Kristina Johnson's engineering path seems as though it was destined. Her father and grandfather were both electrical engineers for the Westinghouse Corporation and first-class tinkerers. Johnson's father, who died her sophomore year of college, fashioned his own ham radio at age 13 and pieced together an electronic keyboard during his senior year in high school—back in 1932.

Johnson exhibited signs early on that she inherited that same engineering gene. She loved math, regularly checking out math books from the library, built telegraph sets, and treasured the slide rule she received as a present. “That might have been when all the trouble started,” she jokes.

After considering a math major in college, then physics, she eventually chose electrical engineering. “It combined the best of both worlds, I thought,” says Johnson, who on September 1 became the university's 12th provost and senior vice president for academic affairs. She is also the first woman to hold Johns Hopkins’ second-ranking position.

A pioneer of applications with liquid crystals, Johnson holds more than 40 patents and is the co-founder of several start-up companies. She comes to Hopkins from Duke University’s Pratt School of Engineering, where she served as dean since 1999—also the first woman at Duke to hold that position.

Johnson was born in Webster Groves, Missouri and raised in Denver, Colorado. Her road to Johns Hopkins University has been an impressive one. As a senior in high school in 1975, her science fair project that used holography to map the growth of a fungus won a city engineering fair. The editors at the Denver Post took notice, electing her to the paper’s annual Hall of Fame.

Johnson enrolled at Stanford University on a Westinghouse Scholarship and graduated with distinction in 1981 with both bachelor’s and master’s degrees in electrical engineering. After earning her PhD at Stanford in 1984, she spent two years on a NATO post-doctoral fellowship at Trinity College in Dublin, Ireland, before joining the faculty at the University of Colorado. During her tenure there (1985 to 1999), she earned a National Science Foundation Young Investigator CAREER Award and worked her way up to full professor before leaving for the top engineering post at Duke.

Johnson has worked on microdisplays for high-definition projection televisions, a 3-D holographic puzzle, HDTV color separations, and optical symbol processing. Her company ColorLink, which she co-founded and sold in 2007, worked on circularly polarized 3-D technology for animated movies such as Chicken Little, Polar Express, and Monster House.

She is perhaps best known in research circles for pioneering work in the field of “smart pixel arrays,” which has applications in displays, pattern recognition, and high-resolution sensors, including cameras.

The new provost’s life does not start and end with her work, however. A sports enthusiast, she started women’s lacrosse at Stanford and also played field hockey. She has a red belt in taekwondo, played for Ireland’s President’s Eleven ladies cricket team, and rides horses recreationally whenever she can.

She’s also very passionate about involving young people, in particular women, in science. In 1990, she partnered with a television weatherman in Denver to create a 10-part educational series called Physics of Light. The highly successful series, geared toward 5th- to 8th-graders, aired on a local NBC-affiliated station and was later distributed to more than 500 schools throughout the Rocky Mountain region.

“All my life since college, I’ve been trying to get women and girls interested in science and engineering. It’s been a passion of mine.” —Kristina Johnson

Johnson is quick to point out that her advocacy extends beyond gender lines. “I’m an advocate for all people—[including] men and minorities,” Johnson says. “In my work with students, I want to see each individual grow and succeed to the best of his or her ability.” —Greg Rienzi
Diagnosing Cancer By the Numbers

If you're trying to create a diagnostic test for cancer, you'd expect that the more information you consider, the better. But recent work by Whiting School mathematicians shows that winnowing down the information you're looking at can be a better strategy.

Advances in gene chip technology now allow researchers to take a tissue sample and easily construct gene expression profiles for thousands of individual genes. Computer programs can then compare the profiles of healthy tissue to cancerous tissue and decide whether a particular kind of cancer is present.

It's not always easy, and even when the prediction works, it often depends on the combined expression levels of hundreds or even thousands of genes. So the information isn't much help for researchers looking for clues about what causes the cancer.

Now the winnowing method developed by department chair Daniel Q. Naiman and Donald Geman, both professors in applied mathematics and statistics, is proving itself not only effective but simple enough for humans to understand, apply, and draw hypotheses from.

Rather than consider the levels of hundreds or thousands of genes, their method depends on the relative levels of only two genes. “We decided to go to the other extreme, to do something as simple as possible,” says Geman.

The idea occurred to him when he was reading an article about programmed cell death. It turned out that by finding the levels of only two proteins, called Bax and Bad, you could tell if a cell was programmed to die. If there was more Bax than Bad, the cell would die; otherwise it would live.

Geman and Naiman wondered if the same thing would work with a test for specific cancers. They obtained microarray data for tissue samples that had been confirmed to be cancerous and took all of the gene-expression levels, threw away the actual numbers, and simply ranked each gene from lowest to highest. Then they compared every gene to every other gene, until they found two genes that by themselves predicted whether a sample was cancerous or not.

“It's cancer if the expression level of A is less than B. It's normal if vice versa,” Geman explains.

Although the technique requires a fair amount of number crunching to find the two genes in the first place, it's something that can be done in a fairly short time on a laptop. And once the pair for each kind of cancer is found, subsequent tests only have to look for those two genes.

Geman and Naiman proposed the idea in a 2004 paper, showing that it worked to predict breast, prostate, and leukemia cancers. Then earlier this year, researchers from the Institute for Systems Biology in Seattle and the University of Texas in Houston confirmed that the technique also works in telling the difference between two cancers—gastrointestinal stromal tumor and leiomyosarcoma—that can appear similar to diagnosticians but require different treatments. Their results appeared in the Proceedings of the National Academy of Sciences.

And because researchers have an idea of what those two genes do, they have a new lead to follow in trying to understand the underlying mechanism of the cancers.

The technique has its limitations. It doesn't provide a universal test for cancer—each particular kind of cancer has to be analyzed to see if two genes can be found that predict it. “It's not a magic bullet,” Geman acknowledges. “So far, none of these methods has made it to the point where it’s part of your blood test.” But stay tuned.

—Kurt Kleiner

Kudos

West Garners National Medal of Technology

In 1962, James West and Gerhard Sessler revolutionized the field of sound technology when they invented the electret microphone, found today in everything from cell phones to hearing aids, from children's toys to the devices astronauts use to communicate from outer space. More than 2 billion electret microphones are produced each year—95 percent of the total number of microphones in use today.

West, who joined the Whiting School's Department of Electrical and Computer Engineering faculty in 2001 after a 40-year career at Bell Laboratories and Lucent Technologies, was honored this past July with the 2006 National Medal of Technology for his achievements in the field of sound recording and voice communication.
New Paths of Excellence

On first meeting, Elliot McVeigh's laid-back demeanor comes through immediately. But don't be fooled. It's a serious kind of laid-back, an approach to life and work that should serve him well as the new Massey Professor and director of the Department of Biomedical Engineering (BME). The internationally renowned department is unique at Hopkins; it straddles the schools of Engineering and Medicine and includes close to 500 undergraduates, 140 PhD and 40 master's students, and 25 faculty members.

Consider McVeigh's vision for BME: “When we hire new people or admit new students, they have to be the very best. And we have to be open-minded,” he says. “They may not be the people whose research areas we were looking for when we started the process, but they have to possess superb scientific acumen. It means we have to be willing to let them lead us down new paths of excellence—maybe even ones we hadn't thought of before.”

An inventor on 11 patents for real-time interventional MRI and real-time MRI devices, McVeigh earned his PhD in medical biophysics from the University of Toronto and began his academic career at Hopkins in 1988, when he joined the Department of Radiology. He made the shift to Biomedical Engineering at Hopkins three years later. Then, while maintaining a part-time appointment at Hopkins, McVeigh joined the National Institutes of Health in 1999 as a senior investigator in the Laboratory of Cardiac Energetics. “My recent research is in developing new imaging techniques and devices to perform therapeutic interventions under image guidance,” he explains.

When the opportunity arose to return full-time to Hopkins and assume leadership of the rapidly growing BME Department, he jumped at the opportunity. “Who wouldn't want this job?” McVeigh asks with a smile. “I've been given a fantastic starting place,” he says, noting in particular the work of the department’s earlier directors, Dick Johns and Murray Sachs, both of whom remain on the faculty as teachers and

The Decker Quadrangle was tented for the October dedication (left). Gala guests entered through Mason Hall (right) and explored the new Computational Science and Engineering building (upper left).
A MacArthur Fellowship for Ruth DeFries

Ruth DeFries can see the forest through the trees, or more precisely, through satellite data.

DeFries, PhD ’81, has spent the better part of the past two decades using sophisticated satellite-imaging systems to obtain a clearer picture of the processes transforming our planet.

An environmental geographer, she uses this imagery to detect human modifications of the landscape and its impact on the biochemical processes that regulate the Earth’s habitability. She’s been able to observe land cover and land use change at regional and global scales to explore the implications on climate regulation, the carbon cycle, and biodiversity.

To honor her work, the John D. and Catherine T. MacArthur Foundation recently named DeFries a MacArthur Fellow.

Often referred to as a “genius grant,” the award comes with $500,000 in no-strings-attached funding over five years.

DeFries, a professor at the University of Maryland College Park, has focused her research on land use in tropical regions, an area that has witnessed a substantial shift toward agriculture at the expense of forests. She initially studied Central Africa and moved on to map areas in Southeast Asia and the Brazilian Amazon.

“The tropics are a region in transition. It’s dynamic and rapidly changing,” she says. “We’re trying to understand precisely what is going on. We’re looking at the implications of deforestation and changes in the climate, specifically the levels of carbon emitted into the atmosphere.”

“We’re looking to develop the scientific underpinnings for land use and find that proper balance for what is best for us in the long run,” she says. “We tend to think in terms of economic benefit, but there are implications to be considered: How does land use impact ecosystems, climate, biodiversity, and water quality?”

Grace S. Brush, a Hopkins professor of geography and environmental engineering who was DeFries’ mentor at the Whiting School, says her former student capitalized on technical advances in satellite imaging to advance the field.

“She is certainly very deserving of this award, for the truly elegant work she does,” says Brush. “She is very clear in her thinking, very smart, and I’m really happy that her work is being recognized.”

—GR
A Hospital Head Who Listens

On a recent afternoon after receiving an award for corporate leadership from the Greater Dallas Asian-American Chamber of Commerce—one of several awards she has garnered in the last few years—Winjie Miao ‘98 returned home with an 11 x 17-inch foam-board headshot of herself. “I was proud of the award, and flattered, but what do you do with a giant poster of yourself?” she laughs. “Maybe make a dartboard … or cover a big bathroom wall.”

For someone who was recently appointed president of Harris Methodist Northwest Hospital, one of 13 acute-care hospitals under the Texas Health Resources (THR) umbrella, Miao maintains a sense of humor and a centered look at what is important to her—in her work and her personal life.

“At the end of the day, I make decisions based on what is right for the patient. You can’t go wrong with that.” —Winjie Miao

And at 30 years old, Miao is one of the youngest nationwide to hold such a post.

With a bachelor’s degree in biomedical engineering from the Whiting School and a master’s in health care administration from the University of North Carolina, Miao jumped right into her engineering skills and ultimately, ended up with a hospital complex where function drives form.

In her new post at Harris Methodist, she has already added new technologically advanced equipment and is looking into creating a more robust education program, wooing more specialists to the roster of physicians, and continuing to reach out to the community through programs like hand-hygiene and CPR education, car seat checks and safety, and a health and wellness program for seniors that includes line dancing. “Already, I see how committed people are to this hospital and its rapidly growing community,” she says. “There is so much energy.”

Before falling asleep each night, Miao analyzes her day. “I think about each conversation I had and what I heard. I ponder the decisions I made and the ones I will need to make. And I always ask myself, ‘What can I learn from that?’”

What drives Miao in her work is knowing that every decision, every idea, is a step toward making the experiences of her patients—and staff—as smooth and positive as possible. “No one wants to be in the hospital; it can be terrifying and painful,” Miao says. “But knowing that I can impact an entire experience for a patient—the big picture for that person and for all of us—moves me to keep asking questions and then, to go forward from there.”

—Victoria Tilney McDonough

Fixing Fick’s Law

Marc Donohue, the Whiting School’s vice dean of research, places a cup of water on a table in his office. A cherry-flavored Life Saver rests at the bottom. “That’s diffusion,” he says, pointing at the cup.

Donohue has been working to better understand diffusion for nearly a decade. Recently, he and a team of colleagues shed new light on a classic diffusion equation—known as Fick’s Law—that has caused questions among mathematicians and researchers for nearly a century.

“Einstein gave a lot of credence to the idea that Fick’s Law is correct,” says Donohue, a professor in the Department of Chemical and Biomolecular Engineering. “But,” he concludes, “his analysis of it was overly simplistic.”

First described by physiologist Adolf Fick in 1855, Fick’s Law provides a mathematical explanation for diffusion. Specifically, it holds that during diffusion (the process by which molecules randomly and gradually spread from a high concentration to a low), the flux—or rate—at which the molecules spread is proportional to the concentration gradient.
Mechanical and Engineering Building was completed in 1914.

Joseph Evans Sperry designed the building, which cost roughly $285,000—a bargain when you consider the price tag of its new neighbor, the recently completed Computational Science and Engineering building: $37 million.

Not to say that Maryland Hall was not state-of-the-art for its day. It contained classrooms and labs equipped for experiments in photometry, high-voltage electrolysis, wireless telegraphy, fuel analysis, refrigeration, materials testing, and a range of other uses.

To illustrate, Donohue uses the submerged Life Saver and the ring of reddish-pink that slowly colors the water at the cup’s bottom. Left to sit for a week, the red coloring slowly creeps toward the top, until finally all the water in the cup is an even shade of pale red.

Classical Fick’s Law holds that the time it takes for the red to reach the top of the cup depends on the concentration gradient. “But, for the past century, everyone has known that concentration is not really the right variable to use in the equation,” says Donohue. “Instead, everyone believed that the flux is proportional to the gradient of the chemical potential.”

In other words, the amount by which the free energy of the system (i.e., cup’s water) would change if another particle (i.e., Life Saver) was introduced.

So, Donohue, along with Gregory Aranovich, a fellow professor in the department, and a cadre of graduate students, set out to determine whether the chemical potential is the true driving force for the equation.

They concluded that it isn’t.

In the June 1914 edition of the Johns Hopkins Alumni Magazine, C.C. Thomas, a professor of mechanical engineering, wrote that the new building was designed not just for undergraduate instruction in engineering, but the “investigation of problems fundamental to the industries and to the advancement of engineering knowledge.”

The main portion of the original building had three floors, an attic, and a one-story structure at its rear called Machinery Hall. The hall, in use through the 1950s, was 200 feet long, 50 feet wide, and 24 feet high. It featured a traveling crane for the handling of heavy machinery and an electrical switchboard that controlled all the space’s functions and “experimental circuits.”

Major General George W. Goethals, a civil engineer who famously supervised construction of the Panama Canal, gave the keynote address at the building’s dedication ceremony on May 21, 1915.

The university dedicated Gilman Hall on the same day, but by some accounts Maryland Hall was finished and occupied first, according to university archivist James Stimpert.

So why is Gilman regarded as the first building? Stimpert has a theory.

“Perhaps this was because Gilman housed the School of Arts and Sciences, which had been around since 1876, while engineering was the new kid on the block and had no history, yet,” he says. “I believe there was also some resistance to engineering on the part of some Arts and Sciences faculty, who feared that the School of Engineering would be a trade school rather than an academic division and would, therefore, lessen Hopkins’ prestige.”

—GR
Work That’s All Fun and Games

He-Man and Voltron action figures no longer rule the toy store. And while there are a few classic games and toys that seem almost guaranteed to remain popular forever, like Monopoly and Barbie dolls, even these favorites need helpful extras each year to keep sales brisk. (Witness Barbie Girls: A doll that doubles as an MP3 player and also instantly links girls to an interactive website.)

Keith Millman ’99, who studied mechanical engineering as an undergraduate, knows all this and pretty much everything else there is to know about toys. He knows who designs them, who manufactures them, and how long they’ve been selling. But Millman isn’t your average toy enthusiast; he’s a professional toy inventor.

Together with his business partner, Westley Ciaramella, Millman owns and operates Catapult Concepts, a toy inventing company the pair launched in 2004. They currently have three toys on store shelves: their successful Piranha Panic, a small table-top game involving dice, marbles, and plastic piranha that threaten to send players back to “start”; a card-balancing game of skill called Shakedown; and Barbie Gymnastics Divas Twirl Team (the duo invented a way to make Barbie twirl a ribbon in one hand while performing a back-spring crowned by a split).

Millman, who loved playing with Legos as a kid, landed his first real job after graduation from Hopkins back in his hometown of Hillsboro, New Jersey—in a strip mall.

“All my friends were going to law school or working in big-time finance jobs and I was working retail in a toy store,” he says. “But, I knew that to be an inventor, I needed to know what manufacturers were doing and where the trends and industry were going.” With a notebook always on hand, he recorded toy brands and manufacturers, new advances in technology, and sketches of his own toy ideas. By summer’s end, he knew exactly what role he’d play in the toy industry.

“I realized inventing would be a mix of engineering and design; everything I like, from imagining to executing a product and solving all the mechanical problems in between.” That fall, he entered the nation’s premier toy design program at New York’s Fashion Institute of Technology, where he later befriended Ciaramella. “For my application portfolio, I included some toy designs I had done but also used an AutoCAD drawing I had done in a senior year engineering course. I do think being an engineer from Johns Hopkins definitely helped my application.”

Completing the two-year program in 2001, Millman joined Big Monster Toys (BMT), one of the nation’s leading toy design firms. After three years with the company, he was itching to start his own. The following year, he wrote a business plan, raised the necessary start-up funds from friends and family, and he and Ciaramella launched Catapult Concepts.

The partners set up shop in the basement of an apartment complex in Long Branch, New Jersey. “With help of a family connection, we rented an apartment on the first floor to live in and used the basement as our workspace and office,” Millman recalls. “We even bought some of our work equipment off eBay, things like a metal working lathe, a mill, a vacuum form machine. Our shop kind of looks like a high school woodshop classroom.”

The start-up company experienced success almost immediately. “In our first year, we had three Mattel products, which is amazing,” Millman says. “Two made it to the shelf—our Piranha Panic game and a new feature for stuffed animals: a way for a stuffed cat’s eyes to close and its head to tilt when it’s being petted,” he explains. “If next year it goes to a dog, we will get an additional royalty.”

In the past two years, the pair has sold six more ideas. “Since it’s all still proprietary information I can’t talk about the actual products,” Millman says, but adds, “I can say that there is a game, a feature doll, a card game, and one is… a girls’ product.”

Though Millman today is light-years away from working retail at the mall, he still gauges the market the same way he did when he was fresh out of Hopkins.

“We go to the toy store a lot. Walking down the aisle, we know what’s considered a hit, who is gaining market share over whom, what toys are doing well, and where there’s room for something new,” he says. “We’re constantly thinking about toys.”

—AR
And They’re Off!

Adam Baumgartner, a sophomore mechanical engineer, is talking in a corner of Latrobe Hall’s basement. He’s describing his involvement on the Hopkins Baja-SAE team and is so excited that he’s actually jumping up and down in place. Standing 6 feet 8 inches (he’s also a forward on Hopkins’ men’s basketball team), he has enthusiasm that is both contagious and, in this cramped setting, slightly overwhelming.

The object of his excitement? A 10-horsepower, dune buggy–type vehicle that he and his Hopkins classmates are crafting to compete in an intercollegiate design competition run by the Society of Automotive Engineers (SAE). The single-seater must be equipped to race across rough terrain, catch air, and chug through deep water. The team’s goal: to create the most efficient machine that can take part in speed, distance, and durability competitions in a wide variety of settings.

Baumgartner’s co-captain for the 2007–2008 season is Avik De, also a sophomore mechanical engineer. Together the two are leading a group of 14 undergraduates (many from Mechanical Engineering, but others from Physics, Biomedical Engineering, and even International Relations) in the design and construction of the vehicle.

After planning, refining, and strategizing their design within the constraints defined by the SAE, the students will build and test the car. Later this spring, the team will compete in a series of international competitions against schools from across the United States, Canada, Latin America, and Korea. They will be judged on their design, cost, speed, traction, land maneuverability, water maneuverability, and endurance.

This marks the fourth year that a Whiting School team will compete in the contest. “Two super-motivated students started it here in 2004 and it is students that have made it a success,” says Lester Su, an assistant professor of mechanical engineering and the team’s faculty advisor.

Each team starts with the same 10-horsepower Briggs & Stratton engine and is allowed to cannibalize a percentage of parts from its previous year’s entry. “We’re making it substantially lighter than last year’s by taking out unnecessary tubes, completely redesigning the drive train, and making our own two-stage chain reduction box,” De says. “It’s a completely redesigned chassis,” adds Baumgartner.

When De explains that the car is designed entirely on the computer, Eric Harden, the department’s senior machine shop coordinator, chimes in, “But just because the computer says it works, that doesn’t mean it works.” While competing is clearly a thrill, the team obviously enjoys putting classroom learning to hands-on use. “There are trade-offs we have to make at every stage. But we’ve had the chance to learn how to use all these tools,” Baumgartner says, walking through the machine shop. “We learned to weld, which is cool. This is a dream come true for me. Definitely something to check off on my life ‘to-do’ list.”

To find out how the 2007–2008 team fares, check its website, http://www.jhu.edu/asme/baja.html, later this spring.

—AL

Expanding Worlds

As a kid, Blair Johnson ’08 was afraid of waves. She wasn’t a strong swimmer and the thought of getting knocked over and rolled into the undertow filled her with horror. Back then, she never could have imagined herself as an undergraduate drawn to coastal engineering; in fact, she never knew such a discipline existed. Flash forward 15 years and Johnson found herself in Granada, Spain, where she passed her summer studying wave patterns, ports, breakwaters, and coastal structures.

Here in Baltimore, the civil engineering major spends much of her time in the basement of the Stieff Building studying the nature of waves. In particular, she’s interested in how waves dissipate over mud, because mud is more elastic than a harder surface like sand and absorbs more of the water’s energy. Her hours logged alongside the 20,000-gallon wave tank gave her the foundation—far more solid than...
mud—to land the Vredenburg Scholarship and further her research abroad.

In the gorgeous city of Granada, where centuries-old buildings stand against a backdrop of jagged peaks, Johnson worked in a lab of almost 30 people, most of whom—professors and doctoral students—were older and more experienced. “We worked on port and harbor construction, specifically creating a new breakwater design,” she says.

The existing breakwater in the Port of Gijon, north of Granada, can dissipate the waves during calm weather. But when weather turns severe, it can’t prevent the waves from battering the beach and port. “We designed a berm that would be an extension, serving as a sort of sandbar in front of the existing concrete-block breakwater, which would help break the waves at an earlier point in their pattern, especially during storms,” says Johnson.

The breakwater design is being finalized, and its construction in the Port of Gijon should be complete within a year, she notes.

The young engineer says she chose to pursue coastal engineering because it would allow her to combine her interests in waves and oceans with structural engineering. “And, I’d get to travel to some amazing places all over the world.”

Her summer abroad as a Vredenburg Scholar didn’t disappoint. “I absolutely loved the culture there,” she says. At first she was surprised when everything shut down from 2 to 5 p.m. every day for siesta. “But soon I learned the pleasure—and importance—of reading a book by a fountain or spending a day walking in the countryside with a friend. People there are incredibly productive, but they also take the time to enjoy the good moments.”

And although she still isn’t a strong swimmer, Johnson hopes to return to the lab—and to the ocean—for a year of post-graduate work. “There is so much more to learn and do in Granada,” she says. “My summer there opened up the world for me.”

Julia Dixon ’08 spent one month training in Costa Rica and a second month in the town of Olanchito in Honduras where she repaired biomedical devices in a small public hospital. A pre-med student majoring in biomedical engineering, Dixon wanted to combine her studies in medicine and engineering. Working with a student partner from the Engineering World Health Summer Institute and a technician from the International Aid’s Medical Equipment Training Program, Dixon devoted her days to finding workable fixes for blood pressure cuffs, EKG machines, pulse oximeters, and nebulizers—all key equipment for a basic hospital.

Because their funding was limited, Dixon and her colleagues had to be creative in their approach to repairs, such as switching or rebuilding parts from several broken oximeters to create a single functioning one. “The work was often frustrating because we didn’t have the resources we needed,” says Dixon. “But I definitely think the summer gave me a full picture of what health care is like in developing countries. I was impressed that the clinicians would do their work every day with so few resources—and make a difference in the lives of so many people.”

As a physician,” she says, “I would like to return to Honduras or another Latin American country. If we in the United States are to help hospitals in [developing nations], we need to tailor our solutions based on their resources. It’s not just a matter of shipping them state-of-the-art equipment.”

Although he grew up in Botswana, Vredenburg Scholar Kwadwo Tettey ’08 gained a deeper insight into his homeland during his summer doing HIV/AIDS research. Working at the Botswana-Harvard Partnership for HIV Research and Education in the capital city of Gaborone, the chemical and biomolecular engineering major studied protein expression versus viral load in HIV/AIDS. The goal: to deepen understanding of the dynamics of the virus and how it progresses.

When he wasn’t setting up experiments and analyzing data, Tettey would visit the nearby hospital. “My research became very real to me,” he says. “Walking the hospital corridors, I would see so many HIV/AIDS patients—men, women, children, every age and sort of person.”

Tettey plans to pursue graduate work in nanotechnology, hoping to combine that work with further HIV/AIDS research. “A lot of people around the world are working very hard to understand and combat HIV/AIDS,” he says. “It is not fast enough, but I believe scientists will come up with a cure. I would like to go back [to Botswana]. And someday I’d like to be a part of finding that cure.” —VTM

Tettey captured this shot during a safari trip and scenic flight over Botswana’s Okavango Delta.
The Sum of Its Parts

For Chieh-San Cheng, MS ’91, everything he ponders is made up of parts—parts, or data, that ultimately create a whole picture or system.

Cheng is the co-founder and president of Global Science & Technology (GST), a company devoted to solving the technical and scientific challenges fundamental to technology-based enterprises. These enterprises range from creating meteorological imaging systems for global climate forecasting to a portable system designed for soldiers in wartime to receive—in real time—information via satellite. Working with the Goddard Space Center, GST's scientists have even been involved in testing the Hubble Space Telescope's wide-field cameras. The company currently has 200 employees, working at six different locations around the country.

Although Cheng created his company, in partnership with two colleagues who were also NASA contractors, with a foundation in meteorology and systems engineering, he insists he has never been an expert in any one specialty. “Neither am I a born leader,” says Cheng, who also earned a master’s in meteorology in 1975 from the University of Maryland. “But I do like people and I wanted to create a company that would not only provide a unique, healthy, and socially aware culture to its employees, but one that would also provide answers and options to the fields of science, engineering, information technology (IT), and technical support.”

In a relatively short time, GST has done just that, serving clients that range from NASA, the FBI, and NOAA (National Oceanic and Atmospheric Administration) to private global and IT companies. GST even uses RenderMan, the same data processing system that, for instance, Pixar used to create the throng of feisty four-wheeled friends in its recent movie Cars. “Pixar uses the program to entertain,” says Cheng. “We use it to tell stories about the Earth—like those of global warming and ocean patterns.”

Cheng started GST in 1991, just as he completed his master's through the Whiting School's Engineering and Applied Science Programs for Professionals (EPP), a degree he had worked toward for four and a half years while he was a NASA contractor.

“The curriculum in that program gave me the confidence I needed… and the big picture in technical management,” he says. “I knew as a child that I wanted to create my own fate, my own vision, and to work for myself. This program provided me with the missing pieces.”

Looking toward GST’s future, Cheng is focusing on medical imaging. “The medical industry has yet to take full advantage of 3-D imaging. Look at Earth and space sciences technology… look at what Pixar is doing in animation; those technologies are so far ahead [of medical technology],” Cheng says.

“We are developing software and programs, using the same technology we have been using to study the ozone hole or forest fire patterns, for example, that could be used to image the whole body at once—and through a low-cost, and lightweight system. Why look at only one section of the body when seeing the whole physical system in a more holistic way could answer so many more questions?”

—Chieh-San Cheng

Beware the Eavesdropper

In the past decade, millions of people have begun to use Voice Over Internet Protocol (VOIP) services that route their telephone calls over the Internet. Because the public nature of the Internet makes eavesdropping relatively easy, VOIP providers are increasingly encrypting the conversations to protect users’ privacy. But the encryption scheme has a weak spot, according to Whiting School computer scientists. Although the words will be garbled, a clever eavesdropper will be able to figure out what language is being spoken. And the researchers suspect that the encryption scheme in some circumstances might “leak” even more information, such as who is talking.

In the arcane world of encryption a vulnerability that gives this much information away is a pretty big deal.

“We can’t be naive about how determined or dedicated the attacker can be. Information, even in small amounts, if gathered in a timely way can have enormous benefits [to the eavesdropper],” says Gerald M. Masson, a professor in the Department of Computer Science and director of the Johns Hopkins University Information Security Institute.

Of course, intelligence services might want to use the newfound knowledge to zero in on potential terrorists. But corporate spies might also use it against competitors—perhaps getting a heads up about the location of a new plant based on the language being spoken in eavesdropped phone calls.

Masson, along with associate professor Fabian Monrose and graduate students Charles V. Wright and Lucas Ballard, showed that...
weaknesses in VOIP encryption let them make pretty good guesses about what language the conversations are being conducted in, even though the actual words remained obscure. They presented their findings at the 16th Usenix Security Conference in Boston last August.

Here’s the problem the researchers discovered: To send a phone call over the Internet, VOIP software first converts the analog signal to a digital one. To save bandwidth, most software uses a trick called Variable Bit Rate encoding—each 20 millisecond “frame” of the conversation is encoded using only as many bits as are needed to convey the information. For instance, a frame that contains a vowel sound will contain more bits than one that contains a consonant like an.

Before these frames are sent over the Internet they can be encrypted. But the encryption doesn’t hide the size of each frame. What the researchers showed is that an attacker who intercepts the conversation can do a statistical analysis of the frame sizes, and use that analysis to make a good guess about what language is being spoken.

The researchers did it themselves, making encrypted VOIP calls between their own computers and playing files from a dataset of native speakers of 21 different languages. Using their technique, they could correctly classify the language being spoken at a much better rate than random guessing. For instance, they could correctly predict if Indonesian was being spoken 40 percent of the time, and Russian and Tamil 35 percent of the time. On average the correct language was one of the top four guesses more than 50 percent of the time.

The software did even better in choosing between two given languages, such as Spanish and English. In 75 percent of the pairings, the technique predicted between two languages with 70 percent or greater accuracy.

The researchers suspect that encrypted VOIP might leak even more information. For instance, an attacker might be able to tease out enough information about the voices speaking to tell if a particular person was involved.

“I think that in general this technology would only have special purpose applications. But that one-tenth of one-tenth of the time where it can provide a slight advantage can have a lot of value,” Mason says. —Kurt Kleiner

Blackbird Takes Blue Jays Under Its Wing

Computer science major Matt Fedderly can’t say much about what he did last summer as an intern at Blackbird Technologies Inc., but he enjoyed it immensely. “I was working with really smart people, and I learned stuff you can’t really learn in school,” he says.

Based in Herndon, Virginia, Blackbird provides high-level information security and other technical support to government and corporate clients, and much of the work is confidential—some, top-secret. “We develop tools and capabilities critical to the success of the global war on terrorism, as well as to address the information technology needs of the intelligence and defense communities and similar challenges in the private sector,” explains Executive Vice President and Chief Technical Officer Richard Moxley.

“It’s a great place for a technical person to work,” he says. “We invest aggressively in internal research and development, becoming expert in the work of our customers and developing ideas for new products that we then take to them.” For example, the company conceptualized and developed a state-of-the-art, hand-held satellite communication device for the Department of Defense that is now being used in places around the world without a cell phone network. That includes areas where the U.S. military is currently engaged, Moxley notes.

The 10-year-old company’s growth recently prompted Blackbird to seek out potential sources for new employees and research collaborators, and Johns Hopkins was high on the list. In addition to the Whiting School’s stellar reputation in information security and related areas, Blackbird Executive Vice President Steve Pann had firsthand experience with the Whiting School through his son Nick, now a sophomore. After a few meetings with Dean Nick Jones and faculty at Johns Hopkins University Information Security Institute (JHU/ISI), Blackbird executives were “very impressed with the quality of the students and with the school’s research and programs in the technical areas we’re engaged in,” says Moxley.

This fall, the company funded the Blackbird Technologies Scholarship, which provides a student with an undergraduate scholarship. “We wanted to invest in students,” says Moxley, “and we see this as a first step toward a more robust relationship.” The inaugural recipient is Barrett Duke, a sophomore majoring in computer engineering.

“We’re grateful for this gift, and tremendously pleased by the confidence Blackbird Technologies has shown in the Whiting School,” says Dean Jones. “We look forward to a growing collaboration on both the engineering-education and research fronts.”

Moxley, Pann, and their colleagues are actively exploring opportunities for new partnerships with the Whiting School. “We’re getting to know more about the students, the programs, the faculty, and the staff,” says Moxley. In addition to supporting the Blackbird Technologies Scholarship, the company will again seek out qualified Hopkins undergraduates for its summer internship program, which is being expanded.

Matt Fedderly would be pleased to return for another summer, he says. “It’s a great opportunity.”

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—Margaret Hindman
Friends We’ll Miss

Jack Spangler

William Jack Spangler, whose affiliation with Johns Hopkins spanned 45 years, died on September 16, 2007 at the age of 62. Spangler began at Hopkins in a work/study position during his senior year of high school and was hired by the Department of Physics immediately upon his graduation in 1963. In 1995, he transferred to the Department of Civil Engineering, where he remained as a senior instrument designer until his retirement last August. He received the Whiting School of Engineering’s Outstanding Staff Service Award in 2002.

“Jack was truly gifted,” says Nick Jones, dean of the School of Engineering, who worked with Spangler on numerous bridge-related research projects over more than a dozen years. “He had a tremendous gift for understanding electromechanical systems, and would diagnose and repair complex mission-critical systems in a calm, unflappable manner.”

Bob Pond

Robert B. Pond, an emeritus faculty member who taught at Johns Hopkins from 1947 until his retirement in 1998, died on October 5, 2007.

Pond was devoted to teaching, research, consulting, and lecturing in the field of physical metallurgy. He was also known to generations of students for the bowties he fashioned out of aluminum for himself and each new professor in the department.

Bob Green, who recently retired from the Materials Science and Engineering Department, recalls his colleague and friend of more than 40 years with whom he founded the department in 1983. “Bob Pond was one of the best teachers at Hopkins Engineering. He knew all the things that are in the books but he also knew the practical side of things from his industry experience at Bethlehem Steel. He was friendly and enthusiastic and as a teacher he was very approachable. All the students loved him. He taught me most of what I know and was a wonderful mentor and friend.”

Pond’s research involved solidification phenomena, the practice of cire perdue casting and growing multiple metallic single crystals in a single mold. For many years, Pond studied the nature of ductility at deformation rates exceeding the velocity of sound in metals and alloys and the deformation of single crystals on a microscopic scale. He took the first high magnification movies of slip bands forming and propagating during tensile formation, using a technique he christened “cinemicrography.”

Dean Nick Jones notes that Pond’s dedication as teacher and scholar continues to be recognized through two awards at the Whiting School: The Robert B. Pond Senior Achievement Award and the Robert B. Pond Excellence in Teaching Award.