

THE NOTRE DAME **engineer**

SPRING 2009 • Volume 1, Number 1

Beyond Silicon Valley

What's next for the electronics industry?

Putting It All Together

New materials for new technologies

Small but Mighty

Nanotechnology and its
potential impact on society



Engineering Peer Mentors

Peer mentors are among the best resources available to first-year engineering students. Representing different departments in the College of Engineering, this group of dedicated juniors and seniors offers a valuable perspective: They have been where the first years are. Many of them are peer mentors today because of their own experiences with peer mentors as a first-year student.

In addition to sharing important information, including study and exam tips, peer mentors are key in helping incoming high school students transition into the engineering program. They are vital in developing communities within engineering.

Peer mentors plan and coordinate social activities (ice skating, whiffle ball, and game nights); study sessions; career events (like “Résumé and Research,” “Engineering & Business,” and “Majors” nights); and service opportunities like blanket-making for local cancer patients, the Center for the Homeless toiletry drive, the Christmas giving tree, and Habitat for Humanity efforts.

The 2008-09 peer mentors, in the large photo from left to right, are **Beth Daley**, chemical and biomolecular engineering; **Eric Schafer**, electrical engineering; **Jean Whitney**, electrical engineering; **Riley Fenlon**, electrical engineering; **Anne**



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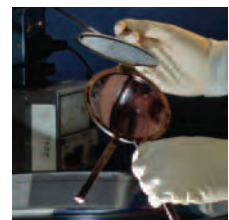
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Introducing the Midwest Institute for Nanoelectronics Discovery



Krishnan, electrical engineering; **Keith Creasy**, aerospace and mechanical engineering; **Ryan Slaney**, aerospace and mechanical engineering; and **Beth Mink**, civil engineering and geological sciences. Creasy, Krishnan, Schafer, and Whitney are serving their second year as peer mentors.

Editor's note: A special thanks to the other 2007-08 peer mentors, who also contributed their thoughts about being an engineering peer mentor: **Andy Crutchfield**, aerospace and mechanical engineering and philosophy (dual degree program); **Tom Economon**, aerospace and mechanical engineering; **Claire Laurentius**, civil engineering and geological sciences; and **Charlotte Low**, civil engineering and geological sciences.



READER SURVEY

We need your input. Is the news provided in The Notre Dame Engineer of interest? What sections do you enjoy most? Do you prefer a printed or Web version? Your opinion matters.

Visit www.nd.edu/~engineer/survey by August 15, 2009.

seeing the big picture

THE REST OF THE STORY

Wind turbine blades (rotors) function in the same manner as airplane wings; wind flowing over the blade produces lift, which is what makes a windmill turn. Also, like airplane wings, turbulence or unsteady flow affects performance. Researchers in the Center for Flow Physics and Control — Professor Robert C. Nelson, left, and Clark Equipment Professor Thomas C. Corke, director of the center — are investigating distributed active flow control as a way to improve wind turbine performance. The blade section they are holding features a number of plasma actuators that can change the flow, and thus the aerodynamic load, of air around a blade. This promotes continuous operation of a turbine at near optimal conditions ... in both steady and unsteady wind conditions for maximum energy conversion without permanently damaging the turbine or shortening its life.





Wind turbines are huge; compare the blade section shown here to the construction workers preparing it for installation. Some of the newest turbines feature a diameter up to 126 meters. The larger the turbine, the larger the load upon each blade, increasing the potential energy generated and the potential damage from ever-changing wind gusts.

Making the Most of Wind

Worldwide wind energy is a growth industry. Denmark, Germany, and Spain are each close to meeting their goal of generating 30 percent of their respective electric power needs from wind energy. In contrast, the United States generates about 1.5 percent of its electricity from wind energy, a far cry from maximizing the resources that could be exploited for America to also meet 30 percent of its electrical needs in this way.

As far back as 1843, people were lamenting that America made poor use of wind. In "Paradise (To Be) Regained," Henry David Thoreau wrote, "First, there is the power of the Wind, constantly exerted over the globe Here is an almost incalculable power at our disposal, yet how trifling the use we make of it! It only serves to turn a few mills, blow a few vessels across the ocean, and a few trivial ends besides. What a poor compliment do we pay to our indefatigable and energetic servant!" While few are proposing that wind is the sole answer to the energy challenge, it is one of the renewable tools at society's disposal, one that is becoming popular, more cost efficient, and soon more effective.

The innovative Plasma Aerodynamic Control Effectors (PACE) designed by Clark Equipment Professor **Thomas C. Corke**, direc-

tor of the Center for Flow Physics and Control, are being used in a joint effort with Professor **Robert C. Nelson** to enhance energy capture from a turbine and to reduce aerodynamic loads and noise produced by the turbine. PACE actuators modify the flow around each blade in real-time, steady and unsteady conditions alike. In addition to reducing maintenance costs, the PACE increase operational hours of a turbine. This means that a turbine can generate more revenue, making the machine more cost competitive. (The cost of power from wind farms has dropped from 38¢ to 4¢ per kWh since 1980, but factors still include the cost of the system itself, lease or purchase of land on which the turbines are located, transmission requirements to connect to the power grid, maintenance, and the amount of time the wind conditions are within the operational range of the turbine.)

PACE extend the operational range of a turbine. Experiments in a subsonic wind tunnel at the University demonstrate separation control, lift enhancement, and improved power extraction. Other benefits of the PACE include that they are fully electronic with no moving parts, can withstand high-force loading, and can be laminated onto the blade surface.



The interior of the new Stinson-Remick Hall of Engineering is well under way. The facility, located on Notre Dame Avenue, is scheduled to be completed in January 2010.

Watch the building's progress at www.nd.edu/campus-and-community/sights-sounds/webcams/met

Dear Alumni, Students and Parents, and Friends of the College of Engineering,

It has been a very busy year in the college. I knew when I joined the University in January 2008 that there were exciting opportunities on the horizon for engineering at Notre Dame. But I did not appreciate how quickly these opportunities would become a reality. During the past 18 months, we have been involved in a flurry of hiring and strategic planning and have already implemented a number of changes within the college, one of which is this publication.

I am very pleased to share with you the inaugural issue of *The Notre Dame Engineer*, our flagship publication for alumni, students and parents, and friends. This magazine, which replaces our long-standing and successful periodical *Signatures*, is designed to keep our many constituents well informed of our progress in academic, educational, and research programs, as well as outreach initiatives. By doing this we hope to show the scope of what it means to be a Notre Dame engineer ... from our alumni who are making great strides professionally as well as serving as leaders in their communities ... to our faculty and students who are exemplary of the Notre Dame mission. We also have many exciting happenings to share with you that

indicate how the college is indeed moving forward with a lot of positive momentum.

This first issue of *The Notre Dame Engineer* focuses on our research programs in nanotechnology and the impact on society we anticipate from our efforts, which are in keeping with the vision that Father Edward Sorin had in 1842 when he founded Notre Dame du Lac (that the University would be a “force for good in the world”). Indeed, the college is claiming this maxim and this vision as its own: The College of Engineering at Notre Dame is and will be a force for good in the world. The features you will see in this issue clearly illustrate how faculty, students, and alumni are achieving this.

We are also pleased to use this issue to demonstrate the very high caliber and quality of our faculty and students. Most recently, **Ahsan Kareem**, the Robert M. Moran Professor of Civil Engineering and Geological Sciences and the Director of the NatHaz Modeling Laboratory, was elected to the National Academy of Engineering. The highest national honor awarded to an engineer, it is the first time in many years that one of our faculty has been so honored. We describe his outstanding accomplishments on page 14.

In August 2009, the College of Science and the College of Engineering, in conjunction with the Mendoza College of Business, will launch the first-ever interdisciplinary graduate program in the history of Notre Dame: the **Engineering, Science, Technology Entrepreneurship Excellence Master’s (ESTEEM)**. We have received nearly 60 applications for this program and will enroll approximately 25 students, each holding a bachelor’s degree in engineering, science, or math. The purpose of the program is to leverage the technical ability of these high-profile students by pairing it with entrepreneurial excellence, in short training the next generation of high-tech entrepreneurs in order to fuel economic development. **Gregory Crawford**, the Warren Foundation Dean of the College of Science, and I believe this innovative new program will set the standard for engineering and science entrepreneurship and will help develop the human and intellectual capital needed for our country’s continued leadership in technology. Future issues of *The Notre Dame Engineer* will describe this program and share new business start-ups developed by its graduates.

On the research front, I believe you all know that last spring the University was awarded the **Midwest Institute for Nanoelectronics Discovery (MIND)**, a new Semiconductor Research Corporation-Nanoelectronics Research Initiative (SRC-NRI) national center. Led by faculty in the College of Engineering, the MIND consortium is pioneering new device applications as candidates to replace CMOS transistors and usher in a new era of nanoelectronic devices. Stay tuned as our researchers race those at University of California at Berkeley, Stanford University, Massachusetts Institute of Technology, and elsewhere to be the first to demonstrate some of these devices.

I am also pleased to announce the awarding of a new **Energy Frontier Research Center (EFRC) on Actinide Materials** to a group headed by **Peter C. Burns**, the Henry J. Massman Chair of Civil Engineering and Geosciences. The group, which includes researchers from the University of California at Davis, the University of Michigan, George Washington University, and Rensselaer Polytechnic Institute, as well as from Sandia, Savannah River, and Pacific Northwest national laboratories, will develop new states of matter based on nanostructured forms of actinides and actinide complexes as potential fuel and waste forms for next-generation nuclear energy generation. The EFRCs are the signature basic research programs recently announced by the Department of Energy.

I hope you will enjoy this inaugural issue of *The Notre Dame Engineer* and look forward to sharing many more with you.

Sincerely,

Peter Kilpatrick
Matthew H. McCloskey Dean of Engineering



THE Small and **LARGE** of It

The choice made by engineering faculty in the late 1980s to focus their efforts on the development of ultra-small, energy-efficient devices was, at that time, a road less traveled. Notre Dame was one of the first universities to take this step. Not only did it lead to the establishment of a center for excellence at the University (the Center for Nano Science and Technology), but faculty efforts have grown significantly over the last 20 years, as has the worldwide focus on nanotechnology.

Today, “nano” is a household word. Even elementary school children know that it means “really small.” Yet, nanotechnology remains a relatively untapped frontier with tremendous potential to impact numerous industries. Not an end to itself, this tiny enabling technology offers advancements in diagnostics, tissue engineering and drug delivery, food, textiles, and more.

Wolfgang Porod, the Frank M. Freimann Professor of Electrical Engineering and Director of the Center for Nano Science and Technology, and graduate student Edit Varga load a wafer for inspection in an electron microscope.







Gregory Snider, left, professor of electrical engineering, and Aaron Prager, graduate research assistant, are loading a wafer into a sputter deposition system, which will coat the wafer with metal for forming transistors on the electrical interconnections between transistors.

To date the most widely explored area of the application of nanotechnology is electronics. The focus has been, in large part, the transistor. It's simple economics. The semiconductor industry, which started at nothing (the first transistor was developed in 1947, but it wasn't until the early 1960s that integrated circuits were developed) passed the \$200 billion annual revenue mark five years ago, yet consumers and researchers remain electronic gluttons.

The downside to this incredible growth is scientifically based. For the last 40 years the electronics industry has been making semiconductor devices smaller, faster, and denser (more powerful). From cell phones and automotive GPS systems to washing machines and robotic floor sweepers, electronic devices make life more convenient. At the same time computers have become more computationally powerful, enabling more complex modeling and simulation programs for research.

Here's the rub: In the very near future, the electronics industry will have made the current silicon-based semiconductor as small and fast as physically possible, while still being able to operate.

Ze Zhang, graduate research assistant, loads a wafer into an inductively-coupled plasma reactive ion etch tool. This machine is used to etch compound semiconductor materials for advanced electronic and photonic devices.

Nanoelectronics offers new ways to compute, novel materials, and energy-efficient devices that can keep pace with computational needs and consumer demands. It can extend the performance of computers and communication systems (*see page 30*). And, Notre Dame is leading some of the exciting efforts in this area.

Engineering faculty pursuing nanoelectronics have focused their efforts on energy-efficient devices and systems with themes ranging from nanoarchitectures, modeling and measurements in nonequilibrium systems, interband tunnel transistors, and graphene transistors. In on-campus fabrica-

tion facilities (*see page 12*), as well as through industry and government partnerships, faculty are pursuing specific projects in architectures for emerging devices, nanomagnet logic devices, lateral field-effect tunnel transistors, and extremely scaled gated tunnel transistors. They are using current frameworks and new concepts to address the challenge of the shrinking transistor.

Faculty are also developing applications in **nanobiotechnology**. One of the current projects features a cross-disciplinary team of 22 researchers in the colleges of engineering and science. Faculty from the fields of chemical and biomolecular engineering, computer science and engineering, electrical engineering, chemistry and biochemistry, and biological sciences are designing micro-sensing devices that will enable personalized health and environmental monitoring (*see page 34*). The nanosensors they are creating will provide *in situ* monitoring for environmental and biomedical targets, as well as distributed monitoring opportunities for developing nations.

A second project explores the phenomenon known as fluorescent intermittency or "blink-



Nano Bits: More Stories to Tell



In addition to working with students during the academic year, faculty in the Center for Nano Science and Technology work with undergraduate researchers and high school teachers during the summer as they address key issues in transistor technology.

No Small Opportunity to Learn

It is important to find solutions to the challenges of the shrinking transistor, increased power consumption, and exponentially greater computational needs. It is equally important to provide research and curricular opportunities for the next generation of engineering innovators. Through key courses in the College of Engineering and the John J. Reilly Center for Science, Technology, and Values, undergraduates can study the societal implications of nanotechnology, while also gaining hands-on research experience. Funding from the University's Strategic Academic Planning Committee and the National Science Foundation supports numerous undergraduate researchers during the academic year, as well as summer research programs for undergraduates and high school teachers. Some students work closely with faculty during the academic year. Others explore various aspects of nanotechnology during an eight-week summer program, Research Experiences for Undergraduates. Teachers participating in their summer program, Research Experiences for Teachers, are encouraged to take what they learn and incorporate it into curriculum modules for their high school classes.

Dunn Named Managing Director



Robert M. Dunn has been named the managing director of ND*nano* and the Midwest Institute for Nanoelectronics Discovery.

Dunn, who most recently served as the director of the Integrated Engineering and Business Practices Program at Notre Dame, will function as a facilitator and advocate of the organizations, working closely with faculty, staff, and industry and government partners as the activities in these research centers continue to grow. He will also coordinate commercialization and outreach efforts, including the development of an industrial affiliates' network.

Dunn graduated from Notre Dame with a bachelor's degree in engineering science in 1965. Prior to returning to the University in 2001, he served as vice president of the corporate manufacturing staff at IBM. During his 30-year tenure with the company, his responsibilities progressed from those of a design engineer to the manager of major product development programs for midrange processors. He also served as technical assistant to the president of the systems technology division in Endicott, N.Y.; manager of the packaging, development, and product

quality assurance division; director of the Systems Technology Laboratory in Austin, Texas; manager of the start-up of an IBM facility in Dublin, Ireland; and vice president and site location manager of IBM's Poughkeepsie, N.Y., site.

Notre Dame Backs "Little" Research in Big Way

In April 2008, the University announced that five projects selected by the Strategic Academic Planning Committee (SAPC) would be the first beneficiaries of internal funding in support of transformational research. SAPC, which is composed of several faculty and administrators representing the University's various colleges, was established to "advance the excellence and visibility of Notre Dame's research enterprise." And, it couldn't have come at a better time. The University, poised on the edge of some exciting and very promising breakthroughs, has upped the ante ... backing its commitment to foster collaborative research on some of society's most pressing issues with \$40 million during the first stage of this initiative. After a call for proposals, the committee began reviewing the 72 proposals that came from each college and school.

Two of the selected projects are engineering led. The first, emanating from the Department of Electrical Engineering and led by Frank M. Freimann Professor **Wolfgang Porod**, director of the Center for Nano Science and Technology, features a team of 29 researchers from across the University. It builds on Notre Dame's efforts in the field of nanoscience to further the momentum gained with the announcement of the Midwest Institute for Nanoelectronics Discovery (*see page 30*) and will continue to foster exploration of alternatives to conventional silicon-based transistor technology via molecular and magnetic Quantum-dot Cellular Automata and nitride-based and magnetic semiconductors, while pursuing research projects in energy extraction technologies and biotechnology.

Porod and team are collaborating with the John J. Reilly Center for Science, Technology, and Values to examine the societal impact of nanotechnology and Notre Dame's Gigot Center to successfully transfer intellectual property to entrepreneurial ventures stemming from current research efforts.

For information on the second engineering-led SAPC project (*see page 34*).

Currently under construction is Innovation Park at Notre Dame, a business incubator being developed to facilitate the migration of research and new venture ideas into the marketplace. When complete, the 12-acre park is expected to include up to five buildings and house clients that range from start-up companies to Fortune 100 corporations.

According to **David Brenner**, the park's president and chief executive officer, in addition to spin-off projects developed from the Midwest Institute for Nanoelectronics Discovery, several young Notre Dame-based ventures are being considered for the first phase of development. Three of these — EmNet, a company that provides wire-



Notre Dame's Innovation Park

and collaborative areas.

The city of South Bend anticipates that similar commercialization activities may also occur in a nanoelectronics research facility being developed by the city in the former Studebaker corridor area of downtown.

less solutions for distributed control and sensing (*see page 40*); MedXCycle, a medical supply company; and RFWare, a student-faculty project resulting in software for first responders in emergency situations (*see page 36*) — will be housed in the first structure, a 54,000-sq.-ft. building that will feature wet and dry laboratories, green house incubation facilities, conference rooms, and administrative

Notre Dame Faculty Involved in Nanotechnology

AEROSPACE AND MECHANICAL ENGINEERING

David Go
Assistant Professor

CHEMICAL AND BIOMOLECULAR ENGINEERING

Paul W. Bohn
Arthur J. Schmitt Professor

Peter Kilpatrick
Matthew H. McCloskey Dean,
College of Engineering

CIVIL ENGINEERING AND GEOLOGICAL SCIENCES

Patricia A. Maurice
Professor and Associate
Dean for Research

COMPUTER SCIENCE AND ENGINEERING

Jay B. Brockman
Associate Professor and
Associate Dean for
Educational Programs

Jesus Izaguirre
Associate Professor

Peter M. Kogge
Ted H. McCourtney Professor

Michael Niemier
Assistant Professor

X. Sharon Hu
Professor

ELECTRICAL ENGINEERING

Gary Bernstein
Professor

Arpad Csurgay
Visiting Professor

Patrick J. Fay
Professor

Douglas Hall
Associate Professor

Debdeep Jena
Associate Professor

Thomas Kosel
Associate Professor

Craig Lent
Frank M. Freimann Professor

James L. Merz
Frank M. Freimann Professor

Alexander Mintairov
Research Professor

Alexei Orlov
Research Professor

Wolfgang Porod
Frank M. Freimann Professor
and Director of the Center for
Nano Science and Technology

Alan C. Seabaugh
Professor and Director of the
Midwest Institute for
Nanoelectronics Discovery

Gregory Snider
Professor

Huili (Grace) Xing
Assistant Professor

CHEMISTRY AND BIOCHEMISTRY

Holly Goodson
Associate Professor

Gregory Hartland
Professor

Kenneth Henderson
Professor

Paul Huber
Professor

Prashant Kamat
Professor, Radiation
Laboratory

Alex Kandel
Associate Professor

Masaru Ken Kuno
Assistant Professor

Marya Lieberman
Associate Professor

Olaf Wiest
Professor

PHYSICS

Gregory Crawford
William K. Warren Foundation
Dean, College of Science

Malgorzata Dobrowolska-Furdyna
Professor

Jacek Furdyna
Aurora and Thomas Marquez
Professor

Boldizsár Jankó
Professor



ing.” The interdisciplinary team — composed of faculty from physics, chemistry and biochemistry, and electrical engineering, as well as researchers the Bioimaging Science and Technology Group at the California Institute of Technology’s Beckman Institute — has already discovered that the on- and off-time intervals of the blinking fluorophores follow a universal power law distribution.

Researchers are currently performing charge fluctuation measurements on individual fluorophores to determine the cause of the blinking. If the team can find a way to control the blinking process, there is great potential for developing better and more stable multi-color imaging of diseases within individual cells. Researchers would be better able to track the development of a disease in general, and physicians could more accurately identify the location and scope of a disease in each patient.

Faculty at Notre Dame are also applying nanotechnology to address the **energy challenge**, specifically solar energy. Solar energy can be used for heating and to produce electricity. In the simplest of terms, a solar cell (photovoltaic device) converts sunlight into

electricity. These devices are used in watches, calculators, road signs, and in remote locations not connected to an electric grid.

Two of the main challenges in harnessing sunlight are device efficiency and cost. Photovoltaic cells are not yet commercially competitive when compared to other options. Faculty in the colleges of engineering and science and the Radiation Laboratory at Notre Dame are working to reconfigure a new generation of photovoltaic cells using nanomaterials. In particular, through the use of nanoparticles and hybrid inorganic-organic materials, they are developing nanostructure assemblies consisting of semiconductor quantum dots, metals, carbon nanotubes, and molecular clusters to better and more economically harvest light energy.

Considering these and other projects under way at the University, it is easy to be excited about the future. What is important to remember is that this is basic research. There are not annual milestones that can be guaranteed. Because of the minute scale at which work must be conducted in laboratories, it may take years before there are viable

Jeffrey Bean, postdoctoral research associate, is reviewing a device manufactured on campus using a scanning electron microscope.

commercial options. But there will be no solutions without this fundamental groundwork ... occurring at Notre Dame and throughout the world.

Just as with the technologies that were commercialized as a result of the space program of the 1950s and '60s, the small steps being taken today in nanotechnology research will provide the foundation for the giant leaps yet to come as researchers continue to work on the molecular level, creating and manipulating material structures and developing new properties and devices that can be employed for the betterment of mankind.

HIGH-RESOLUTION IMAGING

ELECTRONIC AND OPTICAL CHARACTERIZATION

PLASMA AND REACTIVE ION ETCHING

PHOTOLITHOGRAPHY



Kristi Pellegrini, an undergraduate studying chemistry at neighboring Saint Mary's College, is also working toward a degree in electrical engineering at Notre Dame. A Clare Booth Luce Scholar, Pellegrini's research in the Notre Dame Nanofabrication Facility focuses on developing advanced fabrication techniques for high-performance millimeter-wave detectors.



PHOTOMASK FABRICATION

THIN FILM DEPOSITION

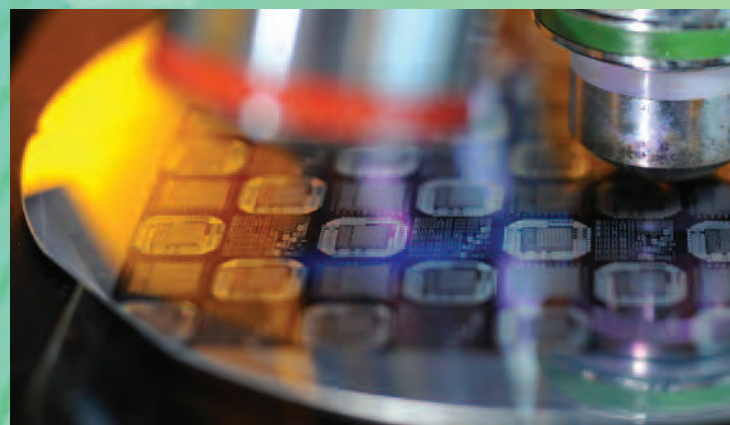
RAPID THERMAL PROCESSING

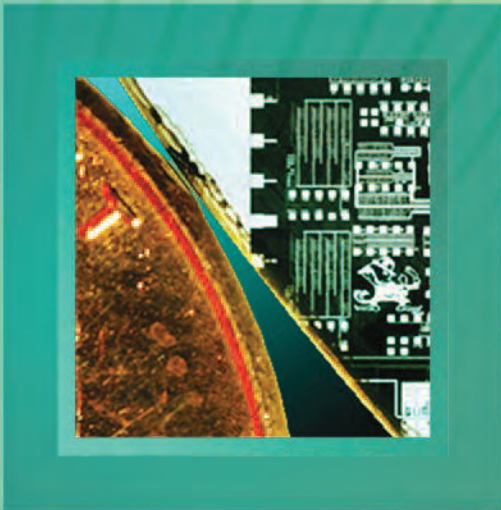
NANOLITHOGRAPHY

PACKAGING

METROLOGY

THINK





The penny shown here gives an added perspective when juxtaposed next to a portion of a wafer that students working in the Notre Dame Nanofabrication Facility (NDF) have created. Notice the Irish “chip art” in the lower left section of the chip. Images like this are fun to make, but they require a good deal of know-how. Each image on the chip comprises several layers of metal and other materials that are normally used to build transistors; the combination of these layers forms the image. To see more of Notre Dame’s chip artwork or learn more about NDF, visit www.nd.edu/~ndnf.

“One of the key elements of nanotechnology research at Notre Dame is that we have a comprehensive facility for fabricating nano- and microelectronic devices,” says **Patrick J. Fay**, professor of electrical engineering, director of the Notre Dame Nanofabrication Facility (NDF), and 1991 graduate. In fact, each year NDF boasts approximately 150 users across the University – faculty, postdoctoral researchers, graduate students, and undergraduates.

Even though much of the NDF equipment is comparable to that found in high-profile industrial and government labs,

the fundamental difference between research facilities in industry and the NDF involves the scope of materials and processes explored.

The NDF offers researchers the ability to investigate a wide range of materials, using a diverse array of processing techniques, without many of the restrictions that are typical of mainstream industrial R&D labs.

For example, the lab supports researchers working on silicon and silicon-related electronic devices, as well as faculty and students exploring other materials. It’s not unusual to find researchers working with gallium arsenide and indium phosphide (compound semiconductors used in ultrafast electronics and optical systems), while others are focusing on materials that have interesting electrical properties but don’t look like traditional semiconductors, such as zinc selenide nanowires, carbon nanotubes, graphene, and organic polymer-based materials.

In addition, devices for solar energy conversion, computation, telecommunications, environmental sensing, and many other applications are being pursued using the NDF’s resources.

Research in the NDF is not restricted to electronics. It includes the study of microfluidic devices for medical applications and micron-scale mechanical device fabrication.

The flexibility and diversity of the research fostered in the NDF is vital to continue advancing the functionality and performance of electronic and non-electronic devices alike for applications in industries such as communications, computing, consumer electronics, health care, energy harvesting and conversion, and transportation.

Developing new materials and devices, manufacturing different types of transistors and other devices, and exploring new paradigms for existing and not-yet-conceived systems and applications is the mission of the NDF.

“Having a complete nanofabrication lab on campus means we can study a wide range of problems in nano- and microelectronics. It benefits everyone and gives Notre Dame a real research advantage.”

Perhaps the most profound impact is on students, many of whom enter industry upon graduation. They leave Notre Dame, and the NDF, with technical knowledge and practical experience, a skill-set that will help them succeed.

One of the most recent developments, however, involves new digs. A new facility, which will be located in the Stinson-Remick Hall of Engineering on Notre Dame Avenue, is currently under construction. “It’s a very exciting time,” says Fay. “We will almost double our space, allowing us to purchase more equipment, augment our capabilities, and accommodate more users ... from across campus and from universities that do not have this type of facility.”



Graduate student Chris Siebert is studying optoelectronic devices. The plasma-enhanced chemical vapor deposition system he is using here deposits an optical antireflection coating on the wafer.



[nano.]



Kareem Named to National Academy of Engineering

Ahsan Kareem, the Robert M. Moran Professor of Civil Engineering and Geological Sciences and Director of the NatHaz Modeling Laboratory at Notre Dame, has been elected a member of the National Academy of Engineering (NAE) for contributions to “analyses and designs to account for wind effects on tall buildings, long-span bridges, and other structures.”

A faculty member since 1990, Kareem specializes in probabilistic structural dynamics, fluid-structure interactions, structural safety, and the mitigation of natural hazards. He uses computer models and laboratory and full-scale experiments to study the dynamic effects of environmental loads under winds, waves, and earthquakes on structures and to develop mitigative strategies to enhance the performance and safety of structures and better understand the impact of natural hazards on the constructed environment.

Most recently, he was named the lead U.S. collaborator for a project titled “New Frontiers of Education and Research in Wind Engineering” at Tokyo Polytechnic University’s Global Center for Excellence. Founded by the Japanese Ministry of Education, Culture, Sports, Science and Technology, the center was established

to build a sustainable urban environment that is resilient to extreme wind events and is in harmony with regional and local environments. But he has served in the administration, management, and organization of numerous professional societies, including the American Society of Civil Engineers (ASCE), as well as committees of the National Research Council, NAE, and the American Association for Wind Engineering.

Among his other recent honors are selection as the inaugural recipient of the Alan G. Davenport Medal, presented by the International Association for Wind Engineering in recognition of his distinguished achievement in the dynamic wind effects on structures. He has also received the Robert H. Scanlan Medal for outstanding original contributions to the study of wind-load effects on structural design and the Jack E. Cermak Medal in recognition of his contributions to the study of wind effects on structures. His receipt of the Davenport, Scanlan, and Cermak medals is an unmatched recognition in this field.



The Future of Computing

The question put to the members of the ExaScale Computing Study: Technology Challenges in Achieving Exascale Systems was a simple one ... “Does the current course of mainstream computing technology allow for a 1,000X increase in the computational capabilities of computing systems by 2015?” The follow-up question (there’s always a follow-up question) was: “If current trends are not considered capable of permitting such an increase, what are the major challenges, and how might they be best addressed?”

“Our goal,” says study lead **Peter M.**

Kogge, the Ted H. McCartney Professor of Computer Science and Engineering, “was not to provide solutions or specific designs for computers in 2015. It was to



develop a deep understanding of the technological challenges that could prohibit such a large increase in computing capabilities for data center-sized systems [supercomputers], departmental-sized systems, and embedded systems.” In the end, all study members agreed on two things: If a 1,000X increase were to be achieved, it would be in a way that does not currently exist and that any such achievement would come through an interdisciplinary approach.

Kogge was chosen by the Defense Advanced Research Projects Agency to lead the study. He also selected the study participants and served as its editor. He recently discussed the study with *IEEE Spectrum*; the radio interview is available at www.ieee.org/netstorage/spectrum/radio/mp3/1208kogge.mp3.

An expert in advanced computer architectures, Kogge is the author of two books and holder of 20 patents. He is also an IBM fellow, as well as a fellow of the Institute of Electrical and Electronics Engineers. Kogge graduated from Notre Dame in 1968 with a bachelor’s degree in electrical engineering; he returned as a faculty member in 1994.

MEP Taps McWilliams

Leo H. McWilliams, associate professional specialist, has been named director of the Minority Engineering Program (MEP). Most recently, he served as co-course coordinator for EG10111/10112, the first-year engineering course sequence, where he still serves as an instructor.

Prior to joining the University in 2002, McWilliams served as a principal engineer at Honeywell International in South Bend, where his duties included the investigation of advanced control concepts for gas turbine engines, the modeling and analysis of hydromechanical and electronic controls for gas turbine engines and the design, analysis, and integration of landing systems for aircraft. A Quadruple Domer, he holds bachelor’s degrees in economics and electrical engineering, which he earned in 1981 and 1982, respectively. In 1985 he received a master’s degree in electrical engineering and was awarded a doctorate in electrical engineering in 1993.



Biting Back – The Global Battle to Control Malaria



In July 2007, the Bill & Melinda Gates Foundation awarded a grant (more than \$20 million) to the University of Notre Dame, to be used over the next five years in support of multidisciplinary efforts to develop and evaluate improved methods for controlling malaria.

It's a noble goal and certainly one that meshes with the mission of the University. After all, malaria kills more than one million people annually, mostly young children and infants and mainly in sub-Saharan Africa. It is a disease of poverty and the underserved, but it is not a disease that's often discussed in the United States. It's not endemic here, so it is easy for many people to ignore. Not **Frank Collins**, the George and Winifred Clark Professor of Biological Sciences and concurrent professor of computer science and engineering; **Gregory R. Madey**, research professor in computer science and engineering; or the team they have assembled. Their goal is to gather evidence of how malaria vectors (mosquitoes) behave, how the disease is transmitted, and how control methods work in specific sites, each with a different rate of transmission, from low to moderate to holoendemic. This is what they have been doing since receiving the grant.

According to Collins and Madey, it is not enough to simply impose malaria controls – insecticide-treated bed nets, indoor residual spray, or medical treatment – without understanding more about locale-specific rates of transmission and the impact of individual control techniques in those areas. In fact, a single method of intervention cannot provide maximum or lasting control. For this reason, this consortium project includes partners from the Swiss Tropical Institute, the U.S. Centers for Disease Control, and the London School of Tropical Medicine and Hygiene, as well as researchers from each of the test sites in Indonesia, Tanzania, Kenya, and Zambia.

In addition to identifying the types of mosquitoes in a particular area, the team is tracking when the mosquitoes bite, morning or night; where they take their meals, indoors or outdoors; and how often they feed. They are also monitoring the human population, tracking everyone (infected or not) to determine how frequently mosquitoes are infecting people in an area.

Using PDAs, team members have already gathered the history of every person in each test area. They are also studying the malaria controls being used in those areas to determine the impact the interventions are having and at what point the insects either become genetically resistant to a particular intervention or change their behavior because of the intervention.

Madey and graduate students in the Department of Computer Science and Engineering will develop databases from the huge amount of information being collected. They will then supervise the data analysis and management methods, geographical information systems, data quality assessment, and modeling and simulations that will help standardize the information. Results will be made available to malaria control program managers around the world, who will be

able to access the data based on the mosquito species, population and location, rate of transmission, and intervention methods used. These efforts will not eradicate malaria, but they may dramatically reduce the prevalence and death rate of the disease.

Above: Neil Lobo, left, research assistant professor in biological sciences, shown in the foreground, works with entomologist Zubaidah Siti in a village on Halmahera, a remote island in Eastern Indonesia.

Right: Ying Zhou, a graduate student assistant in computer science and engineering, programmed the PDAs that team members use to collect data. The information is transmitted to Notre Dame for analysis and modeling activities.



Associate Deans Appointed

Jay B. Brockman, associate professor of computer science and engineering, was appointed associate dean for educational programs within the College of Engineering in June 2008. Although he will continue to teach and conduct research, Brockman is now responsible for all college-wide educational initiatives, including the first-year engineering course sequence, EG10111/10112. He also solicits federal and industrial funding to support innovative educational opportunities for engineering students.



During his tenure in the college, Brockman has played pivotal roles in the development of the Bits-to-Chips program (a joint educational initiative between the computer science and engineering and electrical engineering departments) and EG10111/10112. Most recently, he published *Introduction to Engineering: Modeling and Problem Solving*, which helps students “see the world through the eyes of an engineer.” Its goal, like that of the first-year sequence, is to facilitate a successful transition from thinking like high school students to thinking like an engineer.

A faculty member since 1992, Brockman’s research interests include the design of digital systems and integrated circuits, computer architecture, high-performance computing, multidisciplinary design optimization and engineering education, especially the bridge between high school and college.

Brockman follows **Stephen E. Silliman**, professor of civil engineering and geological science, who had served as associate dean for educational programs since 2002. Silliman is returning to teaching and research within the college, where he been a faculty member since 1986.

Patricia A. Maurice, professor of civil engineering and geological sciences, was named associate dean for research within the College of Engineering, effective January 1, 2009. She will continue to teach and conduct research, and her new responsibilities include identifying strategic issues and directions in research, while also promoting graduate programs to increase their national visibility. She also coordinates existing external partnerships and assists faculty in the development of new industry and government relationships, as well as the expansion of funding opportunities for multidisciplinary research projects.



Maurice’s research encompasses the hydrology and biogeochemistry of freshwater wetlands and mineral-water interactions, the remediation of metal contamination and global climate change. But she focuses on microbial, trace metal and organic interactions with mineral surfaces from the atomic scale up to the scale of entire watersheds, such as the Lake Erie Basin or portions of the Atlantic Coastal Plain.

A faculty member since 2000, she most recently served as director of the University’s Center for Environmental Science and Technology. The author of the forthcoming *Environmental Surfaces and Interfaces from the Nanoscale to the Global Scale* (John Wiley), Maurice is also a member of the American Geophysical Union, Geochemical Society, Mineralogical Society of America, Clay Minerals Society, and American Chemical Society.

She replaces **Peter M. Kogge**, the Ted H. McCourtney Professor of Computer Science and Engineering, who had served as associate dean for research since 2001. Kogge, like Silliman, has returned to teaching and research activities within the college.

College Names Facilities Director

Gerald Cappert has been named the engineering facilities director in charge of all college structures and facilities. He will coordinate planning, installation, renovation, and maintenance for capital projects; perform reviews and needs analyses, including the financial impact of projects; direct day-to-day operations; and maintain the facility assignment database. Most recently, he served as the facilities manager for the College of Science, managing the construction of the Jordan Hall of Science and creating a strategic space plan for academic and research needs. Prior to joining the University in 2006, he served as manager of engineering for Abbott Laboratories, Ross Products Division.



A Strong Foundation

Earthquakes have the power to uproot trees, trigger landslides, and cause tsunamis. They can also level the strongest buildings, knocking them off their foundations. They happen without warning, and the devastation is inevitable. Or is it? **Yahya C. Kurama**, associate professor of civil engineering and geological sciences, is leading a project to develop an innovative building system that is economical to construct and earthquake resistant.

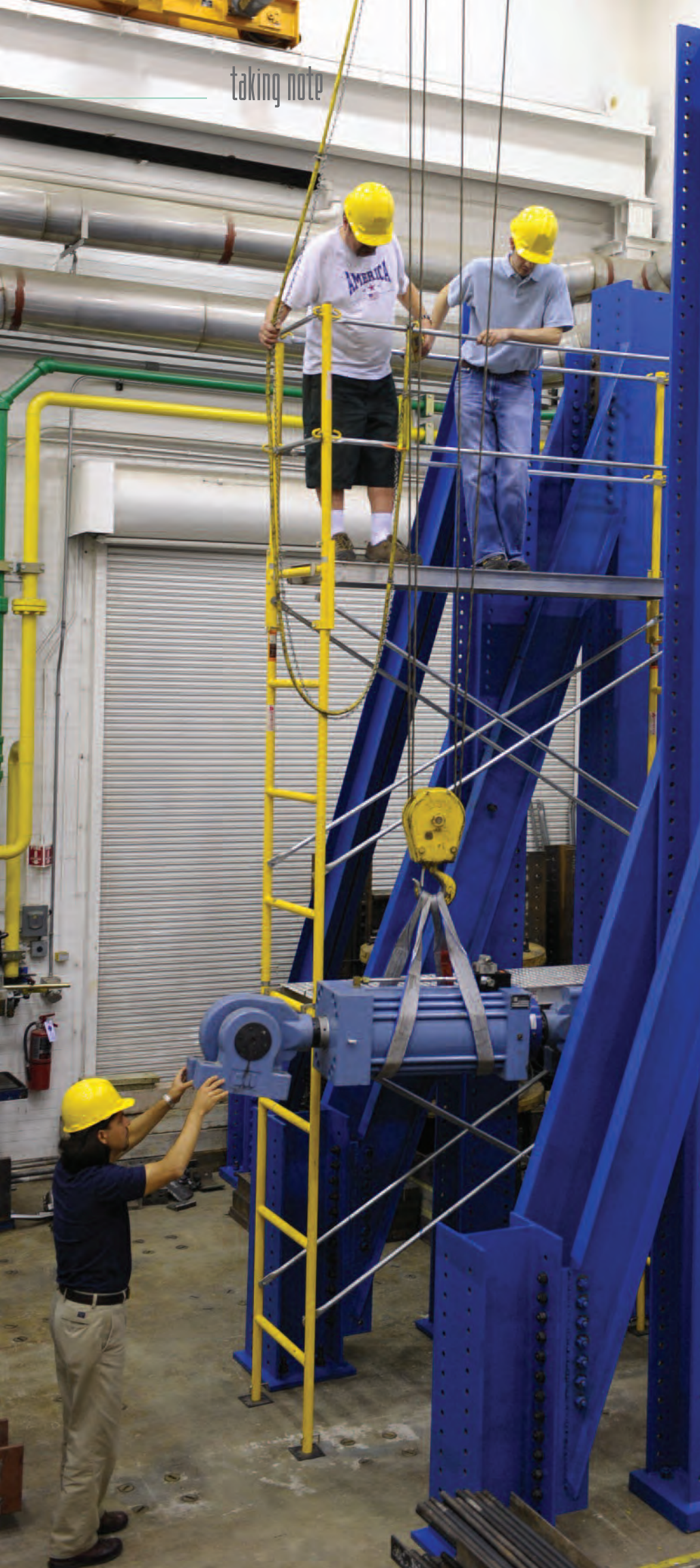
To most people the obvious solution when looking to build an earthquake-proof structure might be to use stronger steel or a heavier foundation. "It's all in the details," says Kurama. "Bigger and stronger is not always better." Working in the Concrete Structures Laboratory, Kurama and graduate student **Brian J. Smith** are designing a hybrid precast concrete wall system that combines mild steel reinforcement with high-strength post-tensioning steel, which will be able to withstand the excessive lateral forces of an earthquake. Such a system would be "self-centering," returning the structure to a plumb position after an earthquake.

Precast concrete typically offers high-quality, cost-effective production in less time than other materials. The use of precast concrete buildings in earthquake-prone areas of the United States, however, has been limited due to the uncertainty about their performance during seismic events. The building codes currently used for precast structures are based on cast-in-place reinforced concrete buildings, essentially eliminating the advantages inherent in precast construction.

Funded by the Charles Pankow Foundation and the Precast/Prestressed Concrete Institute and conducted in collaboration with prominent practicing engineers and precast producers, the key deliverables from the Notre Dame project will be code validation of the new system and the development of a design procedure document for adoption and commercial application in seismic regions. "Our goal is to provide sound evidence of how such a system would act during a seismic event," Kurama said. "This information can then be actively pursued by practicing engineers and precast producers in pioneering commercial applications and developing construction codes. We will forge the concepts here on campus, but the work will be complete when I see the first building constructed."

To follow the three-year project, visit hybridwalls.nd.edu.

The Concrete Structures Laboratory provides a unique opportunity for University researchers to test large-scale prototype walls. During the course of the three-year project, six 0.4-scale hybrid wall structures will be tested under loads similar to those associated with moderate and high seismic events. Pre- and post-test analyses will also be performed and compared to design expectations.





In Good Company

When she was named the 2008 Julius Stieglitz Lecturer, **Joan F. Brennecke** joined a list of distinguished honorees that includes 13 Nobel Laureates and more than 35 members of the National Academy of Sciences. Presented annually by the Chicago section of the American Chemical Society (ACS) and the University of Chicago, this is the

highest ACS section award given.

Brennecke, the first chemical engineer to be honored, is the Keating-Crawford Professor of Chemical and Biomolecular Engineering and director of the Notre Dame Energy Center.

A faculty member since 1989, Brennecke is internationally known for her research in the development of supercritical fluids and ionic liquids. Her research interests include supercritical fluid technology, ionic liquids, thermodynamics, environmentally benign chemical processing, and carbon dioxide separation, storage and usage.



Alworth to Head Engineering Business Program

Robert L. Alworth, most recently senior vice president in charge of international operations and global sourcing for S&C Electric Company in Chicago, was appointed director of the Integrated Engineering and Business Practices Program in the College of Engineering, effective January 2008. Alworth,

who graduated from the University in 1972 with a bachelor's degree in mechanical engineering, returns to Notre Dame with more than 34 years of experience in industry, focusing

on customer service, manufacturing, marketing, product development, and sales. As director, he leads one of the most popular elective programs in the college. Since its establishment in 2001, 75 percent of engineering undergraduates have taken at least one of the two courses offered through the business practices program, with 30 percent participating in both courses. Participants in the program gain a working knowledge of the fundamentals of business practice and a more in-depth perspective of the role of engineering in business. They also begin to develop the interpersonal and decision-making skills that are required to make significant contributions to any business enterprise.

Best Paper Honors EE

"Quilt Packaging: High-density, High-speed Interchip Communications," which was published in the November 2007 issue of the *IEEE Transactions on Advanced Packaging*, was named a co-recipient of the 2007 Best Paper Award. It was selected from among nearly 100 manuscripts published in the year's volume of *Transactions*. Co-authors (from the Department of Electrical Engineering) were Professor **Gary Bernstein**, **Qing Liu**, **Minjun Yan**, **Zhuowen Sun**, **David Kopp**, Frank M. Freimann Professor and Director of the Center for Nano Science and Technology **Wolfgang Porod**, Professor **Gregory Snider**, and Professor

Patrick J. Fay. Although given for a 2007 article, the award was presented at the 58th Electronic Components and Technology Conference in May 2008.

Bernstein led the Notre Dame team that demonstrated the new paradigm for interchip communication called Quilt Packaging. In short, self-aligning keys and slots enable direct chip-to-chip contact. The "quilt" created offers high signal strength, low power dissipation, reduced production costs, and the option to use heterogeneous materials.



IEEE Recognizes Costello's Paper as Most Outstanding

The Institute of Electrical and Electronics Engineers (IEEE) has named **Daniel J. Costello Jr.**, the Leonard Bettex Professor of Electrical Engineering, the recipient of the 2009 IEEE Donald G. Fink Prize Paper Award. Presented annually, the award honors the most

outstanding survey, review, or tutorial paper published among all of the organization's 144 transactions, journals, and magazines. The presentation will take place at the IEEE Information Theory Workshop in October 2009 in Taormina, Sicily.

Costello's prize-winning paper, entitled "Channel Coding: The Road to Channel Capacity," appeared in the June 2007 issue of the *Proceedings of the IEEE*. Co-authored with **G. David Forney** of the Massachusetts Institute of Technology, the paper

describes the 60-year trajectory of research into making digital communications more robust and efficient through the controlled introduction of redundancy.

Channel coding is used in virtually every existing digital communication system, including cell phones, cable modems, DSL lines, and satellite systems. Costello has made sustained and profound contributions to the research described in this article.

Costello, who received his master's (1966) and doctoral degrees (1969) from the University, returned to Notre Dame in 1985 as a member of the Department of Electrical Engineering faculty. He is a fellow of the IEEE and has received the Alexander von Humboldt Foundation Research Prize, the IEEE Third Millennium Medal, and the Seattle University (his undergraduate institution) Centennial Alumni Award.

Teaching & Advising Awards: '08 - '09

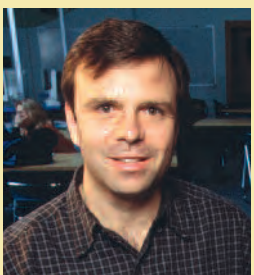
The College of Engineering is pleased to recognize the 2009 Joyce Award winner and Outstanding Teacher of the Year — **William F. Schneider**, associate professor of chemical and biomolecular engineering. His work focuses on developing molecular-level understanding, and ultimately molecular-level design, of chemical reactivity at surfaces and



Schneider

interfaces. A faculty member since 2004, he teaches courses in chemical reaction engineering and physical chemistry.

The 2008 Joyce honorees were **J. William Goodwine**, associate professor of aerospace and mechanical engineering, and **Yahya C.**



Goodwine

Kurama, associate professor of civil engineering and geological sciences.

In addition, **Cathy Pieronek**, assistant dean of academic affairs and the director of the Women's Engineering Program, received the

2008 Dockweiler Award.

Goodwine graduated from Notre Dame in 1988 with a bachelor's degree in mechanical engineering. He returned to the University in 1998 as an assistant professor. His expertise is in geometric nonlinear control theory with robotic applications and engineering mechanics and dynamics.

Kurama joined the University in 1998. His research focuses on concrete structures, steel/concrete hybrid and composite structures, earthquake engineering and structural dynamics, and structural fire design and behavior. *See related story on page 17.*

Pieronek graduated cum laude from Notre Dame in 1984 with a



Kurama



Pieronek

bachelor's degree in aerospace engineering. She has been serving engineering undergraduates since returning to the college in 2002 to establish the Women's Engineering Program.

The Joyce Award, formerly known as the Kaneb Teaching Award, was established in 2007 in honor of the late Rev. Edmund P. Joyce, C.S.C., formerly the executive vice president of Notre Dame. Honoring faculty members who have had a profound influence on undergraduate students through sustained exemplary teaching, it recognizes professors who "create environments that stimulate significant student learning, elevate students to a new level of intellectual engagement, and foster students' ability to express themselves effectively within their disciplines."

The Dockweiler Award, also established in 2007, recognizes faculty or staff members who demonstrate a sustained commitment to Notre Dame undergraduates through outstanding mentoring, academic advising or career counseling services. It was created through a gift from the Julia Stearns Dockweiler Charitable Foundation.

The Problem with Water: It's Dirty

A Pacific Institute Research Report issued in 2002 (*Dirty Water: Estimated Deaths from Water-related Diseases 2000-2020*) suggests that the greatest failure of the 20th century is "the failure to provide safe drinking water and adequate sanitation services to all people." More recently, **Paul W. Bohn**, the Arthur J. Schmitt Professor of Chemical and Biomolecular Engineering, and colleagues from the University of Illinois, Massachusetts Institute of Technology, and Yale University, authored a paper recommending an aggressive research agenda for addressing the global issue of clean water supplies. The paper, which appeared in the March 20, 2008, issue of *Nature*, detailed many of the problems inherent in current water purification strategies, as well as key hurdles to purifying water and minimizing the environmental impact.

Whether deactivating waterborne viruses, developing nanoscale sensors, discovering new techniques for the safe reuse of wastewater, or improving desalination processes, the theme of the paper is "location." Water purification

issues are as diverse as world geography. According to Bohn, conventional methods of water purification can be chemically complex, requiring a high degree of technological expertise, extensive infrastructure, and adequate capital. Even moving a distance as little as 10 miles can present unique challenges. "A design for disinfecting membranes, suited to the United States and Western Europe, won't necessarily be appropriate for use in Bangladesh," he says. "We need, instead, to develop a broad spectrum of different processes suited to a specific [local] technology base."

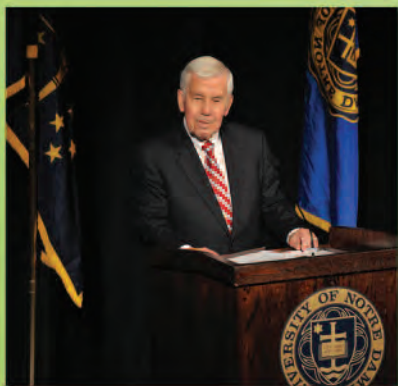
Bohn believes that the paper reflects the University's mission and its commitment to addressing infrastructure issues in the developing world. "Water purification represents a great opportunity to make a real difference in the developing world by delivering new, safe, and affordable methods to increase clean water supplies for the whole world," he says.



The Pacific Institute Research Report *Dirty Water: Estimated Deaths from Water-related Diseases 2000-2020* estimates that up to 135 million people could die of water-related diseases in the next two decades, a major concern in much of the developing world where water supplies and sanitation conditions are suspect.

Going Green

TOWARD AN ENVIRONMENTALLY RESPONSIBLE CAMPUS —
Energy Week 2008, the ND Forum on Energy, and Distinguished Lecture Series



On Oct. 8, Sen. Richard G. Lugar, R-Ind., visited the Notre Dame campus. He spoke with students about energy and foreign policy, toured the Notre Dame Energy Center, and presented the Energy Patriot Award to GreeND, a student organization focused on energy and environmental issues.

Organized by members of the center's student advisory board, each day of Energy Week featured energy education and awareness activities, including participation from major energy companies, a display of hybrid vehicles, carbon dioxide footprint calculators, information on renewable energy sources, tours of the Notre Dame Power Plant, and screenings of documentaries and energy-focused movies, such as "Who Killed the Electric Car" and "An Inconvenient Truth."

Students were also able to participate in a career luncheon featuring representatives from energy companies, attend a "green" prayer service, and take part in the second annual campus-wide "Lights Out." Last year's one-hour "Lights Out" resulted in a 2.7 percent reduction in electricity as measured by the Notre Dame Power Plant. This year's effort garnered a 5.3 percent reduction.

In the dining halls during Energy Week, students were able to select from locally grown and sustainable food items.

"We're very proud of what the students have done and how committed they are to the issue of energy," says **Joan F. Brennecke**, the Keating-Crawford Professor of Chemical and Biomolecular Engineering and Director of the Notre Dame Energy Center. "They expanded this year's Energy Week activities, while focusing even more on the impact that a single person can have, whether or not that person has engineering or scientific expertise. The more we know about energy, the more we can all play a part in finding solutions."

The student advisory board ended Energy Week 2008 by urging all students to attend the 2008 Notre Dame Forum, which examined the challenges of a sustainable energy future. The discussion featured a panel of experts — including Gov. **Bill Ritter Jr.**, of Colorado; General Electric Co. chairman and chief executive officer **Jeff Immelt**; Sustainable South Bronx founder **Majora Carter**; and **Ernest Moniz**, the Cecil and Ida Green Distinguished Professor of Physics at the Massachusetts Institute of Technology. **Anne Thompson**, chief environmental affairs correspondent for NBC News, served as moderator.

In support of an environmentally responsible campus, the Energy Center also implemented a Distinguished Lecture Series for faculty and students. The inaugural lecture was given by **Ken Ostrowski**, a director in the Atlanta office of McKinsey & Company, a global management and consulting firm. Responsible

for McKinsey's North American Electric Power and Natural Gas (EPNG) practice and co-leader of the Global EPNG practice, Ostrowski discussed the challenges of where and how greenhouse gas emissions could be reduced in the United States.

The Notre Dame Energy Center sponsored its second annual Energy Week, themed "Be Enlightened." Running from Sept. 17 through Sept. 24, it was scheduled in conjunction with "Sustainable Energy: A Notre Dame Forum."





The Go-to Green Guy

James M. Mazuerk, a 1991 graduate of the Department of Aerospace and Mechanical Engineering, joined Notre Dame in May 2008 as the first director of the University's new Office of Sustainability. In short, Mazuerk and his office are charged with managing the University's environmental impact, encompassing building design and operations, landscaping, procurement, energy and water conservation, waste disposal, recycling, and service.

Considering that the campus uses 900 million gallons of water, 80,000 tons of coal, 275 tons of copy paper, 8,900 printer cartridges, and produces 12,000 tons of garbage, it is not a small job.

Most recently a partner in the Chicago office of the international consulting firm Accenture, Mazuerk has led major efforts in the development and implementation of sustainability and business strategies for global companies. His experience will serve the University well as it builds its green efforts.

For more information on the University's efforts, visit www.green.nd.edu.

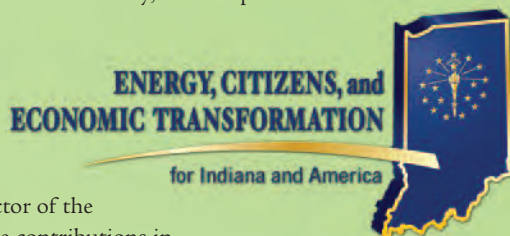
Indiana and U.S. Energy

On July 7, 2008, the University and the Notre Dame Energy Center hosted an energy policy conference, "Energy, Citizens, and Economic Transformation for Indiana and America." Visitors, engineers, scientists, and state and national policymakers focused on the future of energy research, its effect on society, and the potential it bears for the state and the country.

"Already a leader in clean coal technologies and biofuels, Indiana is poised," says **Joan F. Brennecke**, Keating-Crawford Professor of Chemical and Biomolecular Engineering and Director of the Notre Dame Energy Center, "to make contributions in more efficient vehicles, energy storage, emerging solar technologies, and utilizing wind resources. This conference represented a step toward creating active partnerships among universities, industry, and policymakers as we addressed ways to meet the ever-increasing demand for energy, while balancing affordability and sustainability."

Featured presenters included keynote speaker Rep. **Joe Donnelly**, D-Ind., as well as **Michelle V. Buchanan**, associate laboratory director for physical sciences at Oak Ridge National Laboratory; **Patricia M. Dehmer**, deputy director of the Office of Science for the U.S. Department of Energy; **Jay P. Gore**, director of the Discovery Park Energy Center at Purdue University; **Paul J. Mitchell**, policy director for economic development, workforce and energy for the state of Indiana; **Hratch G. Semerjian**, president and executive director of the Council for Chemical Research; **Vinod K. Sikka**, director of product development at Ross Technology-Oak Ridge; and Brennecke.

Conference topics included the challenges and opportunities in basic energy research, the economic impact of investments in basic research, and the links between energy, the economy, security, and the environment.



Seeds for Thought: In Search of Clean (and Inexpensive) Energy



Three projects pursuing novel concepts in clean energy have been funded by the Notre Dame Energy Center's new Seed Fund program. Designed to support early-stage research related to energy production, delivery, and use, the fund was created to promote research for solutions

to energy that are clean, economically feasible, and renewable.

In the first project, "Toward Simulating Chemical and Photochemical Reactions for Clean Energy: Methodologies for the Solid-Aqueous Interface," **Steven A. Corcelli**, assistant professor of chemistry and biochemistry; **Kathie E. Newman**, professor of physics; and **William F. Schneider**, associate professor of chemical and biomolecular engineering, are addressing the modern energy infrastructure, which is built around the extraction and refining of fossil fuels through gas-solid chemical reactions. Specifically, they are studying the structure and reactivity of transition metal oxides in water as it relates to converting light into chemical energy. They are working to contribute to a new set of chemical transformations, processes, and materials by developing accurate and computationally efficient models with which to predict chemical reactions at the solid-aqueous interface.

Prashant V. Kamat, professor of chemistry and biochemistry, and **Paul J. McGinn**, professor of chemical and biomolecular engineering, are working to advance the fundamental understanding of solar hydrogen production. Offering potential as a plentiful source of clean, economical, and transportable stored energy (fuel cells), the solar production of hydrogen from water-oxide mixed-phase systems does not currently provide efficient and environmentally safe conversion methods. Kamat and McGinn are exploring candidate oxide catalysts and methods, reviewing photocatalytic properties and techniques, and hoping to identify the best catalyst compositions in a photocatalyst membrane assembly for use in fuel cells.

The third proposal, "Graded Quantum Dot/Nanowire Heteroassemblies for Photovoltaic Applications," investigates the use of semiconductor nanostructures for solar energy conversion, with the ultimate goal of growing conductive substrates for a new generation of solar cells. **Masaru K. Kuno**, assistant professor of chemistry and biochemistry, and Kamat are working to develop a new paradigm for the creation of low-cost, high-efficiency, solar energy conversion from photovoltaics made of low-dimensional materials.

How Green is ND?



The College Sustainability Report Card, an independent Web evaluator of the sustainability in campus operations and endowments, has given Notre Dame a B- on its 2009 report grade. That's up from a C in 2008.

Other Indiana universities had comparable scores. For example, Purdue also received a B- for 2009 while Indiana University at Bloomington received a C+.

The Report Card and its publishing agent, the Sustainable Endowments Institute (SEI), are supported through grants from foundations and private donations. The SEI is a not-for-profit organization dedicated to research and education to advance sustainability in campus operations and endowment practices.

Jumper to Serve on NRC Committee

In November 2008, Professor **Eric J. Jumper** was appointed to the newly formed National Research Council study committee on Materials Needs and R&D Strategy for Future Military Aerospace Propulsion Systems. He joins researchers from the Air Force Systems for Integrated Defense Systems; California Institute of Technology; Massachusetts Institute of Technology; Mississippi State University; Missouri University of Science and Technology; NASA Ames Research Center; Rolls-Royce, North America; Science Applications International Corporation; Worcester Polytechnic Institute; the U.S. Air Force Academy; and the University of Dayton.

Improving surveillance and interception capabilities via aerospace propulsion is vital to national security. Thus, the goals of the committee are to address the challenge of developing new materials for high Mach vehicles (manned and unmanned) and to identify national directions for propulsion technology.



Jumper, who previously served

on an NRC committee for hypersonics and access to space, has spearheaded a number of advances in this technology. For example, he and then graduate student **Ronald J. Hugo** (now the head of the Department of Mechanical & Manufacturing Engineering at the University of Calgary) made the first time-resolved wavefront measurements for propagation through a Mach 0.8 free shear layer.

Jumper's research encompasses aero-optics, aircraft turbine (jet) engines and aircraft wake dynamics. His expertise in military acquisition and procurement, government technical program management, aerospace engineering and space science, physics, thermodynamics, propulsion and combustion, orbital mechanics, aerodynamics, reentry heating and thermal protection materials, surface chemistry and aero-optics adds to the scope of the committee.

Prior to joining the University in 1989, Jumper served as chief of the Laser Devices Division at the Air Force Weapons Laboratory and professor at the Air Force Institute of Technology. He is a fellow of the American Institute of Aeronautics and Astronautics and a member of the American Society for Engineering Education.



In the Line of Fire

Steel armor, while it increases soldier survivability, adds thousands of pounds to a military vehicle. The armor makes a vehicle stronger, but the added weight reduces speed (critical in a war zone) and overtaxes the engine. The solution, according to **John E. Renaud**, chair and professor of the Department of Aerospace and Mechanical Engineering, will be found in innovative structural and materi-

als designs. He and a team of faculty and students in the Design Automation Laboratory, in collaboration with researchers at nearby AM General (Mishawaka, Ind.), are working to improve soldier survivability in vehicles, whether from a blast or a crash.

Part of a \$1.3 million grant from the U.S. Army Tank Automotive Research Development and Engineering Center, the Notre Dame team is pioneering design and manufacturing methods that include rapid up-armor structural synthesis, topologically controlled lightweight ceramic armor design, and nonlinear transient vehicle crashworthiness design. Their efforts will not only benefit soldiers on battlefields around the world, but they will also impact the local economy.

The team is applying Hybrid Cellular Automata (HCA), a computer-aided design and manufacturing framework developed at Notre Dame, to simulate advanced materials and model their behavior in a variety of crash events, from roadside bombs and mines to rocket-propelled grenades.

Controls Journal Elects Antsaklis Editor-in-Chief

Panos J. Antsaklis, the H. Clifford and Evelyn A. Brosey Professor of Electrical Engineering, has been elected editor-in-chief of the Institute of Electrical and Electronics Engineers (IEEE) *Transactions of Automatic Control* (TAC) by the Board of Governors of the IEEE Control Systems Society (CSS). When the editorial office moves to the University in 2009, he will assume duties, which include oversight of a staff of 50 editors and associate editors from around the world, as they review more than 1,400 submissions and publish 12 issues annually. Founded in 1956, TAC is the flagship publication of the CSS and has served as the authoritative source for research results in the mathematical theory of automatic control systems for the past 50 years.



A faculty member since 1980, Antsaklis has authored and co-authored more than 380 journal articles and conference proceedings, as well as two graduate-level textbooks, and edited six books. He is an IEEE fellow, former president of the IEEE CSS, founding president of the Mediterranean Control Association, and has served on the Subcommittee on Networking and Information and Technology of the President's Council of Advisors for Science and Technology and in the Scientific Advisory Board of the Max-Planck Institute, Magdeburg, Germany. He is also the recipient of a number of professional honors, including a Fulbright Award, the IEEE Distinguished Member Award of the CSS, an IEEE Third Millennium Medal, Notre Dame's John A. Kaneb Award for Excellence in Teaching and Curriculum Development, and the 2006 Brown Engineering Alumni Medal from Brown University.

Young Investigators Honored by AFSOR

Vikas Tomar, assistant professor of aerospace and mechanical engineering, and **Huili (Grace) Xing**, assistant professor of electrical engineering, were two of the 39 engineers and scientists selected by the Air Force Office of Scientific Research (AFSOR) as part of the 2008 Young Investigator Program (YIP). The program is open only to engineers and scientists at U.S. research institutions who have received a doctoral degree within the last five years and show “exceptional ability and promise for conducting basic research.” This year’s YIP honorees will share approximately \$12.1 million for their research efforts as outlined in their winning proposals.

Competition for the award was intense, with the AFSOR receiving 210 proposals encompassing a broad range of areas, including aerospace, chemical and materials sciences, physics and electronics, mathematics, information technologies, and life sciences. Each winner receives a three-year grant.

Tomar, who joined the University in 2006, is investigating nanoscale thermal conduction and mechanical strength correlation in high-temperature ceramics as part of his efforts in the YIP. It coincides well with his work in the department’s Multiphysics Laboratory, where he is studying advanced ceramic matrix composites for use in energy plants. High-temperature ceramics that can work in extreme environments — radiation or corrosion — would significantly benefit the coal industry and development of nuclear power. For example, a simple increase in operating temperature can result in increased energy efficiency.

Xing’s YIP focuses on the quantum limits of nitride RF high-electron mobility transistors. Through experimental and theoretical approaches, she is investigating the physical origins of the upper limit of speed and power-handling capabilities in gallium-nitride based semiconductor transistors. This will advance the development of the next generation radio frequency applications. Similar electronic devices, featuring reduced size and lower energy consumption, have already been employed in cell phone base stations. Xing envisions that high-electron mobility transistors could replace bulky power adapters with millimeter-size chips and could be deployed in hybrid engines in automobiles, efficient terahertz (THz) emitters and a host of other applications. Her project aligns well with her interests in nitride semiconductors and electronic and optoelectronic devices. Xing’s current research activities in this area include the integration of heterogeneous materials using direct wafer bonding, development of high energy efficiency green light emitting diodes for solid state lighting (including ultraviolet and infrared emitters), and THz detection technologies for medical applications. A faculty member since 2004, Xing is a member of the Materials Research Society, Institute of Electrical and Electronics Engineers, Electrochemical Society and American Society for Engineering Education.



Electrical Engineers Receive NSF CAREER Award

Huili (Grace) Xing and **Vijay Gupta** have been named 2009 National Science Foundation (NSF) Early Career Development (CAREER) Award recipients. This is the highest honor given by the U.S. government to young faculty in engineering and science. The CAREER program, which was established by the NSF in 1995, recognizes and supports junior faculty who exhibit a commitment to stimulating research while also providing educational opportunities for students.

Xing’s CAREER project, titled “Graphene and Graphene Nanoribbon Optoelectronic Properties and Devices,” focuses on developing and demonstrating a series of optoelectronic device concepts (primarily photodetectors) based on graphene and graphene nanoribbons (GNRs) and then using those devices as vehicles to extract the optoelectronic properties of graphene and GNRs. Still in its infancy, this research will deepen the understanding of electron excitation-relaxation dynamics, minority carrier lifetime, external electrostatic gating and wave guiding, and dielectric effects, all of which are important for graphene-enabled applications, such as tunable photodetectors, THz emitters, biosensors and other devices yet to be invented. The educational component of Xing’s project involves undergraduate students and middle school teachers and students — especially young girls — via Notre Dame’s Expanding Your Horizons workshops, women students from Saint Mary’s College who are participating in the dual-degree program in engineering and a summer research opportunities program for women faculty from the college.

A faculty member since 2008, Gupta’s research focuses on the systematic and verifiably correct design of cyber-physical systems, such as cooperative multi-agent systems, networked control systems and sensor networks. His CAREER project, titled “Scalable and Optimal Co-design of Control and Communication Protocols in Cyber-physical Systems,” explores the next generation of engineering systems composed of multiple complex dynamical systems interacting across communication networks. The project proposes a scalable and efficient approach for designing the communication and control algorithms for such systems. Applications for the algorithms and protocols that will be developed during the course of the project include advanced automotive systems, tele-medicine, energy conservation, environmental monitoring, traffic control and distributed robotics. Gupta’s project also includes the development of a new interdisciplinary graduate course, new projects for the department’s senior thesis project course and a high school outreach program to motivate students, particularly minority and female students, to pursue engineering as a career.





Good Bones Make Good Cars

In addition to making alternative fuel vehicles, car companies have long wanted to make vehicles safer. Over the years the interior of a car has not exactly been the safest place in the world, even in low-speed collisions. Seventy years ago, for example, dashboards were made of metal, steering columns were rigid and non-collapsible, and the “Click It or Ticket” campaign did not exist. The vehicle body itself was rigid, and the force of an impact was transmitted directly to a vehicle’s occupants.

Important dates in car safety include 1934 – when General Motors performed the first barrier crash test, 1967 – when the National Transportation Safety Board was created, 1984 – when New York passed the first U.S. law requiring seat belt use in passenger cars, and 1986 – when the National Highway Traffic Safety Administration mandated that all new passenger cars feature a center high mount stop lamp. Today, there are also crash attenuators on highways and work safety zones. Much has been done to protect passengers, highway workers, and pedestrians. In fact, 2008 automotive fatalities dropped below 38,000, the lowest since 1961.

While the trend in U.S. motor vehicle fatalities seems to be decreasing, the issue that continues to elude manufacturers is vehicle crashworthiness design. It is one of the most difficult problems to address because of the complex challenges of modeling (It can take weeks to execute computer-aided simulations), the development of new materials, and the cost of manufacturing. Since 2004, **John E.**

Renaud, chair and professor of aerospace and mechanical engineering, has been working with Honda R&D North America to improve passenger safety via structural design.

Turns out that the methods that Renaud and his team – **Andres Tovar**, research assistant professor; **Lianshui Guo**, visiting scholar from Beijing University of Aeronautics and Astronautics; **ByungSoo Kang**, post-doctoral research associate from Hanyang University in Seoul; and graduate students **Neal Patel**, **Chandan Mozumder**, **Punit Bandi**, **Charlie Penninger**, **Huade Tan** and **Jack Goetz** – have been developing to simulate the way bone remodels itself and the varying loads placed on the body can be applied to vehicles via a cellular automata computing paradigm. The team uses a topology optimization software developed at Notre Dame to synthesize structures that will be subjected to nonlinear dynamic transient loading in a crash event. Working with Honda, the team has successfully applied the methodology to synthesize bumper systems, door beams, and knee bolster designs. The objective is to systematically synthesize structural components that absorb energy during a crash, while retaining stiffness nearest to passengers.

Being able to more accurately model crash situations, with their thousands of variables, provides data for the type of automotive materials and structures that will best protect vehicle occupants. Notre Dame and Honda are working together to license the software.

Engineering Faculty Take Top Graduate School Honors Two Years Running

For the last two years faculty in the College of Engineering have been honored by the Graduate School as James A. Burns, C.S.C., Graduate School Award winners for their exemplary contributions to graduate education at Notre Dame.

The 2009 recipient was, **Danny Z. Chen**, professor of computer science and engineering. A faculty member since 1992, Chen is best known as a leader in the emerging field of computational



Chen



Stadtherr

medicine. He has received global recognition for his pioneering efforts in this area, using computational geometry techniques to solve algorithmic problems arising in medical applications, such as radiation therapy and medical imaging. He has published nearly 200 papers and holds five patents. An excellent teacher and mentor, Chen’s former students have distinguished themselves in academia and industry.

Mark A. Stadtherr, professor of chemical and biomolecular engineering, was the 2008 honoree. His research focuses primarily on the development and application of strategies for reliable computing, with particular emphasis in global optimization, verified solution of dynamic systems, and computation of phase behavior. His research stresses the modeling and computation of phase behavior associated with using ionic liquids for more energy-efficient absorption refrigeration from waste heat.

Stadtherr, who joined the University in 1996, was cited by the Graduate School for his guidance of and work with graduate students as director of graduate studies in the Department of Chemical and Biomolecular Engineering for the last 12 years.



Designs for Life: A Sabbatical Story

It's customary for faculty members to take a sabbatical, by definition an extended leave from customary responsibilities. But in no way is a sabbatical considered downtime. Faculty spend this time away from the University collaborating with research partners in a national laboratory, serving as a visiting professor at another university, or completing their next book. The ways in which they continue working are as different as each faculty member. **Stephen M. Batill**, professor of aerospace and mechanical engineering, spent the first part of his sabbatical working as a scholar-in-residence at IDEO and serving as a visiting professor at Stanford University.

Batill structured his time away from Notre Dame to complement his interests in design practice, education, and scholarship. Years ago he visited the IDEO home office in Palo Alto,

Calif., as well as locations in London and Chicago, and was impressed with what he found. "IDEO is arguably the most recognized design consultancy in the United States, maybe the world," he says. "It seemed like an ideal place to observe design practice and thinking." So two years before his planned sabbatical, Batill started talking to **Dennis Boyle**, an IDEO partner and 1975 graduate of the Department of Aerospace and Mechanical Engineering.

IDEO placed Batill in its Health and Wellness practice, where he has been involved in a wide range of projects. Perhaps more relevant to his position as a faculty member at Notre Dame is the opportunity he has had to participate in the company's ongoing discussion about the impact and role of engineers and technology in the product design process. Much of that stems from how IDEO approaches a project ... whether developing a new bicycle, a medical device, or improving access to water in a developing country. The company believes that rather than a series of steps, the design process is a complex and somewhat chaotic system of spaces (processes) that each concept must experience before achieving a workable result. Most important in the process, and vital for engineers to remember, is that they need to consider human behavior, needs, and circumstances. When designing a product, one must ask: Who will use it? How will it be used? What technology does the environment in which it will be used allow?

Is there a benefit to the user by designing a product in one specific way over another?

"Design" is much broader than a single "light bulb moment." It involves a host of decisions that affect humanity. "Engineers have the opportunity to bridge the gap between the challenges and opportunities provided by

technology (the products) and the needs of society," says Batill. "This is the heart of IDEO, and the role that engineers of the future (our students) will need to play. They need to be whole-minded, capable of using both the left and right sides of their brain."

Batill plans to implement many of these concepts into his courses when he returns. But first, he traveled to the Netherlands, where he is spending the second half of his sabbatical working with researchers in the Product Innovation Management Department at Delft University of Technology as part of the Fulbright Scholar Program. While he was at IDEO, Batill received word that he had been named a 2008-09 Fulbright Scholar. His appointment runs from January through August 2009.

According to Batill, designing thinking, at IDEO or among Notre Dame engineering students, is a process that must be cultivated for the future of the engineering profession and engineering education. He believes it is also imperative to explore ways in which a more integrated program of design can be instituted, possibly by establishing collaborative efforts in engineering, industrial design (arts and letters), architecture, and business. "I believe my tenure at the University and now my experience at IDEO will help me to identify key issues, such as the role of visual expression of ideas, prototyping, and communication, which are vital elements of effective design."

Batill has served on the faculty since 1978. Prior to that he served on the faculty at the U.S. Air Force Academy and was an aeronautical engineer at the Air Force Flight Dynamics Laboratory at Wright-Patterson Air Force Base. He is also a Triple Domer, receiving his bachelor's degree in 1969, his master's in 1970, and his doctorate (all in aerospace engineering) in 1972.

Fein to Lead CEST

Jeremy B. Fein, professor of civil engineering and geological sciences, has been appointed director of the Notre Dame Center for Environmental Science and Technology (CEST). He replaces **Patricia A. Maurice**, professor of civil engineering and geological sciences, who had served as director since 2003.

A collaborative effort between Notre Dame's colleges of engineering and science, CEST offers a unique interdisciplinary environment that enhances research capabilities for faculty and students throughout the University as they address complex environmental issues. According to Fein, CEST plays a crucial role in research that involves departments across the University —

such as biological sciences, civil engineering and geological sciences, chemical and biomolecular engineering, chemistry and biochemistry, the Notre Dame Radiation Laboratory, and anthropology — by offering chemical analysis facilities that a single investigator could never manage or maintain alone. Trained technicians maintain the state-of-the-art instruments in the center, providing training for undergraduates, graduate students, postdoctoral researchers, and faculty who use the facility.

A faculty member since 1996, Fein's research encompasses geomicrobiology and aqueous environmental geochemistry. He uses experimental data to construct quantitative thermodynamic



and kinetic models of mass transport in bacteria-water-rock systems, which are used to quantify heavy metal and radionuclide mobilities in systems of geologic and environmental interest, such as contaminated groundwater aquifers and oil-field reservoirs.



Saludos de España

The 2008 Summer Engineering Program in Spain, the first offered by the college in that country, hosted 25 students (24 from Notre Dame and one from the Rose-Hulman Institute of Technology). Two courses, "Introduction to Probability and Statistics" and "Ethical and Professional Issues in Engineering," were taught at the Universidad Politécnica de Valencia in Alcoy. Four days a week the students — aerospace, mechanical, chemical, computer science, and civil engineering majors — attended class. The other days were open for technical excursions and cultural

tours. Program organizers planned field trips to the CEMEX plant in Alicante, the world's largest supplier of building materials and ready-to-mix cement; the Iberdrola Wind Farm in Higuera de la Sierra, one of the largest wind farms in the world; and the Playmobil factory in Ibi, a packaging plant for a variety of Playmobil toys. Student assistants organized tours in the city of Alcoy and surrounding national parks, museums, and sporting events. Participants also took longer trips to Valencia, Toledo, and Granada.

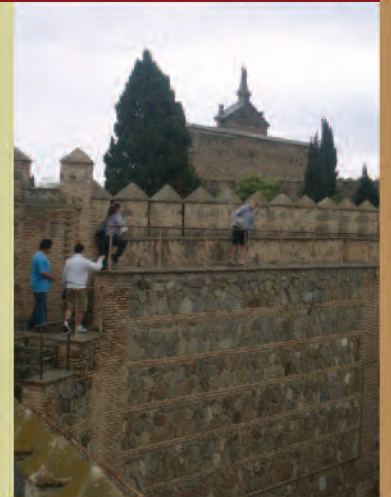
Robert C. Nelson, professor of aerospace and mechanical engineering, served as trip leader and one of the instructors. He was assisted by two professors from the

During one of the technical excursions, students toured the Iberdrola Wind Farm in Higuera de la Sierra. It is the world's largest supplier of electrical energy from wind turbines, serving more than 16 million consumers. Students took time out from their field trip to pose at the base of one of the turbines.



university, **Miguel Angel Sellés Cantó**, who arranged the technical and cultural excursions, and **Elena Pérez Bernabeu**, who taught the probability and statistics course. **John Brauer**, director of the International Summer Engineering Programs, was also instrumental in developing the Spain summer program.

Notre Dame offers more than 40 study abroad programs and five summer programs in 20 countries. Engineering-specific opportunities include programs in England and Spain (summer session); Australia, Chile, Egypt, England, Germany, and Mexico (semester-long); and Ireland (year-long). These programs are designed to help students experience the heritage and culture of another country while still meeting their program requirements in four years.



Students had time to explore and experience the Spanish culture and history. During a two-day trip to Toledo, some of them chose to walk the walls around the city. Built in the 10th century, the walls are beautifully preserved and serve as the perfect backdrop for the city's artistic and cultural legacy.



Flying High in London with GE

Forty-five Notre Dame students and their faculty advisers, part of the Summer Engineering Program in London, visited the Farnborough Air Show as guests of GE Aviation. They were part of a visitors' program to promote the aerospace industry to future engineers.

While at the show, students visited the GE exhibit area and heard firsthand from GE's own **Tom Wygle** ('81, AME), general manager of the GE90 Project; **Tom Brisken** ('71, AME), general manager of the GENx Project; and **Ron Hutter** ('85, AME), director of Turboshift/Turboprop Engine Sales about the future of GE and career development options. The students also joined the speakers at the GE Pavilion for the start of the air show, where they watched flights of the A380, Avro Vulcan B2, Eurofighter, B-1B, F-16, F/A-18F, BA609 Tilt Rotor, and a number of other jets, transports, and helicopters.

The Farnborough show is just one of the activities participating students attend. During the six-week program, they experience life in the United Kingdom, visit European countries, and explore the birthplace of the Industrial Revolution, while attending classes at the Notre Dame London Centre. Students in the program meet for the same number of hours as their counterparts in on-campus summer sessions. In addition to the homework and exams that come with any course, they participate in required field trips to significant engineering facilities in and around London. For information on the summer London program, visit www.nd.edu/~engineer/sumlon or contact **John Brauer**, the program director, at brauer.1@nd.edu.



Since the first session in 1988, more than 550 engineering undergraduates from each of the disciplines offered in the College of Engineering have participated in the Summer Engineering Program in London. Like many of the classes before it, the 2008 group visited the GE Exhibit at the Farnborough International Air Show. They are shown above in front of the GE90-115B, an engine used on the 777 twin-engine airliner.



Summer Tsunami Experience

Ask the average person to name the top life-saving professions. Chances are the list won't include "engineer." According to Associate Professor **Tracy Kijewski-Correa**, engineers should be right up there in the Top 10. "Of course, doctors save lives," she says, "but engineers can save lives, too, by building infrastructure that keeps people safe. It is especially important to put engineering into a social perspective." With that in mind, Kijewski-Correa and her colleagues in the Department of Civil Engineering and Geological Sciences developed the summer research experience for undergraduates, "Interdisciplinary Studies in Tsunami Mitigation and Impacts (ISTIM)." The program, now in its third and final year, is funded by the National Science Foundation. Each year students from universities across the country spend eight weeks engaged in intensive research on campus and two weeks applying those experiences in field study of the impact and recovery following the 2004 tsunami in Thailand and Indonesia. And, each year ethical and humanitarian issues are incorporated into the program activities.

One-on-one faculty mentoring is also a big part of the program as is the opportunity for students from geosciences, coastal engineering, and structural engineering to interact in a multidisciplinary setting to solve complex and urgent societal problems like the threat of natural disasters. "We've all seen the damage Katrina caused and how long rebuilding takes. Imagine the effects of a tsunami on a remote Thai village where the homes are simple shacks and family members are having breakfast when a tsunami strikes with no warning," says Kijewski-Correa. The experience has proven to be a powerful motivator for students, and quite the eye-opener. It is often during trips like this that students realize that the solutions and technologies often applied in the U.S. to mitigate the effects of natural hazards will not work in a developing country or in the wake of a biblical disaster. They have to think of the context, as well as the economic and political climates, to determine what will work.

Thus while engineering solutions like fortified evacuation shelters will save lives, they are meaningless without community education, preparedness and planning. Much the same, an engineer's technical education is meaningless without an understanding of its role and context in helping mankind. The ISTIM program represents just one way that Notre Dame is creating this unique breed of engineer.

For more information on this research experience and to view student projects and photo archives visit istim.ce.nd.edu.

Sleepless in New York

There's a reason New York City never sleeps. The city boasts some of the tallest buildings and most crowded thoroughfares in the nation. It's a constant job keeping up with it all, coordinating the construction and maintenance of the city's expansive infrastructure — streets and highways, bridges, mass transit, airports, water supplies, sewage systems, and waste disposal. At the same time, not keeping up with it is not an option. What better location for 38 undergraduates to experience a behind-the-scenes look at the impact of civil engineering.

Sponsored by the Department of Civil Engineering and Geological Sciences and the Murphy Travel Fund, which is provided to the department by **Dennis F. Murphy** (B.S., CEGEOS '71), the four-day field trip was hosted by Skanska Koch, Inc., Kiewit Eastern Division, Columbia University, the New York City Department of Transportation, and DMJM Harris/AECOM.

More than 30 engineers and project managers met with students throughout the trip as they experienced firsthand the infrastructure challenges faced by cities across the country. Students came to understand the importance of the theory behind these types of projects and their studies at the University. Many also developed concrete ideas for career options.

The trip is the third in a series of junior class field trips which began in 2006; the first two were to New Orleans, where students explored infrastructure related to Southern Louisiana and Mississippi coastal protection.

For more information about the 2008 field trip, visit www.nd.edu/~jjwteach/final_fielddtrip2008.html.

During the New York City Infrastructure Basics field trip in November 2008, juniors in the Department of Civil Engineering and Geological Sciences toured New York City. From the Willis Avenue bridge project and the Croton Water Filtration Plant to Meadowlands Stadium and 20 Exchange Place, students explored the foundations of the city.



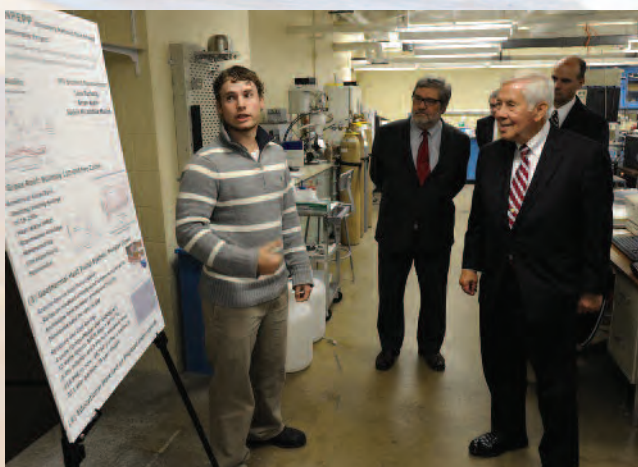


Beautiful (and Energy-efficient) National Parks

The University National Park Energy Partnership Program (UNPEPP) recently funded a joint project between the Notre Dame Energy Center and the National Park Service at Indiana Dunes National Lakeshore to provide energy-related consulting services. This past summer two undergraduates and a recent graduate – **Tom Furlong**, a senior studying aerospace and mechanical engineering; **Brian Klein**, a 2008 graduate; and **Jackie Mirandola Mullen**, a junior pursuing

degrees in German and history – performed energy audits of the park. They also worked with park officials to design a geothermal heat pump and green roof system. The heat pump was designed for the Paul H. Douglas Environmental Education Center located in the park, and the green roof was designed for Building 110, a concrete bomb shelter converted for park use.

As part of the program, the students were required to track and quantify the cost savings – and projected payback in terms of resources, such as energy use reduction and lower greenhouse gas emissions – relating to their recommendations. The energy audits they performed revealed many opportunities for savings, including adding window films and temperature setbacks and installing instantaneous water heaters. Their final recommendations included upgrades to the tune of \$25,530, which would save the park, according to the audits, more than \$6,500 per year. That's a return on investment (ROI) in less than four years.



Other recommendations offered savings but with a longer ROI – the initial investment of \$64,500 for the green roof, which would also extend the life of the roof, would save a projected \$69,000 over 50 years (an ROI of 46.7 years) and a \$124,800 investment in the newly designed geothermal heat pump would save approximately \$4,054 per year (after factoring in the savings from increasing natural gas prices, an ROI of 20.1 years).

“This was a wonderful opportunity for the students to put their training into practice in a real-world setting that encompassed project management skills, teamwork, and leadership opportunities,” says **Joan F. Brennecke**, the Keating-Crawford Professor of Chemical and Biomolecular Engineering and Director of the Notre Dame Energy Center. “It also promoted quite a bit of discussion on the realistic and responsible use of resources.”

UNPEPP is a nationwide program that links universities with national parks to address energy issues within the parks. Through these partnerships, parks gain assistance with energy-related issues, while students obtain problem-solving experience in the energy field. Since its inception in 1997, UNPEPP has funded numerous partnerships between universities and national parks.

Top: Tom Furlong, left, and Jackie Mirandola Mullen, center, discuss energy-saving options for the Indiana Dunes National Lakeshore with Notre Dame Energy Center Director Joan F. Brennecke. Bottom: Furlong was also able to share the team's efforts in the national park with Sen. Richard G. Lugar, R-Ind., during his visit to campus on Oct. 8.

The Influence of Nanoparticles

A paper appearing in the March 20, 2008, edition of *Science* and authored by **Patricia A. Maurice**, professor of civil engineering and geological sciences, described how she and a team of researchers examined the diverse consequences of nanoparticles in the environment.

According to the paper, nanoparticles (materials with at least one dimension of less than 100 nanometers) are present everywhere on, or near, the Earth's surface. They affect the mobility of pollutants in the soil and may even contribute to deep-focused earthquakes. Nanoparticles also impact the environment in other ways, playing key roles in volcanic eruptions, how energy is absorbed from the Sun (implications for global warming), and other concerns, such as acid mine drainage from contamination sites and how soil interacts with fertilizers.

One of the concerns raised by these authors focuses on how nanoparticles in the environment might adversely affect the human body. Some of the particles, many of which are small enough to penetrate cell membranes, could interfere with normal cellular processes. A notable example, cites Maurice, is the action of nanoparticles from asbestos within the human lung. “The biogeochemical and ecological impacts of natural and synthetic nanomaterials,” she says, “are among the fastest growing areas of research today, with not only vital scientific, but also large environmental, economic, and political consequences.”



Chicago Full-scale Monitoring Program Goes Global



Ahsan Kareem, left, the Robert M. Moran Professor of Civil Engineering and Geological Sciences, and Associate Professor Tracy Kijewski-Correa have traveled the globe as part of their program to monitor tall buildings in urban settings. Although the project started close to home — Chicago, Ill. — they have expanded the project to include Seoul, South Korea; Toronto, Canada; and Dubai, United Arab Emirates.

Chi-Town. Second City. “City of the big shoulders.” Chicago has many nicknames. The most widely used one may be “The Windy City.” Deservedly so. But the very thing that makes traveling in the city an adventure for commuters and visitors is what made Chicago the best starting point for a pair of National Science Foundation projects, conducted by **Ahsan Kareem**, the Robert M. Moran Professor of Civil Engineering and Geological Sciences, and Associate Professor **Tracy Kijewski-Correa**. Because of its famous tall buildings, Chicago is a tribute to the modern urban landscape. Yet high-rise structures come with unique challenges, which must

be studied in order to continue to improve the performance, economy, and efficiency of tall building design. That was the purpose of the Notre Dame research. While investigations in Chicago have provided much needed information to calibrate and enhance modern design methodologies, the University team has now expanded its efforts to include new types of construction in Seoul, South Korea; Toronto, Canada; and Dubai, United Arab Emirates.

In each location, buildings representing different structural systems and occupancies (residences vs. offices) were instrumented with accelerometers and, in some cases, global positioning systems to record each building’s response to the

wind every tenth of a second on a continuous basis. Although structures have been monitored in seismic zones, such a long-term and comprehensive monitoring effort had not been previously undertaken in this country for high-rise construction most vulnerable to wind. In fact, the study is the world’s first systematic full-scale validation of tall building design practice, and thanks to the new analysis techniques developed by the project and the unique insights they have afforded, the project garnered the 2008 State-of-the-Art of Civil Engineering Award from the American Society of Civil Engineers.

For more information about the project, visit www.nd.edu/~dynamo.

Faculty on the Move

The following engineering faculty have been promoted:

To Emeritus

Daniel J. Costello Jr.
Electrical Engineering

James L. Merz
Electrical Engineering

Albert E. Miller
Chemical and Biomolecular Engineering

Steven B. Skaar
Aerospace and Mechanical Engineering

To Department Chair

John E. Renaud
Aerospace and Mechanical Engineering

To Professor

Patrick J. Fay
Electrical Engineering

X. Sharon Hu
Computer Science and Engineering

Joseph M. Powers
Aerospace and Mechanical Engineering

William F. Schneider
Chemical and Biomolecular Engineering

To Associate Professor

Debdeep Jena
Electrical Engineering

Tracy L. Kijewski-Correa
Civil Engineering and Geological Sciences

J. Nicholas Laneman
Electrical Engineering

Scott C. Morris
Aerospace and Mechanical Engineering

Aaron Striegel
Computer Science and Engineering

Yingxi (Elaine) Zhu
Chemical and Biomolecular Engineering

To Assistant Professor

Michael Niemier
Computer Science and Engineering

To Research Professor

Alexander Mintairov
Electrical Engineering

Alexei Orlov
Electrical Engineering

Joining the College of Engineering are:

Thomas E. Albrecht-Schmitt, professor
Civil Engineering and Geological Sciences

Basar Bilgiçer, assistant professor
Chemical and Biomolecular Engineering

Haixin Chen, visiting scholar
Aerospace and Mechanical Engineering

David Go, assistant professor
Aerospace and Mechanical Engineering

Chengti Huang, visiting scholar,
Electrical Engineering

Elizabeth Kerr, assistant professional specialist,
Civil Engineering and Geological Sciences

Kapil Khandelwal, assistant professor
Civil Engineering and Geological Sciences

Joseph Nahas, visiting professor
Computer Science and Engineering

Thomas Pratt, research associate professor,
Electrical Engineering

James Schmiedeler, associate professor
Aerospace and Mechanical Engineering

Antonio Simonetti, research associate professor,
Civil Engineering and Geological Sciences

Philippe Sucusky, assistant professor
Aerospace and Mechanical Engineering

Alexandros Taflanidis, assistant professor,
Civil Engineering and Geological Sciences



ONCE UPON A TIME THERE WAS A SLEEPY LITTLE VALLEY IN CALIFORNIA. FOR YEARS THE VALLEY, WHICH WAS ONLY 25 MILES LONG AND 10 MILES WIDE, LAY QUIETLY NESTLED BETWEEN THE SAN FRANCISCO BAY AND THE SANTA CRUZ MOUNTAINS. IT WAS HAPPY TO BE KNOWN AS THE “VALLEY OF THE HEART’S DELIGHT.” LIFE WAS GOOD.

THEN ONE DAY THE LITTLE VALLEY STARTED TO BUZZ.

IN A VERY SHORT TIME, IT BECAME THE CENTER OF AN ELECTRONICS REVOLUTION THE LIKES OF WHICH THE WORLD HAD NEVER SEEN. INSTEAD OF APRICOTS, PRUNES, AND WALNUTS, THE LITTLE VALLEY WAS CHURNING OUT SILICON. COMPANIES SPRANG UP OVERNIGHT. AND ALMOST EVERYTHING THE VALLEY PRODUCED TURNED TO GOLD. LIFE WAS GREAT.

INSTEAD OF BUILDING “BIGGER AND BETTER,” THE LITTLE VALLEY WAS PUMPING OUT “SMALLER AND MORE POWERFUL” ... CHIPS AND DEVICES OF ALL KINDS. AND PEOPLE AROUND THE WORLD CLAMORED FOR MORE. LIFE WAS INCREDIBLE.

BUT THE RESIDENTS OF THE LITTLE VALLEY KNEW THERE WOULD COME A DAY WHEN THEY HAD MADE THE SMALLEST CHIP, THE SMALLEST DEVICE, THEY COULD WITH THE TOOLS THEY HAD. IT WAS A PROBLEM.

IT WAS A BIG PROBLEM.

BECAUSE THEY KNEW THAT DAY WOULD COME SOONER THAN ANYONE THOUGHT, THE RESIDENTS OF THE VALLEY, THEIR NEIGHBORS, AND THEIR NEIGHBORS’ NEIGHBORS ALL BEGAN TO LOOK FOR ANSWERS TO THIS BIG PROBLEM.

BUT THEY STARTED VERY SMALL. THEY STARTED LOOKING ON THE NANOSCALE TO DEVELOP NEW MATERIALS, NEW DEVICES, AND NEW PARADIGMS FOR THE ELECTRONICS INDUSTRY.

Today’s Silicon Valley bears little resemblance to the Santa Clara Valley of the 1940s and ’50s, inset photo. It’s amazing how a few short decades can change the landscape of a community ... and a country.

MIND over Matter

*An Unfolding Tale of
Innovation
and Technology*

As the researchers at Notre Dame started to work, things started to happen. In fact, Notre Dame was one of the first universities to focus on nanoelectronics. Since the late 1980s, the University has developed a niche for itself in the field of nanotechnology.

Robin Joyce, graduate research assistant, loads a wafer into an electron-beam evaporator in order to deposit metal onto it to make transistors or interconnections.



Notre Dame researchers were the first to successfully demonstrate Quantum-dot Cellular Automata (QCA), a transistorless approach to computing. They were also the first to demonstrate magnetic logic, using nanomagnets for logic functions and essentially opening the door to all-magnetic information processing systems.

Most recently, Notre Dame was one of only a dozen universities selected by Sandia National Laboratories as founding academic members of the National Institute for Nano-Engineering, a consortium that serves as a national hub for technological innovation and engineering education. As exciting as these achievements are, they represent a few steps in a long journey.

Another exciting step was taken in March 2008 in South Bend, Ind., when the Semiconductor Research Corporation's Nanoelectronics Research Initiative (SRC-NRI), the University of Notre Dame, the state of Indiana, IBM, and the city of South Bend announced the establishment of a nanoelectronics research center, the Midwest Institute for Nanoelectronics Discovery (MIND).

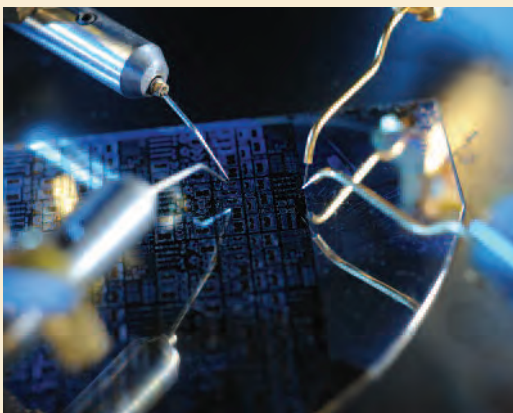
MIND is one of only four such centers funded by the SRC-NRI. Each of the others is located on a university campus. And, each is pursuing the same goal: to enable future breakthroughs in semiconductor technology via nanoelectronics by developing advanced devices, circuits, and nanosystems with performance capabilities beyond conventional devices.

According to **Jeff Welser**, the director of the NRI, "The challenge for nanoelectronics is to ensure that society's expectations for electronic applications can continue to be met. ... Semiconductor technology is the underpinning to everything from the cell phones in our pockets to the supercomputers in our research labs, so nanoelectronics progress is crucial to innovation not only in all areas of science and technology but also to our nation's continued economic growth."

Each of the three other centers — at the University of Texas, the University of California at Los Angeles, and the University of Albany — have already led to economic growth in their local communities, particularly in expanded technology investment and job creation. For example, the development of the center in Albany, N.Y., brought more than 1,000 new jobs and new business development to the area. According to Indiana Governor Mitch Daniels, "For Indiana, this means national leadership in a central technology of the future, and we'd be excited to welcome it anywhere in our state. But it's a special thrill to see it come to Notre Dame, which now enters new dimensions of research prominence and contributions to its home state through the partnership with Purdue."

MIND, while led by Notre Dame, is a consortium that includes Cornell University, Georgia Institute of Technology, Purdue University, the University of Illinois, Pennsylvania State University, the University of Michigan, the University of Texas at Dallas, Argonne National Laboratory, the National Institute of Standards and Technology, and the National High Magnetic Field Laboratory.

Funding of such enterprises is critical, particularly in the early stages. Over the next three years MIND will spend \$20 million on consortium projects. The state of Indiana has promised \$12 million, the SCR-NRI \$3 million, and the city of South Bend \$1 million. In addition, IBM is providing \$2 million in equipment, and the five universities in the consortium are contributing matching funds



"For Indiana, this means national leadership in a central technology of the future, and we'd be excited to welcome it anywhere in our state. But it's a special thrill to see it come to Notre Dame, ..."

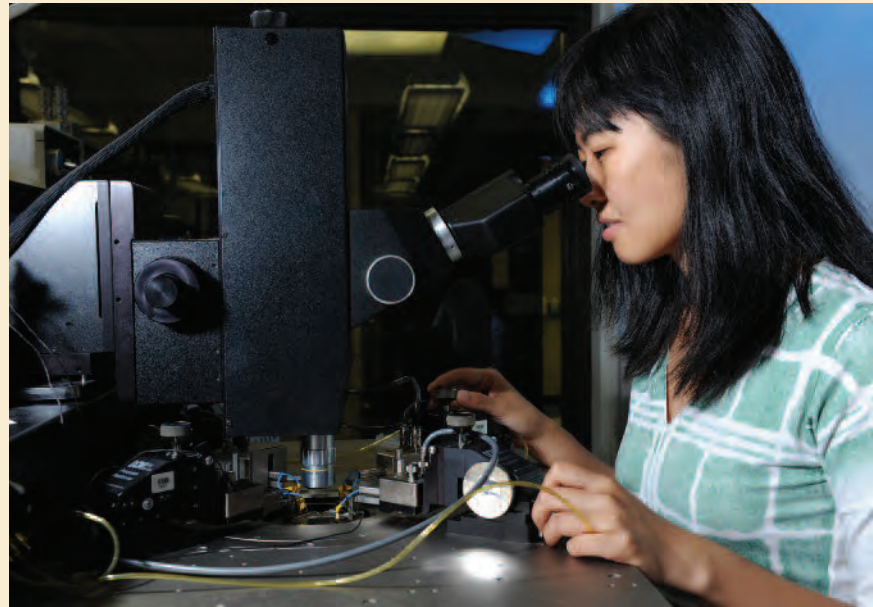
totalling close to \$3 million. MIND organizers anticipate supplemental funding via federal grant applications through the National Nanotechnology Initiative, for which the federal government has allocated \$1.5 billion annually.

Another key to the success of MIND is the availability of clean room facilities. Forty-five percent of the new Stinson-Remick Hall of Engineering will be utilized heavily by the Notre Dame MIND Research Group.

Because central themes of the consortium encompass energy-efficient devices and energy-efficient systems, all MIND researchers will focus on topics not covered by the other SRC-NRI centers. Specific projects include lateral field-effect transistors, extremely scaled gated tunnel transistors, energy dissipation in nonequilibrium systems, nanomagnet logic devices, and circuit design and architectures for emerging devices.

With its history in nanotechnology, Notre Dame is confident in its pursuit of these directions. "Five years ago, some of the ideas we had for switching electrons with quantum mechanical tunneling effects were considered too novel," says **Alan C. Seabaugh**, MIND director and professor of electrical engineering. "Today, we know it's possible. We know how to deal with electronics and move charge. And, we're looking forward to exploring the possibilities and shaping the development of nanoelectronics right here in the Midwest."

MIND also closely ties Notre Dame to the economic development initiatives of Indiana and South Bend. It is anticipated that related commercialization activities will occur in the new Innovation Park at Notre Dame (*see page 10*) and that nanoelectronics commercialization and manufacturing facilities will spring up in the research facility the city is developing to support new jobs and investment associated with MIND and other advances made at the University.



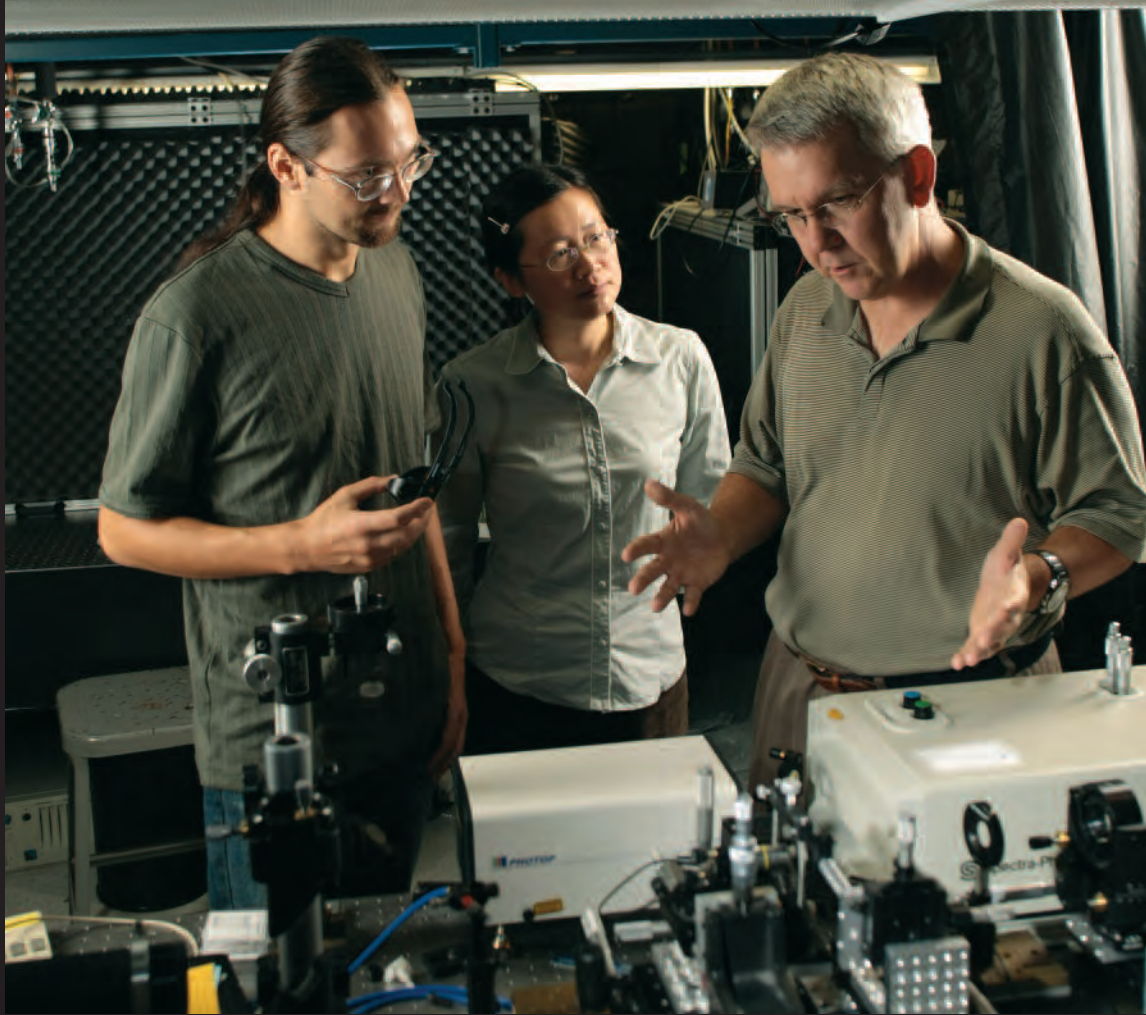
Before taking electrical measurements, graduate student Qin Zhang aligns microprobes to devices.

Maureen Pendergast, left, a student at Marion High School in Mishawaka, Ind.; Alan C. Seabaugh, professor of electrical engineering and director of the Midwest Institute for Nanoelectronics Discovery, center; and graduate student Zoltán Rácz prepare a sample for electron-beam evaporation.



sharing perspectives

NOTES FROM A FACULTY MEMBER



The research initiative in advanced diagnostics and therapeutics discussed here by Professor **Paul W. Bohn** is one of five projects selected by Notre Dame's Strategic Academic Planning Committee (SAPC) to be the beneficiary of internal research funding. Two of the projects selected for the initial round of funding are being led by College of Engineering faculty.

Bohn and his team (22 researchers in the fields of chemical and biomolecular engineering, computer science and engineering, electrical engineering, chemistry and biochemistry, and biological sciences) are designing micro-sensing devices capable of supporting personalized health care and environmental monitoring. Working on the nanoscale, they are spanning biology and chemistry to develop miniaturized monitoring capabilities for environmental and biomedical targets, as well as distributed monitoring capabilities for developing nations.

For information on the other College of Engineering project funded by SAPC this year, *see page 9.*

Advanced Diagnostics & Therapeutics: *Science and Technology in Service to Humanity*

Imagine ... A young girl is found to have a virulent tumor mass in the mastoid process of her jaw. Surgery, risky due to the proximity to the carotid artery and once the only option, is now declined in favor of implanting a small chip, which manages an actively controlled regimen of chemotherapeutic agents directly at the site of the tumor in response to the tumor's immediate metabolic activity.

Imagine ... A relief worker in a Third World country places a small cartridge in the supply-side line of a village's water supply.

Although not trained as a water quality expert, the worker is confident that the integrated diagnostics and reconfigurable molecular coatings of the filter's active pore network will recognize the characteristic contaminants in this particular village's water supply and self-organize into the proper configuration for effective filtering.

Imagine ... An elderly woman living alone and suffering from adult-onset diabetes begins a hypoglycemic episode. Once she would have passed away in isolation, but the *in situ* continuous glucose monitoring biosensor implanted on the distal surface of her left hand creates a signal that raises an alarm and summons an EMT team.

These types of scenarios motivated the formation of an interdisciplinary team of engineers and scientists spanning biological, physical, and computational disciplines to focus on integrated diagnostic and therapeutic platforms capable of supporting the personalized health care and environmental monitoring of the mid-21st century. Critical to these advanced technology platforms, the team features experts in synthetic chemistry, advanced materials, cell biology, genomics and proteomics, nanofabrication and nanoelectronics, fluid mechanics, colloid physics, chemical analysis, and micro- and nanofluidic instrumentation.

Because no single technology is applicable to all critical advanced monitoring problems, the team integrates individual expertise across a spectrum of length scales from the molecular (Å) to the cellular (µm) and engages the four critical elements of advanced technology development: design, fabrication, characterization, and application. These four stages in the life cycle of an idea necessarily involve addressing questions of fundamental and profound scientific importance:

- how do cells integrate multiple chemical and physical cues from their environment to produce changes in signaling and/or phenotype, and
- what is the fundamental nature of fluid flow and colloid-molecular docking dynamics on the nanometer length scale and below?

They also address intriguing technological questions:

- how does one construct low-power portable electronics and power sources so that the biochips of the future can function as stand-alone devices,
- how can one capture and detect a few distinct molecules, and

- what bioinformatics developments are needed to integrate and accurately extract information from complex signals spanning a genomic dataset?

These questions arise naturally in the construction of three-dimensional, multi-level, integrated electronic/fluidic devices incorporating both biological and chemical sensing elements together with the necessary signal acquisition and processing capacity to acquire and report *in situ* diagnostic information from complex sample matrices.

In addition, carefully linked initiatives are creating the architectures and construction/operating protocols enabling the commonplace use of personalized medicine and environmental monitoring, thereby minimizing the infrastructure associated with laboratory-based measurements and making it possible to extract information about complex media directly. Together these efforts constitute a coherent program in which Notre Dame is uniquely poised to leverage its considerable research strengths to address problems that lie at the core of the University's mission.

A 1977 graduate of the University, Paul W. Bohn serves as the Arthur J. Schmitt Professor of Chemical and Biomolecular Engineering and concurrent professor of chemistry and biochemistry.



STUDENT ACHIEVEMENTS AND EVENTS

The Winner Is ...

RFware won the eighth Annual McCloskey Business Plan Competition earlier this year. Sponsored by the Gigot Center for Entrepreneurial Studies in the Mendoza College of Business, the competition is open to traditional entrepreneurial ventures that have not yet been launched or are at the earliest stages of being launched.

The team, led by electrical engineering graduate student **Brian Dunn** and Associate Professor **J. Nicholas Laneman**, applied the most basic elements of a wireless interface to develop a solution for a real-world problem: Police officers and other first responders, whose ability to communicate could mean the difference between life and death, cannot always do so without prior planning and setup of their radios. Even radios that conform to national standards for interoperability don't always talk with each other consistently. RFware's software radio technology enables wireless devices to adapt and communicate using almost any wireless protocol simply by running a different program.



A highly reconfigurable wireless system that can communicate using almost any protocol, RFware was designed to help first responders in emergency situations communicate more effectively via reliable wireless interfaces.

RFware's Software Radio technology will immediately benefit police, fire, and other emergency management departments across the country that have struggled for decades with incompatible communication devices.

RFware is also one of the first Notre Dame-based ventures planning to inhabit the new Innovation Park@Notre Dame (see page 10), a business incubator.

For more information about RFware, visit www.rfware.com.

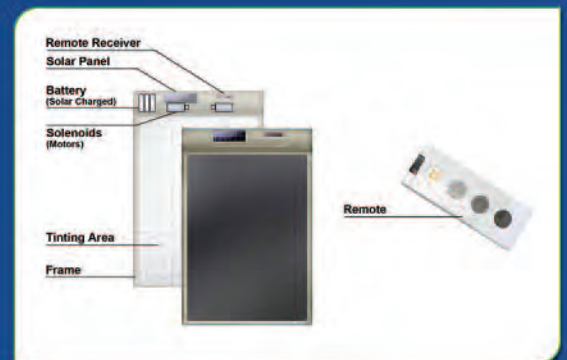


Larry Adbo, far left, a judge in the Annual McCloskey Business Plan Competition at Notre Dame and member of the IrishAngels network, poses along with the 2008 winners — RFware team members, left to right, Christopher Dunn, Brian Dunn, and J. Nicholas Laneman, associate professor of electrical engineering. The team's winnings will serve as the first round of seed money as the start-up company takes shape.

From top honors in the 2007 McCloskey Business Plan Competition at Notre Dame ... to a grand prize showing at the Indiana Collegiate Idol Competition ... to receiving a \$14,700 development grant from the National Collegiate Inventors and Innovators Alliance, the team that created the SmarterShade proved that the simplest ideas can often be the best.

SmarterShade — developed by **Will McLeod**, a fifth-year senior pursuing dual degrees in mechanical engineering and industrial design; **Ryan Tatzel**, a senior studying chemical engineering; and **Michael Stacey**, who received his MBA from Notre Dame in 2007 — currently encompasses four prototype products for homeowners and recreational vehicle manufacturers that transform ordinary windows and skylights into solar-powered, energy-efficient, controllable lighting.

The aftermarket product they have developed is similar to a storm window in that it will fit into an existing window frame. Because it is made of a semi-rigid sheet of scratch-resistant plastic, it is lightweight and easy to install. The SmarterShade also features touch-button control, so the user can select how much light (via transitioning tint levels) is allowed into a room; a SmarterShade window can instantly go from nearly clear to dark.



SmarterShade also costs significantly less to manufacture than other “smart window” technologies. With a patent pending on the SmarterShade, Lono LLC (the company created by McLeod, Tatzel, and Stacey) is focusing efforts on household skylights and windows. Perhaps the best part: SmarterShade requires no electricity. Lono hopes to be able to introduce SmarterShade to the market in less than 18 months.

To learn more about the SmarterShade, visit smartershade.com/index.html.

Made in for the Shade

Colón Receives Fulbright Award

Yamil Colón, a chemical engineering student from Bayamón, Puerto Rico, has been awarded a scholarship for graduate study from the Fulbright Program. Created by Congress in 1946, the Fulbright Program is the U.S. government's premier scholarship program, designed to foster mutual understanding among nations through educational and cultural exchanges.

Colón will be working as part of the Separation Processes and Phase Equilibria group at the University of Santiago de Compostela in Spain. The group, led by Professor **Alberto Arce** and Associate Professor **Ana Soto**, is interna-

nationally recognized for its work with vapor-liquid equilibria (VLE) and ionic liquid (IL) research. He will be studying VLE phases and measuring physical properties of ILs deemed pertinent for industrial applications, including the removal of metal and other contaminants from water, carbon dioxide capture, and the removal of sulfur compounds from diesel fuel.

At the forefront of green technologies, ILs represent more efficient and environmentally friendly media than current technologies — specifically volatile organic compounds (VOCs), which are linked to air pollution and global warming. ILs have the advantage of being non-volatile, meaning that by replacing VOCs with ILs there would be no pollutant emissions and the impact on global warming would be greatly reduced. ILs also represent a more efficient way to perform separations. By using more efficient technologies, the energy required to run the processes would be reduced.

Colón's proposal adviser was **Joan F. Brennecke**, the Keating-Crawford Professor of Chemical and Biomolecular Engineering and Director of the Notre Dame Energy Center. He also worked with Professor **Jeffrey C. Kantor**, his departmental academic adviser, and **Paul W. Bohn**, the Arthur J. Schmitt Professor of Chemical and Biomolecular Engineering (as part of a nano-bio research experience for undergraduates).



Undergraduates Receive NSF Graduate Fellowships

Three University of Notre Dame seniors have been awarded 2009 National Science Foundation (NSF) graduate fellowships: **Christopher Fallin**, **Rachel Paietta**, and **Claire VerHulst**. The NSF Graduate Fellowship

Program supports outstanding graduate students in engineering, mathematics, science, and technology, who are pursuing research based master's and doctoral degrees.

Interested in multicore systems and the interaction between hardware and software, Fallin's NSF proposal outlined a vertical approach — from compilers and systems software down to microarchitecture — to address the reliability and performance problems that will most likely attack future parallel and multicore systems. This fall he will be studying electrical and computer engineering and will be part of the Computer Architecture Lab at Carnegie Mellon University. Fallin is a computer engineering major from Beaverton, Ore. His project adviser was **Patrick Flynn**, professor of computer science and engineering.

A native of Dayton, Ohio, Paietta is pursuing her doctorate in mechanical engineering. She will be studying the biomechanics and structure of the interface between bone and intervertebral discs in the spine at the University of Colorado at Boulder. Her research adviser was **Glen Niebur**, associate professor of aerospace and mechanical engineering.

Verhulst is headed for The Johns Hopkins University where she will pursue a doctorate in mechanical engineering, most likely focusing on turbulence modeling. She has been working in University's new Transonic Axial Turbine Facility with **Scott Morris**, associate professor of aerospace and mechanical engineering, and completed an internship with GE Aviation this past summer. Her research proposal for the NSF fellowship discussed pros and cons of a return to old propeller-driven designs as a way to counter rising fuel costs. Engines with propellers provide better fuel economy but are much louder, which is why a significant effort has been mounted over the last decade to reduce propeller noise. Verhulst is from Brighton, Mich.

Shake Down the Lightning

After taking the “Electric Hybrid Vehicles” course **Brian Bak, Vincent Cano, Stephen Govea, and John Sember** began talking about their senior design project. By the first semester of the senior design course, they had added team member **John Mrugala** and decided they (the Lightning Riders) would build a series hybrid motorcycle to fulfill the project requirements.

According to team members, the ideal vehicle to replace conventional fossil fuel powered automobiles would be a purely electric car. However, energy storage technology (batteries and similar devices) cannot yet support the transition from internal combustion to electric power. Until these technologies improve, a hybrid vehicle is the best bridge between conventional and electric vehicles. Budgetary and timetable constraints ruled out developing a full-size car, but a series hybrid motorcycle seemed achievable because of the availability of a rolling chassis. The only member of the team with machining experience, Sember pushed hard for a ready chassis because he knew that welding and other modifications would be costly and time consuming.

The key deliverables of the vehicle were that it be street-legal — capable of traveling at least 10 miles in a pure electric mode and 50 miles in hybrid mode — and able to sustain a top speed of 50 mph. The Lightning Riders also wanted to be sure that the operator could start and stop the vehicle, as well as use the throttle and brakes, in the same manner as on a conventional motorcycle and that the user interface would display speed, acceleration, battery charge, fossil fuel level, efficiency calculations, and real-time power flow information. Their hybrid needed to contain a data-logging feature to record critical variables for future analysis.

Safety was also a huge concern for the team. A 72-volt battery system capable of delivering over 300 amps is nothing to be taken lightly. While other senior design groups were busy testing their finished projects with voltmeters and oscilloscopes, the Lightning Riders’ list of test equipment included gloves (to protect the wearer from 500 volts) and a motorcycle helmet. Due to time constraints, the hybrid generator component was never fully realized, but the team was able to demonstrate its usability with the parked vehicle.

Although the project budget was insufficient to cover their plans, the team secured additional funding via sponsorships from the Notre Dame Energy Center, Northern Electric, and Medical Electronic Devices & Instrumentation. The base motorcycle, a 1983 Yamaha Seca, was also donated.

The Lightning Riders’ vehicle cost approximately \$4,000 and took a semester to build. A series hybrid vehicle, like the Lightning Riders’ motorcycle, the Chevrolet Volt is scheduled to hit dealerships in late 2010. It is expected to cost between \$35,000 and \$40,000.



A Harmonious Outcome

Nicholas Shaneyfelt, Audrey Marier, and Monica Regnier, a.k.a. the Nora Trio, made history in May when they became the first Notre Dame-based ensemble to win a place in the senior strings division quarterfinals of the 2008 Fischoff National Chamber Music Association Competition.

According to Shaneyfelt, a senior in the Department of Computer Science and Engineering, the trio’s time in the competition was an enlightening experience. In addition to competing with students from some of the best conservatories in the nation (The Julliard School, San Francisco Conservatory of Music, and the Eastman School of Music) on the stage of Notre Dame’s DeBartolo Performing Arts Center, each of the trio’s members was pursuing a double major at the University ... a fact that impressed the judges.

During the quarterfinals, they played for approximately 20 minutes from their 65-minute repertoire, performing a Haydn piece, a piece by Bedrich Smetana, and, finally, a piece by British composer Frank Bridge. “We didn’t make it to the next round, but the experience we gained left a positive mark on us,” says Shaneyfelt. He believes that his two degrees, in particular, play off one another quite well. “Music informs my creative side when I hit a roadblock and code refuses to compile, while engineering brings out a more methodical, left-brained approach to my practicing that can do wonders for a tough musical passage.”



The Nora Trio from Notre Dame — Nicholas Shaneyfelt (piano), a senior pursuing double majors in computer science and piano performance, Audrey Marier (violin), and Monica Regnier (cello) were the first Notre Dame-based ensemble to become senior strings quarterfinalists in the 35-year history of the Fischoff National Chamber Music Association.

Scholarship Kudos

Tessa Riester, a junior in the Department of Civil Engineering and Geological Sciences, was named one of the three recipients of a Verlon W. Braselton Memorial Foundation Scholarship for the 2008-09 academic year. Awarded annually, the foundation seeks to support engineering education, focusing on “ambitious, hard-working, dependable students with far-reaching goals in the industry.” Students selected are well-rounded individuals who, in addition to being excellent scholars, are active in a variety of outside interests.

Tools of the Trade



From left to right, Caitlin Kopf, Joshua Bartrom, Laura Peveler, Matthew Prygoski, and Claire VerHulst used Pro/Engineer to design a hip implant for minimally invasive surgery, as well as to create the fixtures with which to make the implant's mold. Kopf, Peveler, and Prygoski graduated in May 2008.

Spring semester 2008 **Joshua Bartrom, Caitlin Kopf, Laura Peveler, Matthew Prygoski, and Claire VerHulst** teamed up to create a design and the mold for a new hip implant for minimally invasive surgery. In conjunction with a CAD/CAM course, their work was actually part of proprietary research that is being conducted by faculty in the Department of Aerospace and Mechanical Engineering in collaboration with Zimmer, Inc., Inc., a world leader in the design, manufac-

ture, and distribution of orthopedic implants and fracture management products.

The students used Pro/Engineer (Pro/E) from Parametric Technologies to help in the design process. Some of them had been using Pro/E since their sophomore year. But most of the exposure to Pro/E in the College of Engineering typically occurs in the junior year during the CAD/CAM course, where students learn to sketch and extrude features, creating detailed drawings and assemblies. They are then intro-

duced to mechanism design and the behavioral modeling tools for simulation and optimization. Finally, they learn how to machine parts.

Throughout the semester the students learned to appreciate how useful design tools, like Pro/E, can be. "We wanted to work with polymers because they are more biocompatible than some of the more traditional implant materials," says Bartrom. "Pro/E made the design process — and changes along the way — very easy." The students were able to create the parts needed through rapid tooling and stereolithography. They even made the fixtures, which they used to test the implant, simulating the same angles and loads as the femoral shaft in the human body.

They also came to appreciate the societal impact their work as engineers can have: According to the American Academy of Orthopaedic Surgeons, by 2050 there will be an estimated 650,000 hip fractures annually. Currently, there are more than 352,000 hip fractures in the U.S. each year. Minimally invasive surgery with biocompatible implants lessens complications from surgery and promotes quicker recovery times for patients, most of whom are over 65.

Meet the Slatt Fellows: Past and Present

The 2008 Vincent P. Slatt Fellowships in Energy were **Michael Call**, aerospace and mechanical engineering; **Yamil Colón**, chemical and biomolecular engineering; **Christopher Esber**, biological sciences; and **Caitlin Lambert**, chemical and biomolecular engineering.

In his project "A Study of Aerodynamic Devices for Load Control," Call examined aerodynamic control devices such as micro tabs, shape memory materials, and other devices for blade load control — specifically for the blades on a wind turbine — in order to assess the advantages and disadvantages of each in relation to optimum performance and energy capture. His adviser was **Robert C. Nelson**, professor of aerospace and mechanical engineering.

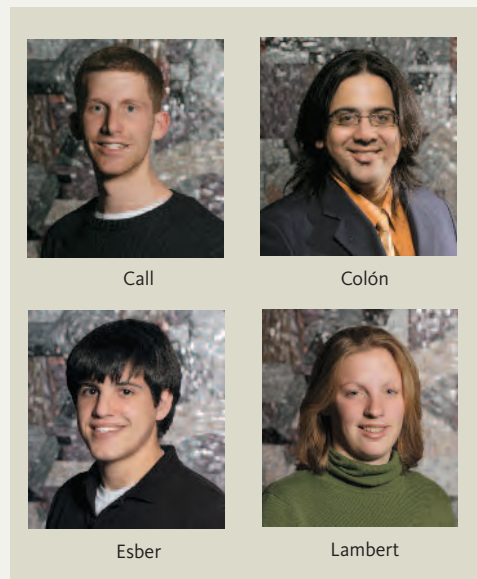
Joan F. Brennecke, the Keating-Crawford Professor of Chemical and Biomolecular Engineering and director of the Notre Dame Energy Center, was Colón's adviser. He spent the past year evaluating the potential use of specific ionic liquids based on the thermophysical properties of each in different compositions of ethanol. His project was titled "Heat Capacities and Densities of Ionic Liquids and Ethanol Mixtures as a Function of Temperature."

Esber, whose project was titled "Evaluating the Role of Evolutionary Change in Wetland

Carbon Budgets," studied the changing abilities of an ecologically important C_3 coastal sedge to store carbon over a century of rising carbon dioxide levels, sea levels, and temperature fluctuations in order to show that adaptation can develop more efficient plants and more below-ground carbon storage. His adviser was **Jason McLachlan**, assistant professor of biological sciences.

Lambert spent her fellowship experience collecting isothermal vapor-liquid equilibria data for a variety of ionic liquid and water mixtures, which she used to estimate binary model parameters for miscible binaries and predict ternary and higher order system fluid phase equilibria behavior. Her project was titled "Vapor-Liquid Equilibria of Ionic Liquid and Water Mixtures." Brennecke was also her adviser.

Although they have not yet begun their work, the 2009 Slatt Fellows (the largest group yet) have been selected. They are: **Scott Deakins**, a junior in the Department of Aerospace and Mechanical Engineering; **Kyle Higdon**, a sophomore in aerospace and mechanical engineering; **Meehan Lenzen**, a sophomore studying civil engineering and geological sciences; sophomore **Thomas Noel** in the Department of Chemical and Biomolecular Engineering; **Kelsey Poinsette-Jones**, a sophomore studying environmental science; and



sophomore **Kathleen Stanley**, who is studying chemical and biomolecular engineering.

Now in its fourth year, the Slatt Fellowship program recognizes and supports the energy-related research activities of undergraduates, from the use of fossil fuels and nuclear and renewable energy sources to the development of biofuels and more efficient transportation and energy utilization systems. The fellowship was created by **Christopher** (B.S., EE '80) and **Jeanine Slatt** in honor of **Vincent P. Slatt** (B.S., EE '43).

Lighting the Lamp

On the ice that means scoring a goal. In the classroom, it has an entirely different meaning ... one that **Jason Nightingale** (M.S., ME '07) discovered as he was working on a joint doctorate at the University in mechanical engineering and mathematics, coaching a local high school hockey team, and becoming a new dad.

What Nightingale found as he coached the boys' hockey team at Marian High School in nearby Mishawaka, Ind., is that he enjoyed working with this age group. He could see the impact coaches, and teachers, had on these students, and he wanted to be part of preparing the next generation of innovators. So instead of heading to industry or a research laboratory, Nightingale accepted a position at the Culver Academies in Culver, Ind., where he teaches physics and serves as an assistant coach for one of the school's hockey teams. He has continued his work on his doctorate at the University and expects to complete his program during the 2008-09 academic year.

His wife **Alice**, who received her master's in aerospace engineering from the University in 2007, is also completing her doctoral work at Notre Dame. She teaches Algebra II and serves as an assistant girls' basketball coach at the Academies.

The Culver Academies — Culver Military Academy and Culver Girls Academy — are college preparatory boarding schools for students in grades 9 through 12. The student body is comprised of approximately 800 students from 41 states and 22 countries.



In his spare time as a doctoral candidate, Coach Jason Nightingale inspired the Marian High School hockey team, shown above. He now serves as physics instructor and assistant coach for the U-16 boys' hockey team at the Culver Academies in Culver, Ind.



EmNet sensors mounted on manhole covers are smaller than other sensor devices and much more portable. In 2008 the Granger, Ind.-based EmNet installed CSOnet — 110 wireless sensors in 40 square miles of sewer — in the South Bend, Ind., area. The company will install ten smart valve controls in summer 2009 to further reduce overflows and flooding and maximize storage in existing basins. The city is investing \$4 million in CSOnet, a considerable savings compared to the \$400 million the city projected it would need to spend on sewer overflow abatement programs to meet standards mandated by the Environmental Protection Agency before this technology was available.

Follow the River

Following the river sounds like a great adventure, until one realizes that U.S. rivers and streams are also the destination of 850 billion gallons of raw sewage. Most of this annual overflow is caused by combined sewer systems (CSS), which are prone to flooding. CSSs can be found in more than 700 cities across the country, affecting millions of residents.

About four years ago, led by faculty in the departments of electrical engineering and civil engineering and geological sciences, engineers from Notre Dame, Purdue University, the city of South Bend, and a start-up company named EmNet, LLC., collaborated to create a wireless sensor actuator network that could address municipal sewer overflow issues. Their initial work was part of a grant from the Indiana 21st Century Research and Technology Fund. Tests were first conducted in St. Mary's Lake on campus, and a pilot program was initiated in a nearby retention basin. Both were successful. In fact, the pilot deployment prevented an estimated six million gallons of sewage from entering the St. Joseph River, which runs through South Bend and neighboring Mishawaka.

Citywide installation of the system, called CSOnet, was completed in February 2008. It features 110 wireless sensors, which connect to an EmNet server. The system monitors and manages overflow. In addition, the information, which is collected in real-time, allows work crews to better understand the system. A second phase to the project is slated for completion in summer 2009.

According to **Luis Montestruque** (Ph.D., EE '04), EmNet's chief executive officer, South Bend's system is "arguably the largest permanently installed urban-scale wireless sensor network and one of the first cyber-physical systems in the world."

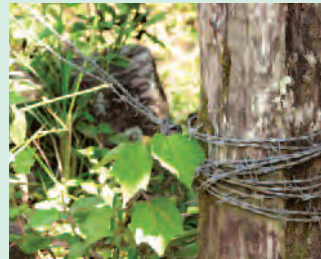


The Bridge to Somewhere

The message of change, hope, and building bridges does not belong solely to political campaigns. Six students in the Department of Civil Engineering and Geological Sciences seeking to make a difference in the world combined their academic interests with their desire to serve their fellow man. They formed Notre Dame Students Empowering through Engineering Development (ND SEED), a registered and approved 501(c)3 corporation. They solicited sponsors, and teamed with Bridges to Prosperity (B2P), a not-for-profit organization that fuels positive change by helping impoverished rural communities around the world construct reliable footbridges, which provide access to schools, clinics, jobs, and markets.

After identifying a Honduran community that needed help, the team began additional fund raising and explored design options used in other B2P-related projects.

In October 2008, they visited the village of Pena Blanca, about 120 miles northwest of Tegucigalpa, the capital. As they familiarized themselves with the geology, topography, and hydraulics of the site, they were also projecting traffic volumes and bridge loads (key design elements). In addition, they checked out the local availability of labor and materials. Pena Blanca was chosen because the current bridge is very old and, as the students put it, very scary. The current supporting cable, which is tied to a tree on one bank, is barbed wire. One bank is also much steeper than the other. This means that the team will need to build more massive piers than originally thought to ensure structural integrity and safety. The current bridge does not have any piers.



The team — juniors **Rafael Deheza** and **Patrick McHugh** and seniors **Anna Lacey**, **Sean McNichols**, **Katie Sushinsky**, and **Jessica Winschel** — is in the process of designing the bridge. Their work is being supervised by Associate Professor **David J. Kirkner**, and their final design will be submitted to both B2P and the Honduran government for approval before construction begins in May 2009.

Pena Blanca residents who assist in the construction phase will continue their training in footbridge technology with local organizations, so that they may construct bridges for other nearby communities long after ND SEED has completed this specific project.

ND SEED is grateful to the support they have received from their sponsors — corporate sponsors: B2P, the College of Engineering, the Department of Civil Engineering and Geological Sciences, Clark Construction, Froehling & Robertson, Inc., Lawson-Fisher Associates P.C. Engineers, McCormick

Engineering, LLC, and Keast & Hood Co., as well as individual sponsors: **Dennis Murphy**, **Joseph Hauser, J. Graham Knox, Dr. and Mrs. Charles Griffen**, **Vincent N. Greggo**, and **James and Susan DeQuattro**. They also received a supportive intramural grant from the Helen

Kellogg Institute for International Studies.

For more information about ND SEED, visit www.nd.edu/~ndseed.

Putting Waste Heat to Work



Paul R. Brenner inspects a University of Notre Dame server that is located in the Arizona Desert Dome of a local greenhouse. Placing the server in the greenhouse saves utility costs for the University and reduces the cost of heating the greenhouse during winter months, a large savings to the city of South Bend, Ind.

Paul R. Brenner, high-performance computing engineer in the Center for Research Computing at Notre Dame, is used to desert heat. Not because he recently returned from serving in Afghanistan as part of an Air Force Reserve deployment, but because he was instrumental in installing a computer server in the Arizona Desert Dome at the Potawatomi Park greenhouse in South Bend, Ind. The server generates waste heat, which will offset the cost of heating the greenhouse during winter months.

His work, featured in an article in the May 8 issue of the *Chronicle of Higher Education*, will save the University and the city of South Bend a substantial amount of money, approximately \$100,000 in utility costs for the University and a comparable amount that the city had spent to heat the space during previous winters.

A Double Domer, Brenner received his bachelor's degree in civil engineering from Notre Dame in 1998 and his doctorate in computer science and engineering in 2007.



staying in touch

ALUMNI HIGHLIGHTS



Brisken



Budden



Comerford



Fitzpatrick



Harvey



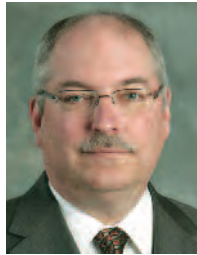
Hasbrook



Hawes



Keating



Piotrowski



van Nispen



Voglewede



Zapata-Kalainoff

Yasser ABOU-AISH (M.S., CE '82) was named director of public utilities for the City of West Palm Beach, Fla., on Feb. 14, 2008. Prior to his appointment by the city, he served as senior program director of Earth Tech, Inc., and was also employed by the Minneapolis Water Works as water superintendent.

Patrick J. BARRY (B.S., ME '84) has been named the director of the Gigot Center for Entrepreneurial Studies at Notre Dame. Prior to his appointment, Barry served as an adjunct professor in the Mendoza College of Business and advised a number of start-up ventures as principal and founder of Arete Advisors, a management consulting firm.

On January 11, 2009, the Notre Dame Club of Greater Cincinnati presented **Thomas A. BRISKEN (B.S., AME '71)** with the 2009 Exemplar Award in recognition for outstanding professional leadership and generous sharing of his time, talent, and resources for the betterment of the Cincinnati community. Brisken is the GENx general manager at GE Aviation.

Lt. Col. Brad BROEMMEL (B.S., AERO '85) retired from the United States Air Force following a distinguished career. Most recently, he served as director of the Command and Control Division Space Systems Program.

Effective July 1, 2008, **Tim BUDDEN (B.S., EE '88)** was named president of Esterline AVISTA.

He joined the company in 1990 and has been working very closely with the company's software clients during the last four years in his previous role as vice president of engineering.

Huadong (Sam) CHEN (M.S., ME '07; Ph.D., AME '08) and **Biao ZHANG (M.S., ME '07; Ph.D., AME '08)** joined BMH Robotics in St. Louis, Mo., in March 2008. As robotics and vision system engineers, they are responsible for research and development projects, as well as developing prototypes, products, and technologies for market.

Mark M. COMERFORD (B.S., MET '84) has been appointed president of Alloy Products at Brush Wellman Inc. In this new role, Comerford has responsibility for Alloy Products' manufacturing, technology, supply chain, and commercial activities. He joined the company in 1998 and has served as vice president of sales (Strip Products) and president of Brush International.

Brian T. FITZPATRICK (B.S., CBE '97) was appointed assistant professor of law at Vanderbilt University Law School. Fitzpatrick's expertise is in civil litigation and federal courts.

In March 2008 **Francis HARVEY (B.S., MET '65)** was appointed to the advisory board of VIASPACE, Inc. Headquartered in Pasadena, Calif., the company is dedicated to commercializing technologies from NASA and the U.S.

Department of Defense. Prior to his appointment, Harvey had served as the 19th Secretary of the Army (Nov. 2004 through March 2007), where he was responsible for the annual budget, as well as a workforce of more than one million active duty Army National Guard, Army Reserve soldiers, civilian employees, and contracted service personnel. He spent the majority of his career with the Westinghouse Electric Corporation, where he held several senior leadership positions. Harvey currently serves on the board of six other companies.

A flight director since 2000, **Annette HASBROOK (B.S., ME '85)** served as the lead flight director at Mission Control in Houston during the shuttle Discovery's 14-day mission to the International Space Station, which began May 31, 2008. The mission was the second of three flights to launch components of the Japan Aerospace Exploration Agency's Kibo Laboratory.

In addition to being designated by President George W. Bush as a 2008 Meritorious Rank Award winner (for senior executive service) **W. Michael HAWES (B.S., AERO '78)** was named associate administrator for Program Analysis and Evaluation at NASA. In this new position he is responsible for providing objective studies and analyses in support of policy, program, and budget decisions for the NASA administrator. He most recently served as the deputy associate administrator for Program Integration in the Office of Space Operations.

Roger KEATING (B.S., ME '83) has been appointed as senior vice president, digital media, of Hearst-Argyle Television, Inc. He most recently served as a member of Time Warner Cable's strategy-setting operating committee and corporate executive vice president (Los Angeles Region).

William L. OBERKAMPF (B.S., AERO '66; Ph.D. AERO '70) received the College of Engineering Alumni Honor Award in May 2008, in recognition of his achievements as a pioneer in computational simulation verification and validation, V&V. Oberkampff is a distinguished member of the technical staff in the Validation and Uncertainty Estimation Department of Sandia National Laboratories.

UOP L.L.C., appointed **Peter PIOTROWSKI (B.S., CBE '74)** senior vice president of its Process Technology & Equipment business unit in March 2008. Previously, he had served as the general manager for the UOP Process Technology & Equipment for Europe, the Middle East, and Africa, where he maintained oversight for licensing, service, and support activities. He also oversaw the opening of the company's Dubai office. A member of the UOP family since 1974, he will be based at corporate headquarters in Des Plaines, Ill.

Although **Todd PTACEK (B.S., ME '07)** narrowly missed qualifying for the 2008 Olympic Trials, he's already looking down the road ... toward the 2012 Summer Games. He was listed as one of eight provisional runners who could have been included if the 2008 final for the 3,000-meter steeplechase had been expanded beyond 24 runners. Ptacek is an engineer for General Electric Transportation in Erie, Pa. (Editor's note: There were eight athletes with Notre Dame ties who participated in the 2008 Summer Olympic Games.)

James P. SCHMIEDELER (B.S., ME '96) received the Presidential Early Career Award for Scientists and Engineers (PECASE). Of the 58 recipients honored during a ceremony at the White House on Nov. 2007, he and 19 others had previously been honored with a National Science Foundation Faculty Early Career Development Award (CAREER). Most recently an assistant professor of mechanical engineering at The Ohio State University, he joined the Notre Dame faculty in August 2008.

Mary L. SPECKHART (B.S., EE '82), CEO of Sophisticated Closets, L.L.C., has designed Rollovalet™, a motorized shelving system that

provides easy access to previously inaccessible storage space. Released in April 2008, the system is available exclusively to builders, remodelers, and architects.

In June 2008, **Hugo van NISPEN (B.S., CBE '83)** president and managing director of KEMA's U.S.-based consulting operations, was named one of Consulting Magazine's Top 25 Consultants for 2008. Van Nispen joined the company in 2003 to launch a new management consulting practice, which now accounts for approximately 30 percent of the company's overall revenue. Prior to joining KEMA, van Nispen was an associate partner with Accenture.

In January 2008, **Philip A. VOGLEWEDE (B.S., ME '94)** accepted a position as assistant professor in the Department of Mechanical Engineering at Marquette University. Previously, he had served as assistant professor at the University of South Carolina, research assistant at Georgia Institute of Technology, and resident engineer in the Findlay, Ohio, division of Whirlpool Corporation.

National Semiconductor Corp. appointed **Jeff WATERS (B.S., EE '87)** regional vice president of the company's Japan Division in February 2008. Based in Tokyo, he oversees sales and marketing efforts in Japan. Prior to this appointment, he was responsible for leading National's efforts in corporate marketing communications and new product definition and launch.

Maj. Melinda ZAPATA-KALAINOFF (B.S., CBE '94), most recently an assistant professor at the U.S. Military Academy, where she taught general chemistry and chemical engineering, is now a research analyst serving with the U.S. Army Operational Test Command at Fort Hood. Her duties include testing new vehicles and equipment as part of the military acquisition process. Recognized for her research in education via a 2007 Hispanic Engineer National Achievement Awards Corporation Luminary Award, she also received an Army commendation medal from the Academy in 2008 for developing and executing a study of cadet understanding of chemical equilibrium using principles of mass and charge conservation. Zapata-Kalainoff will join the active duty permanent faculty at West Point as an Academy professor in 2013 upon completion of her doctorate.



Giving Back

Katie Andersen (B.S., ME '01), a subsection manager of turbine airfoil analysis at GE's Airfoils Center of Excellence, was one of two women from GE Aviation chosen for the GE Women's Network (GEWN) award, which recognizes women who not only succeed in a demanding technology career but also exemplify outstanding leadership on the job and in recruitment and developing women in technology roles. "I've had the benefit of excellent mentors throughout my career, ... and I am privileged to be able to give back to students who are just learning what opportunities are available for them," she says.

For the last seven years Andersen has participated in GEWN and the Women in Technology (WIT) Group. Through her involvement in WIT, she has coordinated GE Aviation's presence at several regional Society of Women Engineers' (SWE) conferences and provided speakers for collegiate SWE chapters. She's also been involved in organizing mentoring lunches to connect women in engineering co-ops and interns with more experienced engineers for career guidance.

A graduate of the company's Edison Engineering Development Program, Andersen has spent the last four years of her career in turbine airfoil analysis and design. The group she now leads is responsible for cooling design, stress and life predictions, and aeromechanics assessment of turbine hardware on all of GE's military and commercial engine applications.

To submit information for Alumni Highlights, offer story ideas, or comment on *The Notre Dame Engineer*, contact the editor at: nwelding@nd.edu.

The Road to Tanzania

Mt. Kilimanjaro is the backdrop for the real-life tale of a major AIDS epidemic; a growing number of orphans; a popular tourist destination; and a Notre Dame alum who, looking at all of these elements, developed a business plan and created a 501(c)3 charitable organization (humanitarian, not religious, in nature) to build a financially self-sustaining educational center that could feed and educate the orphans.

The journey began in 2006 when **Stan Taylor** (B.S., EE '85) spent part of the summer in Africa. "The family and I spent a couple of weeks doing the 'safari tourist thing,' which was pretty amazing," he says. "Then I joined a group of 20 other volunteers from Libertyville, Ill., and spent a week with Father Augustine Kawishe, a local Catholic priest, and orphans from the village of Mailisita, Tanzania (just outside the town of Moshi), trying to identify if there were meaningful ways we could help."

Indeed, there were.

The team, which included a pediatrician, an attorney, a nurse, and a construction specialist, determined that the orphans were healthy enough to be educated, the area was politically and economically stable enough to support development, and the tourism trade brought enough money into the area to sustain a school/guesthouse combination.

Fr. Kawishe, parish workers, and many local residents had been working for some time to feed and educate the orphans who had been fortunate enough to be taken in by extended family. Most of those families would not have been able to provide the children with a home were it not for Fr. Kawishe's assistance. The two-room school he oversees serves 80 kindergarten and pre-kindergarten children between the ages of five and seven. This age group is particularly important because, in Moshi and Mailisita, an early education (including learning to speak English) is vital to getting into the overcrowded primary school system and very competitive secondary schools. In the past, only those who have attended the best English-medium primary schools have been able to progress, and only a small number of those. In the ten years that Fr. Kawishe been operating his school, not one of his students has gained entry into a secondary school, which underscores the need to teach children English as early as possible. It not only gives them an advantage as they compete for coveted spots in a very few secondary schools but also in the local job market as they grow older.

The idea of building a joint school/guesthouse came because there are no major hotel chains operating in the area. Accommodations for safari and Kilimanjaro climbing expeditions are usually provided in the form of private bed and breakfast facilities featuring 10 to 20 rooms. Following the foundation's plan, a 14-room facility could generate enough income to support 300 primary school students on an ongoing basis.

Approximately one-third of the monies have been raised, with the remainder planned from future private donations. Because of the dedication of local and international volunteers, the school is about 45 percent complete, and the guesthouse about 10 percent complete, with final construction expected to be completed by 2011. Costs are in line, and even slightly better than originally anticipated, and the first class of first graders will begin their journey in January 2010.

*Editor's note: If Stan Taylor's name sounds familiar, it may be because of his many Notre Dame ties. He is the son of **James I. Taylor**, professor emeritus of civil engineering and geological sciences and associate dean emeritus of the College of Engineering. The younger Taylor's wife, **Susanne (Noonan) Taylor**, graduated from Saint Mary's College in 1986 and received an MBA from Notre Dame in 1989.*



In July 2007, a group of Libertyville, Ill., residents, led by Stan Taylor (far right), and local citizens created a busy worksite ... digging the foundations for the Mailisita school/guesthouse and laying approximately 30 tons of concrete blocks. By the time they left, five classrooms were ready for roofing.

In July 2008, Taylor led a fourth group to the region. They continued construction on the guesthouse and finished the first two classrooms. Another group travelled to Mailisita in July 2009. For more information and project updates, visit www.mailisita.org.



Not all participants in this endeavor have had the privilege of travelling to Mailisita or laying a concrete block. The foundation was created in 2007 specifically for those who could not participate in this way or were restricted from giving to faith-based organizations. All contributions to this humanitarian organization are tax-deductible and, as Taylor points out, "All donations (100 percent) have gone, and will continue to go directly to the purchase of building materials and labor for the construction of the Mailisita Education Center." Administrative and other costs have been generously provided by separate designated donations.

To Boldly Go



Matt Robinson (B.S., '96 ME; Ph.D., '01 AME) has worked at NASA's Jet Propulsion Laboratory since 2001.

In August 2007, NASA's Phoenix Mars Lander left Cape Canaveral in a billow of white smoke. In May 2008, it landed on Mars in a cloud of red dust. By June, the Phoenix deployed its robotic arm (the one **Matt Robinson** spent the last five years developing, designing, and testing) to gather soil samples. And, in July, the instruments aboard the spacecraft confirmed water in the samples. The Phoenix was one step closer to achieving the goals of its creators.

A senior member of the engineering staff in the Mobility and Robotic Systems section of the Jet Propulsion Laboratory, Robinson spent his first two years in the lab researching and developing vision-based control algorithms for robotic manipulators on mobile platforms (unmanned space vehicles). Most recently, from 2003 to 2007, he has served as the robotic arm flight software lead responsible for the development, integration, and testing of the lander's robotic arm flight software. He developed ground software for simulating the arm's activities and processing the data it retrieved. And, he designed and performed tests on the arm to analyze its capabilities

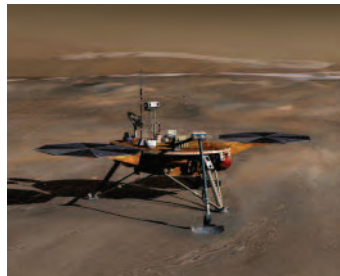
and improve sample acquisition and handling techniques.

But the job didn't end with a successful launch and landing. Since touchdown, Robinson has been serving as a member of the Phoenix operations team. His duties include planning and sequencing the robotic arm's activities, as well as processing and analyzing the data. "It has been an adventure," he says. "It took five years to go from project initiation to landing ... but it was worth it [visiting the Martian pole for the first time]."

According to Robinson, the experience exceeded his expectations, which he attributes to the quality of the individuals on the team. "It has been an honor to work with many of the top engineers and scientists in the field of unmanned space exploration," he says, "certainly a humbling experience ... because of their dedication and expertise and because of the scope of the project."

Robinson believes the need to explore is an innate human characteristic and that Mars is the ideal target for expeditions beyond Earth. "It's our nearest neighbor, and from a geological perspective, the planet in our solar system that's most similar to the Earth," he says.

Although it will be years before NASA can send people to Mars, there is much that Robinson and the Phoenix Mars team members can accomplish with similar unmanned missions. In the final weeks of the mission, Phoenix team members attempted to acquire ice samples and process them using the instruments on board the spacecraft, thus providing scientific data on the habitability of Mars — past, present, and future. They hoped to uncover clues about whether life ever existed on Mars, characterize its climate and geology, and determine if it might be habitable.



Originally scheduled to end in late August, the Phoenix Mars mission was extended through September 30. NASA reported that the projections for solar power continued to look good, so it intended to take full advantage of the opportunity. The agency last heard from the Phoenix on Nov. 2, 2008. Its batteries were not expected to last through the Martian winter, when the Phoenix would be encased with carbon dioxide ice.

Photos courtesy of NASA's Jet Propulsion Laboratory.



A World without Cable?

Frank Capra's *It's a Wonderful Life* explores how different life would be without George Bailey. But George Bailey wasn't one of the 2008 honorees of the Cable Television Hall of Fame; Hubert J. "Hub" Schlafly Jr. was. Think of Schlafly as cable's George Bailey. The recipient of two Emmy Awards and holder of 16 patents, Schlafly forever changed the scope of television, particularly cable systems.

Schlafly graduated from the University in 1941 with a degree in electrical engineering. By 1947, he was the director of television research for 20th Century Fox. He created the TelePrompTer, developed an early version of a pay TV system, and pioneered satellite technology for national distribution of cable signals, directing the first installation

and testing of two-way transmission on an operating cable system. In June 1973 at a convention of 3,000 cable operators, Schlafly and the TelePrompTer Corporation sent a program from Washington, D.C., via satellite to the convention floor in Anaheim, Calif. It was the first domestically transmitted national cable program.

Over the years Schlafly has played a vital part in the development of multimedia information displays, theatre television, broadcast studio equipment and systems, military command and control room design, and, yes, cable television system operation. There's no doubt that the box in the living room might operate very differently if not for his efforts.



LOOKING Back



In the 1970s, the aerospace laboratory was situated next to the Joyce Center. Known as the “Aero Shack,” its humble exterior belied the cutting-edge research that was occurring inside. Even now, it’s hard to grasp the scope and potential impact of activities occurring behind the brick and mortar of the current facilities – the Hessert Laboratory for Aerospace Research and the new White Field facility. What is not readily visible is the fact that the University has more than 120 years

of experience in aeronautical research (flow control), a history that boasts many firsts. The first hand-driven wind tunnel in America was built on campus in 1882. The first scholarly paper in America discussing modern methods of launching a plane and controlling its flight was written by a Notre Dame faculty member shortly thereafter. In 1937, a faculty member built the first three-dimensional smoke tunnel for flow visualization on campus. Within 10 years another faculty member was the first to visualize Tollmien-Schlichting waves, which are vital in understanding and controlling turbulent flow. The world’s first supersonic smoke tunnel, studying flow at speeds up to 900 miles an hour, was also developed here. The pattern of achievement in experimental fluid dynamics and aerodynamics is undeniable.

Today, faculty continue to make strides in flow diagnostics, prediction, and control that affect a variety of applications, such as fluid-structure interactions, noise control, energy efficiency, and renewable energy. *See a related story on page 2.*

