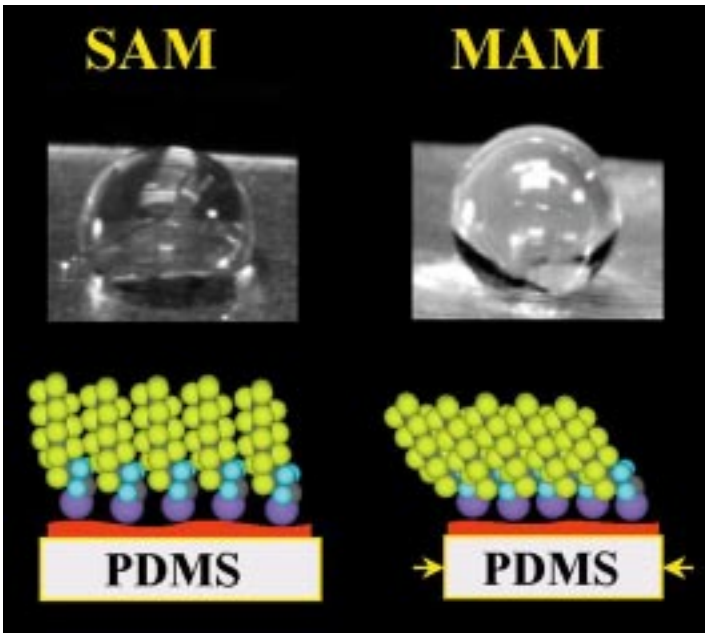
NC STATE UNIVERSITY

College of Engineering News

For Our Engineering Alumni and Friends Spring 2002

Superhydrophobic Polymer Developed



A sheet coated using the new MAM method (right) repels water better than a sheet coated the conventional way (left). The respective molecular alignments are depicted below the images.

It may not be nice to fool Mother Nature, but Jan Genzer, assistant professor of chemical engineering at North Carolina State University, has done just that to create a polymer with increased hydrophobic, or water repellant, properties. This new material could be used in many beneficial applications ranging from tunable insulation coatings to medical implants.

"In nature, molecules organize spontaneously into beautiful patterns," said Genzer. "It is the molecular template 'encoded' into the molecules that dictates how close the molecules can come together – Mother Nature simply will not allow them to come closer than is convenient." With their new technique, however, Genzer and his colleagues can overcome nature's restrictions by assembling the molecules onto surfaces whose surface area can be increased (for example by stretching the film) prior to the attachment of the molecules. After the molecules are covalently attached to the stretched substrate, the substrate surface is brought back into its original size, causing the molecular arrays to reconfigure and densify beyond their natural limit.

Genzer and colleagues discovered this new technique somewhat by accident. They were searching for a substrate on which to store samples. Cellophane tape was too sticky, so they began working with the chemical bonds of polymer materials to find a surface that would adhere just the right amount. Their experimentation led to the development of a new technology that is based on what the inventors call mechanically assembled monolayers (MAMs). The researchers demonstrated the capability of this novel technique by creating MAMs from semifluorinated molecules and found that structures were less sticky than most previously developed and commercialized non-stick coatings.

Another happy accident led to additional scientific data supporting the longevity of the hydrophobic quality of the new material. While this work was going on, Genzer's lab moved to a different space and

(*See* **Polymer,** *page 3)*

Two Elected to National Academy

Davis

Hodgson

Robert F. Davis, Kobe Steel Ltd. Distinguished University Professor of Materials Science and Engineering, and Thom J. Hodgson, James T. Ryan Professor of Industrial Engineering and Director of the Integrated Manufacturing Systems Engineering Institute, of NC State University have been elected to membership in the National Academy of Engineering (NAE).

Davis was cited for "contributions in the development of silicon carbide and group III-nitrides as practical electronic materials for devices." He received his BS from NC State in 1964, his MS from Pennsylvania State University in 1966 and his PhD from the University of California-Berkeley in 1970, all in ceramic engineering.

Hodgson was cited by NAE for "contributions to the advancement of industrial, manufacturing and operational systems in industry, academia and government." He received his BSE in science engineering, his MBA in quantitative methods and his PhD in industrial engineering and operations research from the University of Michigan in 1961, 1965 and 1970, respectively.

As Landfills Fill Up, NC State Researchers Seek Alternatives

With landfills filling up and closing in North Carolina and communities resisting the locating of new landfills in their area, the need for solid waste management planning is taking on new emphasis. The Wake County landfill will close in 2004, for example, but an alternative site has not yet been established. Open space is becoming scarce in Wake County at a time when the population is growing, resulting in more trash than ever. According to the North Carolina Office of State Planning, Wake County's population has increased from 426,311 in 1990 to 592,218 in 1999. That's nearly 166,000 more people generating garbage. In addition, a 1999 US Environmental Protection Agency estimate places 55 percent of our solid waste in landfills.

NC State University researchers Morton A. Barlaz, professor and associate head of civil engineering; S. Ranji Ranjithan, associate professor of civil engineering; and E. Downey Brill, professor of civil engineering and head of the department, along with their colleagues from Research Triangle Institute, want to help communities identify solid waste management alternatives that consider both recycling and composting and their associated impacts on the environment. Their approach to the study of trash management involves the application of a technique called life cycle analysis – a process by which both energy consumed (or produced) and emissions to the environment are calculated.

This research group looks at the overall effects, including advantages and disadvantages, of alternatives for integrated solid waste management – from collection of waste, recyclables and yard waste, to recycling and composting, to waste combustion and disposal in landfills. According to Barlaz, there are many tradeoffs in solid waste management among the cost, the amount of waste recycled and pollutant emissions. His research team wanted to develop an easy way to evaluate these tradeoffs.

Wake County's population has increased from 426,311 in 1990 to 592,218 in 1999

Barlaz and his colleagues have created a comprehensive, yet flexible, approach to exploring and studying alternative solutions that are tailored for each community, enabling consideration of costs and environmental benefits of alternative solid waste management plans. This approach is implemented within a prototype software system.

The NC State research group recently developed a hypothetical but realistic case study to see how the model would work when applied to individual communities. The researchers studied different levels of recycling and showed how, in many instances, recycling can reduce emissions of greenhouses gases while also reducing society's dependence on landfills.

Barlaz pointed out that when the methane gas produced in landfills is recovered for energy, the landfill actually produces more energy than it consumes, thus reducing both the consumption of fossil fuels and the air emissions associated with power production. Methane is recovered from the northern Wake County landfill and from 10 to 15 percent of landfills across the US. This procedure has a couple of advantages. First, the gas is not emitted to the atmosphere and therefore doesn't become part of the pollution problem. Second, captured methane can be used instead of "virgin" fossil fuels, and the landfill becomes a net energy producer.

Making decisions that are both cost-effective and environmentally friendly is difficult, but this research could help the process. "Using the hypothetical case study, we've demonstrated how to identify a range of solid waste management alternatives including the least-cost solution that meets a 25 percent recycling target, and the least-cost solution that does not exceed a certain amount of greenhouse gas emissions, for example," said Ranjithan. "You can explore and identify solutions that meet the requirements you specify. I think the model has a lot of potential to help communities throughout North Carolina."

Husband, Wife Earn Engineering Degrees, Never Saw Campus

Distance learning at NC State University has grown tremendously in the past few years. During 1999-2000, the College of Engineering granted more than 45 master's degrees long distance.

After hearing about NC State's Video-Based Engineering Education (VBEE) program, Stephen and Pamela Mount of Darlington, SC, decided to take distance education classes as part of NC State's off-campus Master of Engineering degree program. Steve focused on industrial and mechanical engineering; Pam concentrated on chemical engineering. The husband-and-wife team never set foot on campus until graduation day in December 2000

The first time Steve and Pam Mount ever saw the NC State campus was graduation day.

"The VBEE program gave me the flexibility to build a curriculum that pertained directly to my work and to study without quitting my job," said Steve. "The Master of Engineering degree has been the best thing yet for the development of my career."

Approximately 30 courses per semester are offered through VBEE (www.vbee.ncsu.edu).

Nuclear Engineering Meets New Industry Needs

After a long period of stasis, the nuclear power industry is experiencing a reawakening. Government and industry are taking a fresh look at possible applications of nuclear power for energy generation, especially in light of recent energy crises across the nation.

Currently, nuclear power provides 17 percent of the world's electricity and 21 percent of the nation's electricity, but the industry has not grown in the past few decades. According to Paul J. Turinsky, professor and head of the Department of Nuclear Engineering at NC State, no new nuclear power plants have been sold in the US since 1979, and most of today's nuclear engineers were trained during the boom years of the 1960s, when there was more optimism about the future of nuclear power as an energy option.

This bubble of expensive, "baby boomer" talent is approaching retirement, and few young engineers are waiting to replace them. According to a recent report by the Nuclear Engineering Department Heads Organization, from 1990 through 1998 undergraduate enrollment in nuclear engineering programs decreased by 72 percent. "Every bachelor's or master's student in nuclear engineering at NC State has an average of 3.5 potential jobs waiting upon graduation," said Turinsky.

Developments in the past three years, as well as a proven track record of inexpensive, safe, efficient operation of existing plants, have brightened the picture for the future of nuclear power considerably. A number of existing nuclear power plants are receiving 20-year lifetime extensions based on their good operation records. Over the past several years, operators have run US nuclear plants so efficiently that the economic climate is now very favorable for competition in the energy marketplace. According to Turinsky, nuclear power is again finding a place at the table during discussions of energy generation options as those individuals who are developing energy policies are coming to realize that all possibilities must be considered to solve today's energy crises.

NC State is ready to participate in this nuclear energy renaissance. Its nuclear engineering educational programs are ranked 7 out of 35 accredited programs in the US (*US News and World Report*), and its nuclear engineering outreach programs, summer programs, teachers' workshops and scholarships attract wide interest. In addition NC State operates the primary university research reactor in the Southeast, which helps attract top students and turn out well-trained professionals. The power industry has expressed increased optimism for the future of nuclear power, exemplified by recent sizable gifts to the nuclear engineering program by CP&L and Duke Energy. Government, too, is recognizing the need for more training with such measures as Senate Bill S242, which almost triples funding for university nuclear engineering departments.

All these efforts are beginning to pay off in the form of increasing enrollments in NC State's nuclear engineering program, generally considered the best in the Southeast. Information about nuclear engineering at NC State is available at www.ne.ncsu.edu.

CEM Offers Unique Hands-On Training

It's a chronic problem for students in applied fields: book learning versus real-world, hands-on experience. Both are essential, especially in fields where workers should understand both theory and practice to function effectively. For this reason, curriculum designers in NC State's Department of Civil Engineering try to incorporate real-world experience into all three of their majors.

Construction Engineering and Management (CEM) is such a major. Established in the 1950s as the first degree of its kind in the US, this major provides the opportunity for students to prepare for careers in commercial building, highway, heavy or residential construction. The senior project class, CE 469, provides a choice of projects from among the three areas.

According to Michael L. Leming, associate professor of civil engineering, students in this course of study headed for careers in the home building industry last year chose to participate in a unique project that is the brainchild of Allen Wells (CE '89), vice president of construction in the Raleigh division of Centex Homes.

Wells arranged for a dozen students in the home building concentration of CEM to shadow Centex project engineers for a day to get a taste of the reality of their profession.

In December 2000 Centex employees, NC State students and Habitat for Humanity volunteers met at a building site in Durham to construct two homes for low-income families. The students worked beside professional construction engineers who were pleased to share their knowledge. The experienced workers challenged the students to a "race to the ridge," with each group working on a separate house. (The "old hands" won, but just barely.)

This kind of hands-on experience is invaluable for senior students as they prepare for jobs in the home building industry. "The NC State program is strong in both the structure and the management aspects of construction engineering," said Leming. "Our teaching philosophy dictates that our students understand how to build a structure as well as how to design it."

Polymer *- continued from front.*

some forgotten MAM samples sat on the laboratory bench for six months. Later analysis demonstrated that the MAM surfaces were still intact after all that time.

"This technique can open new possibilities for controlling the assembly of molecules on surfaces. We have found a way of independently controlling the spacing between molecules that depends on our wish, not what nature tells us," Genzer said.

The next step will be to study various physical phenomena that are associated with packing molecules, for example, transitions from liquids to solids. After that, Genzer's team hopes to study practical applications for this new polymer.

Awards & Notes

Some of the abbreviations used in this column and elsewhere in this newsletter are BAE (biological and agricultural engineering), CHE (chemical engineering), CE (civil engineering), CSC (computer science), ECE (electrical and computer engineering), IE (industrial engineering), IES (industrial extension service), MSE (materials science and engineering), MAE (mechanical and aerospace engineering), NE (nuclear engineering), NSF (National Science Foundation), OR (operations research) and TE (textile engineering).

The awards listed here are just a few of the many honors received; for more information, visit the website: www.engr.ncsu.edu/news/awards/index.html.

- John Bailey, MAE, and Salah Elmaghraby, IE, were awarded the Alexander Quarles Holladay Medal for Excellence for 2000.
- In May the UNC Board of Governors approved the establishment of a BS degree in biomedical engineering at NC State. The program was implemented in fall 2001.
- B. Jayant Baliga, ECE, received the R.J. Reynolds Tobacco Company Award for Excellence in Teaching, Research and Extension for 2000.
- Ruben Carbonell, CHE and Kenan Institute, received the 2001 Alcoa Foundation Distinguished Engineering Research Aware of Engineering received an Outstanding Performance Award at the Freshman Honors Convocation for creating an environment conducive to African American student success.
- Engineering faculty members who recently won NSF Faculty Early Career Development (Career) Awards are Gregory Buckner, MAE, $375,000, "Intelligent Control Systems for Active Magnetic Bearings: An Enabling Technology for Flywheel Energy Storage Systems"; Francis de los Reyes III, CE, $374,998, "Molecular and Engineering Approaches for Analyzing Microbial Selection in Activated Sludge: Competition between Filaments and Floc-formers"; Joel Ducoste, CE, $375,000, "A Unified Approach to Understanding, Education and Design of Disinfection Processes Using Computational Fluid Dynamics"; Christopher Healey, CSC, $370,403, "Assisted Navigation in Large Visualization Spaces"; Gianluca Lazzi, ECE, $375,000,"Advanced Bioelectromagnetics for Wireless Biomedical Devices"; Veena Misra, ECE, $375,000, "Novel Approaches for Integration of Vertical Si Nanoelectronics"; Eric Rotenberg, ECE, $300,000, "Slipstream Processors"; Peter Wurman, CSC, $300,000, "Automated Synthesis of Bidding Strategies for Trading Agents"; Michael Young, CSC, $465,695, "Plan-Based Integration of Control and Coherence in Intelligent Exploratory Environments."

Foundation Gifts & Grants

- Mr. and Mrs. I. Tunis Corbell presented a gift of $168,557 to the College of Engineering to establish the I. Tunis and Bernardina B. Corbell scholarship for students pursuing an undergraduate degree in engineering, with first preference to students who had attended Knotts Island Elementary School in Currituck County. Corbell is a 1950 electrical engineering graduate of NC State.

Corbell

- BASF Corporation has given $40,000 to the College to support chemical engineering and mechanical engineering.
- The $25,000 Bill Horn Faculty Development Fund, given in memory of Bill Horn, professor of transportation engineering at NC State from 1956 to 1990 and co-founder of Kimley-Horn and Associates, Inc., was established by his children and their spouses: Laura Horn Borden (BSCE '82) and her husband Roy, who is a professor of civil engineering at NC State; R. Michael Horn (BSCE '81) and his wife Laura; and Donna Horn Ott (BSCE '84) and her husband William.
- The Frank C. Ziglar Jr. Memorial Graduate Fellowship has been established to benefit mechanical and aerospace engineering students. This memorial endowment honors Ziglar, who earned his BS in physics from NC State in 1965, for his outstanding career with NASA. Donald E. Moreland, who was Ziglar's stepfather and served on the faculty at NC State for 42 years, and his wife, Verdie S. Moreland, are giving this endowment.
- Jean B. Parcel of Lakeland, Florida, has endowed a gift to establish the Martin W. Parcel Scholarship, in honor of her husband. The scholarship will be awarded to materials science and engineering juniors and seniors on the basis of merit and need.
- Justin M. Lawson of Lewisville has been selected to receive an Ernest James and Ethel Hudgins Angelo Scholarship in the College of Engineering at NC State. Lawson is the fifth recipient of the Angelo scholarship.
- Duke Energy Corporation awarded $343,000 to the College of Engineering. E. O. Ferrell presented the gift, a large portion of which is designated for programs in nuclear engineering. Duke Energy has shown strong support to NC State over the years.
- The Mitsubishi Electric and Electronics USA Corporation has given $340,000 to the Department of Electrical and Computer Engineering. This grant will support the research of Wentai Liu, professor of electrical and computer engineering, and the Analog/RF/Mixed Signal Design Alliance. The gift was presented by Mitsubishi vice president J. Gary Edge.

- The College of Engineering received an Outstanding Performance Award at the Freshman Honors Convocation for creating an environment conducive to African American student success.
- Joseph DeSimone, CHE, won the O. Max Gardner Award, Inventor of the Year Award, Governor's Entrepreneurial Company of the Year Award, and the Esselen Award for Chemistry in the Public Interest.
- In August the College received approval to plan a distance education master of civil engineering degree program.
- Tom Dow, MAE, won the BASF Corporation Award for scholarly accomplishments.
- Jon Doyle has been named SAS Institute Distinguished Professor of Computer Science.
- Joel Ducoste, CE, won the Ralph Metcalfe Chair Award.
- Shu-Cherng Fang, IE, won the Advocacy Award from ACAAGS and a Distinguished Service Award.
- Christopher Frey, CE, won the Chauncey Starr Award.
- William "Rocky" Fulp, Minerals Research Laboratory, was selected as Outstanding Earth Science Educator in a Non-Traditional Setting.
- Jan Genzer, CHE, was awarded the 2001 Camille Dreyfus Teacher-Scholar Award.
- An article by John Gilligan, research and graduate programs, appeared in the September issue of Prism.
- Christine Grant, CHE, was inducted into the Academy of Women by the YWCA and received the Provost's African American Professional Development Award.
- Keith Gubbins, CHE, received the William H. Walker Award for Excellence in Contributions to Chemical Engineering Literature from AIChE.
- John Hanson, CE, won the Forensic Engineer of the Year Award.
- Jason Haugh, CHE, was awarded a Camille and Henry Dreyfus New Faculty Award.
- Eric Klang, MAE, received the George H. Blessis Teaching and Advising Award.
- Detlef Knappe, CE, received the Young Civil Engineer Achievement Award.
- Carl Koch, MSE, was elected TMS Fellow.
- Robert Kolbas, ECE, was named IEEE Fellow.
- Gianluca Lazzi, ECE, was awarded a biomedical engineering research grant from the Whitaker Foundation.
- Wenke Lee, CSC, won the NC Networking Initiative Fellowship Award.
- Yuan-Shin Lee, IE, won the Alcoa Foundation Engineering Research Achievement Award.
- Awards for Excellence winners are Margery Page, CSC; Rudy Salas, ECE; and Ellen McDaniel, ITECS.
- Sarah Rajala, ECE and academic affairs, was elected Fellow of IEEE. She was also recognized by IEEE Eastern NC Section as Outstanding Engineering Educator for Contributions to the Field of Engineering Education.
- Arnold Reisman, ECE, was awarded the Electrochemical Society Award in Solid State Science and Technology.
- Michael Rigsbee, MSE, was elected Fellow of ASM International.
- William Roberts, MAE, received the BASF Corporation Award for scholarly accomplishments.
- Charter members of the Academy of Outstanding Faculty Engaged in Extension are Larry Royster, MAE; Rooney Malcom, CE; Robert Edwards, IES; Herbert Eckerlin, MAE; Albert Boyers, MAE; Paul Khosla, CE; Jack Weaver, NE; Clarence Smith, IE; Wayne Friedrich, IES; William A. Smith, IE; Ronald Simpson, IES; Mohamed Fikry, VBEE; Jaime Trevino, IE; Charles Culbreth, IE; Roy Borden, CE; Gene Fornaro, IES; James Daggerhart, IES; Charles Mayo, NE; James Leach, MAE; Joseph Davis, IES; and Joseph Hummer, CE.
- Munindar Singh, CSC, received the IBM Partnership Award.
- Joni Spurlin was named director of assessment for the College.
- Brian Taff, electrical engineering and mechanical engineering, received the Faculty Senior Scholarship.
- Orlin Velev, CHE, received the Camille and Henry Dreyfus New Faculty Award.
- Mladen Vouk, CSC, was elected Fellow of IEEE.
- Mohammed A. Zikry, MAE, was awarded the 2001 Ralph Teetor Award from the Society of Automotive Engineers.

Katharine Stinson 1917 – 2001

Stinson

Katharine Stinson, the first woman to graduate from NC State's engineering program and arguably the most illustrious alumna of NC State, died July 29 in Pinehurst at the age of 83.

After receiving her BS degree in mechanical engineering with an aeronautics option in 1941, Stinson joined the Civil Aeronautics Administration, now the FAA, as their first woman aeronautical engineer. Stinson was a devoted and long-time supporter of the College and its students.

Anyone who would like to honor Katharine Stinson's memory with a donation may make it to the "Katharine Stinson Scholarships" in care of the NC State Engineering Foundation, Campus Box 7901, NC State University, Raleigh, NC 27695.

NC State – Ghana Connection Yields Rich Rewards

Imagine studying engineering with limited access to textbooks, calculators and computers – a challenging task. Engineering universities all over the world want to provide their students the best possible equipment and resources, but in many areas this task proves nearly impossible. However, our shrinking and complex world requires engineers everywhere to be trained to use state-of-the-art tools.

Students at Kwame Nkrumah University of Science and Technology (KNUST) in Kumasi, Ghana, West Africa, attend the only engineering school in their nation. These engineering students must learn their profession without the benefit of resources most American university students take for granted – textbooks, reference materials, computers and laboratory equipment. Five years ago the students obtained virtually all of their engineering education through chalkboard lectures by their professors.

Now KNUST chemical engineering students will have an easier time getting the textbooks and computer equipment they need, thanks to the work of Christine S. Grant, associate professor of chemical engineering at NC State. While her primary activity at NC State is research and teaching (she currently has close to $2 million in active grants), four years ago Grant led a project designed to upgrade facilities and resources in the chemical engineering department at the Ghanaian university.

According to Grant, "The goal of the project is to bridge the global educational gap between the US and Ghanaian students by interfacing educational aids such as computers and textbooks with innovative instructional technologies, with a focus on cutting-edge information technologies." To do this, NC State University, NC A&T State University and KNUST are collaborating on an initiative that could serve as a model for interinstitutional exchange programs at other universities. A secondary goal is to develop educational materials to produce globally aware, US-trained engineers.

In 1998 Christine Grant led a project to upgrade facilities for chemical engineering students and faculty at KNUST in Ghana, West Africa.

This initiative has resulted in a solid foundation for expansion of the program. Several Ghanaian students have enrolled in graduate school in the engineering departments at NC State and NC A&T. An NC State engineering student visited KNUST through the NC State Study Abroad Program in 1999 to install a new unit operations laboratory experiment in the chemical engineering lab.

The project has provided more than 500 engineering textbooks, various reference materials and five new state-of-the-art computers as well as bookshelves, desks and air conditioning units for the combined computer laboratory/departmental library at the university. To accomplish this, Grant acquired $81,000 from a variety of sources, including the NC State Committee on International Programs Seed Grant, the Engineering Information Foundation and the United Technologies Corporation.

(*See* **Ghana,** *page 8)*

IE Researcher Fine-Tunes Robotic Control with Virtual Reality

Have you ever identified so strongly with a movie character that you felt the action was happening to you – that *you* were the one in a bus going over a cliff or being chased by a gigantic boulder? Did you grip the armrests of the movie theater seats with your heart pounding? Understanding that effect is the goal of David B. Kaber, assistant professor of industrial engineering at NC State. Kaber and his graduate students want to characterize this phenomenon as it occurs in the use of virtual reality systems so they can apply that understanding to the design of graphical user interfaces for remote control of robotic systems, which have practical applications from medicine to space exploration.

Telepresence is the technical term for the feeling that you are actually present at a site far removed from your physical location. Many of us have accidentally experienced this, but if researchers can determine exactly what triggers this sensation, then they can design virtual reality systems and interfaces that assist operators of remote robotic manipulators, or teleoperators, who need to be fully immersed in the experience for maximum efficiency.

Kaber's studies link cognitive psychology and engineering in experiments to determine the degree of telepresence human subjects experience in synthetic tasks simulating real-world teleoperations (remote control robot operations), such as landmine disposal and hazardous materials-handling. Psychological factors suspected to influence telepresence include subject concentration, allocation of attention and "situation awareness," a measure of one's perception and interpretation of physical surroundings. Engineering technology can enhance the sense of telepresence through virtual reality interfaces integrating head-mounted displays with high fidelity, three-dimensional models of remote robot/task environments and live video feeds on remote manipulator action. According to Kaber, the quality of the interface is critical to telepresence and, therefore, high quality performance of remote system operators. "We're looking at system factors, but we're also looking at psychological factors, and I think that's a nice blend of engineering and psychology in a research program," said Kaber.

This multidisciplinary approach to virtual reality research is the focus of Kaber's four-year NSF Career grant.

Three Generations Reflect on NC State Through the Years

Three generations of graduates from one family recently reflected on their experiences at NC State.

They are H.J. "Boe" Green (BS Forestry '50), his daughter Susan Green Patterson (BS Science Education '72), her former husband David N. Sinodis (BS Entomology '73; M. Agriculture '75), their son Joseph N. (Joe) Sinodis (BS Mechanical Engineering '99; MS Mechanical Engineering '01), Joe's wife Christine Nelson Sinodis (BS Biochemistry and BA Chemistry '98), and Joe's cousin Emily S. Edwards (BA Psychology expected '02).

Three generations of an NC State family: (left to right) Emily Edwards, H.J. "Boe" Green, Susan Green Patterson, Joe Sinodis, Christine Sinodis and David Sinodis.

Other family members associated with NC State are Emily's father (Susan Patterson's brother-in-law) Michael W. Edwards (BS Textile Management '73), David's stepson Brian D. Grantham (BS Industrial Engineering '99) and finally Christine's brother and sister, Erik D. Nelson (BS Biology and BS Psychology '99) and Caryn S. Nelson, who started NC State in fall 2001.

Physically NC State was a very different place in the late 1940s, Green noted. Football games were played in Riddick Stadium, now a parking lot, and basketball took place in Frank Thompson Gymnasium, now Thompson Theatre. The Court of North Carolina was filled with Quonset huts.

Despite all the physical changes, many things about NC State have remained the same, family members said. Most notable are the friendliness of the campus and the sound of the trains running by the dorms.

Susan Patterson's and David Sinodis's generation experienced social protest during the Vietnam years, and predominantly male traditions at NC State were changing at that time.

NC State has been the setting for romance in this family. Susan Patterson and David Sinodis met in chemistry class and Joe and Chris Sinodis met on campus as well. For all three generations of this family, NC State continues to be one of the foundations underpinning their lives.

Change of Address?

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Permeable Pavement Environmentally Friendly Option for Parking Lots

Most of us don't consider a parking lot a thing of beauty, but the honeycomb design of some new parking lots in eastern North Carolina is easier on the environment than standard asphalt and could be considered an attractive alternative to traditional designs.

NC State researchers William F. Hunt III, extension specialist in urban stormwater in the Department of Biological and Agricultural Engineering, and John R. Stone, associate professor in the Department of Civil Engineering, are working to discover how well these new parking lots, constructed of "permeable pavement," are performing. Permeable pavement is a construction material that allows storm water to drain naturally through the soil rather than becoming polluting runoff. Runoff has the potential to contaminate soil and water with oil and other pollutants.

According to Hunt, permeable pavement is really nothing new — it was first used during World War II to create airplane runways and tank roads on sandy beaches. Nicknamed "Marsh Mats" for the Marshall Islands in the Pacific, these pavements were the forerunners of the new pavements being studied at NC State. The contemporary construction technique involves layering materials to create a lot that is both permeable to water and sturdy enough to support heavy cars. A geotextile fabric that keeps the gravel layer stable but allows water to pass through is spread on a base layer of gravel, then a layer of sand and a concrete or plastic lattice grid complete the pavement. The next step is to plant a spreading variety of grass such as Bermuda to add stability and texture. Overall, these lots cost a little more than conventional lots to construct, but the price may well be worth a bit extra to protect surrounding waters from pollutants.

In fact, according to Hunt, "The total costs could be less because permeable pavement may reduce the amount of money put into infrastructure, such as ponds and storm drains."

For about two years the research group has been observing the permeable employee parking lot they installed for the Hannibal Building in Kinston. So far the lot has performed well; it is in good condition with no runoff contaminating the surrounding area.

In January 2001 civil engineering undergraduate students Jamey T. Westmoreland, Jason A. Houston and Eric T. Taylor selected as their senior project designing a similar parking lot at Wilmington's Legion Stadium, which is near Greenfield Lake nature reserve. If these studies indicate long-term high performance both structurally and environmentally, permeable pavement could become a common sight and one that is certainly more attractive and gentler on the environment than the miles of asphalt that currently surround us.

NC STATE UNIVERSITY

College of Engineering
Office of the Dean
Box 7901
Raleigh, NC 27695-7901

Nino A. Masnari, Dean of Engineering
Ben H. Hughes, Exec. Dir., Development and College Relations
Martha K. Brinson, Dir., Engr. Communications, Editor
Linda E. Rudd, News Writer
Mark R. Ransom, Graphic Designer
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Ghana - *continued from page 6.*

Christine Grant (center) works with chemical engineering graduate students at NC State University. While her primary activity at NC State is research and teaching, she finds time to lead projects that have a dramatic impact on the lives of Ghanaian engineering students.

Grant hopes the project will grow in the next several years. "We hope long term to include an exchange of undergraduate students between NC State and KNUST, offer Web-based courses to students in Ghana over the Internet, further develop electronic communication between students and faculty at the two institutions and eventually arrange for participation of successful Ghanaian-born chemical engineers in the US with KNUST through either teaching or laboratory development in their home country," she said.

Another long-term goal Grant hopes will result from this project is the creation of a West African Environmental Center located at KNUST. This center could serve as a focal point for meetings, conferences and environmental summits among chemical engineers in academia, industry and government to discuss potential solutions to environmental problems.

Grant's work has made a difference in the lives of these Ghanaian engineering students, opening doors to opportunities that wouldn't have been available otherwise. To honor Grant's contributions the KNUST chemical engineering department renamed their departmental library and computer room the C. S. Grant Room – a fitting tribute to Grant's energy and devotion to improving engineering education.

Read more news about the College of Engineering on the Web **www.engr.ncsu.edu/news/.** Questions? Call (919) 515-2311.
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