McCormick

Northwestern Engineering

Robert R. McCormick School of
Engineering and Applied Science
Northwestern University

Chicagoland collaborations

McCormick partners with local cultural institutions

Julio M. Ottino, Dean | April 2008

Chicagoland collaborations

Four stories that illustrate creative design collaborations between McCormick and Chicagoland cultural institutions

SHEDD AQUARIUM

Finding innovative solutions

In the world of aquatic medicine, those who care for marine life — from small colorful fish to large marine mammals — often face unique challenges. That's why one of the world's leading aquariums, the John G. Shedd Aquarium in Chicago, has teamed up with the Robert R. McCormick School of Engineering and Applied Science. Together, these two organizations are collaboratively working to further the science of aquatic medicine and enhance animal care, while providing unique opportunities for students to learn engineering design.

The Shedd-McCormick partnership was inspired Bill Van Bonn, DVM, Shedd's senior director for animal health, and Bob Shaw, a McCormick alumnus and member of the McCormick Advisory Council. The two realized that many of Shedd's needs could be met by undergraduate engineering students from Northwestern who already work with a variety of clients on projects that complement their classroom education. Over the past several years McCormick students have designed and engineered new systems that Shedd Aquarium can use for animal health and enrichment.

"Animal care is our top priority, and we are excited about the opportunity to further our knowledge and ability to care for all of our amazing animals through this partnership," says Van Bonn. "Northwestern's engineering program is unrivaled, and it's wonderful to see first-rate students apply their teachings and skills to our animal care priorities. It's a win-win for all of us."

When it's more than Jonah in the whale

One of the first projects to result from the partnership was the Endo-Grabber, a device created to retrieve inedible items from the stomach of a whale, dolphin, or other marine mammal. When a wild marine mammal becomes stranded or washes up on shore, veterinarians sometimes find the animal has swallowed a foreign object, usually a man-made indigestible item such as a plastic bag. Typically veterinarians have had to rely on rigging up their own devices on the spot to retrieve these harmful items.

While extremely rare, an accidental swallowing can happen in an aquarium as well. That's why Shedd Aquarium wanted such a tool, just in case something fell into the water at the aquarium — and equally important, to help develop of a tool that can possibly save animals in the wild.

"There is really no tool on the shelf that is effective enough to assist in these procedures," says Van Bonn. "Most of the medical equipment available today is designed for humans or companion animals, like dogs. After 15 years of working with marine mammals, I found myself saying, 'I'm sure we could build some kind of tool that protects the animal and is helpful.'"

A student team in a design class offered through the Segal Design Institute took up the challenge, and Van Bonn was surprised at how quickly solutions came. "I've spent 10 years trying to design something, and in 10 weeks these students came up with a prototype that had a lot of promise," he says. "It was refreshing to see these engineering students come to the design table without hesitancies, which those of us in animal training and animal care often possess and which may have prevented us from building a device like this in the past."

The grabber was originally designed as a device that, when used in conjunction with an endoscope, could grab an object in a mammal's stomach using a system of tubes and knobs. When the initial class ended, there was still much work to do. Jeff Mills (mechanical engineering 07) took on the project and spent much of his undergraduate career trying to further enhance the tool.

to fishy problems

Immediate left Bill Van Bonn, senior director for animal health at the Shedd Aquarium, and student Jeff Mills discuss the EndoGrabber. *Bottom* A beluga whale plays at the aquarium. *Far left* Vanessa Valenzuela, Stephanie Lo, Justin Li, and Ilana Rosen with their device that will create a bubble wall for the dolphins.

All photos by Andrew Campbell

Mills thought the device could be better, but in order to improve the design, he and three other students who continued to work on the design had to first learn about whale anatomy. "We realized that when you go through the throat, you can see the heart pumping against the skin," he says. "So to have something sharp is dangerous."

The group had to learn how much force was needed to get through the sphincter muscle into the stomach and studied the size and curvature of the stomach itself. They then improved the design, creating a head that could rotate both left and right and up and down. But the device still wasn't perfect. "We didn't have any control at the end," he says. "Nothing was working yet. It was just ideas coming together."

Later, Mills again took on the project with two other students as an independent study. That's when they developed the current system, which uses a joystick attached to covered wires that control the grabber head at the end.

Mills alone kept working on the project as a summer internship and came up with the final design, which includes better materials and an optimized system. "Safety was one of the biggest factors," Mills says. "You want to make sure there's no way this is going to break off in the animal."

The final design uses a three-inch grabber head that can move 90 degrees in every direction. With the head's six-inch neck, the grabber can reach every part of a dolphin's or beluga whale's stomach. Each component that holds the grabber together has a backup in case something breaks, and wires are covered by contoured tubing to allow for a smooth entrance and exit. The teeth on the grabber head range from small in the front to large in the back so smaller objects can easily be seized.

"Shoes can actually fit into the creases of the grabber," Mills says. "The arc in the back and the hole in the center of the head reduce the weight, and something like a golf ball can fit nicely in there. It has a lot of interesting design features."

The best part, Mills says, was using the math and engineering skills he learned in school and actually applying it to a real mechanism. "Being able to actually go down to the shop and build it — it's just a really cool experience," he says.

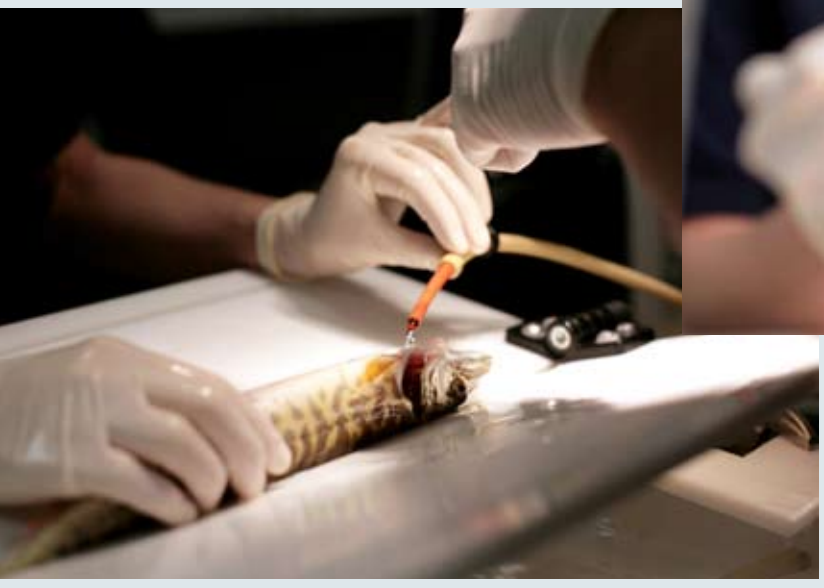
Now the device sits on the shelf at the aquarium — and luckily, Van Bonn and his staff haven't had to use it. They have been training with it, however, since a different student group created a model of a whale's stomach for practice.

"It's more likely to help colleagues who work on animals that come in from the wild, but it's nice to know we have it on hand here at Shedd just in case," Van Bonn says. And he's right. Several of Van Bonn's colleagues at other organizations are interested in purchasing one of their own. That might be a possibility, since Mills developed a full set of manufacturing specifications. In addition, new student teams will continue to work on the grabber design, creating different types of jaws and attachments to grab different objects, making the grabber even more adaptable.

Inspiring dolphins' minds

It's not all work and no play at one of the world's largest aquariums — which is home to some of the smartest and most playful animals on the planet. Four female Pacific white-sided dolphins jump, dive, and splash their way through each day in Shedd's popular Oceanarium, which draws more than 2 million visitors each year.

Jason Sandberg watches as the Shedd Aquarium veterinary staff repair a fish's fin.



Sally Ryan

Shedd animal trainers are always inventing new ways to stimulate the dolphins' intellectual capacity through fun games and exercises. "Most of the items they play with are passive — like basketballs," Van Bonn says. "They love to play with them. They throw them around, and they carry them down to the bottom of the pool and watch them fly up to the surface. But we continue to strive to provide them with the best care and felt we could create an interactive toy that is less repetitive through the partnership."

Shedd asked a McCormick design class to come up with a device to enrich the dolphins' environment and provide more interaction between the dolphins and guests. The first team came up with a radio-controlled boat that would drive around the surface of the exhibit. That idea was ultimately eliminated, however, because of safety concerns and because it did not utilize the underwater viewing area.

So this year, another design class took on the project to see how they could modify it. The team originally considered a radio-controlled submarine but quickly found it impractical — any slight bump could break such a device, and the idea of allowing visitors to control the submarine brought up too many safety concerns.

"Instead we came up with something that gives visitors the illusion that they're interacting with the dolphins," says team member Vanessa Valenzuela (mechanical engineering 10).

The design her group created is a submergible platform complete with interchangeable features, including a ball, artificial seaweed, a hydrophone and a bubble wall. "The platform and its features provide a variety of audio, visual, and tactile stimulation for the dolphins while allowing for expansion in the future," says team member Ilana Rosen (manufacturing and design 08).

The simplest attachment is the boomer ball — a toy ball dolphins already use in their habitat. Normally these hard plastic balls have holes drilled in them so they'll sink, but the team hopes to create a ball that will float by filling it with ice, thereby keeping the dolphins attention with something new.

The artificial kelp attached to the platform gives the dolphins something to feel and touch. Since Shedd trainers acknowledged the dolphins love rubbing their bodies against the windows of the exhibit, the team made kelp from plastic car wash material and filled it with slices of pool noodles — foam floatation toys — that would encourage the dolphins to rub up against it and directly interact with the platform.

The hydrophone is an underwater microphone that records the numerous noises dolphins make through echolocation. When dolphins sends out a click (which allows them to sense their environment and find prey), the hydrophone will record the noise. These noises can then be filtered to a frequency humans can hear and could be broadcast to guests watching from above and below the surface. (Visitors currently hear prerecorded noises.)

The team also hopes to incorporate the hydrophone into the last feature of the device: the bubble wall. Dolphins love bubbles, according to Shedd's animal trainers. Dolphins have been known to create bubbles underwater and bite at them. They even test themselves to see how close to the surface they can bite the bubbles before the bubbles break. Some dolphins can even make large bubble rings to swim through. "Bubbles represent play for both dolphins and humans," says team member Justin Li (computer science '09).

The team says they hope to synchronize the hydrophone and the bubble wall so that when a dolphin sends out an echolocation click to the hydrophone, bubbles would come out of the tube. "We're trying to engage that sense of perception," Li says.

Through it all, the team says they've learned time-management skills, and they've learned that just because they think something will work doesn't necessarily mean it will; everything has to be tested.

"For the kelp, we thought we'd use 'noodle' pool toys because we figured if it makes us float it must work," Valenzuela says. "But actually

we didn't know if it would make the kelp float."

The biggest challenge for the team was designing something for a client that communicates through clicks. "Our clients were dolphins," says team member Stephanie Lo (manufacturing and design '08). "We're used to having human clients and asking them their preferences and needs. For this we had to go and research animal behavior. That's the only thing we had to go on."

And for this project, the dolphins must not only accept the device but interact with it, too. "We have to challenge them on a physical and intellectual level," Li says, "so they're not just bored."

But in the end, the team might not see the fruits of their labor. Though they hope to have a working prototype, it could take weeks or even months for the dolphins to interact with their idea. "We're hoping that because bubbles are part of their natural environment, they will play with it," Valenzuela says.

Throughout the process the team periodically presented their progress to Van Bonn and other Shedd staff to gain useful feedback and modification suggestions. "Whether the projects work or not, we've always been impressed by the students' commitment and dedication to our projects," Van Bonn says.

Sedating fish

In an aquarium of more than 26,000 animals, patients are visited by the doctor every day for everything from routine health checkups to surgeries.

Some fish are easier to examine up close than others, and when Van Bonn and his team need to check on some of the more slippery and wiggly ones — most of which are exotic and unusual — they must keep them underwater in order to survive. "We can't say, 'Hold still and turn over,' in order to examine a fish and make sure it's doing well," Van Bonn says.

So Shedd, like other aquariums, uses fish anesthesia, which is diluted in water so the fish can breathe it through its gills and become sedated. "For humans, you can buy a vaporizer that will deliver anesthetic gas, and you can control precisely what the patient is breathing and make a real-time change," Van Bonn says. "Nothing like that exists for fish."

While some fish are put under for checkups, others are sedated for surgery — and there's no such thing as a routine surgery at Shedd. Working closely with animal care staff who monitor the animals 24/7, Van Bonn and Shedd's animal health team are often called in when something is out of the ordinary that may warrant an additional procedure.

Shedd surgeons have repaired a bull frog's knee and have removed many cancerous masses from different fish. (Fish get cancer both in the wild and in the aquarium.) "We have a number of cancer survivors in the collection now, which is a benefit of living in an aquarium that cares so deeply about its residents," Van Bonn says.

Van Bonn also notes that Shedd's commitment to animal care is allowing many animals to live longer lives, so close check-ups are more important in caring for a geriatric collection. "Many of these animals would not have survived in the wild this long," Van Bonn adds.

Veterinarians at Shedd have designed their own anesthesia systems, and while their own makeshift approaches have worked successfully, none is sophisticated enough to control the amount of anesthesia in real time, which is something Van Bonn and others desire. A senior biomedical engineering design course took on the challenge in 2006 and created a fish anesthesia machine that included an examining table for the fish and a computer system that could adjust the anesthesia and water in real time.

"We knew that we wanted something really intuitive and easy to use," says team member Tiffany Keung Oettinger (biomedical engineering '06). "The veterinarians are in surgery running around and they don't have a whole lot of time to mess with it."

To use the system, a veterinarian positions a tube in the fish's mouth and inputs the correct amount of anesthesia into a computer.

FIELD MUSEUM

Professor helps discover immigrant networks

Noshir Contractor, the Jane S. and William J. White Professor in Behavioral Sciences in the Department of Industrial Engineering and Management Science, is no stranger to partnering with Chicago institutions. Contractor (below right), whose research focuses on social and organizational networks, recently worked with the Field Museum on a project called "Creative Networks: Mexican Immigrant Assets in Chicago."


Andrew Campbell

The project, funded by the Rockefeller Foundation, was a collaboration among the Field Museum's Center for Cultural Understanding and Change, the Team Engineering Collaboratory, and the Science of Networks in Communities research group at the University of Illinois at Urbana-Champaign, where Contractor worked before coming to McCormick in 2007.

From March through August of 2005 Contractor collaborated with anthropologists to investigate how Mexican immigrants in Chicago and its surrounding suburbs use social networks to find services. To map these networks, an interdisciplinary team of social network researchers and ethnographers gathered data from immigrants through focus groups and surveys. Researchers used IKNOW — a web-based network data collection, mapping, visualization, and analytic environment developed by Contractor and his team — to study the patterns of knowledge and information through networks.

"The findings provided a suite of innovative metrics about immigrants' use of their network and cultural assets to obtain assistance with education, health care, and jobs," Contractor says. "These metrics offer new insights on policies for assisting recent immigrant populations."

The results of the study were published in late 2006, but Contractor and officials from the Field plan to continue to work together.

The computer then sends a message to two tanks beneath the table — one holding water, one holding anesthesia — to mix the right anesthetic solution. The group designed LabVIEW software to control the valves in the tanks' pumps.

"The hardest part was that we didn't know how to do any of it — the software, the hardware — so we had to learn both software code and the mechanics of the system," Oettinger says. "Then we had to create a table that was adaptable and could be bleached and sanitized after every use."

Though it was hard work, by the end of the class Oettinger's team was the only one with a working prototype. "It was really good to be able to take a project from nothing and build it into something that worked and that was usable," she says. The design even won the third place Margaret and Muir Frey Memorial Prize, which is awarded each year to McCormick students for innovation and creativity in senior capstone work.

Once the initial design team graduated, Jason Sandberg (biomedical engineering '09) took on the project as a work-study student, refining and testing the design. He then worked on improving the software and user interface before transferring the system from a desktop computer to a laptop. That required all new hardware and a new system input.

"I didn't have much knowledge of electronics, so it took me a while to troubleshoot it," he says. "The first time I tried to build a circuit, the whole thing melted. Things that I thought would take me four hours to figure out actually took three weeks. But that made it a good learning experience — I was forced to figure everything out."

The optimized system was delivered and tested in late February. "This is a wonderful veterinary tool in that it allows us much more flexibility and much more capability to tailor the delivery of the anesthetic agent to the patient's needs in real time," Van Bonn says.

Though Oettinger has graduated and is now an engineer for a pharmaceutical company, she says the skills she learned creating the system have helped her immensely. "The biggest thing in the real world is being flexible and knowing that you have to constantly learn things," she says. "It's more about knowing where to find resources and having an open mind and not expecting to know everything."

McCormick and Shedd look to the future

The partnership between Northwestern and Shedd has grown over the past several years and has been beneficial to both organizations. As Shedd continues to build on its commitment to providing the very best animal care, it will look to Northwestern for support. And McCormick is happy to oblige, says Matt Glucksberg, professor and chair of the Department of Biomedical Engineering, who was the adviser on the fish anesthesia project.

"The Shedd is a unique resource for McCormick," he says. "It's not just a rich source of projects and an inviting environment for our students. They have real problems that have real engineering solutions and the students know that if they do their job they will see their ideas used in one of the premiere cultural institutions in Chicago."

—Emily Ayshford

Emily Ayshford

Kinetic art installation exhibits smart electronics

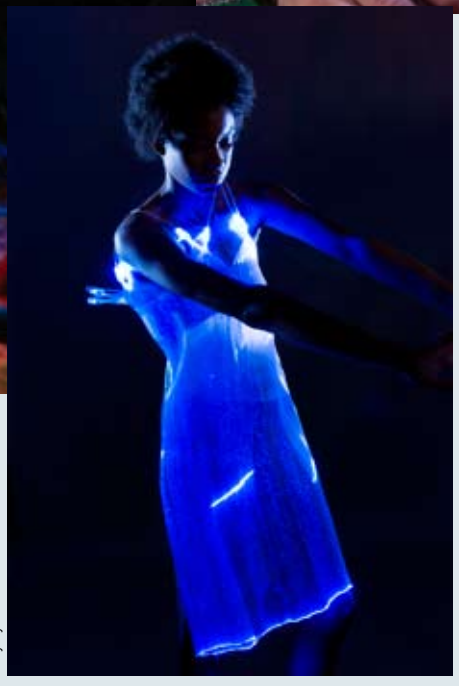
If you're there, they'll find you. They'll sense your presence, stop right above you, then call more than a dozen of their friends to come take a look. Soon, 16 lights will illuminate your presence.

This is a vision of the future of lighting, born of a collaboration between art and engineering.

It's a new kinetic art installation, soon to be installed at the University of Illinois at Urbana-Champaign and the product of a partnership between the School of the Art Institute of Chicago and McCormick. The piece was commissioned from Anders Nereim, professor and chair of the architecture, interior architecture, and designed objects department at the School of the Art Institute. Nereim's work focuses on creating architectural components with embedded intelligence, which allow, for example, lights to move across the ceiling and look for areas that need to be lit. Using this idea, Nereim built two prototypes for the installation that, he says, "thrashed themselves apart in about a week."

Andrew Campbell

generates illumination



Emily Aysthford

"It was very, very clear that it needed a great deal of help with the mechanical engineering," he says.

Enter Michael Peshkin, professor of mechanical engineering at McCormick (pictured above right), who has experience with robotics and who just happens to be an old friend of Nereim's.

The two were on a bicycle trip through Yellowstone National Park when they began talking about the project, spending several hours filling a notebook with possible mechanical solutions to the problem. Meanwhile, the two schools were looking for a way they could collaborate, so the project became something of a test case.

Peshkin — with the help of University of Colorado undergraduate student Dan Johnson, who will attend graduate school at McCormick in the fall — helped create the 16 independent lights, which run along tracks on a 4-by-8-foot sheet of plywood overhead. The lights use infrared sensors to find humans down below, then send out signals to the other lights to come over and illuminate the person as well.

"It's fun," Peshkin says. "It took creativity and whimsy, and it's interesting to see how the lights behave. It's like: They found me, they're coming."

Nereim says he even sees bullying behavior among the lights — sometimes they'll trap one light against the wall, which causes that light to go into an error mode.

Both Nereim and Peshkin say they hope this project leads to future collaborations. "The process of getting well-designed objects out into the world requires both engineering and art," Nereim says.

Dresses shine light on clothing of the future

Out with the old and in with the light.

In the future, sidewalks will be filled with people whose clothing flashes pictures and messages from light-emitting diodes. Patterns will change with the temperature, and lights will synchronize with the beat of a heart or the rhythm of breath.

That's the vision of Anke Loh, fashion designer and assistant professor of fashion design at the School of the Art Institute of Chicago, and Alan Sahakian, the Bette and Neison Harris Professor of Teaching Excellence in biomedical engineering and electrical engineering and computer science.

The two have collaborated for the past year on creating illuminated clothing that responds to sound and temperature. Before their partnership began, Loh had some success with designs using Luminex, a special fabric woven with fiber optics. But the clothing only lit up, and Loh wanted to take the garments to the next level by making the illumination dynamic and responsive. She approached McCormick, and Sahakian stepped up to the challenge.

"I worked on developing some sensors and electronic circuits and drivers that would make the fabric sensitive to sound and temperature," Sahakian says. The result was a red Luminex fabric with green LEDs that are illuminated along with the beat of music or the sound of a voice.

Another similarly designed fabric changed colors with the temperature of the air.

The team exhibited their work last fall — at Illuminate, a showcase event sponsored by Chicago design shop Luminaire, and at an exhibit at the Chicago Tourism Center.

Sahakian then wanted to get students involved, so he recruited electrical engineering students Linda Buzzi and Jonathan Bender (both '08) to work on the project as their senior capstone design project. The two helped create the circuitry needed for an illuminated dress to act as a receiver for a transmitter implanted in a bracelet. When the person wearing the bracelet comes close to the dress, the garment will change colors and patterns.

Loh says she began mixing technology with fashion when she came to Chicago two years ago. "I just think it's an interesting approach," she says. "I think it will go in this direction anyway, and maybe in 20 years this will be part of our ready-to-wear garments."

Sahakian says he and Loh will apply for more funding in order to continue to improve the design of the fabric by creating more complex patterns and eventually moving images. Sahakian also hopes to incorporate his interest in biomedical electronics into a dress that responds to cardiac activity or respiration.

"There's a lot of potential for creativity," Sahakian says. "This is an example of an interaction that worked out really well between McCormick and the Art Institute. There's a lot of potential to build on that."

—Emily Ayshford

ADLER PLANETARIUM

NU'Nergy, the car of Northwestern's solar car team from 2003 to 2005, is now on loan to the Adler Planetarium in Chicago. Members of the team installed the car in March, and now visitors to the planetarium can see first-hand how the sun can be used to provide automotive power.

Wildcat computer programming team heads to world finals — again

The distractions in the room might have seemed overwhelming, with the chatter of students from around the world amid the clatter of computers filling up with code. But the Northwestern Wildcats remained focused on their task — to earn a spot among the best programmers in the world.

The scene was the ACM International Collegiate Programming Contest World Finals last March in Tokyo, where McCormick computer science majors Nikolay Valtchanov ('09), Anda Bereczky ('10), and Nikola Borisov ('10) competed. The team is headed back to the finals this year after its second consecutive win at the North American mid-central regional championships, which involved 114 teams from universities in five states. The Wildcats will be among the top 100 computer programming teams (from a field of more than 6,700 teams) competing in the world finals, held this April in Banff Springs, Alberta, Canada.

"It's a very exciting experience," says Hai Zhou, associate professor of electrical engineering and computer science and one of the team's coaches.

The contest works like this: Teams of three students each get eight to ten puzzles derived from real-world problems for which they must find good algorithmic solutions and then implement them efficiently in a modern programming language within five hours. Each team is given only one computer, which means only one team member can write code at a time, and the team that solves the most problems in the least amount of time wins. But teams also don't want to be too quick to submit answers, as each incorrect solution means a time penalty.

"It's a big challenge to divide the work correctly," Borisov says. "And it's important to have easy problems done at the beginning of the contest. Otherwise you fall behind, and it's really tough to catch up."

The contest began back in 1970 at Texas A&M University and since has grown into a global competition with students from more than 1,800 universities in 83 countries participating.

The problems require teams to write programs that can, for example, find the shortest path between two cities or that correctly adjust the spaces between letters. But such problems can be surrounded by pages of narrative to make them more like complicated, real-world issues. "Even if the problems are easy, they are packaged in a way that don't seem easy," says Bereczky.

"It's really intense," Valtchanov says.

The Northwestern team has thrived at the regional competitions; last year it was the only team to solve seven problems, and this year it was one of just three teams to solve six problems.

All three competed in programming contests in high school in Eastern Europe, giving them a leg up on the competition, and all three were able to bring their talent to Northwestern and continue their studies thanks to financial aid, which Northwestern began offering to international students in 2005.

Andrew Campbell

From left **Anda Bereczky, Peter Dinda, Nikolay Valtchanov, Nikola Borisov, and Hai Zhou**

Little did they know that their hard work would take them even farther across the globe to the contest's world finals in Tokyo last year. But there they discovered they still had room for improvement; they wrote the wrong program to start with, they say, and put their efforts into it rather than figuring out a different solution.

The team members say the best parts of the competition were the lectures from top employees at IBM. After the competition last summer, Google even flew the Wildcats to its Manhattan office for a tour. Valtchanov accepted a summer internship at Google, while Bereczky and Borisov will spend the summer interning at DreamBox Learning Inc., an educational software start-up cofounded by McCormick alumnus and University Trustee Ben Slivka.

Right now, though, the team is focused on preparing for the world finals. "We'll work together better because we know each other better," Bereczky says.

Both Zhou and Peter Dinda, professor of electrical engineering and computer science and the team's other coach, act as the team's mentors and facilitators, giving the team lectures on concepts not covered in their classes and finding funding for the trip to the finals. Dinda says the competition prepares the students for jobs as software engineers. "It teaches them to be effective problem solvers and to program on a large scale, which is very valuable," he says.

This year's trip to the finals will be bittersweet — teams are only allowed to compete twice, so the team cannot qualify again. But Dinda says the group has already been successful in recruiting another team. "Their interest in this is infectious," he says.

—Emily Ayshford

Building a new tradition

McCormick introduces a concentration in architecture

Chicago has long been at the forefront of architecture and building, overcoming swampy soil and raging fires to become the home of groundbreaking skyscrapers and great American architects like Louis Sullivan and Frank Lloyd Wright. The Department of Civil and Environmental Engineering at McCormick will build on that tradition by offering a new concentration in architectural engineering and design beginning in fall 2008.

The program will help prepare engineering students for building industry careers as architects, structural designers, builders, project managers, and developers. It will provide students with a broad understanding of building systems and design, give them the ability to communicate and collaborate with architects, and introduce them to issues in sustainability and green design.

Julio M. Ottino, dean of McCormick, who spearheaded the development of the program, saw an opportunity to combine Chicago's architectural strengths with the strong design initiatives at McCormick. "Given the city's prominence in architecture, I felt that it was important that Northwestern be part of this world," he says.

Developed by Joseph Schofer, associate dean of McCormick and professor of civil and environmental engineering, and Brian Moran, professor and chair of the department, the program will be directed by the new Richard Halpern/RISE International Distinguished Architect in Residence Laurence Booth.

Booth was born in Chicago and earned a bachelor of architecture degree from the Massachusetts Institute of Technology. In 1966 he opened a firm with James Nagle in Chicago, and in 1981 established Booth Hansen Associates, where he now serves as design principal. He has been a visiting lecturer at several universities and has received many professional honors.

Booth will act as mentor and teacher in the new program. "We're not going to teach a subject that's already defined," he says. "We have a real challenge in the building environment today, and it's not altogether clear what the vision of the future is. We're going to have to be creative to survive, so the focus of this will really be on creativity — giving students an opportunity to learn creativity, to exercise creativity, and to carry creativity on in their lives."

The architect in residence position was made possible by a generous donation from Richard and Madeline Halpern and RISE International. Richard Halpern is the cofounder and chairman of project management and construction consulting firm RISE International and has worked on projects ranging from the Sears Tower construction to the O'Hare International Airport expansion. His wife, Madeline, is a Northwestern alumna who received her BS in 1977 and her MSJ in 1986.

"I've worked with architects my whole life, and I feel that Chicago certainly is a mecca for fine architecture in America," Halpern says. "The city needs a program that is managed by and housed in one of the top universities in the country. I think this architecture program will enable students at Northwestern to add to the quality of engineering and architecture throughout the United States and the world."

The donation jumpstarts an idea that has been considered for years. Faculty, students, and the Department of Civil and Environmental Engineering advisory board, chaired by Halpern, have long discussed creating a concentration in architecture since it became clear the demand for such a program existed. "Very often we see good prospective students, who we'd like to have come here, but they'd like an architectural component. We think we may have lost

From left **Joseph Schofer, Julio M. Ottino, Lawrence Booth, Brian Moran**
Immediate left **Richard Halpern**

Andrew Campbell

some students because we didn't offer such a program," Moran says. "We also want to appeal to the creative side of the students in the department. We want a design and innovation framework that fits within the broader curriculum of McCormick."

McCormick was also encouraged to pursue this program by several senior professionals in the field, including William Baker, a partner at architecture and engineering firm Skidmore, Owings & Merrill and a member of the department advisory board, and Joseph Burns, managing principal at the structural engineering firm Thornton Tomasetti and now a member of the advisory committee for the concentration.

The new concentration seemed natural because civil and environmental engineers use design in their profession every day. "We think a number of our civil and environmental engineering undergraduates will be very interested," Moran says.

Even students who don't go into architecture can benefit from knowledge in such areas as building materials, information technology, safety, and energy efficiency. "We hope to teach structural analysis and design so that students can look at a tall building and see not only its design but also understand the way it works," says Schofer.

Besides architecture and design, students will learn about the business side of the construction industry. "This is really a creative investigation, and this program will involve more than architecture," Booth says. "It will involve engineering, of course, but it will also involve all the realities that go into a building system: clients, politics, authorities, financing, and contractors. I've been doing this long enough that I know all the issues that can come up."

To round out the program, students will take courses on the history and culture of architecture. Studio courses, taught by architects, will provide opportunities for design exercises that can serve as portfolio projects for students.

"I'm excited to use my experience and pass it on to others to make architecture as interesting for them as it has been for me," Booth says. "The world of the future is going to have to do more with less — the world can't sustain this country's consumption rate. To be involved in defining that future with the students is going to be exciting. There's no textbook here, and that's what makes it interesting."

Booth and McCormick professors are in the process of working out the details of the curriculum but plan to create new courses for the program on building systems and design that will complement existing civil engineering courses on analysis, design, and materials. The new courses will build on McCormick's longstanding commitment to design, represented in classes offered by the school's Segal Design Institute and in graduate programs such as the master of product development.

Students who complete the program will be prepared to join the construction industry after graduation or pursue graduate studies in architecture or construction management.

—Emily Ayshford

From students to

Four Northwestern schools join together to launch the next generation of medical devices

Around campus they gather, huddled over laptops and notebooks, spending hours brainstorming, researching, constructing, stumbling, and constructing again to create medical devices and business plans that will fulfill needs and save lives. Alone they are future engineers, lawyers, physicians, and businesspeople. Together they are innovators of the present day.

They are students in NUvention: Medical Innovation, the inaugural course offered by a new visionary academic partnership. The course, conceived by students and brought to life by motivated faculty, brings together four Northwestern University schools — McCormick, the Feinberg School of Medicine, the Kellogg School of Management, and School of Law — to teach students how innovation goes from the lab to the patient.

"Design-think is now at the center of discussions of U.S. technological leadership and innovation," says McCormick Dean Julio M. Ottino. "Good ideas happen at interfaces; there are lots of interfaces when one puts four schools together."

Building an innovative course

In 2006 Swami Gnanashanmugam, a student at Feinberg; James Sulzer, a PhD student at McCormick; and others involved in InNUvation, a student group focused on entrepreneurship, approached Ottino with an idea for a course focused on medical devices.

Shortly thereafter Ottino created the Center for Entrepreneurship and Innovation — aimed at empowering engineers with the skills to be successful entrepreneurs — and after connecting with the deans of the other three schools, Ottino asked the center to bring the course to life. The center, in turn, created NUvention to develop interdisciplinary courses like Medical Innovation, which teaches students the life cycle of products and how to build businesses around those products.

Jim Ziv

Around the same time, Ed Voboril, recently retired chairman of the board for Greatbatch Inc. and now chairman of the board of Analogic Corp., was considering teaching at McCormick. All that was holding him back was the fact that he and his wife were building a new home in Arizona, where they hoped to retire.

As fate would have it, Voboril, while at a McCormick Advisory Council meeting in October 2006, received a call that his house had burned down. Ottino sent Voboril a note asking if there was anything he could do to help, and a week later, Voboril called Ottino up to say that he and his wife had decided to make Chicago their home while a new Arizona home was constructed. Voboril wanted to help out with creating a new innovation course, so Ottino appointed him chairman of NUvention.

"It put me in a position to come back and couple my interest in education with my experience in medical technology," Voboril says. Voboril, Ottino, Mike Marasco, the director of the Center for Entrepreneurship and Innovation, and others spent much of spring 2007 creating the curriculum for the course.

What resulted was a two-quarter course, meeting over the fall 2007 and winter 2008 quarters, called Medical Innovation. Students who enrolled from each school were placed into groups based on their interest in different medical disciplines — cardiology, radiology, orthopedics, trauma, emergency medicine, ophthalmology, urology, neurosurgery, general surgery, and otolaryngology, better known as ear, nose, and throat (ENT) — and given the charge of creating an innovative medical device with a business plan that they could present to venture capitalists at the end of the second term.

Each week students heard lectures from both Northwestern professors and guest speakers on how to design devices, deal with regulations, determine market potential, pitch an idea, search and get patents, create a business plan and raise money to fund a project. Between classes students observed doctors in action, assessed clinical needs, designed innovative devices, built prototypes, and created business plans.

The 10 companies represented on NUvention's advisory board each gave $25,000 to fund the creation of prototypes. "Based on their support for this concept, they gave an important lift to the program," says Voboril.

Mary Hanlon

Above **Usha Periyanayagam, in blue, listens while Swami Gnanashanmugam explains their team's heart device to faculty.**
Opposite **Alicia Loffler, Richard Lueptow, and Patrick McCarthy discuss a team's medical device.**

Marasco says Medical Innovation has exceeded expectations both in and outside the classroom. "I think it has been invigorating to experience something new and recognize that we're really building something that is unique that will hopefully have significant impact at Northwestern as a whole," he says.

Visualizing a hearing solution

For McCormick undergraduate Nicholas Deep (biomedical engineering '08) — one of only a couple undergraduates in the class — the Medical Innovation course caters to his interest in combining both engineering and medicine. "I can actually conceive of an idea and take it to market and sell it with the ultimate goal of helping people," he says.

Choosing the ENT team was easy; as a child, Deep had meningitis, which caused a cranial fluid leak in his right ear and caused him to lose part of his hearing. Throughout his childhood Deep frequently visited the same ENT doctor, who tracked his progress. "I became close with him, so I've always wanted to become an ENT," he says.

His teammate Jodie Zimmerman, a graduate student at Kellogg, came to Northwestern to learn how to commercialize new medical technology, so Medical Innovation was a natural fit. "This course fits right in that niche," she says. "It's a great opportunity to test it out risk free, so that when you do it in the real world, you don't make the same mistakes."

To begin, the team shadowed surgeons and doctors in the ENT clinic at Northwestern Memorial Hospital to look for tools that were inefficient or needed improving. They then created a list of 50 user needs and prioritized them based on what they could achieve given their time and resources.

Andrew Fishman, assistant professor of otolaryngology–head and neck surgery at the Feinberg School of Medicine, acted as one of the team's clinical advisers. "The idea was for them to come up with the ideas rather than for us to spoon-feed them," he says. "We focused on making them inventors and training them to go through this process, and we really held back on just dropping ideas into their lap." Fishman did provide feedback on their options and gave advice on what would be realistic and practical.

The group eventually developed four product concepts. Then, after meeting with their advisers, they came up with mini-business plans for two products. At that point in the class, each group had to pitch their products to a panel of investors, who gave feedback and access to funds to build prototypes for one concept.

The ENT group decided to focus on a mainstay of every doctor's office — the otoscope, which doctors use to look into patients' ears. Every type of physician from pediatricians and general family doctors to specialists use otoscopes to diagnose ear infections.

"It is viable for a large market, and there's a lot of opportunity for improvement," Zimmerman says. The group did market research

Right Nicholas Deep describes his team's otoscope to faculty.

to determine which improvements to the otoscope would be most helpful to those in the field.

Through it all the group's faculty adviser, Alicia Löffler, director of Kellogg's Center for Biotechnology, helped them stay on track by checking in every week. "I made sure they were allowed to have crazy ideas and then I made sure they focused," she says. "It's all about practice. It's all about giving them the opportunity to make decisions and mistakes and learn from those mistakes. And as an entrepreneur, sometimes you just have to jump and do it. You always need to make decisions with incomplete information. But you also have to know when is a good time to jump."

In the end, the group decided to create an otoscope that could take photos. Both Deep and Zimmerman are quick to list off the benefits of such a device: It could help doctors teach medical students by showing them the middle ear, and it could help physicians monitor the progress of an ear infection. "Some doctors look at 30 ears a day," Zimmerman says. "Do you really remember what that one kid's ear looked like?"

The photo-otoscope, along with computer programming tools, could make diagnostics more efficient and could even help diagnose ear problems in third-world countries by allowing physicians here to diagnose problems from e-mailed photos. More efficient diagnostics could mean fewer antibiotics prescribed, and showing patients photos could give them a better sense of what's happening in their ears. "The doctor could say, 'This is what's going on, and this is why you should take your medicine," Zimmerman says.

Similar products exist, but they are bulky, expensive, and largely used by specialists. A more affordable otoscope would, says Deep, provide a more integrated approach to diagnosing ear infections.

In February the team was in the midst of creating several prototypes, doing more market research, searching patents, and creating a business plan. "The biggest challenge is actually putting the pieces together," Deep says. Building a true prototype will determine the price and market and could determine whether the group will try to sell their product or build a company.

Either way, both Zimmerman and Deep say they've learned a lot from students in other schools — whether it's how to build a prototype or how to create a business plan. "Working with such a cross-functional team is a huge advantage," Zimmerman says. "You're going to have to work with engineers and doctors on advisory boards, and I never thought I'd get a chance to do that in business school."

And in a team that includes both undergraduate and graduate students, the playing field is even. "We all look at each other as equals," Zimmerman says. "Everyone just has so much to contribute with their own specialization."

Fishman says he has been impressed with the group's motivation and thinks they'll be successful. "I think it would be a very useful tool, especially in an academic environment," he says. "I'd like to have one of their products myself."

While Zimmerman plans to use her experience to further her business career, Deep's future likely includes attending medical school. But he'll never lose that entrepreneurial bug he's caught in Medical Innovation.

"I'm going to want to keep the idea of innovation and entrepreneurship close," he says. "I want to always be involved in research, and if I ever have an idea, I know how to make it happen."

Mending the heart

Knowing how to "make it happen" is also the goal of Medical Innovation student Usha Periyanayagam, who isn't the typical McCormick graduate student — she's a fourth-year student at the Feinberg School of Medicine who took a leave of absence to get her master's degree in engineering design and innovation.

"I actually heard about Medical Innovation in medical school, and I was considering doing it from a medical perspective," she says. "But I realized I wanted to do medical engineering device work, and I was curious to learn more about the field — like how to make products and how to take products and make them sustainable."

Though Periyanayagam hopes to go into emergency medicine,

she joined the class's cardiovascular team — the largest team in the class — because of the field's long history of innovation.

Joining her on the team was Chris Lubeck, who is studying at the Northwestern University School of Law after getting a graduate degree in materials science from McCormick. "I thought there would be a lot of materials science issues with the cardio team, which would be interesting," he says.

So the cardiovascular team, like the ENT team, went about observing cardiovascular surgeons in the field to identify needs. Apparently, the field's long history of devices didn't stop their creativity — they identified 100 clinical needs that could be met. From there they brainstormed solutions, brought them to leaders in the field, and asked for their advice.

It didn't hurt that their faculty adviser was Patrick McCarthy, renowned heart surgeon, professor and chief of cardiothoracic surgery at the Feinberg School of Medicine, head of the division of cardiac surgery at Northwestern Memorial Hospital, and codirector of the hospital's Bluhm Cardiovascular Institute. McCarthy is also an innovator himself, having patented systems for valve operations.

"My job was to help them come up with 50 clinical needs, and they came up with 100, so they were overachievers," McCarthy joked. "I helped them prioritize and whittle that down to some pretty solid projects."

The large cardiovascular team eventually split into two groups, with Periyanayagam and Lubeck's group concentrating on what they call a left ventricle apex device. For most heart surgeries focused on the heart's left ventricle, surgeons must crack open the chest to get at the heart. The group's device would allow surgery on the left ventricle through the skin using a tube. Some surgeries are already performed this way through the femoral artery in the leg, but surgeons have just started doing surgeries through the apex of the heart, Lubeck says.

As part of their system, the team included a device that would close up the hole in the heart and possibly allow for easy access again. At least, that's the plan for now — the team continually tries to improve upon the design. "We're always trying to think of what we can do better," Lubeck says.

McCarthy says he was impressed by both of the cardiovascular teams' ideas and thought they had a future. "They are coming up with really highly sophisticated devices."

To test their device, the team will eventually use cow and pig hearts — a foray into anatomy that some team members hadn't previously experienced. For Lubeck, working with hearts — alive or not — is definitely a new experience. "I never knew what a left ventricle was, and then I saw someone's chest cracked open," he says.

As the team contemplated whether to create a business or sell the idea, Periyanayagam says the course provided an invaluable look at the other side of engineering. "A lot of engineering projects stop before you get to the business stage," she says. "You come up with an idea but you never understand what happens next — like getting lawyers or speaking with business people."

Teaching students this process is the key to an innovative future, Voboril says. "We need to have a continued stream of innovations in our economy, and the students in our class are the drivers who will move us forward."

Mary Hanlon

Above **Ed Voboril**
Left **Mike Marasco**

Improving for the future

For his part, McCarthy says the class also introduced him to Dean Ho and Guillermo Ameer, faculty members in McCormick's biomedical engineering department. McCarthy says he was impressed with their research and hopes to collaborate with them in the future, and Voboril says bringing such faculty together has been a hallmark of the course.

"It has been outstanding," Voboril says. "I find that in an academic environment, oftentimes faculty don't see people outside of their department. We've got very close collaborative relationships among the four schools, and I think that could be a benchmark in terms of how to break down walls and take full advantage of all the University has to offer."

Throughout the next year, Marasco says the Center for Entrepreneurship and Innovation will continue to create new courses for students with the entrepreneurial spirit. For example, Marasco and William J. White, professor of industrial engineering and management science, will offer a Principles of Entrepreneurship course to underclassmen for the first time this spring. The course is already full with 120 students registered, and the waiting list is 40 students long. And while the center improves upon Medical Innovation, it will look at creating new courses with similar structures.

The center also will soon launch both an advisory board and a venture capital advisory board, which Marasco hopes will be a resource for faculty. "I think we're making a difference here at McCormick," he says. "Great innovations that never leave the lab are not great innovations. They have to be applied. That's what engineering is all about — an application of science. And we represent a way to actually do that."

— Emily Ayshford

New faculty bring decades of experience, cross-disciplinary efforts

To remain at the top of its game, the McCormick School continues to pour resources into seeking out and recruiting top faculty from all areas of engineering. Over the past two years, 24 new faculty members have joined McCormick.

"New faculty invigorate the school and bring a new perspective on teaching and research," says Julio M. Ottino, dean of McCormick. "We know that they will provide valuable leadership and inspiration to the entire school."

The three recent hires featured here are senior faculty with distinguished careers already under their belt, and all three come to McCormick with the knowledge that innovation requires efforts that cross the boundaries of schools and departments.

Jack Linehan

While some professors seek connections across the University, Jack Linehan, professor of biomedical engineering and director of Northwestern's Center for Translational Innovation, is the connector.

Linehan, who was previously a consulting professor at Stanford University and was the founding chairman of the biomedical engineering department at Marquette University, says his experience with research, education, and administration make him well-suited to bring together researchers across disciplines.

While working for the Whitaker Foundation, Linehan was responsible for implementing and managing major biomedical engineering educational grant programs. There he realized that the most fascinating problems that biomedical engineers attempted to solve were at the interface of medicine and engineering. "Translational science is basic science but it's use-driven science," he says. "I recognized that if innovation was a process, it could be intellectualized and taught."

His interest in education, innovation, and motivation has allowed him to bring people with technical knowledge together, help them understand clinical needs, and go from idea to prototype to market. He will continue in that role as director of the Center for Translational Innovation.

"Coming to Northwestern was a unique opportunity: All the stars were in alignment to carry out such a program," Linehan says. "There was a great opportunity for me to come and build intellectual bridges between McCormick and the Feinberg School of Medicine."

The challenge in getting teams together isn't only a matter of money or resources, he says. "The main problem is time. Everybody is so busy that no one has time to go outside their labs and make the connections that will result in new collaborations to address unmet clinical needs in an innovative way."

One way Linehan hopes to get faculty members together is by creating experiential and cross-disciplinary courses that bring innovation into the classroom. "Faculty members are really interested in students," he says. "If you start talking about building a new course, they say, how can we bring it all together so it's exciting and enabling for the students?"

Chang Liu

Chang Liu, who has a joint appointment as professor in both mechanical engineering and electrical engineering and computer science, says his goal is to build a research group that will produce cross-disciplinary researchers, products, and knowledge that benefit both the scientific community and the market. "I want to join different areas together," he says. "I believe that gives people a more diverse training and research experience, and today's complex problems require solutions across disciplines."

Liu comes to Northwestern from the University of Illinois at Urbana-Champaign, and here he will continue to research his passion: sensors. Everyone is familiar with sensors that allow cameras to take pictures or recorders to record sound. But Liu wants to use sensors to create intelligent design systems. "What we envision is beyond today's knowledge and accomplishments," he says.

Liu studies biology for inspiration for both touch and flow sensors — areas that currently lack good sensors for recording and communicating the senses. For example, Liu is studying how fish use their lateral line of sensors to sense the flow of water around them.

"How do they know when there's a fish nearby to eat?" he asks. "How do they maneuver in a very tight space? How do they do this elegant maneuvering in a school?"

Every fish in the world has these sensors — but so far no man-made vehicle does. If a submarine had sensors that work as a fish's does, it could record much more information on water movement. Such flow sensors could also lead to better airplanes.

"I'm very interested in learning from biology," he says. "Biology has wonderful sensors."

Clockwise from top
Hani Mahmassani,
Chang Liu,
Jack Linehan

All photos by Andrew Campbell

Liu's research group is also developing artificial hair-cell sensors. Hair cells provide a variety of sensing abilities for different animals: they help humans hear, and they help insects detect vibration. By creating these hairs using microfabrication technology, Liu's group is increasing sensor performance while deepening the understanding of how different creatures use these sensors.

"I don't see my research as solving all the problems, but I think there is a very critical link that can unlock many engineering endeavors," he says.

Hani Mahmassani

Hani Mahmassani, recently appointed the William A. Patterson Distinguished Professor in Transportation, knows that modeling traffic networks doesn't just involve engineers — it requires economists, sociologists, computer scientists, and psychologists as well.

That's one reason he took an appointment with civil and environmental engineering that included an affiliation with Northwestern's Transportation Center, an interdisciplinary research center. "Northwestern has a very distinguished tradition in cross-disciplinary study of transportation," he says. "It was one of the first to take that approach and has maintained it over the years."

Most people deal with traffic and transit networks on a daily basis, often confronting a problem Mahmassani would like to solve — the "breakdown phenomenon," or a traffic jam. "Understanding and trying to control breakdowns is a very important element of traffic control," he says.

Mahmassani comes to McCormick from the University of Maryland, where he was the founding director of the Maryland Transportation Initiative. His specialty is modeling traffic networks and using real-time information — through traffic signs, vehicle sensors, and wireless devices — to give drivers information about traffic in the area.

It's not as simple as telling people there's traffic up ahead. Rather than telling drivers current information, which could change by the time the driver gets there and which drivers often ignore, Mahmassani says the best models predict what sort of traffic to expect down the road.

"What makes transportation systems unique is that everything having to do with transportation ultimately goes back to people," he says. "Human decision making is a central element in what I do."

Mahmassani has developed algorithms that help route the flow of traffic and optimize performance in a traffic system. He has also developed an evacuation model currently used by the Federal Highway Administration and is currently working on a project funded by the National Science Foundation looking at how traffic patterns work under extreme conditions. Mahmassani is also interested in studying "congestion pricing" — or charging drivers for using certain lanes.

So when Mahmassani comes to a traffic jam himself, what does he do? "I try to behave as a driver in ways that are efficient," he says — in other words, not needlessly slowing down to rubberneck. "But I get frustrated like everybody else."

—Emily Ayshford

Metallic foam shifts shape

Researchers have turned a stubborn alloy into a shape-shifting foam by just giving it a little breathing room. David Dunand, the James N. and Margie M. Krebs Professor of Materials Science and Engineering at the McCormick School, has teamed up with Boise State University professor Peter Müllner and McCormick postdoctoral research fellow Vee Boonyongmaneerat to create a foam from a nickel-manganese-gallium (Ni-Mn-Ga) alloy that changes shape when exposed to a magnetic field.

Andrew Campbell

David Dunand holds a metallic foam similar to the metallic shape-shifting foam he helped create.

The new foam could translate to smaller, lighter pumps and more aerodynamic airplane wings.

When exposed to a magnetic field, a single crystal of the Ni-Mn-Ga alloy will deform approximately 10 percent. The alloy then retains its new shape when the field is turned off but returns to its original shape if the magnetic field is rotated 90 degrees. That's what scientists call "magnetic shape memory."

But single crystals of materials like this are extremely expensive and time consuming to make (just like gems), and most materials are created as "polycrystals" — a collection of randomly oriented crystals. In polycrystals each individual grain moves in a different direction when exposed to the magnetic field, and the overall deformation is cancelled so that the alloy ends up not moving at all.

When Dunand and Müllner met at a conference in late 2006, they decided to combine Müllner's knowledge of magnetic shape memory materials with Dunand's expertise in metallic foam. They hoped a polycrystalline foam of the alloy, which looks like a sponge, would allow more space for individual crystals, letting them move more like a loosely connected collection of single crystals.

Boonyongmaneerat was working on a project using nickel foams for fuel cells, so the researchers decided to use his process to create the Ni-Mn-Ga foam. The researchers took powders of oxide and pushed the liquid metal alloy between the grains of the powders, creating a composite. They then removed the oxide powders from the composite with acid — leaving behind a metallic foam.

That just left the question: Would the foam change shape? To find out, Dunand shipped the foam to Boise State, where Müllner and his student Markus Chmielus tested the foam in a rotating magnetic field. Though it didn't move the 10 percent that a single crystal would, it did move 0.12 percent.

"It was very exciting because we went from zero to an actual value, albeit small, but comparable to the best competitor," Dunand said.

That competitor is Terfenol D, another material that also changes shape magnetically under a different mechanism. It has been around for a long time, is expensive to make, and is already maxed out at 0.12 percent deformation.

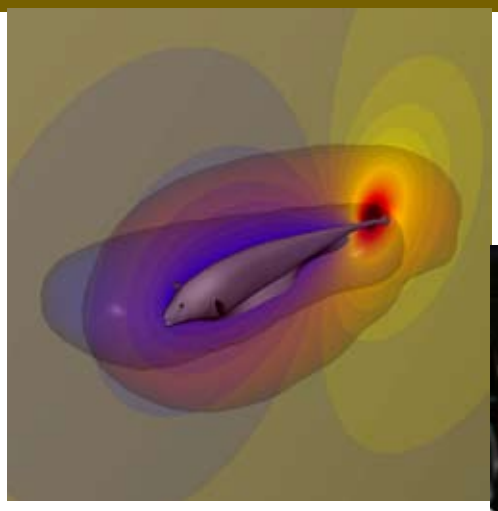
Dunand thinks that once the Ni-Mn-Ga foam is optimized — through casting it differently or perhaps heat-treating it differently — it will provide better results. He believes that such a foam could be a lighter, cheaper replacement for Terfenol D applications such as sonar, actuators, and magneto-mechanical sensors. Dunand and Müllner also believe the foam could replace applications that require small, rapid movement, like very small actuators consisting of a foamed rod and a coil, replacing bulkier classical linear motors with rotors, stators, gears, and shafts, possibly for biomedical applications or for opening and closing valves in energy-efficient car engines.

The material could have even bigger applications, however. Dunand said it's possible that the foam could eventually be used to control slight changes in the shape of airplane wings to make them more aerodynamic based on the speed of the aircraft. "The goal is to be able to change, ever so slightly, the aerodynamics of the flow of air to make the flight more efficient at all speeds," he said.

Dunand and Müllner coauthored a paper on the research that was recently published in the December 14, 2007, edition of *Physical Review Letters.* For now, researchers will continue to optimize the strains of the foams by examining both processing and foam architecture. In the meantime, Boise State and Northwestern have jointly filed an application for a patent.

The research of both Dunand and Müllner was sponsored by the National Science Foundation.

—Emily Ayshford



Andrew Campbell

Neelesh Patankar (left) and Malcolm MacIver observe a black ghost knifefish.

Sending signals

Researchers hope to make neuromechanical model of fish

When the sun goes down, the black ghost knifefish trawls the muddy Amazon River, using a long, ribbon-like fin on its underside to dart both forward and backward, and sending out electrical fields to find prey and navigate. The elusive fish are so mysterious that South American natives believed they housed the souls of departed friends and family.

But in a McCormick School lab, the mystery is rapidly disappearing. Researchers are working to create a neuromechanical model of the knifefish that could provide insight into how our brains take in information and use that information to move.

Malcolm MacIver, assistant professor of mechanical and biomedical engineering, has worked with the knifefish for some time, quantifying the signals emitted by the fish and creating computer models to reconstruct activity of its nervous system. When he came to Northwestern in 2003, MacIver and his team had already developed a good computational model of the fish's sensory system.

Then two years ago, MacIver teamed up with Neelesh Patankar, associate professor of mechanical engineering, to develop a mechanical model that predicts how the knifefish moves in water. Patankar had already used such computational techniques to create an algorithm that simulates the motion of an object through a fluid. His model is so exact that animators have even used it to program animated objects in water. Patankar's challenge with MacIver's knifefish was to extend that technique to a body that actively moved itself through water.

To do so, he had to solve for both the swimming velocity of the fish (corrected so it's consistent with the movement of the fish's body and fins) and the velocity field of the surrounding fluid. That allowed him to calculate the force generated by the fish to swim.

Patankar, working with postdoctoral researcher Anup Shirgaonkar and PhD student Oscar Curet, eventually created a mechanics model that, when given information on the fish's shape and how the fish moves its fins, can solve how that fish will swim and how the surrounding water will move. "Our algorithm can find a way to actually simulate how something goes from one location to another and what kind of forces the muscles would need to produce that movement," Patankar says.

When they applied the model to the knifefish, the team found that the knifefish's long fin pushes water out in rings of fluid that travel down its body — almost like it's swimming through a smoke ring. "Those rings carry momentum and generate force that pushes the animal in the opposite direction," Patankar says.

Now that the team has both a sensory model and a mechanical model of the fish, the biggest challenges lies ahead; they hope to reconcile both models to figure out what kind of message the brain sends to the muscle to make it move how it wants it to move. Because the fish brain is similar to the human brain, it can act as a simplified model and provide insights into how our own brains work.

Researchers have begun developing computer models that integrate both areas, and Patankar and MacIver must figure out the mapping that happens in the brain between sensing and moving. "What happens in between is this really complex sensory motor transformation," MacIver says. "How that process works isn't really well understood because we're not approaching the system with any good hypothesis."

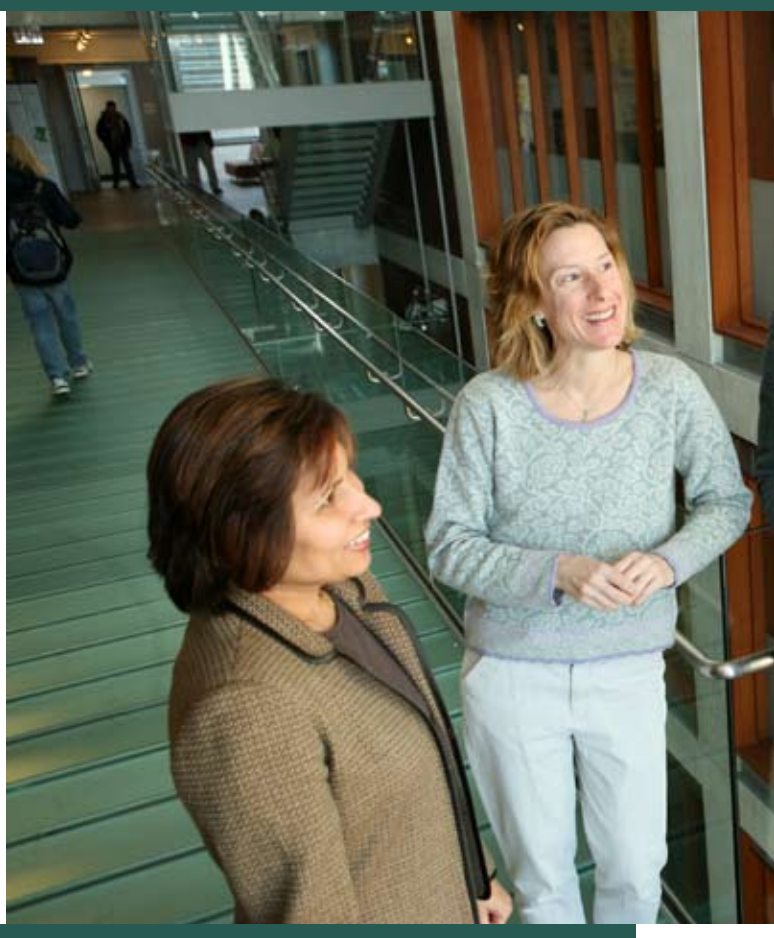
A combined model could give them a starting point to create such a hypothesis, he says. Then researchers could put electrodes on the fish's brain to test the hypothesis. "Through this collaboration we're going to get a really complete neuromechanical model, which we can then use to explore very fundamental problems about the nervous system and how animals — including humans — take sensory data and generate motor output," MacIver says.

That information could be used to create better robots or ease movement disorders. It could also be used as a tool to understand the impact of mechanics on evolution, Patankar says, and could lead to better animation and technology in the gaming industry. "It would have all these applications that would make it a very good tool to have," he says.

—Emily Ayshford

Fostering leadership development at McCormick

Kellogg classes prepare profs for management roles



Engineering professors' research usually focuses more on algorithms than accounting. Yet many professors at McCormick manage large departments and budgets, and others have developed technologies that could translate into start-up companies.

Fifteen McCormick faculty members are now better prepared to face such challenges after taking Business for Scientists and Engineers, a new faculty education class offered in winter 2008 through the Kellogg School of Management.

Last year Kellogg teamed up with the Johns Hopkins School of Medicine to create an executive education certificate program called Business for Scientists, which introduced scientists from Johns Hopkins to business concepts and industry tools. That partnership also produced Science for Managers, another certificate program aimed at teaching investors, executives, analysts, and government officials about physiology, disease, and regulatory affairs. Those classes were taught by faculty from Johns Hopkins and from Kellogg, the Feinberg School of Medicine, and the Judd A. and Marjorie Weinberg College of Arts and Sciences.

> **"Our faculty members each run small research enterprises, and some manage large budgets and large staffs. Providing them with the opportunity to gain insight and strategies from their colleagues at Kellogg will allow them to excel as organizational leaders."**
>
> — Dean Julio M. Ottino

When McCormick Dean Julio M. Ottino learned about the Business for Scientists course, he knew it was something that would benefit his faculty. "Our faculty members each run small research enterprises, and some manage large budgets and large staffs," says Ottino. "Providing them with the opportunity to gain insight and strategies from their colleagues at Kellogg will allow them to excel as organizational leaders."

Ottino got together with J. Larry Jameson, the Lewis Landsberg Dean at the Feinberg School, and Daniel Linzer, then dean of Weinberg College and now University Provost, to get them on board with the idea. The course name was changed to include engineers, and faculty members from all three schools were invited to apply for the three-weekend course.

Building business savvy

"To succeed in the life science industry, managers need to be science savvy, and scientists need to be business savvy," says Sangeeta Vohra, director of executive programs at the Center for Biotechnology Management at Kellogg. "If faculty members want their start-ups to succeed, they need to have some basic business skills. And quite a few of the faculty are not looking at start-ups but feel that the learning from this course will be very useful in the way they manage their departments and labs."

A total of 44 faculty members — 27 from Feinberg, 15 from McCormick, and 2 from Weinberg — were admitted to the program and promptly found themselves on the other side of the classroom. Class topics range from basic accounting to business strategy and marketing.

Andrew Campbell

From left **Sangeeta Vohra, Cate Brinson, Guillermo Ameer, and Linda Broadbelt**

"Most of the work that we do in our lab is highly applied, and there is a significant translational research component," says Guillermo Ameer, associate professor of biomedical engineering. "The skill gained in this course will be useful both from an organizational point of view and when talking to potential investors in technology."

"It has been excellent," says Cate Brinson, the Jerome B. Cohen Professor of Engineering and chair of the Department of Mechanical Engineering. "I wasn't sure what to expect when I went into it, but it has been phenomenal. In some ways it was the mystique of Kellogg that was the draw. They have such a great reputation, and I thought this was my opportunity to experience it firsthand."

Like many engineers, Linda Broadbelt, professor of chemical and biological engineering, hasn't had any finance or economics classes since her undergraduate studies. Broadbelt says she was prepared for boring lectures on accounting modules but instead got engaging conversations and fascinating stories about all different aspects of business.

"It's first-rate," she says. "I've really enjoyed it."

Leadership from all angles

During one afternoon session, Adam Galinsky, the Morris and Alice Kaplan Professor of Ethics and Decision in Management at Kellogg, lectured the group on leadership skills. But it wasn't your average PowerPoint lecture: Galinsky told stories about the challenges of implementing new firefighting strategies in the New York City Fire Department and showed clips of the movie *12 Angry Men* so the group could study the main character's leadership tactics.

And during the lecture, the faculty members weren't just passive listeners; they regularly piped up to challenge an idea or offer a suggestion. "We're an unusual audience," Brinson says. "They said we were especially lively. And in some ways that makes sense. We're used to being on the other side. We're all used to being teachers."

As a department chair, Brinson says she'll use the leadership lecture to help consider how to move her department in the right direction by getting a consensus and then turning it into a faculty vision. "In an academic department, there isn't a boss, where everyone has to do what the boss says," she says. "So leadership is more like in *12 Angry Men.* The lead character wasn't in charge, so we can look at what skills he used to bring people together."

Using business skills outside academia

The course wasn't just limited to lectures — participants also receive readings to study before class — and topics weren't just limited to professors' roles at school. The class considered the case of the biotechnology start-up company Scios, which had failed to have a single product approved during its 15-year history. The class discussed how the company should proceed — and whether it should partner with another company or put itself up for sale.

"That case study showed how a company grows and how biotech start-ups have a high failure rate," Vohra says. "The case discussion allows the participants to be interactive and is a great way to learn and understand."

These real-world scenarios are what attracted Broadbelt to the course, since she wondered how to turn her research into a company or more effectively do technology transfer. She also found new connections with faculty from different schools. "I've been meeting people from across campus and creating links with the medical school," she says. "This class has really fostered new partnerships."

"It's a perfect opportunity for faculty to get together on different grants and partnerships," Vohra says. "They say, 'Hey, let's get this idea going.'"

Vohra says the organizers of the course hope to make it a yearly offering. "There's a lot of demand," she says. Both Brinson and Broadbelt hope the class could be extended to graduate students as well.

"To become a faculty member, you just need a PhD, that's it," Brinson says. "You don't have to know how to manage people or money or projects. But those are critical skills for success. Perhaps in our graduate curriculum we could bring some of this back for our students."

—Emily Ayshford

From smart machines to "artscience"

Recent books by and about McCormick faculty cover the breadth of engineering and design

All photos by Andrew Campbell

Bridging the human-machine divide

We assume technology will always make our lives easier, and in many cases it has. Yet as machines get "smarter," we often get more frustrated. We don't like our car navigation systems because they don't let us give any input on the route. We don't like "smart" buildings that make decisions for us, like how far the blinds should be pulled and what type of lighting should be turned on. We don't like them because in those situations we lose control.

So how can humans and machines communicate effectively? Don Norman, the Allen K. and Johnnie Cordell Breed Senior Professor in Design, professor of electrical engineering and computer science, and codirector of the Segal Design Institute, addresses this in his recently published book *The Design of Future Things.*

The book is the latest everyday design book by Norman, who has been called the "don of design." It received accolades from national media outlets, and Norman was even featured in a *New York Times* science article headlined "Why Nobody Likes a Smart Machine."

The book focuses on the ever-increasing role of automation in our homes and cars — how it's done badly and what can be done to make it right. "The proper way to provide for smooth interaction between people and intelligent devices is to enhance the coordination and cooperation of both parties, people and machines," Norman writes. "But those who design these systems often don't understand this. How is a machine to judge what is or is not important, especially when what is important in one situation may not be in another?"

Norman writes that the future of design lies in the development of smart devices that drive our cars and clean our floors. The challenge is to create these machines so that they support our lives and add to our pleasure and convenience without adding stress. That will require combining the rigor of business and engineering with the understanding of social interactions and the aesthetics of the arts.

"In the past, we had to think about how people would interact with technology," he writes. "Today, we also need to take the machine's point of view…. In the past, we merely used our product. In the future, we will be in more of a partnership with them as collaborators, bosses, and, in some cases, servants and assistants."

Engineering a family project

It could very well be the first father-daughter mechanics book ever.

Cate Brinson, the Jerome B. Cohen Professor of Engineering and chair of the Department of Mechanical Engineering, has coauthored a new book, titled *Polymer Engineering Science and Viscoelasticity: An Introduction,* with her father, Hal Brinson. "I'm pretty sure there are father-son books, but this could be the only father-daughter," she says. "But I don't know how you verify its uniqueness."

First of its kind or not, writing the book was no easy feat — it took about 10 years and work on three different continents to make it come together. Cate and her father, a recently retired mechanical engineering professor from the University of Houston who also attended Northwestern, had talked about writing a book together for some time. Both taught advanced courses in polymers and viscoelasticity and shared notes, and since Hal had always wanted to create a book out of his notes, why not do it together?

"We would sometimes get into arguments about how you're supposed to explain a concept," she says. "And then it would turn out that we're both right."

They worked on the book little by little through the years, with Hal coming up to Illinois for the summer, Cate going down to Texas for a time during the winter, and Hal traveling to Germany while Cate was there on sabbatical. A final deadline from the publisher meant Cate was stuck putting the finishing touches on it during a flight to China.

Despite all the work, Cate says she would recommend her peers write a book with a parent. "You listen to each other in a depth that maybe you never reach with a typical colleague. Your relationship grows. And what a great family legacy!"

The book is likely too technical for the lay audience but could be used by working scientists and engineers who never studied polymer behavior in detail or in advanced undergraduate or graduate courses on materials. The book covers the physics of polymer behavior from a molecular level as well as viscoelasticity, a mathematical description of how polymers behave under mechanical loads and with varying temperature.

Mixing art and science

When Julio M. Ottino, dean of the McCormick School, developed his well-known theory on chaotic mixing and folding of fluid elements, he didn't start with experiments and equations — he started with a painting. That inspiration — the combination of both artistic and scientific techniques for innovation — is the hallmark of an "art-scientist," the term author David Edwards uses for Ottino and others in his new book *ArtScience: Creativity in the Post-Google Generation.*

In the book, Edwards highlights Ottino's childhood and university studies in Argentina, his graduate work in America, and his career at Northwestern. It recounts his first gallery exhibition of paintings and sculptures, his subsequent work combining his passion for both art and science, and how the interrelation between the two led to breakthrough research.

During his exploration of mixing, Ottino painted a watercolor that demonstrated how he believed fluid mixing worked. He looked at the painting every day as he continued his research. The mixing of art and science led to his discovery of chaotic mixing and folding — which appeared on the covers of *Nature* and *Scientific American.* His well-known book on the matter, *The Kinematics of Mixing: Stretching, Chaos, and Transport,* is illustrated with his art.

Ottino's belief in the importance of the role of art and design in the scientific process is reflected in the continued prominence of design at McCormick. In the past two years McCormick has launched the Design:Chicago seminar to connect design-related activities throughout the Chicago area. McCormick also held a National Academy of Engineering annual meeting titled "Design: Innovation and Engineering."

"We see design as a pathway to innovation," says Ottino, who is also a Distinguished Robert R. McCormick Professor and the Walter P. Murphy Professor of Chemical and Biological Engineering. "In many ways engineering can be seen as more of an art than a science. Engineering and art both seek to break paradigms in order to see things that haven't been seen before."

At the core of the book is the importance of interdisciplinary collaboration — the idea that multiple viewpoints are imperative in the search for solutions to society's greatest problems. "Analysis and creativity should complement one another," Ottino says. "Solving important problems — such as global health, energy, and the environment — will require strengths in both areas."

—Emily Ayshford

Top Don Norman
Above Julio M. Ottino
Left Cate and Hal Brinson

Banking on the versatility of their McCormick education, these alumni are thriving in finance careers

Success by the numbers

A lifelong love of sports and statistics lands Daryl Morey his dream job

As a young boy growing up in Granger, Ohio, Daryl Morey could often be found rooting for his home state teams the Indians, Browns, and Cavaliers. That interest in sports soon led him to study the numbers. "My favorite team was the Indians, and I wanted to figure out which players were good," Morey says. "I was looking for ways to rate and evaluate players because my Indians lost every year, and I didn't understand why."

Twenty-odd years later, the same questions still intrigue Morey, who in May 2007 became the general manager of the Houston Rockets. Morey is the first statistician in the NBA to fill the general manager position, a role typically held by former coaches or players.

Explaining the field of analytics, Morey boils it down to a strategy for risk management that is more reliable than human decision making. "Whenever there's a young star player coming out of the NBA everyone says, 'Oh, he reminds me of so-and-so and so-and-so who was good,'" Morey says. "Quantitative analysis can tell you that he's similar not just to the great player, but also to these other eight players who failed. By doing that, it gives you a better sense of the real probability and risk you're taking in a decision."

Morey's first chance to apply his interest in statistical analysis to sports came when he was a freshman at McCormick. As luck would have it, he was reading a book by Bill James — a renowned baseball writer and statistician considered the "godfather" of quantitative analysis — when he flipped to the back page and discovered that the author's sports statistics firm, STATS LLC, was located in nearby Skokie. A few weeks later Morey — along with a calculus classmate, Michelle, who would later become his wife — secured a job there through the Walter P. Murphy Cooperative Engineering Education Program. Morey answered phones, entered transactions, and eventually started giving trade advice to clients participating in the firm's fantasy baseball operation. By the time STATS LLC expanded into basketball a few years later, he was forecasting and building complex statistical models.

After graduating with a degree in computer science in 1996, Morey served a stint as a consultant in the defense industry before going on to earn his MBA at the Massachusetts Institute of Technology. It wasn't long, however, before his path once again led back to the world of sports. Equipped with his business degree, Morey took a consulting job at the Parthenon Group, where he helped broker deals. When a group of investors and Parthenon clients who had worked with Morey ended up buying the Boston Celtics, they invited him to come on board.

Morey moved to the Rockets in 2006, and a year later was named general manager. He has high hopes that his unique perspective will translate into a competitive advantage for the Rockets: "We're trying to differentiate ourselves on technology and information, having better data on everything done in basketball around the world. If a shot's being taken somewhere in the world, we're tracking it."

Morey is quick to credit his background as an engineer for the basic critical-thinking skills necessary to his post, and he says he draws on his McCormick education as a computer scientist every day. "Having a computer science degree and being a software engineer is enormously helpful as I'm leading and guiding the staff here. Everything we build is proprietary, and designing and building our software in a foundationally strong way is critically important."

So how does it feel to be the NBA's star statistician? "It's a great job, a dream job," Morey says. "I never complain and I get angry at anyone in our organization who does, because at the end of the day we're working on a game. How bad can it be?"

A knack for complexity underpins Yie-Hsin Hung's achievements

For Yie-Hsin Hung the decision to attend Northwestern was a family affair. Her father earned his PhD in civil engineering from McCormick, and after graduating from high school in Pittsburgh, the younger Hung headed west to follow in her father's footsteps.

As a mechanical engineering major at McCormick, Hung was especially driven. Carrying a heavier-than-usual class load and working at IBM each summer, she was able to earn her degree in under four years and was accepted into Harvard's MBA program straight out of Northwestern, one of an elite cadre of incoming Harvard students to earn the honor.

At the time, Hung says, she didn't know that her career direction would veer towards finance. "Harvard was one of the few schools that had a general management program, so I could get exposure to a lot of things," she explains. While in Boston, Hung met classmates who had experience as Wall Street analysts, and their stories piqued her interest. After spending a summer working at supercomputer company Cray Research in Minneapolis, Hung was hungry to broaden her experience. "I had gotten the business exposure, so next I wanted exposure to the financial side of things," she says.

Following that curiosity led Hung to where she is today: at the New York world headquarters of Morgan Stanley, one of the world's largest investment banks and global financial services firms. As managing director and head of global strategic acquisitions and alliances within Morgan Stanley's Investment Management division, Hung leads a staff of six. Her division oversees $600 billion of Morgan Stanley's $782 billion in total assets under management.

Hung got her start in the industry in 1986 at Dean Witter, a small investment-banking group. Beginning as a general industry analyst, she graduated into covering the real-estate market. In 1989 Congress created the Resolution Trust Corporation to bail out scores of insolvent savings and loan associations, and, in turn, sell off their assets. The change made real estate an extremely appealing sector of the market, Hung says. "Suddenly there were large portfolios of property available at distressed prices. That created lots of opportunities for entrepreneurs and enormous merger and acquisition activity."

Hung says she especially appreciated the complexity of the companies she was studying, a preference that harkens back to her days as an engineer. "Each company has its own tax situation, and a lot more analysis is involved in working with real estate-related companies than with other types of enterprises. I think my interest in them is reflective of my engineering background — I wanted to get into more complex situations."

Morgan Stanley absorbed Dean Witter in 1997, and Hung continued on as a real-estate expert until 2000. Afterwards she held several positions within the Investment Management division before transitioning into her current role in late 2006. In this position Hung is responsible for developing and implementing the division's growth-by-acquisition strategy, identifying and scooping up crack investment companies and teams to bolster the firm's already extensive capabilities.

During Hung's tenure the Investment Management division acquired a minority stake in Avenue Capital, a sizable hedge fund focused on investing in distressed securities, and purchased FrontPoint Partners, a group of about a dozen hedge fund teams. While the decisions she faces are laced with risk — "As the saying goes, 'Past performance does not guarantee future results,' and you make bets on people and their likelihood of success," she says — Hung clearly relishes, and has excelled at, her work. "It's very rewarding when it works — when you bring on a team and as a result of the combination of Morgan Stanley's global footprint and their capabilities, you're able to raise a lot of global assets."

Hung is quick to make the connection between how she spends her days now and the instruction she received more than 20 years ago at McCormick. "A lot of the training in engineering is about problem solving and identifying what needs to be done," she says. "I learned a tremendous amount."

—Josie Raney

New faculty

Dirk Brockmann, associate professor, engineering sciences and applied mathematics

Noshir Contractor, Jane S. and William J. White Professor of Behavioral Sciences, industrial engineering and management sciences

Lance Fortnow, professor, electrical engineering and computer science

Jason Hartline, assistant professor, electrical engineering and computer science

Jiaxing Huang, assistant professor, materials science and engineering

Younggang Huang, Joseph Cummings Professor of Civil and Environmental Engineering

Derk Joester, assistant professor, materials science and engineering

Diego Klabjan, associate professor, industrial engineering and management sciences

Paul Leonardi, Breed Junior Professor of Design and assistant professor, industrial engineering and management sciences

John Linehan, professor, biomedical engineering

Chang Liu, professor, mechanical engineering and electrical engineering and computer science

Hani Mahmassani, William A. Patterson Distinguished Professor in Transportation, civil and environmental engineering

Justin Notestein, assistant professor, chemical and biological engineering

Cheng Sun, assistant professor, mechanical engineering and electrical engineering and computer science

Igal Szleifer, Christina Enroth-Cugell Professor in Biomedical Engineering

Christopher Wolverton, professor, materials science and engineering

Faculty honors

José Andrade, assistant professor of civil and environmental engineering, won the 2006 Zienkiewicz Prize from the Institute of Civil Engineers (Britain) for his paper "Capturing strain localization in dense sands with random density."

Zdeněk Bažant, Walter P. Murphy Professor of Civil and Environmental Engineering and professor or materials science and engineering, presented the plenary opening lecture at the European Congress on Computational Methods in Applied Sciences and Engineering (ECCOMAS) Thematic Conference on Mechanics of Heterogeneous Materials at the Czech Technical University in Prague. He also presented plenary opening lectures at the sixth Hellenic Society for Theoretical and Applied Mechanics International Congress of Mechanics held at the University of Patras, Greece; SEMC 2007, the Third International Conference on Structural Engineering, Mechanics, and Computation in Cape Town, South Africa; and the inaugural conference of the newly formed Taiwan Concrete Institute. Bazˇant was also elected as to the European Academy of Science of Sciences and Arts, based in Salzburg.

The American Society of Mechanical Engineering (ASME) honored **Ted Belytschko,** McCormick School Professor, Walter P. Murphy Professor of Mechanical Engineering, and professor of civil and environmental engineering, by naming its applied mechanics award the ASME Ted Belytschko Applied Mechanics Division Award.

Justine Cassell, professor of electrical engineering and computer science and AT&T Research Professor in communications studies, has been awarded a Women of Vision Award from the Anita Borg Institute for Women. She was elected a fellow of the Stanford Center for Advanced Study in the Behavioral Sciences, joined the editorial board of the *International Journal of Learning and Media,* and presented the plenary lecture at the International Conference on Artificial Intelligence and Social Behavior.

Bob Chang, Walter P. Murphy Professor in materials science and engineering and electrical engineering and computer science, was elected a fellow of the Materials Research Society.

Ed Colgate, Pentair–Eugene and Bonnie V. Nugent Teaching Professor in mechanical engineering, gave the keynote address at the 2007 Association for Computing Machinery Virtual Reality Science and Technology Conference. He was also named editor in chief of IEEE Transactions on Haptics.

Isaac Daniel, Walter P. Murphy Professor in civil and environmental engineering and mechanical engineering, was elected a fellow of the American Society for Composites.

Pablo Durango-Cohen, assistant professor of civil and environmental engineering, and his student Pattharin Sarutipand won the Young Author Prize at the World Conference for Transport Research in Berkeley, California.

Horacio Espinosa, professor of mechanical engineering, received the 2008 Lazan Award from the Society for Experimental Mechanics and the 2007 Young Investigator Medal from the Society of Engineering Science. He gave a plenary lecture at the International Conference on Experimental Mechanics in Greece.

Kathy Faber, Walter P. Murphy Professor in materials science and engineering, presented the plenary lecture at the 50th anniversary meeting of the Korean Ceramic Society in Seoul.

Rich Finno, professor of civil and environmental engineering, was named Civil Engineer of the Year by the Illinois Section of the American Society of Civil Engineers.

Ken Forbus, Walter P. Murphy Professor in electrical engineering and computer science, gave a keynote talk at the SPIE meeting on "Quantum Communications Realized."

Lance Fortnow, professor of electrical engineering and computer science, was elected a fellow of the Association for Computing Machinery.

Bob Fourer, professor of industrial engineering and management sciences, was named editor of the *INFORMS Journal on Computing for Modeling: Methods and Analysis.*

Abe Haddad, Henry and Isabelle Dever Professor in electrical engineering and computer science, was appointed to a three-year term as visiting professor at the National Chung Hsing University in Taichung, Taiwan.

Dean Ho, assistant professor of mechanical engineering and biomedical engineering, delivered a keynote presentation at the Institute of Electrical and Electronics Engineers' Nanomedicine International Conference and received a V Foundation for Cancer Research Award.

Tito Homem-de-Mello, associate professor of industrial engineering and management sciences, received the 2007 INFORMS Revenue Management and Pricing Section Best Paper Prize.

Aggelos Katsaggelos, Ameritech Professor of Information Technology in electrical engineering and computer science, was the plenary speaker at the Symposium on Signal and Image Processing and Computer Vision in Barranquilla, Colombia.

Ray Krizek, Stanley F. Pepper Professor of Engineering in civil and environmental engineering, was inducted into the Innovation Hall of Fame of the University of Maryland's A. James Clark School of Engineering.

Harold Kung, professor of chemical and biological engineering, was recognized by Elsevier, the world's leading publisher of science and health information, as one of the 50 most-cited authors in catalysis for two separate papers. He also gave a keynote lecture at the 20th North American Catalysis Society Meeting.

Prem Kumar, AT&T Professor of Information Technology in electrical engineering and computer science, gave an opening keynote talk at the SPIE meeting on "Quantum Communications Realized."

John Linehan, professor of biomedical engineering, was appointed to the U.S. Food and Drug Administration's Science Board.

Wing Kam Liu, Walter P. Murphy Professor in mechanical engineering and civil and environment engineering, received the Robert Thurston Lecture Award from the ASME. He was appointed to the newly developed ASME Chair of the Nanotechnology Council.

Hani Mahmassani, William A. Patterson Distinguished Professor in Transportation in civil and environmental engineering, was elected an emeritus member of the Transportation Network Modeling Committee of the Transportation Research Board.

Phil Messersmith, associate professor of biomedical engineering and materials science and engineering, gave the keynote lecture at the Ninth Annual Conference on Surface Science of Biologically Important Interfaces in Manchester, England.

Bill Miller, William H. Miller Professor of Chemical and Biological Engineering, has been named North American editor of the *Biochemical Engineering Journal.*

Brian Moran, professor and chair of mechanical engineering, was elected secretary of the Society of Engineering Science.

Don Norman, Allen K. and Johnnie Cordell Breed Senior Professor of Design in electrical engineering and computer science, gave keynote speeches at the 2007 Brand ManageCamp conference, the Forrester Research Technology Leadership Forum, and the 2007 Healthcare Design Conference and presented the Nissan Distinguished Keynote Lecture at the Fourth International Driving Symposium on Human Factors in Driver Assessment, Training, and Vehicle Design in Stevenson, Washington. He also became codirector of the MMM Program.

Greg Olson, professor of materials science and engineering, gave the China Distinguished Materials Scientist Lecture in Beijing.

Monica Olvera de la Cruz, professor of materials science and engineering and chemical and biological engineering, and Graziano Vernizzi, research assistant professor of materials science and engineering, received the 2007 Cozzarelli Prize from the *Proceedings of the National Academy of Sciences.*

Julio M. Ottino, dean, Distinguished Robert R. McCormick Professor, and Walter P. Murphy Professor of Chemical and Biological Engineering, was invited to give the Pirkey Centennial Lecture at the University of Texas at Austin.

Manijeh Razeghi, Walter P. Murphy Professor in electrical engineering and computer science, was elected a fellow of the Materials Research Society.

John Rudnicki, professor of civil and environmental engineering and mechanical engineering, gave the Maurice A. Biot Lecture at Columbia University. He was also elected chairman of the Department of Energy's Geosciences Council.

Mary Silber, professor of engineering sciences and applied mathematics, was elected to the Society of Industrial and Applied Mathematics Council.

Julia Weertman, Walter P. Murphy Professor Emerita of Materials Science and Engineering, was elected a fellow of the Neutron Scattering Society of America in 2008.

William J. White, professor of industrial engineering and management science, wrote an article in the *Wall Street Journal* in December 2007 about the career strategy of taking a "demotion" to ultimately move ahead to an even better job.

1950s

Donald B. Bickler ('56), veteran mechanical engineer, who was awarded NASA's Exceptional Engineering Achievement Medal for his work on the Mars Pathfinder rover (Sojourner), was named a 2006–07 fellow of the American Society of Mechanical Engineers (ASME).

David O. Rickson ('59) of Bay Village, Ohio, retired as plant manager at Holophane Corp. He also spent 20 years in real estate. He and his wife, Jeannine Parker Rickson (SESP '59), met at Northwestern and enjoyed 43 happy years of marriage until her death in 2003. They had three children, David Rickson (Weinberg '85), Beth Rickson Popler (Weinberg '92), and Regan.

1960s

John J. Uicker Jr. (MS '63, MS '65), an engineering educator and author, was named a 2006–07 fellow of the ASME.

Edward F. Voboril ('65), chairman of Greatbatch Inc., a maker of components for implantable medical devices, was named chairman of the board of directors of Analogic Corporation.

David J. Werner (MS '66, PhD '69), chancellor emeritus of Southern Illinois University at Edwardsville, was named interim provost and vice president of academic affairs at Indiana University of Pennsylvania.

Abhijit Acharya (MS '68, PhD '75) was appointed to the board of directors of Naviscan PET Systems, an organ molecular imaging company.

E. Glenn Holmwall ('69) retired as director of Defense Logistics Information Service's customer products and services directorate.

1970s

Maureen Barry Grzelakowski ('76, MS '79) joined the Christian publishing company Zondervan as president and CEO.

Kenneth A. Monroe ('75) was hired as a senior project manager for program management in the Cleveland office of ADAMS Management Services Corporation, a provider of program management and advisory services for the health care industry.

Mark R. Norman (MS '75), director of the technical activities division of the Transportation Research Board, was named to the Institute of Transportation Engineers International Board of Direction.

William F. Yearout Jr. ('75) was hired as vice president of new business development at Trumpet Builders in St. Louis.

Laurie R. Hernandez ('79) was hired by Baxter International Inc. as vice president, strategy.

1980s

Michael D. Bryant (MS '80, PhD '81), the Accenture Endowed Professor of Manufacturing Systems Engineering, was named a 2006–07 fellow of the ASME.

Roberto Ballarini (MS '81, PhD '85) of Minneapolis is the James L. Record Professor of Civil Engineering and department head at the University of Minnesota's Institute of Technology.

Margaret B. Ross ('81), president of the Kimball Group, cowrote *The Data Warehouse Lifecycle Toolkit* (2nd ed.).

Mark Donald Heid ('82), program director for WebSphere Application Server Marketing at IBM, was a panelist for the AJAXWorld Conference in New York in March 2008.

Gregg M. Damminga ('83, MS '85) of Eagan, Minnesota, is operations director for Cypress Semiconductor in Bloomington. He and his wife, Debbie, won their classes in the 2007 American Powerlifting Federation's National Powerlifting Championships held in May in Saco, Maine. A former Northwestern football player, Damminga set an age and weight world record total for the squat, bench press, and dead lift with 2,005 pounds and a national record for the dead lift with 725 pounds. He is the reigning 2006 AFP/World Powerlifting Congress world champion.

John P. Mayer ('83) is executive director of the Center for Computer-Assisted Legal Instruction, which in 2007 added its first member school in China.

Send us your news!

Please e-your news to magazine@mccormick.northwestern.edu.

Arvind Rajan (MS '82, PhD '87) was hired by Prudential Fixed Income Management as head of quantitative eesearch and risk management.

Robert C. Sinn ('82) was hired by the Chicago office of the structural design firm Thornton Tomasetti Inc. as senior vice president.

Eric M. Robbins ('84) was hired by Boston-based Extraprise as vice president of marketing and business development.

Michael J. Rusinko ('84) managing director of Accenture's Minneapolis office, was appointed to the Minnesota State High School League, a voluntary, nonprofit association of more than 400 public and

private schools.

Betty Cheng ('85) of Okemos, Michigan, professor of computer science and engineering at Michigan State University, received a Michigan State University Distinguished Faculty Award in February. She has worked on high-assurance computing systems with industrial collaborators in the areas of software engineering, requirements analysis and modeling, and reuse. She recently launched a new research program in autonomic computing.

Helen S. Kim ('85) will be joining Kosan Biosciences Inc. in Hayward, California, as senior vice president and chief business officer.

Timothy C. Ovaert (MEM '85, PhD '89), an engineering professor at the University of Notre Dame, was named a 2006–07 fellow of the ASME.

Joe Girardi ('86) is the manager of the New York Yankees.

Katrina L. Helmkamp ('87) is joining the Whirlpool Corporation as vice president of refrigeration.

Kent Philip Mesplay (MS '87, PhD '93) was one of three Green Party presidential candidates to appear on the ballot for the Illinois primary elections in February.

Habib M. Alshuwaikhat (PhD '88) of Dhahran, Saudi Arabia, was promoted to professor in sustainable urban planning in the graduate program for city and regional planning at King Fahd University of Petroleum and Minerals.

Erik Jon Frieberg ('88) was named chief marketing officer in the U.S. headquarters of Dutch business process software company Cordys.

Jonathan H. Holley ('88) was named CEO of Jasper Asset Management, a new fund management, mergers and acquisitions, and wealth management arm of the Jasper Capital Group. He will be based in Jasper's offices in London and Dubai.

Thomas J. Mitoraj (MEM '88) is director of WiMAX business development at Motorola.

Steve Robert Ommen ('88) was promoted to professor of medicine in the division of cardiovascular diseases at the Mayo Clinic in Rochester, Minnesota.

Jacob Fish (PhD '89), professor of engineering at Rensselaer Polytechnic Institute and director of the university's Multiscale Science and Engineering Center, was elected a fellow of the American Academy of Mechanics.

Jianzhong Jiao (PhD '89) was hired by OSRAM Opto Semiconductors in Santa Clara, California, as manager of Regulations and Emerging Technologies.

Mushabbar Karimi (MME '89), a senior manufacturing engineer at the Robert C. Byrd Institute for Advanced Flexible Manufacturing, was named employee of the month for November 2007.

Clyde E. Henderson (materials science '73), orthopedic surgeon, Cincinnati

On his career: As a physician who specializes in the diagnosis and treatment of arthritic conditions, Henderson has become an accomplished total-hip and total-knee replacement surgeon. His career has provided opportunities to give back in numerous ways — supporting patient advocacy on the state and national levels and serving as a motivational and educational speaker for local organizations.

What he learned at McCormick: "I learned to balance my development as a scientist with growing as an individual and family man. I must recognize the materials science and engineering department faculty, especially Morris Fine, for their encouragement, confidence, and guidance."

How he stays connected: Henderson still communicates regularly with many of his McCormick friends and travels with some of them. To stay connected with the broader alumni population, Henderson reads alumni publications, visits the Northwestern Alumni Association web site, and donates to McCormick (National Society of Black Engineers) and the University.

Best McCormick moment: Henderson remembers dragging his wife to his material science lab to get specimens from the heat-treatment furnace at 3 a.m. on a number of occasions. He was also honored to have the opportunity to perform research on Vitallium®, a material he now uses in implants.

Most unlikely application of his engineering background: After graduation Henderson was often asked how his engineering degree would help him in his medical career, but he was never surprised to find the many applications of engineering in medicine. What is surprising, Henderson notes, is "how it helps my golf game, gardening, and photography hobbies. Engineering principles help me understand the crucial mechanics of grip, stance, and swing. My studies in engineering taught me patience, persistence, preparation, and perseverance."

Words of advice to current students: "Become well-rounded in your nonacademic activities and enjoy the exposure to the diversity of people and ideas. Being a Northwestern grad carries a lot of prestige and the responsibility to give back."

—Lina Sawyer

Kary Hisrich (industrial engineering and environmental engineering '98), strategy and operations manager, Deloitte Consulting, San Francisco

On her career: "Engineering is a great background for consulting. It has taught me how to logically approach, structure, and frame a complex problem to solve for the best answer. It has also taught the value of how to work effectively in a team environment."

Most unlikely application of her engineering background: After studying industrial engineering, Hisrich says she is no longer capable of looking at a line or process without thinking about how to make it more efficient. "Last January, I was standing at 15,000 feet on Mount Kilimanjaro with 4,000 feet more to climb on packed, icy snow, in single-digit temperatures, and a line of people in front of me. I worked with my fellow climbers to develop a strategy, and we navigated the line and the icy mountain to reach the peak."

How she stays connected: As an active member of the Northwestern University Leadership Circle Regional Council, Hisrich networks with fellow McCormick and Northwestern alums regularly. She also assists Bay Area high school seniors applying to Northwestern as part of the alumni interviewing process. "McCormick was such a significant part of my life and the foundation of my career, so I donate to the annual campaign. McCormick has given me so much; the least I can do is give back."

Best McCormick moment: In 1997 Hisrich was president of the Society of Women Engineers and held an event for Chicago inner-city girls. One of the activities involved building suspension bridges out of cardboard, string, and tape. "The girls were astounded when they tested the bridges they constructed by laying their purses on them — the bridges remained intact. One of the girls jumped up and down and yelled, 'I love engineering!' It made my day."

Words of advice to current students: "Enjoy your time at Northwestern — there is no other place like it. Also, find a career that you love, and it won't really seem like work."

—Lina Sawyer

1990s

Sizwe W. Mncwango ('90, MS '90) is managing director of Masana Petroleum Solutions, a "black economic empowerment petrochemical firm"" that took over the commercial division of BP Southern Africa.

Makola Mjasiri Abdullah (MS '91, PhD '94) was named dean of the Florida A&M University College of Engineering Sciences, Technology, and Agriculture.

In October 2007 **Alicia S. Boler-Davis** ('91) was profiled by *Jet* magazine as the first black female plant manager at a General Motors Corporation vehicle assembly plant.

Mark Howard Orttung (MS '91) was hired by CashView, an online finance management service provider, as vice president of product development.

James George Clessuras ('92) became a partner at Palo Alto law firm Wilson Sonsini Goodrich & Rosati in February 2008.

Sean Conlin (MEM '92, Kellogg '92) of Washington, D.C., rejoined Deloitte & Touche Consulting after 10 years in the entrepreneurial world. He oversees project teams working for the Department of Homeland Security and the Transportation Security Administration. He started a series of branding workshops to develop internal Deloitte talent and plans to expand development of the federal supply chain practice. He and his wife, Karen, created Helping Our Heroes Foundation, which provides financial and morale assistance to service members who were wounded in Iraq. The White House recognized the foundation as a leader in community service.

Karen McEwen Farthing (MS '93, MS '94) is the pastor of Pilgrim United Church of Christ in Elyria, Ohio.

Mario Greco ('93) of Chicago leads the Mario Greco Group at Rubloff Residential Properties. He specializes in the North Side of Chicago, representing traditional buyers and sellers, as well as developers who convert land or buildings into residential properties. In 2007 he received the Chicago Association of Realtors Platinum Award as the No. 2 full-service realtor in Chicago. He has sold more than $400 million worth of real estate since leaving the active practice of law in 2002.

William H. Schmitt (MEM '94) was hired by Mountain View, California, software production management company Electric Cloud as vice president of business development.

Sunil C. Shroff ('94), a cardiologist, has joined the staff of Silver Cross Hospital in Joliet, Illinois.

Matthew J. Boler (MEM '95) was named president and CEO of the Boler Company, succeeding his father, John Boler.

Peter Gerdine ('95) of League City, Texas, was named site distribution team leader at Solutia Inc. in Alvin. He manages logistics and inputs and outputs of the site's seven production units. In May he earned his MBA from the Jesse H. Jones Graduate School of Management at Rice University.

Minesh K. Shah ('95) joined Sharpcast in Palo Alto, California, as vice president of marketing.

Brett Gerwin ('99) of Birmingham, Ala., began a two-year fellowship in vitreoretinal surgery with Retina Specialists of Alabama in June after completing his residency in ophthalmology at the University of Alabama at Birmingham.

Robert H. Miller (MEM '99) joined MPC Containment International LLC in Chicago as vice president of engineered solutions.

2000s

Ajay Chawan (MEM '03) started a company with his father to develop a food processing method invented his father called CarboStar that slows the rate at which carbohydrates burn.

Cody R. Hansen ('07), an engineer at General Motors, married Mary Elizabeth Ferris (Weinberg '06) in July 2007.

Samir Shah ('98, MS '03) was hired by life reinsurance company Scottish Re Group Ltd. as executive vice president and chief risk officer, based in the company's Hamilton, Bermuda, headquarters.

Kurtis Shimko (MEM '03), a consultant with Bain & Co., who is currently doing a six-month rotation in London, was featured in a September article in the *Wall Street Journal* about recent graduates who work overseas to strengthen their résumés. Before joining Bain, Shimko worked in South Africa.

Brian Ruhe (MS '04) was the subject of a January 2008 article in *Career World* about how his own experiences as a double amputee influenced him to choose a career in biomedical engineering, with a focus on prosthetics.

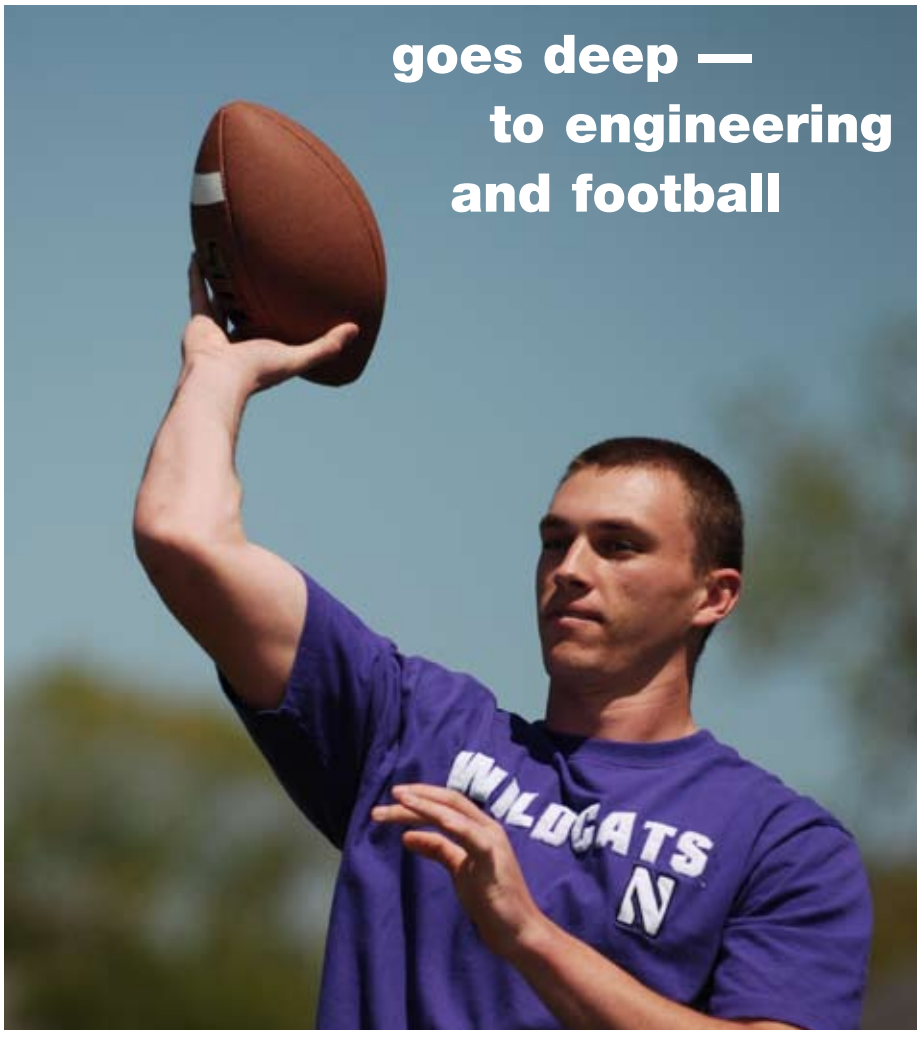
Erin Payton (MS '05) received the 2007 Momentum Award from Medtronic Corporation for employee volunteerism. The annual award is given to a select few employees who "demonstrate outstanding commitment to their community."

Robert John Steffen ('07) was featured in an October 2007 article in the *Minneapolis Star-Tribune* about medical students who choose to attend the University of Minnesota Medical School because of changes in the school's curriculum that allow more flexibility than other medical schools.

In memoriam

Frederick W. Brenne, '23
Willett E. Wentzel, ' 33
Joseph F. Faner, '38
Mrs. Edith B. Greer, '41
Robert L. Haley, '41
Hans G. Birnbaum, '42
John H. Fredrickson, '44
Norbert E. Pentz, '44
Russell H. King, '45
Col. Roger H. Lengnick, '45
Lloyd E. Nelson, '45
Irving A. Stein, '45
Gordon N. Stowe, '45
Edward I. Peters, '47
John F. Thomas, '47
Duane E. Blunt, '48
Thomas R. Brownell, '48
Charles W. Inman, '48
Hari D. Sharma, '48
Frank A. Bullmer, '49
George C. Hampel, '49
Donald E. Rappaport, '49
Wesson J. Ritchie, '49
Henry J. Ingram Jr., '50
Donald L. Jones, '50
Robert F. Mahood, '50
John L. Senter Jr., '51
Samuel Mirshak, '52
Walter J. Talley Jr., '52
James D. Walker, '52
William Henry Barnes, '56
H. Donald Jeter, '56
Richard L. S. Stec, '56
Marvin C. Bergwall, '61
H. Howard Harrison, '61
Matthew C. Sielski, '62
Lawrence R. Dennis, '63
Conrad E. Littig, '64
John Kaugars, '65
Byron J. Prugh Jr., '66
Robert A. Bolin, '69
Lt. Jerry D. Reeves, '72
Amr Sayed Azzouz, '74
Morgan S. Burke, '86
Lizabeth A. Schneider, '87
Chaturapadh Nakavachara, PhD '05

Eric Peterman goes deep — to engineering and football



Andrew Campbell

Eric Peterman (industrial engineering and management science '09) barely has time for himself between his studies, playing for the Northwestern Wildcats football team, and serving on the McCormick Student Advisory Board. But that's just fine with him — he loves playing football and loves being involved with the school. As he finishes up his junior year, Peterman hopes his future holds a career in football or the airline industry.

Why did you choose industrial engineering and management science as a major?

When I came here I just wanted to be an engineer. My freshman adviser, Jared Tuberty, was a great guy who helped me choose between industrial engineering, civil engineering, and mechanical engineering. I told him what I was interested in, and he suggested some classes for me to take. I love dealing with numbers, and I think that is something that the industrial engineering and management science department really demands. I like working with optimization, and I enjoy making things efficient, whether it's how I design my room or how I manage my time when I do my homework. I'm currently taking five classes, so time management is really important.

What is it like playing on the football team?

I love it. I've played sports my whole life, and I came to Northwestern as a quarterback. Two weeks into my freshman season, some wide receivers got injured, so I volunteered to step up into the position. It actually worked out well — I got to play my freshman year, and I started in 2006 and 2007. Playing in the Big Ten — one of the best sports conferences in the country — is just a great opportunity. I feel like Northwestern is an Ivy League school that participates in the Big Ten, so you get the best of both worlds. It's tough, though, because football takes up a lot of time. We practice year-round. Even in the spring, I get up at 6 a.m. and workout from 7 until 9 a.m. Then I have class all day, and then I do my homework at night.

How did you get involved with the McCormick Student Advisory Board?

I saw an e-mail looking for applications, so I applied, went through the interview process, and was accepted. The board acts as a liaison between student groups and faculty. It also oversees other student groups — right now one of our big projects is putting together an application for student groups to be recognized by McCormick. We also plan Engineering Week [a week of events for undergraduates that encourages interdisciplinary interaction, collaboration, and innovation]. I'm also on the committee for the Harold B. Gotaas Undergraduate Research Award, which is given to the senior who presents the best research paper. I just like being involved and having a say in what goes on at McCormick — I don't just want to be another student walking around. I like interacting with the faculty —Steve Carr [associate dean for undergraduate engineering] was my professor freshman year, and we've had a good relationship since then.

What are your future plans?

I'd like to play in the NFL if the opportunity presents itself, but otherwise I'd like to work in the airline industry. I'm fascinated with the idea of mapping routes and creating networks. This summer I'm going to work as a consultant with Aon, a risk management and reinsurance company based in Chicago.

—Emily Ayshford

National Medal of Science Symposium

May 14, 2008
8 a.m.
nmss.northwestern.edu

Join us for two upcoming seminars in Evanston. Both events are free and open to the public, but online registration is required.

May 6, 2008, 4 p.m.
designchicago.northwestern.edu

DESIGN: Chicago

Panelists and speakers include design professionals from

Bruce Mau Design
Herbst Lazar Bell,
IDEO
Institute of Design/IIT
Jerome Caruso Design
Motorola
Northwestern University
University of Illinois

NORTHWESTERN
UNIVERSITY

Robert R. McCormick School
of Engineering and Applied Science
Northwestern University
Technological Institute
2145 Sheridan Road
Evanston, Illinois 60208-3100

Nonprofit Organization
U.S. Postage
PAID
Northwestern University