENTLY VISITED HAS AN ANNUAL NATURAL GAS BILL OF $3.5 MILLION.

While energy conservation is the primary goal of the IACs and the Save Energy Now initiative, the project also helps local economies remain strong.

"Keeping energy expenses to a minimum is especially important in today's economy," says Eckerlin. "If the energy cost of a plant gets too high, it may close and move overseas, taking away jobs from the community. We want to do what we can to prevent that from happening." ■

footnotes
FRONTLINE

Annie Antón, computer science, has been appointed by Department of Homeland Security (DHS) Secretary Michael Chertoff to serve on the DHS Data Privacy and Integrity Advisory Committee for a four-year term.

Douglas Barlage, **Do Young Eun** and **Wenye Wang**, electrical and computer engineering; **Xiaosong Ma**, computer science; and **Jon-Paul Maria**, materials science and engineering, each received a Faculty Early Career Development (Career) Award from the National Science Foundation (NSF). The Career award is one of the highest honors given by NSF. NC State has received 31 NSF Career awards in the past 5 years alone.

David Beasley, biological and agricultural engineering, was named Fellow of the American Society of Agricultural and Biological Engineers (ASABE) in July 2006.

Don Bitzer, computer science, was inducted into the Consumer Electronics Hall of Fame in October 2006. He is a member of an Emmy-award-winning team that invented the flat plasma display in 1964; their invention is the forerunner of the high-definition plasma televisions of today.

Mohamed Bourham, nuclear engineering, was named interim head of the Department of Nuclear Engineering effective July 1, 2006. He replaces Paul Turinsky.

Broughton High Class of 1950 honors their class president with a gift of more than $26,000 to the College of Engineering at NC State University. The gift, in memory of **Homer L. (Pete) Jenkins** (IE '59), who passed away in 1999, will create a scholarship endowment.

Mark Clapp, a dual-degree student majoring in textile engineering and biomedical engineering with a minor in Spanish, was named College of Engineering Faculty Senior Scholar for 2006-07.

Joel Ducoste, civil, construction, and environmental engineering, received a Fulbright research scholar award to Belgium during 2006.

Ryan Michael Field, a senior with a dual major in electrical engineering and physics, was awarded a $10,000 scholarship from the Astronaut Scholarship Foundation.

Edward Fitts (IE '61) and **Smedes York** (CE '63) received Watauga Medals at the NC State University Founders' Day Dinner in March 2006.

Paul Franzon, electrical and computer engineering, was elected Fellow of the Institute of Electrical and Electronics Engineers (IEEE).

Jan Genzer, chemical and biomolecular engineering, has received a Special Creativity Award from the Division of Materials Research at the National Science Foundation.

Christine Grant, chemical and biomolecular engineering, and **Annie Antón**, computer science, were selected to participate in the 12th annual US Frontiers of Engineering Symposium by the National Academy of Engineering (NAE).

Robin Gardner, nuclear and chemical engineering, was appointed to the National Academy of Science Committee on Radiation Source Use and Replacement through October 2007.

Carol Hall, chemical and biomolecular engineering, was named Camille Dreyfus Distinguished University Professor.

Alex Huang, electrical and computer engineering, was elected Fellow of the Institute of Electrical and Electronics Engineers (IEEE).

David Kaber, industrial and systems engineering, was awarded the Alcoa Foundation Engineering Research Achievement Award for 2006.

Russell King, industrial engineering, was elected Fellow of the Institute of Industrial Engineers (IIE).

Carl Koch, materials science and engineering, was awarded an Alexander Quarles Holladay Medal for Excellence for 2006. The Holladay Medal is the highest honor bestowed on a faculty member by the NC State University Board of Trustees.

Yuan-Shin Lee, industrial and systems engineering, received the 2006 Award for Technical Innovations in Industrial Engineering Award from the Institute of Industrial Engineers (IIE).

Frank Mueller and **Laurie Williams**, computer science, were selected to receive **2006 IBM Faculty Awards** valued at $20,000 and $27,000, respectively.

James Nau, civil, construction, and environmental engineering, has received the 2006 George K. Wadlin Distinguished Service Award from the American Society for Engineering Education (ASEE).

Industrial Engineering adds "and Systems" to its name

The Industrial Engineering department's new name, the Edward P. Fitts Department of Industrial and Systems Engineering, reflects the changing character of the department, emphasizing the importance of systems engineering in the area of industrial engineering. The department was endowed with a $10 million gift from Edward P. Fitts, founder and former chief executive officer of Dopaco. The commitment is the largest gift ever received by the College of Engineering from an individual donor and the largest endowed gift to academics in NC State's history.

Engineering summer programs expanded

Programs now include elementary as well as middle and high school students

The new elementary school program is a week-long day camp for rising third through fifth graders led by elementary school teachers in partnership with engineering faculty from NC State. For more information, visit **www.engr.ncsu.edu/summerprograms**, or call (919) 515-9669 for high school camps or (919) 515-2315 for middle and elementary school camps.

George Roberts, chemical and biomolecular engineering, received the Alcoa Foundation Distinguished Engineering Research Award for 2006.

Shantel L. Samuel (BS Computer Engineering '02) received a 2006 Modern Day Technology Leaders Award at the Black Engineer of the Year Award Conference held in Baltimore, Md. The Modern Day Technology Leaders Award "recognizes men and women who are shaping the future of engineering, science and technology."

Bastian Schroeder, a PhD candidate in civil engineering, received three awards for 2006. He has been named an Eisenhower Graduate Fellow, an Eno Fellow and a Transportation Founders Fund (TFF) Fellow.

Richard Spontak, chemical and biomolecular engineering, received the 2006 Recognition Award from the International Network for Engineering Education and Research (iNEER).

Michael Steer was named the Lampe Professor of Electrical and Computer Engineering. He is the first to hold the endowed professorship established by the Ross W. Lampe family of Smithfield.

Orlin Velev, chemical and biomolecular engineering, was selected to receive a Camille Dreyfus Teacher-Scholar Award.

Mladen Vouk was named head of the Department of Computer Science effective July 1, 2006. He had served as interim since July 2004.

James Young, **Philip Westerman** and **Robert Evans**, biological and agricultural engineering, received honors from the American Society of Agricultural Engineers in 2005-06. Young won the Massey-Ferguson Educational Award; Westerman won the Gunlogson Countryside Engineering Award, and Evans was named a Fellow of the Society.

Ribbon-cutting ceremony celebrates Environmental Engineering Lab

In March 2006 the Department of Civil, Construction, and Environmental Engineering marked the opening of a new laboratory dedicated to environmental engineering research with a ribbon-cutting ceremony held in Broughton Hall. The 5,200-square-foot facility supports the department's research programs in water and wastewater treatment, contaminant transport and site remediation, solid waste engineering and molecular microbial ecology. Morton A. Barlaz serves as director of the laboratory. The ceremony was held in conjunction with the 2006 Water Resources and Environmental Engineering Graduate Research Symposium.

Engineering Online adds Rocky Mount venue

Recognized as one of the best values for distance education delivery in the nation, the College of Engineering at NC State has added another venue to its offerings — bringing engineering degree programs to the Rocky Mount area. A partnership with East Carolina University, Edgecombe Community College, Halifax Community College, Nash Community College and Wilson Technical Community College offers an undergraduate pre-engineering program at the Gateway Technology Center at Wesleyan College. The addition of the Rocky Mount site will give local businesses and industries the ability to hire employees with better skills and allow existing employees access to higher education opportunities. For more information, visit **engineeringonline.ncsu.edu**.

For more information, visit **www.engr.ncsu.edu/news**

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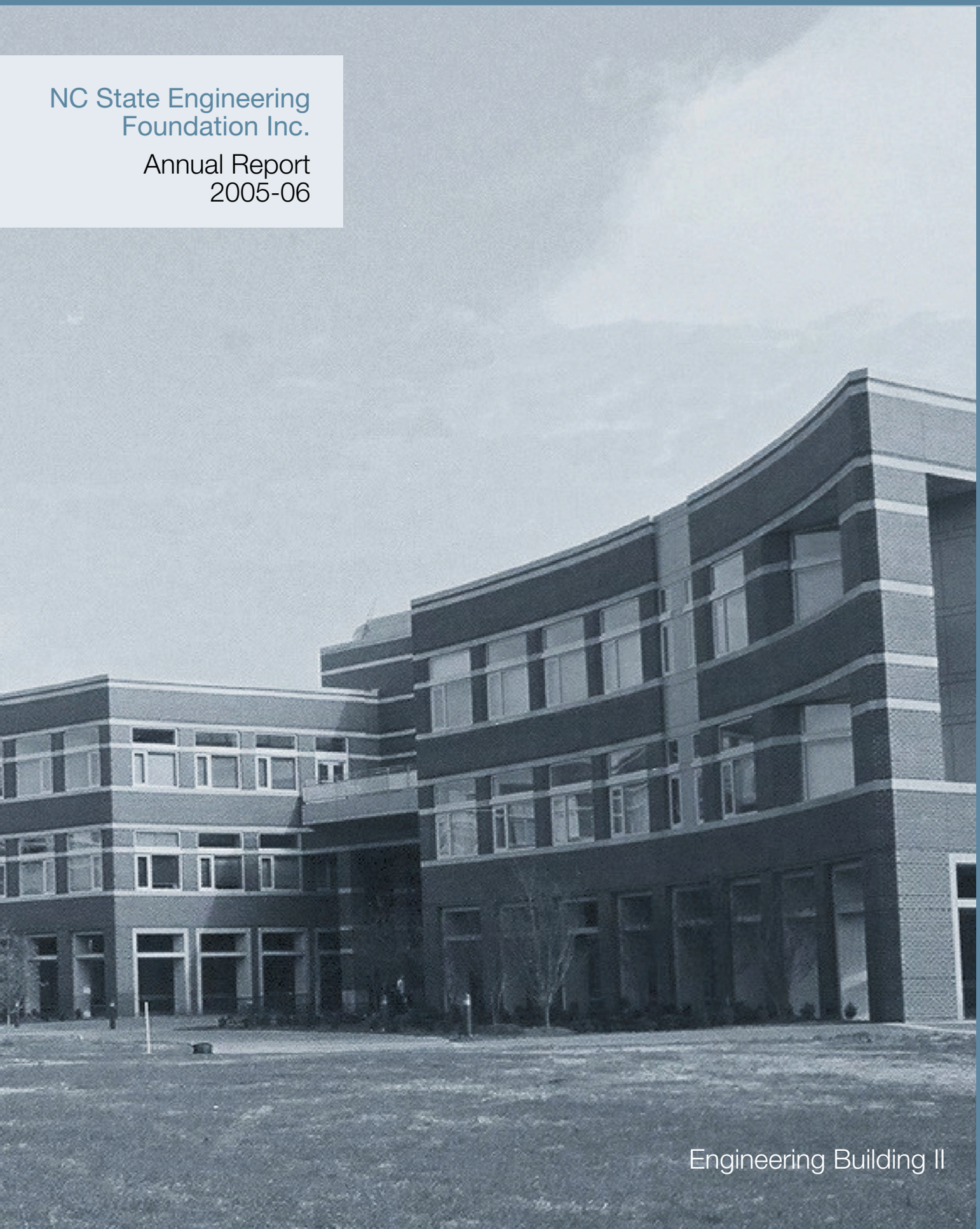
Annual Report 2005-06



Engineering Building II

From the executive director

Ben Hughes

Dear Alumni and Friends,

Webster's Dictionary defines momentum as measure of the motion of a body equal to the product of its mass and velocity. Momentum is an accurate word for where the College of Engineering is at this time in its history. Below are a number of our recent successes.

We received news at the end of June that the State of North Carolina has approved funding for EB III, the third of five planned buildings on Centennial Campus. Construction is expected to begin in spring 2007.

In April 2006 we dedicated the Edward P. Fitts Department of Industrial and Systems Engineering (ISE). This is the first academic department within the College of Engineering to be named and will set the bar for the future naming within the college. The ISE faculty and staff are working on a strategy to leverage Mr. Fitts' investment, along with other alumni gifts, to advance the department into top 10 national rankings.

One of our long-time corporate friends, Progress Energy, made a generous gift to the newly built EB II building, naming the third floor conference suite. Progress Energy has been an outstanding partner with the college and has made a renewed commitment to hiring our graduates and collaborating with our faculty on research projects.

We added more than eight new endowed professorships to the list established during the *Achieve!* Campaign. These professorships allow us to attract outstanding faculty and retain our best talent.

As we begin a new school year, we will have a record number of entering freshmen in the College of Engineering's Class of 2010. They bring not only strong academic credentials but also an impressive history of service to their communities.

To continue this success and to attain an even higher degree of academic achievement, we must look to our alumni to support the college at an unprecedented level with their time as volunteers and as investors in our programs, students and faculty. Please check our website at **www.engr.ncsu.edu/ncef** to see even more of the exciting things that are happening.

Finally, I want to thank Nino Masnari for his excellent leadership during the past 10 years as dean. Indeed, he has been a driving force in the success of the college. We wish him well as he returns to the ranks of our world-class faculty in the Department of Electrical and Computer Engineering.

Your many contributions have had a direct impact on our successful momentum. Thank you for your loyalty and generous support to the College.

— Ben Hughes
Executive Director
Development and College Relations

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Former scholarship recipient April Morris Kloxin (left), the first to receive an Angelo scholarship, attended the dinner with her former benefactor, Bill Angelo. Joining them are current Angelo scholars, Madeha Baqai and Aaron Jones. *(Photos: Becky Kirkland)*

Engineering Foundation Holds Annual Endowment Dinner

The Annual Engineering Endowment Dinner was held March 16, 2006, at the Jane S. McKimmon Center. The event brought together 300 endowment donors, students and faculty. Hosted by the NC State Engineering Foundation Inc. and the College of Engineering, the event celebrates the importance of private support of academic achievement. Sponsors for this year's event were Caterpillar, North Carolina Electric Membership Corporation and R.J. Reynolds Tobacco Company.

In addition to providing financial benefits, scholarships and fellowships also offer alumni, friends and supporters a means to demonstrate their interest in NC State engineering students. These donors understand the impact scholarships have on continuing to build top-quality programs in engineering education.

Nicole Seabrook and Gina Hicks are recipients of O'Dell scholarships created by Russ and Susie O'Dell.

Donors 2005-06

R. STANHOPE PULLEN SOCIETY

The R. Stanhope Pullen Society, named after the Raleigh philanthropist who donated the original 62 acres of land for the site now known as North Carolina State University, recognizes donors who have included NC State University in their estate plans. Here, the College of Engineering at NC State recognizes individuals who have planned gifts for the College, either in their wills or through a life income gift such as a charitable remainder trust that provides income for the donor(s) or a beneficiary for life or a term of years and passes the remainder to the College. These gifts are typically funded with cash, bonds, stock, real estate or other real property. They often result in a named endowment fund that benefits the College in perpetuity.

The names listed for the Pullen Society include donors who announced planned gifts prior to June 30, 2006. For information about including the College of Engineering in your estate plans — or if you have already done so and would like to become a member of the Pullen Society — contact David Mainella, Associate Executive Director of Development, NC State Engineering Foundation, Campus Box 7901, NC State University, Raleigh, NC 27695-7901, (919) 515-9957, (866) 316-4057 toll free, or david_mainella@ncsu.edu.

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Gifts listed below were received July 1, 2005, through June 30, 2006. For years of consecutive giving, a single asterisk indicates five years or more; a double asterisk, 10 years or more.

Gifts made directly to the NC State Engineering Foundation Inc. are utilized exclusively for the benefit of the College of Engineering. The Dean's Circle was created to recognize the vital support that annual, unrestricted gifts provide.

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Jim Davis and Lynn Eury attended the 2005 Engineering Leadership Dinner.

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It only takes a moment

One of the best ways to show your support for your *alma mater* is joining the Dean's Circle. Your tax-deductible gift to the NC State Engineering Foundation Inc. of $1,000 or more in unrestricted funds qualifies you for membership. Whether it is for student recruitment, faculty development, scholarship support or other programs not supported by the State, these critical dollars are of utmost importance. Please call David Mainella or Gwen Bell at (919) 515-7458 for more information. It only takes a moment.

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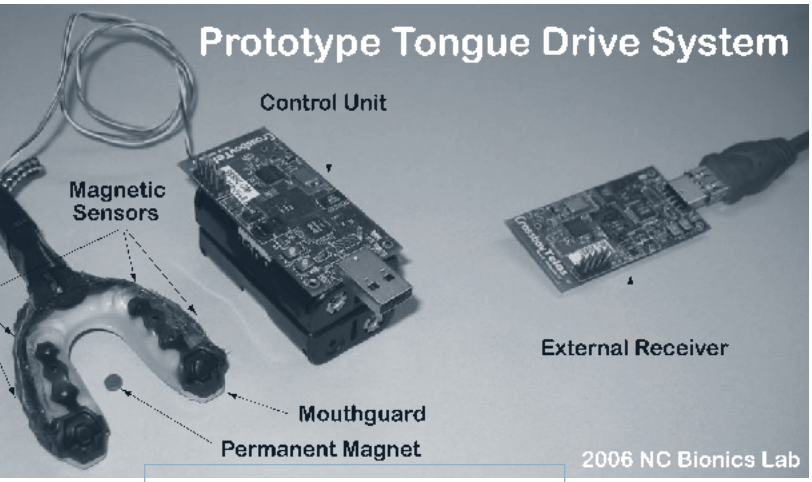
Tongue Drive system revolutionizes assistive devices for disabled

Device will improve comfort and control for quadriplegics and spinal cord injury patients

What do orthodontic braces and trendy tongue piercing have in common? They were the inspiration for a new assistive device that allows quadriplegics to take greater control of their lives. And while one might think tongue studs and orthodontic braces are better suited for rebellious teens and bad bites than people with disabilities, the technology they inspired offers spinal cord injury patients an effective, cosmetically acceptable and less invasive technology for interacting with the world.

Dr. Maysam Ghovanloo, assistant professor of electrical and computer engineering at NC State University, has developed the Tongue Drive system — an innovative interface that promises to be the next generation of assistive devices for people with severe disabilities. The basic device consists of three components: a tiny permanent magnet the size of a rice grain, which can be attached to the tongue by means of piercing or implantation; a set of tiny magnetic sensors held in place by brackets on the lower or upper teeth; and a control unit. The control unit with sensor interface circuitry, wireless transmitter and a pair of watch batteries is contained in a coin-sized, sealed package that rests under the tongue.



The Tongue Drive system consists of a tiny permanent magnet, a set of tiny magnetic sensors and a control unit small enough to fit inside the mouth. *(Image: courtesy Maysam Ghovanloo)*

The Tongue Drive system uses wireless transmission to communicate with a basic PDA (personal digital assistant) or a nearby computer using Bluetooth or Wi-Fi technology. Ghovanloo's team has written software to decode the signals from the mouth sensors, translate them to user commands, then communicate the commands to a device, such as a computer or a powered wheelchair. Using the tongue much like a hand on a computer mouse, a person can move the pointer and give complex commands such as drag and drop or double click. When driving a wheelchair, the user can control the wheelchair movements with proportional control, giving the user a smoother, more continuous motion rather than the stop-and-start motion provided by switch-based devices.

Ghovanloo is collaborating with Elaine Rohlik and Dr. Pat O'Brian at WakeMed Rehab Hospital in Raleigh to test the Tongue Drive prototypes.

"Our goal was to develop a cosmetically appealing and comfortable device that was minimally invasive and that would give a severely disabled person with a spinal cord injury or a degenerative nerve disease the ability to lead a productive and more independent life," says Ghovanloo. "Not only does this device meet this goal, it does so at a very low cost since its components are basically off-the-shelf technology and no surgery is required." ■

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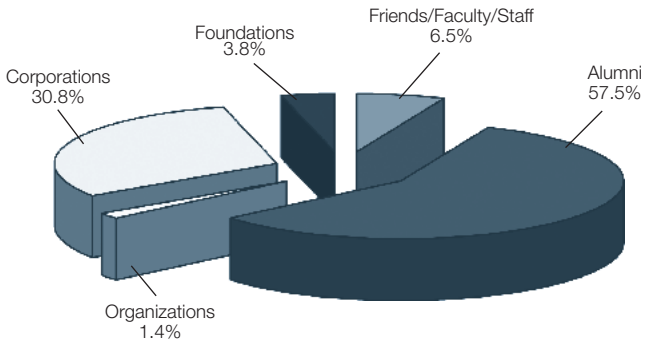

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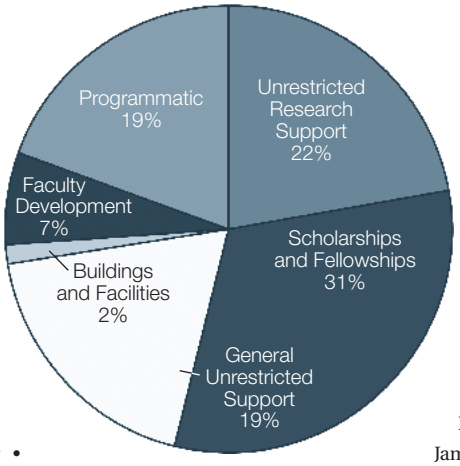

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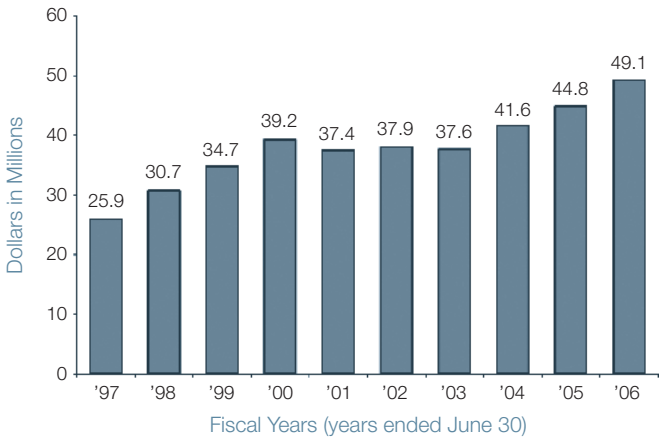
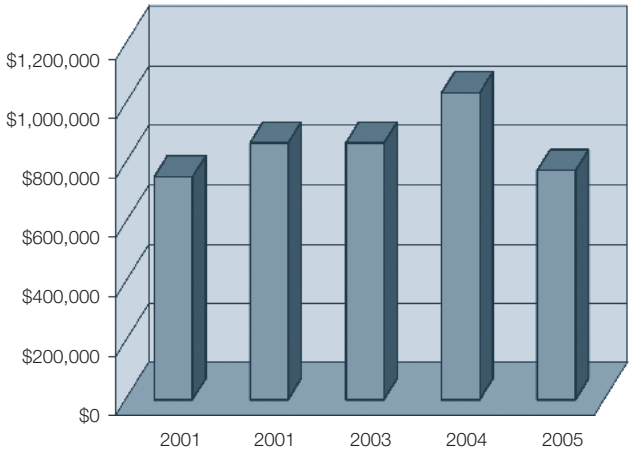


UNRESTRICTED GIVING TO THE COLLEGE OF ENGINEERING



Grover C. McNair Sr. • Robert E. and Peggy S. Meares • Arthur J. Meier • Charles S. Mitchell • Amelia N. Mitta Memorial • Forest O. Jr. and Sandra Mixon/BS&T Friends • Forest O. Jr. and Sandra Mixon/RTI • Jule Modlin Jr. • Mulkey/General Hugh Shelton Leadership • W. Grigg Mullen • Henry C. Murphy III Memorial • Raymond L. Murray Nuclear Engineering • Hugh C. Murrill Memorial • Edgar B. Nichols Jr. and Sr. • Brock M. Nicholson • North Carolina Electric Membership Corporation • Russ O'Dell • Francis P. O'Dell Fellowship • Hayne Palmour III • Frank T. Pankotay Memorial • Martin W. Parcel Memorial • David W. and Anne B. Pearsall • Eric Paul Pearson • Johnnie L. Pearson • Thomas D. and Tressa L. Pearson • Charles R. and Freda Y. Pendred Memorial • Ronald G. Pendred • Larry K. Petty/Ben Franklin • Phoenix Family • Richard L. Porter Memorial • James A. Powell • Powers Manufacturing • Pratt Family • Procter & Gamble Company • Professional Construction Estimators Association, Inc./Kyle Cave Memorial • Progress Energy • Verna S. Ramsey • Joe W. Reese • C. Robert and Joan Rhodes/ Ben Franklin • Frances "Billie" Richardson • Mark C. Roberts Memorial • B.D. and Patricia Rodgers • D. Edwin Rose/Shelco, Inc. • R.N. Rouse & Company • James T. Ryan Memorial • Eugene C. and Winifred Sakshaug • Norman G. and Sylvia L. Samet • SAS Institute • Ed Scott • William deRosset Scott III Memorial • Nicholas E. and Sandra B. Scronce • E. Chester Seewald • Shelco, Inc. • Andy Sepelak Memorial • Joseph H. and Mary S. Sherrill • G.H. and Ruth Singleton • Charles Smallwood Fellowship • Clarence M. Smith Jr. • Drexel "Rex" K. Smith Jr./Ben Franklin • Early C. Smith • Henry B. and Virginia T. Smith • Ron E. Smith Jr. • Theresa Mooney Snyder • Dr. Hans H. Stadelmaier • Dr. Vivian T. Stannett Memorial Fellowship • Steelfab, Inc. • Paul M. Stephens • William D. Stevenson Jr. • Katharine Stinson • Dr. Robert F. Stoops • Square D • Hubbard and Mable Sullivan • Raymond S. Talton • Henry C. and Nancy A. Thomas • Richard Greenwood Thomas • James Wayne and Mozelle Rose Thompson Memorial • Frederick J. Tischer • UNCA/NCSU 2+2 • L.L. Vaughn • Ed Vick Fellowship by Kimley-Horn Assoc. • Herbert B. Walker • M. George Wayburn • Louis S. Whatley • Edwin L. Welch Sr. Memorial • Lin Wiggins Memorial • Harold B. Williamson Memorial • Charles T. Wilson Sr. • Simon Brown Woolard • Louis E. Wooten Memorial • J.W. "Willie" York • Frank C. Ziglar Jr. Fellowship

ENDOWED PROFESSORSHIPS

NC State Engineering Foundation Inc.

Alcoa Foundation Professorship • Celanese Acetate Professorship • Walter Clark Professorship • Camille and Henry Dreyfus Foundation Professorship • Henry A. Foscue Professorship • INVISTA Professorship • William R. Kenan Jr. Research Professorship • Lampe Electrical and Computer Engineering Professorship • R. A. and Mildred Lancaster Professorship • R.J. Reynolds Professorship • James T. Ryan Professorship

NC State University

A. Doug Allison Professorship • Civil Engineering Distinguished Professorship Worley H. Clark Professorship • E.I. Clancy Professorship • Dopaco, Inc. Professorship • Dean F. Duncan Professorship • John. C.C. Fan Professorship • Edward P. Fitts Industrial Engineering Professorship • Edward P. Fitts Industrial and Systems Engineering Professorship • Kobe Steel Ltd. Professorship • McPherson Family Professorship • Progress Energy Professorship • SAS Institute Distinguished Professorship • Zan Prevost Smith Professorship in Mechanical Engineering • Edward I. Weisiger Professorship • Edgar S. Woolard Professorship

GENERAL ENDOWMENTS

Clifton A. Anderson Teaching Award • CEEF/IBM/Martin • Celanese Acetate Academic Excellence • COE Entrepreneurs' Program – Barnes • COE Entrepreneurs' Program – Harry • COE Entrepreneurs' Program – Wingo • COE Faculty Development • Computer Science Enhancement • Covington Enhancement Fund • S. Frank and Doris Culberson Academic Enhancement in CHE • Tom and Mimi Cunningham Academic Leadership • Dr. Joseph W. David • Dean Ralph Fadum • James E. and Lois C. Deas • Delta Airport Consultants • Diversity in Computer Science • ECE Memorial Library • Excellence in Undergraduate Computer Science Education • Fairchild Extension Awards • Goodrich Faculty Research Award • Bill Horn Faculty Development • F. Neal Hunter • W. Eugene Hunter Academic • IBM Faculty • Janus Development Group • Berry G. Jr. and Glenda D. Jenkins • J.A. Jones Construction Program • William R. Kenan Jr. CHE Research • J. Harold Lampe Engineering Excellence • William Lane ECE Outstanding Teacher Award • Lattice Academic Enhancement for CE • Lattice Academic Enhancement for MSE • Henry V. Liles Jr. • MAE General • H. Rooney Malcom • William R. Mann • Charles R. Manning Enhancement • Manning/Blanchard • Walker Martin • William F. Morris Family • NC State Engineering Foundation Academic Enhancement • North Carolina Licensing Board for General Contractors • A.P. Norwood Chapter of Chi Epsilon • Nuclear Engineering Academic Excellence • Pathway to the Future – CSC • Boris B. Petroff • Phoenix Summer Outreach • Progress Energy Dean's Fund • Progress Energy Fellow • Kemp Reese and Edna Reese • James M. Robinson Jr. • B.D. Rodgers • Henry M. Shaw Lectures • Albert and Alice Shih • Fumio Shimura Material Science and Engineering Academic Enhancement • Student Award and Activities • Dr. K.C. Tai Memorial • Wachovia Fund for Excellence • Grace Tanigawa Traynor Memorial • William F. Troxler Design Center Support • William F. Troxler Enhancement Fund • Hannibal G. Warren Memorial • John K. Whitfield Memorial • Rex T. Willard Academic Leadership • C.T. Wilson Construction AGC Student Chapter • Edgar S. Woolard Dean's Discretionary • Robert G. Wright Transportation Engineering

John McCarter's vision – moving the college forward

When John T. McCarter (NE '73) became president of the NC State Engineering Foundation Inc. (NCSEF) Board of Directors in 2004, his vision was to continue moving the College of Engineering and the board forward in the restructuring effort begun under the leadership of Robert G. Wright, the previous president of the board. McCarter's job over the past two years has been to take that restructuring initiative to the next level.

McCarter, who is the former president and region executive of General Electric Power Systems Sales – Europe, brought to the NCSEF board years of experience serving on the boards of both charitable and professional organizations, including the Center for the Disabled, United Cerebral Palsy, the Association of American Chambers of Commerce of Latin America and the Council of the Americas. His lifelong career with General Electric gave him a unique perspective on how organizations function, making him a highly qualified leader during the restructuring.

As president, McCarter provided strong leadership for the legislative initiative to secure full funding of Engineering Building III, which is critical for the planned College of Engineering move to Centennial Campus. McCarter has helped redefine the purpose and goals and objectives for the board and its five individual working committees. Following the reorganization effort begun under the leadership of Wright, McCarter has helped streamline the role of the executive committee and appoint the new leaders for the five working committees.

In the wake of the highly publicized investment problems of several major corporations and in the spirit of reform and transparency among nonprofit organizations, McCarter provided important direction in developing a code of ethics and a conflict of interest policy in the bylaws of the board. The board enthusiastically embraced this effort.

A loyal alumnus, McCarter has served on the NCSEF Board of Directors since 1993. His longtime commitment to NC State University and the College of Engineering is evident. During his four terms on the board, he has served on the finance committee; the nominations, orientation and recognition committee; and the college relations committee (formerly the marketing committee). He was also instrumental in the realization of the $500,000 gift from the GE Foundation to support the RAMP-UP program in the college.

John T. McCarter

Active at both the college and university levels, McCarter has served on NC State University's External Advisory Board for International Programs and was GE's executive liaison to NC State. In 1997 he endowed the Mr. and Mrs. John T. McCarter Sr. Scholarship. Named in honor of his parents, the merit scholarship is awarded to students enrolled in engineering. In 2003 he was awarded a Distinguished Engineering Alumnus Award in recognition of his accomplishments. He is also in the process of endowing the John T. McCarter Jr. Enhancement Fund in nuclear engineering. The endowment will provide much-needed unrestricted support for use by the head of the Department of Nuclear Engineering.

"Simply put, John McCarter has been one of the key leaders in the recent success of the foundation board of directors, both as our president and as a major benefactor," said Ben Hughes, executive director of the NC State Engineering Foundation Inc. "His vision as a generous donor is evident in his most recent gift of vital unrestricted support to his home department."

McCarter is a native of Philadelphia, Penn., and claims Hickory, North Carolina, as his adopted hometown. He earned his bachelor's degree in nuclear engineering in 1973. The College of Engineering and the NC State Engineering Foundation are grateful for McCarter's service as president of the Board of Directors.

By the Numbers . . .

THE COLLEGE OF ENGINEERING

Academic Programs/Students

- 18 bachelor's, 17 master's, 13 doctoral degree programs
- 15th "best undergraduate engineering degree program" among public colleges of engineering whose highest degree is a doctorate by *US News & World Report*
- Ranks among *all* US engineering colleges:
  - 4th in the number of BS degrees awarded
  - 6th in the total number of degrees
  - 4th in BS degrees awarded to women
  - 5th in BS degrees awarded to African Americans
- Largest college at NC State, with more than 7,000 students; enrollments typically include more than 5,500 undergraduates and 1,800 graduate on-campus students
- More than 50 percent of incoming freshmen are in the top 10 percent of their high school graduating class
- Annually more than 1,200 undergraduate and 500 graduate degrees awarded; graduation rate: 75.3%
- 170 distance education courses offered each year
- No. 1 Best Buy ranking for Online Master of Engineering and Master of Civil Engineering degrees
- $3.3 million in scholarships/fellowships awarded annually
- First to establish a nuclear engineering program; operated the world's first nuclear reactor used for teaching, research and public service
- Annually engages in statewide outreach to more than 5,000 students and 500 teachers in K-12 programs, supported by over $6 million in grants for science, technology, and mathematics education; over 1,000 K-12 students attend College of Engineering summer camps each year

Academic Departments

- Biomedical Engineering
- Chemical and Biomolecular Engineering
- Civil, Construction, and Environmental Engineering
- Computer Science
- Electrical and Computer Engineering
- Industrial and Systems Engineering
- Materials Science and Engineering
- Mechanical and Aerospace Engineering
- Nuclear Engineering

Engineering Programs Affiliated with Other Colleges

- Biological and Agricultural Engineering
- Paper Science and Engineering (Wood and Paper Science)
- Textile Engineering (Textile Engineering, Chem. and Sci.)

Research

- Ranked 20th among public research colleges of engineering by *US News & World Report*
- Ranked 17th in research expenditures and 14th in industry support among all engineering colleges in the US
- Annual research expenditures exceed $95 million
- Over 20 centers, institutes, and labs, conducting research in a broad range of engineering and computer science areas

Faculty and Staff

- 930 faculty and staff, including 247 tenured/tenure-track faculty members
- 11 faculty are members of the National Academy of Engineering, and 77 have received Presidential and National Science Foundation recognitions for achievement, including 52 NSF Career Awards

Technology Transfer

- In 2005-06 the College filed 25 patent applications, was granted 1 foreign and 20 US patents, and had 62 invention disclosures and 1 copyright disclosure

Extension, Engagement, Economic Development

- The College of Engineering's Industrial Extension Service (IES) is the first industrial extension service established in the nation (1955)
- Over the past five years, companies assisted by IES reported $500 million in direct economic impact from IES' services, and in 2005-06 alone, IES helped retain or create 1,237 jobs across the state

Alumni

- Total living alumni: 47,218
- Total degrees awarded: 50,808 (38,559 bachelor's and 12,249 graduate degrees)

Support

- Total budget: more than $175 million
- Total endowment: 287 endowments with a market value of $62.3 million
- Total gifts and grants commitments: $42.3 million annually
- *Achieve!* Campaign totals for Engineering: $206.1 million towards $225 million goal
- Edward P. Fitts gave $10 million to endow the Edward P. Fitts Department of Industrial and Systems Engineering, the first endowed academic department and largest endowed gift to academics in the university's history

Other

- The College of Engineering is moving its entire facilities to Centennial Campus; Engineering Building II was completed in 2005-06; and Engineering Building III has received funding for construction
- The Engineering Career Fair at NC State is one of the largest university career fairs in the nation

NC STATE engineering

ACADEMICS • RESEARCH • EXTENSION

Campus Box 7901 NC State University Raleigh, NC 27695

New professorship established by Clancy & Theys

Family with close ties to NC State honors their father with the E.I. Clancy Professorship

One way to grow the faculty and attract nationally recognized professors is to pledge $1 million to create a professorship, which is exactly what brothers Tim and Tick Clancy did for the Department of Civil, Construction, and Environmental Engineering. The E.I. Clancy Professorship in Construction Management will be established using the $1 million gift from the company and matching funds of $500,000 to be provided by the Distinguished Professorship Endowment Trust Fund once the pledge is fulfilled, bringing the total value of the endowed professorship to $1.5 million.

The Clancy family has a long history of philanthropy in many areas, but because their father attended State, the family thought it was time to honor him by doing something in his name for the department. Tim Clancy, president, and Tick Clancy, executive vice president, noted that their father had wanted to be an engineer from a very early age.

AN ASHEVILLE NATIVE, ERNEST I. CLANCY (BSCE CONSTRUCTION OPTION '38) WAS ONE OF THE FIRST TO GRADUATE FROM THE CONSTRUCTION PROGRAM AT NC STATE.

Clancy founded the company with his brother-in-law, J.C. Theys, in 1948, so Tick said they would like to recognize him with this gift as well.

An Asheville native, Ernest I. Clancy (BS '38 CE Construction Option) was one of the first to graduate from the construction program at NC State. He was also a Professional Engineer and a registered surveyor. Prior to founding the company, he worked during World War II in Alaska, supervising the construction of runways for the Civil Air Patrol. A long history exists between Clancy & Theys and "State College," as Ernest Clancy called it. The company has had numerous projects on the NC State campus, including Winston Hall and Engineering Building II. Its employees have come to campus many times to give seminars and lectures. In 1999 Ernest Clancy established a scholarship endowment in the department, to which the company has since contributed.

"Our goal with this professorship is to attract more students to the department, so if this endowment adds one faculty member, that would be great," said Tim Clancy. He noted that they employ more graduates from NC State than from any other university, and that one reason construction in NC is so strong is the education offered by the Department of Civil, Construction, and Environmental Engineering at NC State.

E.I. Clancy

Engineering Building II
(Photo: Will Rowland)

NC State celebrates dedication of Engineering Building II on Centennial Campus

The College of Engineering at North Carolina State University held a dedication ceremony to celebrate the occupation of Engineering Building II (EBII) in April 28, 2006. The completion of Engineering Building II is a landmark event in the history of the College of Engineering at NC State. Construction of EBII was made possible through the passing of the NC Higher Education Bond Referendum in 2000 by the citizens of North Carolina.

ENGINEERING BUILDING II REPRESENTS THE SECOND PHASE OF THE PLAN TO MOVE THE ENTIRE COLLEGE OF ENGINEERING TO CENTENNIAL CAMPUS.

The keynote speaker for the event was Robert "Bob" McGhee, chairman and CEO of Progress Energy. Other speakers included Wendell Murphy, chairman of the NC State University Board of Trustees; Dr. James L. Oblinger, chancellor of NC State University; and Dr. Nino A. Masnari, who was then dean of the College of Engineering.

Following the ceremony, Progress Energy representatives McGehee and Fred Day presented a check for $1.2 million to Oblinger and Masnari. *(See story next page.)*

Engineering Building II represents the second phase of the plan to move the College of Engineering to Centennial Campus. The building, which houses the Department of Electrical and Computer Engineering and the Department of Computer Science, has 210,000 square feet of classroom, laboratory and office space. The project cost $46.5 million. Perkins & Will was the architect for the building, and Clancy & Theys was the general contractor.

Currently in the planning stage is Engineering Building III (EBIII), which will house the Department of Biomedical Engineering and the Department of Mechanical and Aerospace Engineering.

The event was hosted by the College of Engineering and the NC State Engineering Foundation Inc. Sponsors of the dedication ceremony were Cisco Systems, EMC, IBM, Network Appliance, Progress Energy, Red Hat and Tekelec. ■

Progress Energy invests $1.2 million in College of Engineering

The College of Engineering at North Carolina State University has received $1.2 million from Progress Energy to support initiatives within the College. The gift was announced at the Engineering Building II dedication ceremony April 28, 2006.

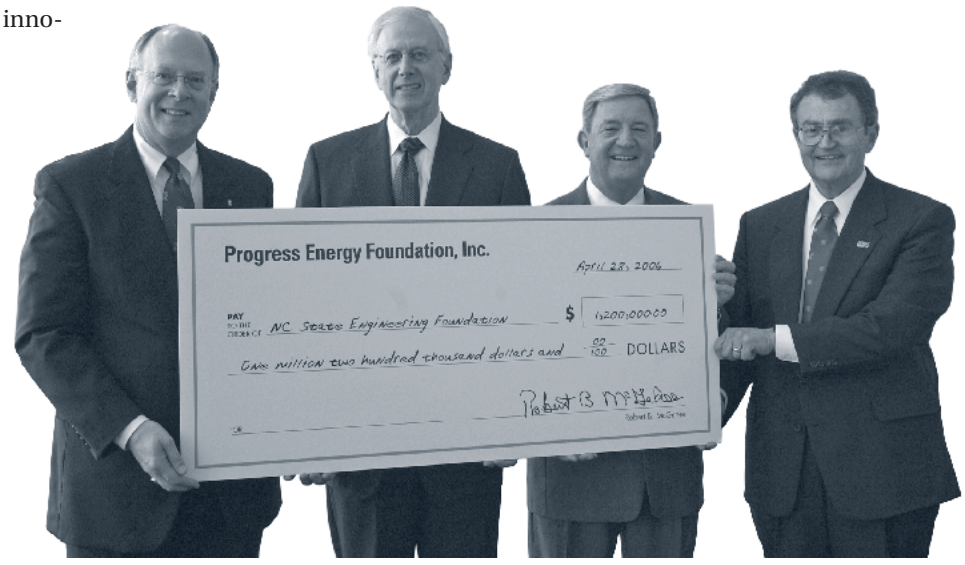
"At NC State, we take great pride in building relationships and partnerships across a broad spectrum of North Carolinians, including the business community," said Chancellor James L. Oblinger. "Progress Energy's continuing support of NC State reflects a shared commitment to support for the state's economic development and the value of higher education. We appreciate Progress Energy's partnership and confidence in NC State."

Part of *Achieve! The Campaign for NC State*, the gift is the largest given by Progress Energy to the college and will support three endowments. Two of the endowments will be dedicated to professorships, a top priority of the NC State *Achieve!* campaign. Progress Energy is a Fortune 250 diversified energy company with more than 24,500 megawatts of generation capacity and approximately 3 million customers in the Carolinas and Florida.

"Progress Energy is proud to support North Carolina State University's College of Engineering with this gift," said Bob McGehee, chairman and CEO of Progress Energy. "NC State is educating the employees of tomorrow who will develop new technologies and environmental innovations to power the future. It is important we make investments today that will educate and grow the future workforce."

"Progress Energy is a long-standing and valued corporate partner of the College of Engineering and NC State with a strong recruitment relationship and a focus on the areas of research and K-12 engineering outreach," said Ben Hughes, executive director of the NC State Engineering Foundation.

Progress Energy has demonstrated their continued interest in engineering education at NC State through many decades. In recognition of the generous support Progress Energy and their employees have provided to the College of Engineering, the bridge, terrace and conference rooms in Engineering Building II will bear Progress Energy's name. Located on the third floor of the new Engineering Building II, the Progress Energy area includes two large conference rooms, a brick terrace and the bridge that connects the two wings of the building. ■



Chancellor Oblinger (left) and Dr. Nino Masnari (far right), accept a check for $1.2 million from Progress Energy representatives Robert McGehee and Fred Day. The funds will support three endowments in the College of Engineering. *(Photo: Becky Kirkland)*

Chairman of the NC State Engineering Foundation Board of Directors John McCarter (left) presents Ed Welch with a plaque recognizing his service as a member of the Engineering Foundation Board of Directors and long-standing loyalty to the College of Engineering. *(Photo: Becky Kirkland)*

College honors Masnari with naming of Gateway

The College of Engineering has named the Centennial Campus gateway in honor of former dean of engineering, Dr. Nino A. Masnari. Located at the end of Oval Drive, the Nino A. Masnari Engineering Gateway is the main entrance to what will become the engineering building cluster on Centennial Campus. The honor recognizes Masnari's 10 years as dean and "his many contributions to educational and research program development at North Carolina State University and for vision and leadership in moving the College of Engineering to Centennial Campus."

Duke Energy donates $135,000

Duke Energy, a loyal supporter of NC State University and the College of Engineering, has awarded $175,500 to NC State University. Of that amount, $135,000 is designated specifically to the College of Engineering for a variety of academic and outreach programs, scholarships, departmental support, event sponsorship and equipment updates.

Northrop Grumman gives $45K

As part of *Achieve! The Campaign for NC State,* Northrop Grumman has donated $45,000 to support College of Engineering senior design projects in computer science, electrical and computer engineering, materials science and engineering, and mechanical and aerospace engineering; scholarships; minority engineering programs, and the University Career Center.

The staff of the NC State Engineering Foundation Inc. gather on the north balcony of Page Hall. (Left to right) Stacy Zearing, Ken Tate, Joyce Pollard, David Mainella, Gwen Bell, Russ O'Dell, Ben Hughes and Martin Baucom. (Not pictured is Wendy Cibils.) *(Photo: Jenny Weston)*

About the Engineering Foundation

The NC State Engineering Foundation Inc. (NCSEF) was organized in 1944 as the North Carolina Engineering Foundation Inc. by area industrial and business leaders. The purpose of the Foundation was to form a tax-exempt, non-profit organization to promote and receive monies to support the College of Engineering at North Carolina State University. The NCSEF is governed by a 32-member Board of Directors, which oversees more than $50 million in assets. The Board, along with the Foundation staff, also works to enhance the image and presence of NC State's College of Engineering.

Still the primary recipient of private support for the College of Engineering, the NC State Engineering Foundation Inc. continues the original mission developed by its founders and raised $31.3 million in support of the College of Engineering in fiscal year 2005-06.

Ben H. Hughes
Executive Director
Development and College Relations

David Mainella
Associate Executive Director of Development

Martin Baucom
Director of Corporate Relations and Special Projects

Francis P. (Russ) O'Dell
Director of Development
Department of Chemical and Biomolecular Engineering

Stacy Zearing
Director of Development
Department of Civil, Construction, and Environmental Engineering

Kenneth M. Tate
Director of Development
Department of Computer Science

Gwen H. Bell
Administrative Officer

Wendy Cibils
Administrative Secretary

Jennifer Goodwin
Accounting Clerk

Show your support — make a gift to the College of Engineering

Your gift to the College of Engineering at North Carolina State University can support a variety of funds, programs and academic endeavors. These many opportunities to give can be tailored to your needs and interests.

You are in control of how your contributions are allocated. Unrestricted gifts provide resources for a variety of funding priorities in the college. Gifts to the College of Engineering can also be designated to specific departments, academic programs and other funding opportunities.

Giving to the college is the best way to support scholarships, fellowships, professorships, academic programs, faculty research and areas that are not supported with state funds. These gifts make a huge impact on all facets of university life.

The College of Engineering appreciates your interest in its giving programs. If you would like more information, you can visit our website at **www.engr.ncsu.edu.ncef** or you can contact us:

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Thank you!

While space limitations allow listing only those donors who contribute $100 or more, we appreciate the support of all our alumni and friends. Every attempt has been made to ensure the accuracy of the information presented in this report. However, we admit mistakes sometimes occur inadvertently. Please notify our office of any corrections you have. We welcome inquiries regarding your support of the College of Engineering at NC State. This document was produced by the NC State Engineering Foundation Inc. and Engineering Communications. No state funds were used; 52,000 copies of this document were printed at a cost of $29,958, or 57 cents per copy on recycled paper.

engineering

Motorsports helps teach math and physics to K-12 students

A new math and science curriculum that appeals to young NASCAR enthusiasts has been developed at NC State.

(Story on page 18.)

Keep in Touch! Win Free Tickets!

Engineering alumni, here's a chance to **win free Wolfpack basketball tickets!** (Note: tickets are non-transferrable; winner must show i.d. in person at the ticket call window.)

Fill out or update this registration form:
www.engr.ncsu.edu/ncef/registration/
(You must include your email address. We will not share this information.)

You'll receive the College of Engineering's e-newsletter — *Engineering Frontline-Online* — plus be eligible for the drawing in mid-January.

GO PACK!

Visit the College of Engineering at North Carolina State University on the Web:

www.engr.ncsu.edu

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