Vanderbilt

engineering

Fall 2011

ISIS

Health Care Aerospace
DEFENSE Embedded Systems
Wireless Sensor Networks
EDUCATION Cybersecurity
CYBER-PHYSICAL SYSTEMS

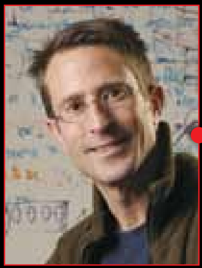
Impact

ISIS' pioneering model-integrated computing is at the epicenter of a transformation in engineering

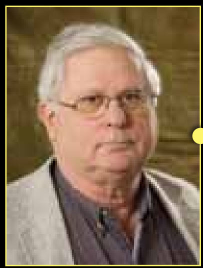
honors and awards

James H. Clarke, professor of the practice of civil and environmental engineering, has been elected to the executive committee of the American Nuclear Society's Decommissioning, Decontamination and Reutilization Division. The division is charged with promoting the development and use of technologies associated with the management of nuclear facilities and materials.

Dean and Professor of Electrical Engineering **Kenneth F. Galloway** has been named to the Academy of Fellows of the American Society for Engineering Education. Galloway is the current past chair of the ASEE Engineering Deans Council.

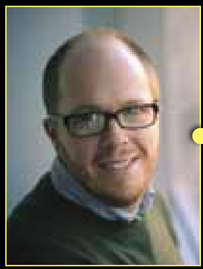


H. Fort Flowers Professor of Mechanical Engineering **Michael Goldfarb** has received the inaugural Edward C. Nagy New Investigator Award from the National Institute of Biomedical Imaging and Bioengineering. Goldfarb is the director of the Center for Intelligent Mechatronics.



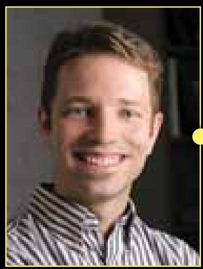
Paul H. King, professor of biomedical engineering, emeritus, is the 2011 recipient of the highest award given by the biomedical engineering division of the American Society for Engineering Education. The Theo C. Pilkington Outstanding Educator Award honors lifetime achievement in teaching, research and administration.

Clare McCabe, professor of chemical and biomolecular engineering, received Vanderbilt University's Madison Sarratt Prize for Excellence in Undergraduate Teaching. The winner is selected by the university's chancellor from nominations by undergraduate students.

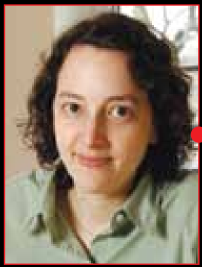


Assistant Professor of Biomedical Engineering **W. David Merryman** has received a National Science Foundation Faculty Early Career Development (CAREER) Award. The grant will further his research in tissue engineering. Merryman has also been named a 2011 University of Tennessee Alumni Promise Award recipient.

Hak-Joon Sung, assistant professor of biomedical engineering, has been awarded a National Science Foundation's Faculty Early Career Development Award. The grant will support Sung's new approach to regenerate injured small blood vessels as well as create a new toolbox for minimally invasive surgery.



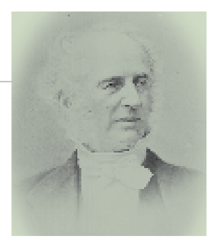
Assistant Professor of Mechanical Engineering **Robert J. Webster III** has been awarded a National Science Foundation's Faculty Early Career Development Award. The award will aid his efforts to design more accurate and less invasive surgical tools called continuum robots.



Sharon Weiss, associate professor of electrical engineering, has been accepted into the 2012-2013 class of the Defense Science Study Group. The group introduces selected scientists and engineering professors to the challenges facing national security and encourages them to apply their talents to these issues.

Yaqiong Xu, assistant professor of electrical engineering, has been awarded a National Science Foundation's Faculty Early Career Development Award. The grant supports her efforts to measure, at the single-molecule level, the electrical and mechanical interactions between individual carbon nanotubes and DNA molecules.

engineering



On the cover: With model-integrated computing as its core, ISIS develops advances that impact aerospace to education and health care to defense.

INSIGHT ◦ INNOVATION ◦ IMPACT®

Volume 52, Number 2, **fall 2011**

Editor
Nancy Wise

Designer
Christopher Collins

Assistant Art Director
Michael Smeltzer

Art Director
Donna Pritchett

Contributors
Brenda Ellis, Mardy Fones, Becky Green, Jennifer Johnston, Teresa Rogers, Sandy Smith, T.J. Stiles, Cindy Thomsen, Gregory Tragitt (BE'78)

Photography
Neil Brake, Daniel Dubois, Steve Green, Joe Howell, John Russell

Web Edition Development
Devin McWhorter

Visit the School of Engineering on the web at *www.vuse.vanderbilt.edu* and Vanderbilt's alumni publications at *www.vanderbilt.edu/alumni/magazines*

Vanderbilt Engineering, the Vanderbilt University School of Engineering magazine, is published twice yearly in cooperation with the Office of Development and Alumni Relations Communications for alumni, parents of current students, faculty and other friends of the School of Engineering. Editorial offices are located in the Loews Vanderbilt Office Complex, 2100 West End Ave., Suite 820, Nashville, TN 37203. (615) 322-4624.

Contact Engineering Development and Alumni Relations at PMB 401531, 2301 Vanderbilt Place, Nashville, TN 37240-1531. (615) 322-4934.

Send news items and address changes to the editor at: PMB 407703, 2301 Vanderbilt Place, Nashville, TN 37240-7703.

Our Engineering Education Past . . . and Future

Our university's benefactor, Cornelius Vanderbilt, was an engineer. He may not have had a formal education in engineering but he used his ingenuity to solve problems faced by society in his time, and he created products and services that added value to the economy.

DANIEL DUBOIS

Dean Galloway

In this issue of *Vanderbilt Engineering*, as we begin a yearlong observation of the quasquicentennial of the School of Engineering—our 125th anniversary—we celebrate the past while renewing our vision for the future as a leading engineering school creating and disseminating new knowledge. We are fortunate to have T.J. Stiles, Pulitzer Prize-winning author of *The First Tycoon: The Epic Life of Cornelius Vanderbilt*, contribute to this significant milestone by writing the feature article, "Vanderbilt was an Engineer" on page 22 of this issue.

As with many of Cornelius Vanderbilt's contemporaries, the Commodore recognized the value of engineering as a means of technological and economic advancement. He, along with Andrew Carnegie, Ezra Cornell, James Duke, Asa Packer, John Rockefeller, Leland Stanford and Stephen Van Rensselaer among others, recognized through their endowments of universities with similarly successful engineering schools that a growing economy required an educated workforce.

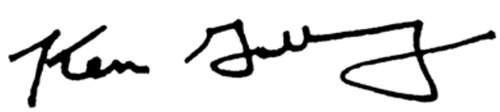
The value of an engineering education is echoed across the centuries and a capable engineering workforce is still a topic of great concern, especially in a troubled economy. The National Academy of Engineering President Charles Vest urges, "In the U.S., we must compete in the global economy and maintain our American standard of living. … Prospering in the knowledge age requires people with knowledge."

Scholars have been stressing the importance of the knowledge economy for decades. But what does this mean? Peter Drucker, the world-renowned management scholar, had a deep appreciation for the engineering profession and defined the knowledge economy as one that focuses on production and management of knowledge. Understanding how to apply knowledge for economic gain requires a highly educated society. This belief is validated by our engineering graduates being sought by organizations in nearly every sector of the market, not just technology companies.

In *Science* magazine, Norm Augustine (retired CEO of Lockheed Martin Corp.) stated, "More than half of the increase in the U.S. gross domestic product has been attributed to advancements in science, technology and innovation." I cannot think of a time in our history where this fact has meant more to our global competitiveness than now. Recently Paul Otellini, president and CEO of Intel wrote in an opinion piece, "If we want the next Intel, GE, Google or Facebook to be born and grow up in America, we must begin producing more engineers. These jobs support our future." Engineering and engineering education have never been more important to the future of our country.

I offer this quote to you as a parting thought: Robert Solow (Nobel Prize in Economics, National Medal of Science) stated, "There is no evidence that God ever intended the United States of America to have a higher per capita income than the rest of the world for eternity." Work must never stop on American innovation for global economic prosperity.

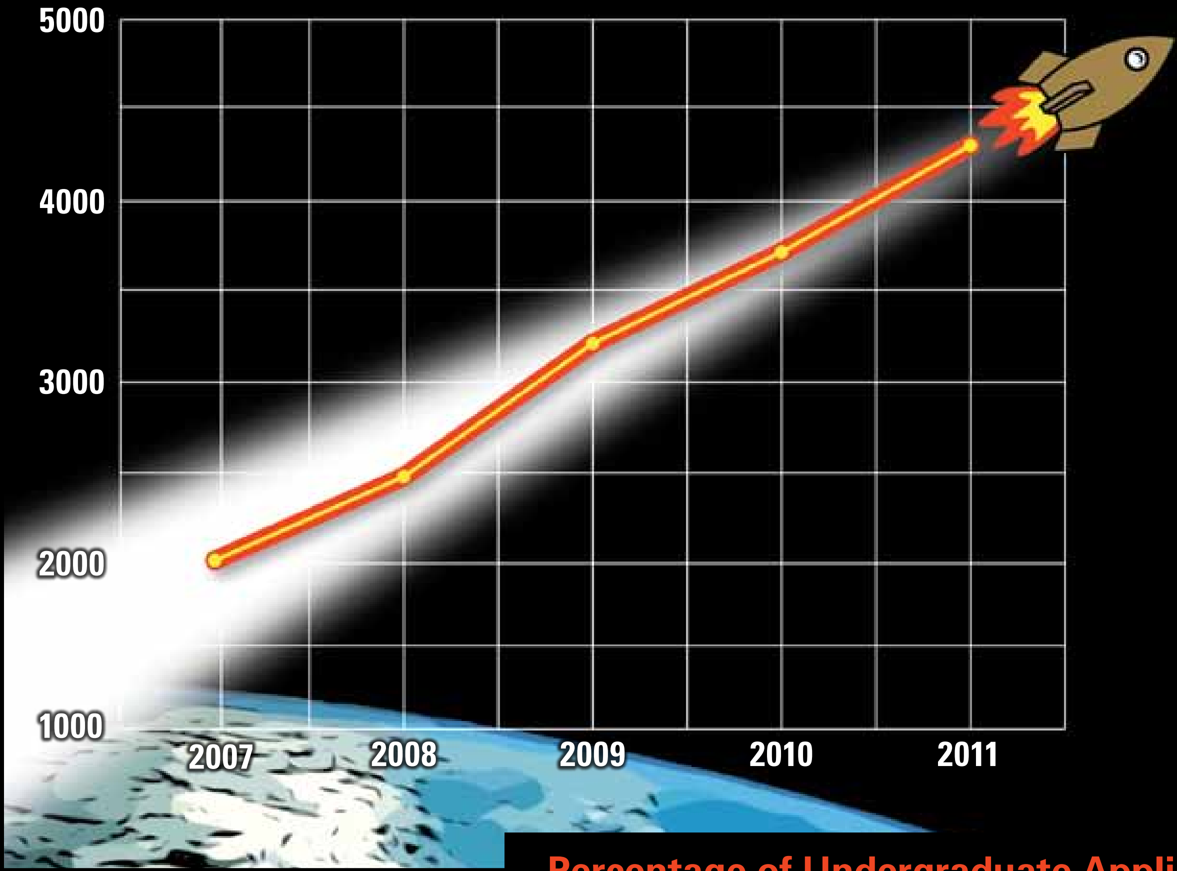
Please join me, the faculty, the staff and the students of the School of Engineering in celebrating our rich heritage. I hope you find the historical contents of this issue of *Vanderbilt Engineering* interesting (and possibly nostalgic), as well as the activities in which our students and faculty are currently engaged.



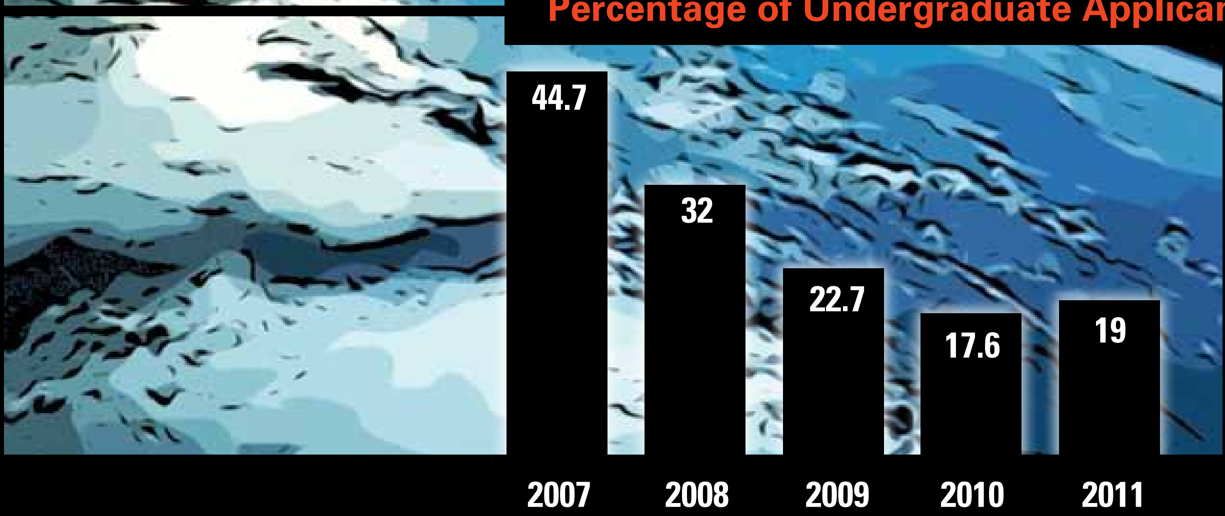
Kenneth F. Galloway
Dean

The Vanderbilt University School of Engineering has seen its numbers increase since its first group of engineering students and faculty in 1886. Here's the latest:

Number of Undergraduate Applicants



Percentage of Undergraduate Applicants Admitted



Engineer on the Board

Leslie Labruto, BE'11, has joined the Vanderbilt University Board of Trust as the 2011 Young Alumni Trustee. Young alumni trustees are elected by graduating and just-graduated seniors—engineering and nonengineering majors alike—to be their voice on the university's governing board and serve as fully voting board members.

Leslie Labruto

Labruto majored in civil engineering and earned a double minor in engineering management and energy and environmental systems. As a junior, she was president of SPEAR (Students Promoting Environmental Awareness and Recycling) and led an initiative, in partnership with Vanderbilt Student Government, to establish Vanderbilt's $75,000 Green Fund for sustainable student initiatives on campus. She also helped create Vanderbilt's first Humanitarian Senior Design Project, which aims to bring renewable energy to a community in Guatemala, and participated in programs such as Engineers Without Borders. She is now a graduate student at the University of Cape Town in South Africa studying renewable energy.

Labruto joins recent engineering alumnus **Ayotunde Ositelu**, BE'09, as one of four young alumni trustees, providing student and young alumni perspectives to the Board of Trust.

Computing … It's Not Just for Computer Scientists and Engineers Anymore

No matter what their field of scholarly pursuit, engineers and researchers need a common tool: scientific computing. To assist psychologists, sociologists, economists, biologists and others in the social, life and natural sciences develop the computer skills they need, the School of Engineering and College of Arts and Science has launched a new minor in scientific computing.

The minor was created by faculty from both schools and will be available to students in all colleges. It is co-directed by **Robert Bodenheimer**, associate professor of computer science, **Thomas Palmeri**, associate professor of psychology, and **David Weintraub**, professor of astronomy.

"The computer science major and minor do a great job preparing engineers to understand the theoretical and practical foundations of computation, but they are not designed for people who want to use computers to solve computationally demanding scientific or engineering problems," Bodenheimer says. "That's where the scientific computing minor comes in."

Bodenheimer says he and the other professors involved believe the minor will have broad appeal. "It will make computational methods and thinking more accessible to students interested in understanding its impact in modern science and engineering," he says, adding that while faculty from computer science, psychology and physics led the way in the design of the minor, there was also input from mathematics, mechanical engineering, biomedical engineering, chemistry, biological sciences and other disciplines.

Well-deserved and Well-done

The School of Engineering celebrated the promotion of three faculty members to professor and one to associate professor at the final faculty meeting of the 2010-2011 academic year. **G. Kane Jennings** was promoted to professor of chemical and biomolecular engineering, **Clare McCabe** was promoted to professor of chemical and biomolecular engineering, and **Nilanjan Sarkar** was promoted to professor of mechanical engineering. **Sharon M. Weiss** was promoted to associate professor of electrical engineering with tenure.

JOHN RUSSELL

Jennings

JOE HOWELL

McCabe

JOHN RUSSELL

Sarkar

Dean Kenneth Galloway also presented awards to graduate students, staff and faculty. The Excellence in Teaching Award was presented to Professor of Mechanical Engineering **Nilanjan Sarkar**. The 2011 Edward J. White Engineering Faculty Award for Excellence in Service was presented to **Paul King**, professor of biomedical engineering, emeritus. **Linda Hurst**, media technical supervisor, received the 2011 Judith A. Pachtman Staff Service Award. Galloway recognized mechanical engineering graduate student **D. Caleb Rucker** as author of the best student research paper of 2010, published in *IEEE Transactions on Robots*.

The new minor is offered for the first time this fall and was created with support from a National Science Foundation grant. The program also serves a bigger need, Bodenheimer adds. "By improving the computational skills of scientists and engineers, we can achieve the broader impact of improving science education in the United States."

Shooting Toward an Award


NASA MARSHALL SPACE FLIGHT CENTER

What do you do after you earn an award from NASA? If you're the Vanderbilt University School of Engineering team, you do it again. For the second year, the Vanderbilt Aerospace Club won the Payload Design Award in the NASA University Student Launch Initiative. Teams from 29 universities were charged with the design, construction and launch of a reusable rocket with a scientific or engineering payload and its safe return. Vanderbilt's rocket used compact onboard thermoelectric generators that captured electrical energy from waste heat of the exhaust as the rocket rose in altitude, eventually reaching 4,644 feet. NASA commended Vanderbilt for the most creative and innovative payload experiment while maximizing scientific value and safety.

Did you know?

35%

of tenure/tenure-track faculty have won early career awards

Be a Fan!

The School of Engineering is on Facebook.

Find us at *www.facebook.com/vanderbiltengineering*

Imp

Ted Bapty and Sandeep Neema spearhead the initial stage of DARPA's Adaptive Vehicle Make research program, focusing on design languages, automation and flow.

pact

by Jennifer Johnston

ISIS' pioneering model-integrated computing is at the epicenter of a transformation in engineering

JOHN RUSSELL

Engineers work unobtrusively across the street from the Rhinestone Wedding Chapel, Bobby's Idle Hour bar and recording studios in Nashville, breaking out of the traditional boundaries of computer research at Vanderbilt's Institute for Software Integrated Systems (ISIS) right in the heart of the city's Music Row.

"In a way it's synergistic," says Janos Sztipanovits, E. Bronson Ingram Distinguished Professor of Engineering. "All the creative types come together in this area. It's a good mingling place for both geeks and musicians."

The founder and director of ISIS, Sztipanovits recently spearheaded the institute's transition from smaller, less modern digs to new headquarters on 16th Avenue just blocks away from campus. It was a fitting upgrade for a team that won more than $17.5 million in research funding for 2011. Of that, $12.5 million represented new awards, all in major national research programs.

> "We are a major source of design methods, and not only that, we create open source tools, which makes our new design technology widely accessible to the public."
>
> —Janos Sztipanovits

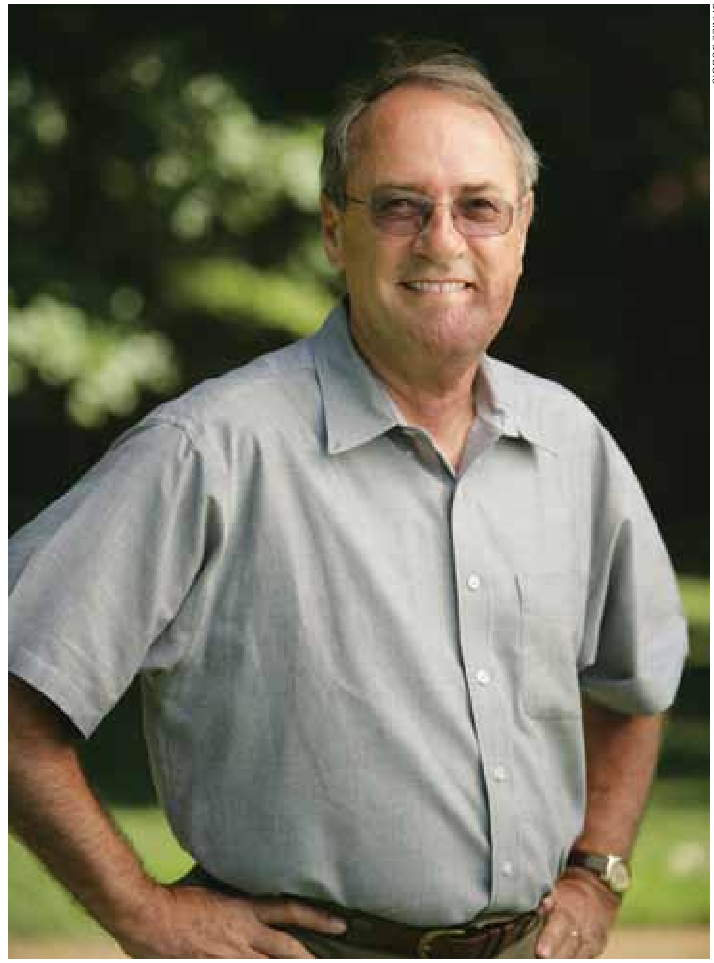
Rapid Innovations

Fueling its pioneering research are rapid innovations in information technology that drive enormous changes in science and engineering. This information technology growth has an impact on virtually every system encountered by humans: health care, education, transportation, defense and even the environment.

Since its establishment in the School of Engineering in 1998, ISIS has become an internationally recognized science and technology center for both designing and creating physical and computational systems, from small, embedded devices like pacemakers to globally deployed complex systems such as networks of satellites.

"We are a major source of design methods, and not only that, we create open source tools, which makes our new design technology widely accessible to the public," Sztipanovits says. "ISIS software tools get serious reviews every day from users worldwide, multiplying the impact of our academic publication tremendously."

ISIS crosses boundaries without hesitation to find new ways to solve today's intricate engineering problems, he says.


DANIEL DUBOIS

ISIS founder and director Janos Sztipanovits, E. Bronson Ingram Distinguished Professor of Engineering

"Our research portfolio reflects that agility completely. The technology core of what ISIS is building—model-integrated computing—is really at the epicenter of this transformation in engineering," he says.

Patients and Defense

Recent ongoing research highlights the institute's broad impact. Sztipanovits led an ISIS team, for example, in a collaborative project with the Vanderbilt University Medical Center to develop a patient management system for sepsis treatment. Triggered when bacteria invades through wounds or IV lines, sepsis causes the body to literally attack itself and leads to more than a quarter million deaths annually. Now in clinical trial in the hospital's intensive care unit, Vanderbilt's system for rapid sepsis detection integrates with an automated decision support system to help guide physicians through the involved treatment process.

The project is part of a larger collaborative effort with the Medical Center to create a new generation of health information systems that are privacy aware and secure. The effort is supported by the National Science Foundation as part of the Science and Technology Center TRUST (Team for Research in Ubiquitous Secure Technology), as well as the Department of Health and Human Services' Strategic Health IT Advanced Research Project on Security (SHARPS), funded by a $1.6 million federal grant.

At the same time that ISIS piloted this innovative patient management system, a national project began that has the potential to transform the manufacturing processes in the defense industry. The Adaptive Vehicle Make research program, a flagship initiative of the Defense Advanced Research Project Agency (DARPA), represents a challenge to a large research team that includes representatives of prominent institutes, corporations and universities, of which Vanderbilt is a lead player.

The team must figure out, among other charges, how to build a complex vehicle like an amphibious combat vehicle in one-fifth of the usual time. ISIS' Ted Bapty and Sandeep Neema spearhead the initial phase of the AVM project, focusing on design languages, automation and flow.

Computer software, hardware and myriads of physical components have to integrate seamlessly to meet DARPA's challenge, the researchers say. The ultimate goal is democratization of design, where not only major manufacturers can come up with innovations, but small companies, individuals, even student groups have a chance to compete. To test the idea, DARPA will distribute the resulting tool suite to high schools and initiate national competitions where the best designs will be manufactured in automated AVM fabrication lines.

"There's an incredible number of engineering domains or disciplines that have to be involved to make this happen," says Bapty, research associate professor of electrical engineering.

The technology base, however, is common, says Neema, research associate professor of electrical engineering. "We should be able to apply these concepts to a variety of vehicles from a submarine to a flying Humvee." (The flying Humvee only exists in the imagination—for now).

STEVE GREEN

ISIS and Vanderbilt University Medical Center developed a system for rapid sepsis detection that helps guide physicians through the complex treatment process.

JOHN RUSSELL

From left, Gautam Biswas, Xenofon Koutsoukos and doctoral student Daniel Mack. The trio uses algorithms to analyze flight data for a project that could lead to detection and prevention of adverse events in aircraft.


COURTESY OF DARPA

The ISIS team is designing and building the information architecture for the nation's F6 program, an advanced space system of networked satellites.

Cyberphysical Interaction

Another high-profile assignment has Sztipanovits and Xenofon Koutsoukos, associate professor of computer science and computer engineering, pairing with General Motors, the University of Maryland and the University of Notre Dame in a project called the Science of Integration for Cyber-Physical Systems.

The five-year, $5 million NSF-funded project tackles the precise and theoretically well-founded engineering of cyberphysical systems. CPS are the new generation of engineered systems built as networks of interacting computational and physical elements to deliver advanced capabilities in cars, aircrafts and spacecraft.

"We do not have a science to do this integration," Koutsoukos explains. "The problem is extremely difficult and very costly. Companies design new models, and they have to do it fast while managing costs and making sure the product is safe." At the same time, new design and technologies are rapidly changing.

Most cars and planes combine multiple components from multiple manufacturers and it is not always well understood how the components work together, Koutsoukos says. Further complicating matters is the issue of intellectual property—manufacturers don't want to provide information that would inform competitors.

That is where ISIS engineers can make a real impact. Their computer modeling techniques help predict and evaluate how different parts—from software to hardware to motors, wires, various materials and moving parts—will interact.

The new integration science (supported by design tools) that the team is charged with creating would ease the integration of all components. In the final phase, the researchers will create virtual prototypes to simulate a vehicle so it can be tested before manufacturing—all while keeping down costs and avoiding errors.

Complex Software in the Air

Another area where ISIS researchers apply model-integrated computing is in creating models that can diagnose faults in systems before they happen. For one such project, Koutsoukos pairs with Gautam Biswas, professor of computer science and computer engineering, on a grant from NASA to improve software health management (the system dependability and prognostics) in modern aircraft.

Working closely with Honeywell and a regional airline, Biswas, Koutsoukos and others on the team are developing VIPR (Vehicle Integrated Prognostic Reasoner), a system which seeks to isolate, detect and prevent adverse events in commercial aircraft.

As part of the project, the researchers employed data mining algorithms to analyze years of flight data to uncover where irregularities occurred, find out why they happened and discover ways to detect problems earlier.

"In one adverse event we found, the engine shut down fairly soon after takeoff. The plane was forced to return to the tarmac," Biswas explains. The FAA considers that a serious event, even though no one was injured.

The researchers went back at least 50 flights and analyzed data for that particular plane. They made an interesting discovery: A small leak had developed in a fuel meter near an engine. The engine, receiving erroneous information that it wasn't getting


DANIEL DUBOIS

Gabor Karsai leads the ISIS F6 team and another that creates decision support tools for the military.

Using Vanderbilt patented technology, troops will be able to use smartphones to locate snipers in the field.

enough fuel, began to overcompensate. The meter eventually ceased to function, which led to the engine overheating and shutting down. If the software system had communicated the fuel gauge malfunction earlier, the engine problem could have been avoided. "We are using data-mining algorithms to process data and derive the precise knowledge to catch faults earlier," Biswas explains.

Challenging and High Stakes

Although ISIS has a partner list packed with household names ranging from aircraft manufacturers to the U.S. Department of Education, some of its most complex projects are part of the security and defense realm.

In one, Associate Professor Koutsoukos works with the Army Research Office in collaboration with MIT; the University of California, Berkeley; and the University of Memphis on a five-year DARPA-funded project to refine a sensor network for tracking and target recognition in urban terrain.

In a different collaborative effort, Gabor Karsai, professor of electrical engineering and computer science, leads a team that partners with George Mason University to create decision support tools to help the military determine the best course of action in complex situations. The work, sponsored by the Air Force Research Laboratory, has implications for disaster preparedness in emergencies like the aftermath of Hurricane Katrina. Evaluating potential problems in action plans means planners can make small fixes now to prevent big problems later.

Perhaps Karsai's most exciting program is part of the creation of a network in the sky. It is called the F6 project and is funded by DARPA, with NASA acting as technical supervisor and Lockheed Martin and Kestrel Institute as subcontractors. The engineers are challenged to create an advanced space system of many smaller satellites that could communicate with each other while hurtling through orbit at 25,000 miles per hour.

"Conventional satellites are single, very expensive and very large, and if something goes wrong, very hard to repair," Karsai explains. A networked system of smaller satellites creates redundancies that mean the failure or loss of one or two satellites wouldn't be disruptive. The ISIS team will design and build the information architecture for the $5 million undertaking.

"This is a challenging and high-stakes project. In two years, we are going to do a flight test. Whatever we build will end up on the platform," Karsai says.

Smartphone for the Defense

Akos Ledeczi, associate professor of computer engineering, and his team are working on a countersniper application for smartphones that will aid soldiers in battle. The app, called SOLOMON (Shooter Localization with Mobile Phones), is funded by a two-year, $500,000 grant from DARPA.

Here's how it works: A custom headset worn by solders is programmed to collect the sound of gunfire and send the information to the soldier's smartphone. Neighboring phones share the data, compute the location of the shooter and display it using

ISIS engineers work in the heart of Nashville's creative Music Row.

Google Maps. Building on earlier prototypes built by Ledeczi's team, this version runs off a single microphone per smartphone and does not require a central computer to work. Vanderbilt has applied for patents for the techniques used in this process.

ISIS has numerous ongoing projects related to applications that can make smartphones even smarter. Some involve creating and improving building blocks of software programs, called middleware. Other projects use the middleware as a jumping-off point. They rely on and share open source systems that make computer code more accessible and easier to use.

Cybersecurity and TRUST

The resilience of today's software integrated systems depends on more than just combating the wear and tear caused by natural forces, Sztipanovits says. Today corporations, universities, government agencies and individuals have to prepare for cybersecurity issues.

"Now we're dealing with an intelligent adversary," he says. "We have to find ways for the system to protect itself." Sztipanovits leads a variety of cybersecurity projects and is Vanderbilt's principle investigator with NSF's TRUST. TRUST partners—Carnegie Mellon, Cornell, Stanford, UC Berkeley and Vanderbilt universities—concentrate on the development of new cybersecurity science and technology.

Engaging Students

The imagination and adaptability of ISIS engineers also flourishes in education. Biswas has worked for years with colleagues at Vanderbilt's Peabody College for Education and Human Development to help students, especially middle schoolers, better learn and understand science.

A recent emphasis has been software-driven teaching aids. Biswas works with colleagues from Stanford University on an NSF-grant project called FACILE (Formal Analysis of Choice-Adaptive Intelligent Learning Environments) that helps students develop learning strategies.

Educators have documented that students learn better when they teach concepts to others, Biswas says. In this case, they will teach interactive computer agents and then use what they themselves have learned to solve challenges that relate to their own experiences, such as how to reduce carbon footprints in schools.

In a different project, Biswas and Peabody's Associate Professor of Science Education Doug Clark and Assistant Professor of Education Pratim Sengupta are developing new projects where students learn by creating simulations and solving challenges in computer games.

In addition to research, many ISIS investigators are professors or instructors in the School of Engineering, and ISIS projects present opportunities for hands-on learning for engineering students. Currently, ISIS supports 38 graduate students as well as undergrads.

That's part of the ISIS mission. "What we are doing is fascinating and intellectually challenging," Sztipanovits says. "We feel all the time that we are at the heart of things. We are part of something big. And we want to attract the best minds to this area of study."

It Took a Team

Who better than engineers to know that teamwork is key to successful problem solving? There's no better demonstration of teamwork than the way alumni, donors, parents, faculty, staff and friends of Vanderbilt University worked together to achieve ambitious goals for the recent Shape the Future campaign. The campaign, which launched in 2003, has concluded and we're honored and proud to announce that Vanderbilt—and the School of Engineering—successfully raised more than $1.75 billion in a historic initiative focused on investing in people, primarily through scholarships and endowed faculty chairs.

What a Remarkable Achievement—and We Thank You

Thank you from the engineering students who will receive scholarships, allowing them to attend one of the nation's top research universities and graduate without crushing student debt.

Thank you from the outstanding professors who will use endowed chairs to fund vital research, support teams of brilliant graduate students assisting in new findings, and equip labs with specialized equipment needed to seek new solutions.

Thank you from the faculty and staff who come to work each day energized by the prospect of transferring knowledge and furthering discoveries.

Thank you from parents and grandparents, whose bright young engineering students will thrive in pursuit of knowledge.

Thank you from the administration, those dedicated to being good stewards of the financial contributions entrusted to them for today's and future generations.

That fiscal stewardship involves continuing to build scholarship funds for Vanderbilt's need-based undergraduate scholarship endowment, Opportunity Vanderbilt. While we achieved Opportunity Vanderbilt's initial endowment goals, more funding is needed to sustain expanded aid and ensure tomorrow's talented students can choose Vanderbilt.

Need for Scholarship Funds Continues

Currently, more than 61 percent of undergraduates receive financial aid, so it is vital that the scholarship endowment continues to increase. For the 2011-12 year, Vanderbilt has set a goal of raising $20 million in funds for the Opportunity Vanderbilt scholarship initiative. With your support and the support of others committed to assuring that young engineers succeed, the School of Engineering will help meet that goal and continue shaping the future of engineering at Vanderbilt and in society.

Vanderbilt University School of Engineering Campaign Accomplishments

Each of Vanderbilt's 10 schools had specific goals to meet for the campaign. Here are the School of Engineering's goals and results:

Shape the Future goal:	**$75 million**
Shape the Future results:	**$85.4 million**
Percentage raised:	**114%**
Endowed chairs at start of Shape the Future:	**5**
Endowed chairs to date:	**13***
Percentage increased:	**260%**
Scholarships at start of Shape the Future:	**35**
Scholarships to date:	**88**
Percentage increased:	**251%**
Opportunity Vanderbilt goal:	**$8.5 million**
Opportunity Vanderbilt results:	**$12.3 million**
Percentage raised:	**144+%**

*Includes chairs not yet announced

Picture the Results


ZACK GOODYEAR


JOHN RUSSELL


DANIEL DUBOIS

Walter A. Casson Jr., BE'56 (left), endowed the Casson Family Scholarship in Engineering. **M. Douglas LeVan**, J. Lawrence Wilson Professor of Engineering (center), holds the J. Lawrence Wilson Chair in Engineering honoring Lawrence Wilson, BE'58, and Barbara Wilson, BA'58. **Gabriella DiCarlo**, Class of 2013 (right), is the inaugural recipient of the Smith Seckman Reid Engineering Scholarship, established in 2003 by Smith Seckman Reid Inc. and its employees who are alumni of the School of Engineering.

Material Research

Çağlar Oskay succeeds by focusing on failure in the real world

by Sandy Smith

JOE HOWELL

Çağlar Oskay is an expert in failure and that makes him—and his work—a success. Oskay, assistant professor in the Department of Civil and Environmental Engineering since 2006, has focused much of his research on the failure of structures and predicting the lifespan of heterogeneous materials through multiscale computational mechanics.

"People have started looking into materials, not from a 'this is what God gave us and this is what we have to do' perspective, but from a design perspective," Oskay says. "With nanotechnology, we can look at materials as a way of engineering the materials rather than just using the materials. These developments are pushing the multiscale boundaries." His area of engineering, Oskay explains, involves the development and use of computer simulation technologies to understand the mechanical behavior of advanced materials and structures.

Pushing boundaries is familiar territory for Oskay, who is valued by the U.S. Air Force for his drive to ensure real-world applications for his research.

> “What he’s trying to do is absolutely integral to the basic research efforts we have in-house.”
>
> — Ravi Chona, *director, Structural Sciences Center, Air Force Research Laboratory, Wright-Patterson Air Force Base*

“Academicians by and large will develop methods and models and apply them to simple configurations to demonstrate that they work,” says Ravi Chona, director of the Structural Sciences Center at the Air Force Research Laboratory, Wright-Patterson Air Force Base in Ohio. “Rarely are they willing to get into the issues of real applications. Çağlar doesn’t shy away from that, which is very, very good from my perspective. What he’s trying to do is absolutely integral to the basic research efforts we have in-house.”

Failure is Important

Two of Oskay’s main areas of research are applicable to materials used in military aircraft, which are consistently being reconfigured to fly farther and faster. Using computer models, Oskay attempts to predict when materials might fail under extreme conditions, such as high heat and traveling at extremely high rates of speed. Another area studies failure rates of complex composite materials.

Oskay says research of the past 50 to 70 years has revealed how traditional materials fail, allowing solutions to be found, but that today’s advanced materials still need research.

“There have been many, many different composite materials invented, and we don’t know how they fail, in what way they fail, and how to model their failure,” he says. “What we’re trying to come up with is computational strategies that can be used to model and assimilate the failures.”

This has become increasingly important, not just to the military, but also to the flying public. The new Airbus A350, due to be delivered to airlines in 2013, is expected to use more than 50 percent composite materials, including in portions of the wings and fuselage. Such composite materials hold the possibility that they might prevent corrosion and aging issues associated with all-metal aircraft; being lighter, they could increase cargo capacities, improve aircraft performance and lower operating costs.

“When composite materials first were introduced as structural components, designers and engineers were using such high safety factors that they didn’t need to look at cyclic failure [failure caused by repeated use],” Oskay says. “As we get more confidence with the materials, it becomes evident that cyclic failure is possible.”

NTSB

Pipes made of modern composite materials might prevent pipeline ruptures such as this one in Michigan.

In the Pipeline

More composites are also appearing in automobiles, largely because they are lighter than metals and contribute to greater energy efficiency. Oskay has investigated whether composite carbon-reinforced fibers can replace metal in shock absorbers. “The way they [composites] fail is different than traditional met-

JOE HOWELL

Oskay encouraged Paul Sparks, BE'08, MS'11 (right), to focus on engineering research. A Ph.D. student, Sparks says he's never looked back.

als. Metal will bend—a tube will buckle and absorb energy," Oskay says. "If you have a brittle material, it crushes into little pieces. Each crushing event that happens is absorbing the energy." Composite materials can actually absorb more energy than metal, but more needs to be understood about these new materials, he says.

Creating materials that can make vehicles lighter will be important for more than automobiles. Their use can be expanded into areas such as aircraft and tanks, Oskay says. Lighter vehicles can maneuver in different terrains, be carried by air or watercraft, and are less likely to get stuck in mud. Before the new materials can be used, however, engineers like Oskay need to understand how these composite materials perform and fail.

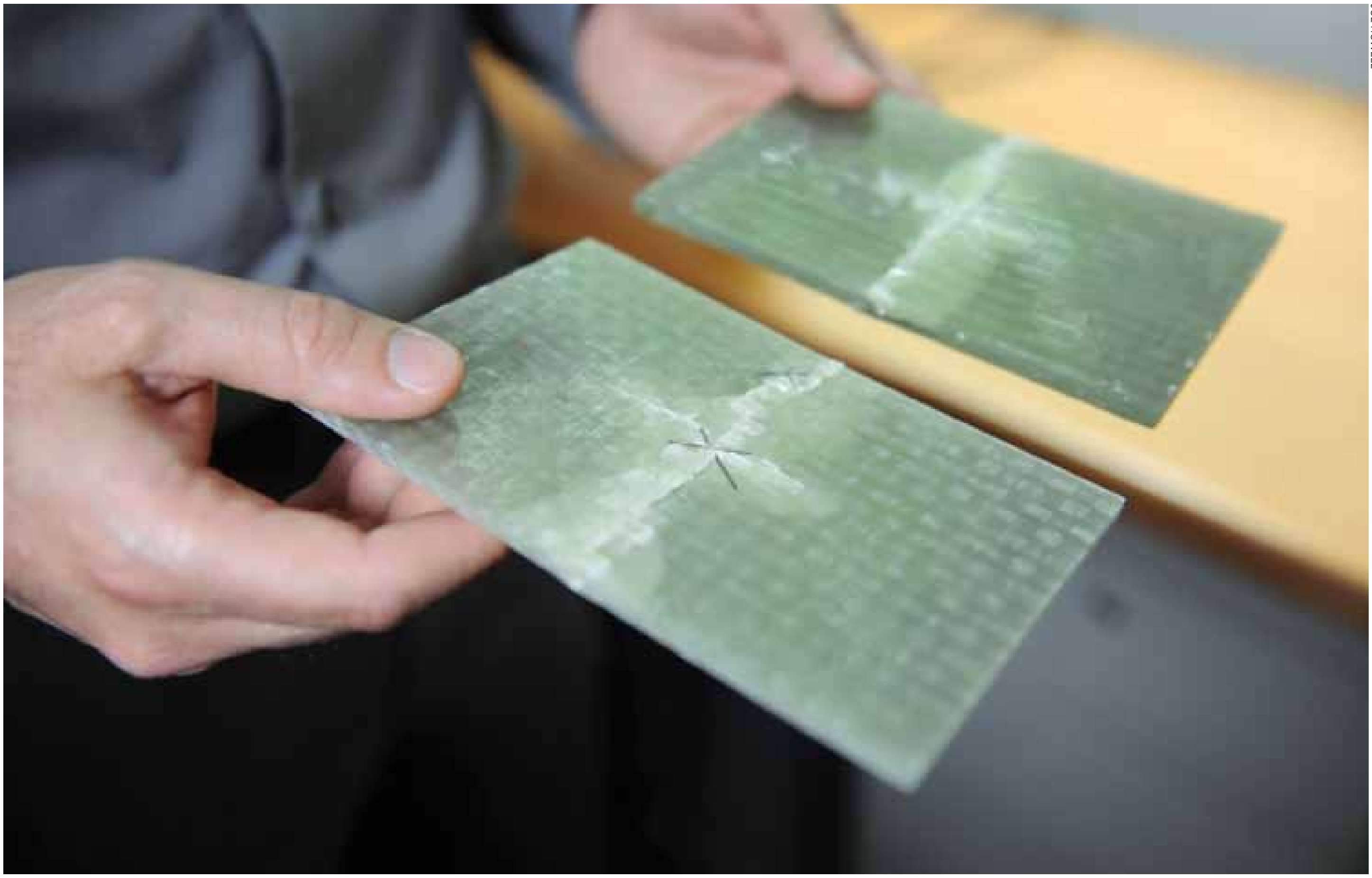
Another area of research also began with military implications but could prove important in other areas. Oskay and his lab are studying polyurea, a soft composite material that has shown to have tremendous blast resistance. While the military applications are obvious—in everything from ships and tanks to soldiers' helmets—there are other uses as well. Oskay cites recent gas pipeline explosions in New York and California. If those pipelines had been coated with polyurea, the damage could have been limited and deaths from pipe shrapnel might have been avoided.

Oskay's particular research explores uses of polyurea as a coating for composite or metallic materials, especially if it includes nano- or micro-inclusions to make it stiffer. "We've seen that the thicker the material, the better it is. If you confine it [polyurea], the better it is," he explains. "We are actually coming up with some answers—we're trying to see if we can come up with a material that has optimal blast resistance."

"The material is there; it's not something that is unobtainable," Oskay says. "We are trying to understand [the material] so that we can tweak it in a way to make it work better. It is close to being applied to real structures."

Crossroads of Materials, Structures and Math

Oskay's focus on real-world applications is at the heart of all his research, including creating mathematical formulas to explore microstructures of complex materials. "We're trying to bring the impact of multiscale modeling, which has had a tremendous



Tests Oskay ran on these composite material samples demonstrate differences in strength and durability. The materials may one day be used by the U.S. Navy.

impact on academia, to something that can be useful in industry. We're trying to come up with methods that will transition tools that are being developed and bring them to industry."

His career path—which he says is "not linear"—has taken him far from his original intention: to study soil and soil properties during earthquakes. Earthquakes are extremely common in his native Turkey, and he endured several there. A love of math and computers drew him into computational mechanics. After completing his doctorate in civil engineering at Rensselaer Polytechnic Institute in Troy, N.Y., he stayed for three years as a postdoctoral student further exploring multiscale computational mechanics.

"This field is at the crossroads of materials, structures and math," he says. "It gives me the opportunity to understand systems and the science of things and come up with tools that are useful to everybody."

Endless Possibilities

Oskay pushes the researchers in his laboratory to broaden their approaches as well. Paul A. Sparks, BE'08, MS'11, who is pursuing his doctorate in structural mechanics and materials, says Oskay encouraged him to think beyond a traditional design engineering career. "He posed the question, 'Paul, wouldn't you prefer to be at the forefront of research and innovation within your field?'" Sparks says. "And I thought to myself, 'Indeed.' Solving complex problems which don't have solutions is much more rewarding than being a design engineer. I have never looked back since that day."

Sparks has joined Oskay in working with the Air Force Research Laboratory in Ohio, where he gained new insight into his adviser. "It was there that Dr. Oskay exposed me to the inner workings of the endless possibilities of research and the importance of collaborating with professionals across the realm of academia," Sparks says. "Not only is he committed to academic excellence, but he is concerned with my general well-being and growth."

Oskay may make himself an expert in the topic of failure, but the line ends there. It's not a subject in which he allows his students, his research or himself to excel. ●

Lessons Learned

by Cindy Thomsen

JEREMY SHARP

Cam Chalmers, BS'98, keeps an eye out for new ventures from his high-rise condo in Dallas.

Entrepreneur Cam Chalmers built a rejected class project into a multimillion-dollar educational software company

Some of the biggest businesses started out as ideas dreamed up in student apartments and dorm rooms. Two Stanford students started Google as Ph.D. projects. When he was at Yale, Fred Smith turned in a term paper outlining his idea for an overnight delivery service—FedEx. Vanderbilt's Cam Chalmers, BS'98, created an online study tool that he tried to turn in as an engineering project for a class in the School of Engineering.

"My basic idea was for this software that you'd install on your computer and enter questions and answers and then it would quiz you," Chalmers says. "I loaded in all the curriculum and the professor wouldn't allow it [for the project]." Chalmers understood. "It was a class about networking. He wanted a project about networking," he says—so the Vanderbilt computer engineering senior developed a different assignment for the course.

After graduation, Chalmers moved to Chicago and worked as a software engineer with Lucent Technologies. But his original idea was always in the back of his mind.

"I've always had an entrepreneurial bug, and after two years I partnered up with a Vanderbilt friend and we decided to try and do something on our own," he says. "I brought up my idea and we decided to fully develop it. The Internet was just starting up, and we thought we could be on the front end of the curve with this educational software."

Young Pioneers

With the gift of a free place to live in Fort Lauderdale, the two took off to Florida and spent the next six months developing what became Study Island, Web-based educational software used by students from kindergarten through 12th grade. Students receive user names and passwords so they can log on from any computer. Teachers make assignments that have to be completed on the computer. The students work through a series of lessons and take assessments. The software includes games to play that keep students interested; teachers can log on at any time to monitor a student's progress.

"Today the idea of students being able to log on from any computer regardless of its location seems pretty obvious, but back in 2000, schools were just starting to have Internet access," Chalmers says. "We understood this trend and were able to become real pioneers in educational software."

Each Study Island program is created to meet specific state standards and curriculum requirements.

"When we started, the state standards movement was well under way. Every state has an outline of what they want taught in every grade level and in every subject," he says. That meant Chalmers and his partner, David Muzzo, BS'97 (Peabody), needed to learn those subjects and requirements, then create different content for specific states.

The first schools to sign up were in Ohio. Once that first sale was made, the rest were easier.

"It was hard selling the product at first—picking up the phone and calling a principal," Chalmers says. "At the time we were just 24 or 25, so we didn't have a lot of credibility and we weren't educators. But as we started getting feedback from our first customers, our confidence grew and we were able to hire salespeople to make those tough calls for us."

Teachers found that students liked using the program and that they were improving their proficiency in reading and mathematics across grade levels. Educators were sold. (More than 50 percent of Ohio schools subscribe to Study Island. It has been used by more than 10 million students nationwide.)

In 2001 the company relocated to Dallas. Five years later, Study Island was in 25 states. The company had grown so much that Chalmers was working less on the creative side of the business and more on the management side.

"In 2007 we sold a large portion of the business to Providence Equity, and we hired a CEO and CFO to help out," Chalmers says. "We had strong opinions [about how Study Island should be run] because this was the company that we built, but we weren't the ones there every day doing all the work. It got to the point where my partner and I were half in and half out, and that wasn't very fun."

The multimillion-dollar company, now known as Archipelago Learning, went public in November 2010. Chalmers and Muzzo officially left the company in January 2011.

Creativity plus technology

Chalmers always knew he wanted to be an engineer of some sort, but it wasn't until he bought his first computer as a first-year student that he found his true calling. The more he studied computer engineering, the more he saw the link between creativity and technology.

"Creativity is integral to being a good innovator," he says. "You have to have creativity. You have to understand the need and then create the technology. A lot of engineers are accused of creating the technology first and then trying to fit it around a need, but the best innovators understand the need first."

> "The Internet was just starting up, and we thought we could be on the front end of the curve with this educational software."
>
> —Cam Chalmers

Chalmers credits Vanderbilt not only with providing a top-notch education, but with contacts that served him well in business. Muzzo, his Study Island business partner, was a fraternity brother and economics/human and organizational development major who came from an entrepreneurial family.

Those Vanderbilt contacts may very well come in handy again as Chalmers figures out what to do next.

"I'm not in a hurry to start something new," he says. "I want to make sure it's a really good idea—I don't want to spend a lot of time on something unless I'm confident it will work out."

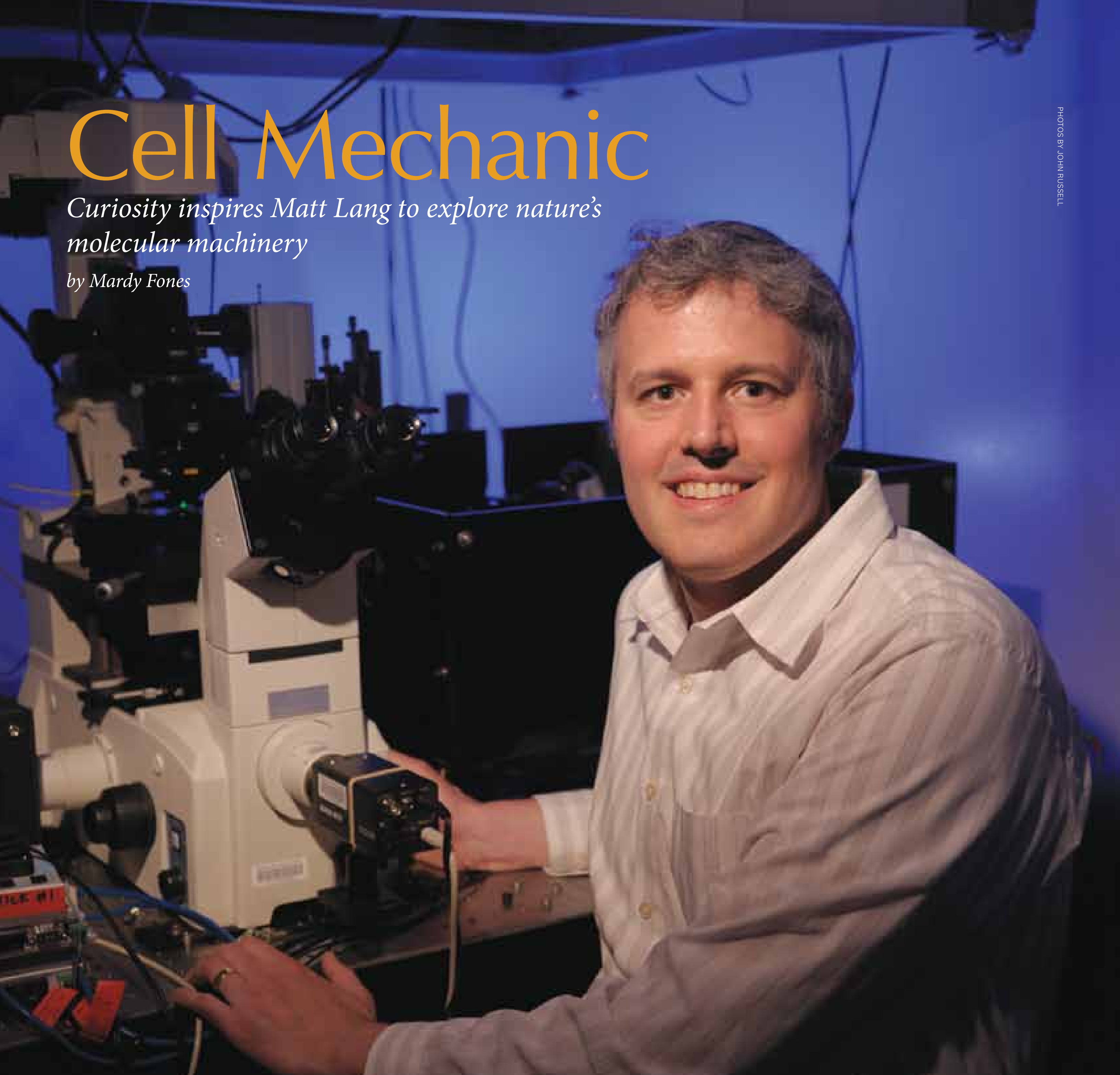
Regardless of his next move, Chalmers is rightfully proud of his accomplishments so far.

"It's nice to look back and know that you created something that's actually helping people," he says.

Cell Mechanic

Curiosity inspires Matt Lang to explore nature's molecular machinery

by Mardy Fones



PHOTOS BY JOHN RUSSELL

Matt Lang is fascinated by how things work. He comes by that trait naturally. "My father is a civil engineer and he got me started making things, doing house wiring, using tools. As a Cub Scout, I won the Pinewood Derby with the car I built," says Lang, associate professor of chemical and biomolecular engineering.

The Machinery of Biology

Fast forward 30 years and Lang works at the crossroads of engineering and biology, exploring how human cells work on the single-molecule level. He has combined his passion for building with curiosity about the mechanics of cells. "We are just starting to understand biological components and how they can be combined to create new biological systems, hybrid [biological and nonbiological] systems and biologically inspired systems," Lang says. "You can build with biology. The body's ability to copy cells with few errors is a manufacturing feat worthy of study and imitation."

But first comes understanding the machine language of the cell, he says. If each cell can be considered a miniature machine, then its machine language is how the cell's components, mechanics and biological force know how to operate and interact. "Once we understand the machine, we can start targeting how to use or disrupt the machinery," he says.

Lang, who came to the School of Engineering from MIT in fall 2010, works out of a new, custom-designed and environmentally controlled lab space in Olin Hall. Using a variety of microscopes with lasers and lenses arranged in mathematically exacting configurations, he manipulates and adjusts the shape, position and timing of laser beams to test and study cell molecular activity. The microscopes, custom modified by Lang, rest on tables that float on cushions of air, diminishing vibrations that can alter measurements.

Molecular-level Solutions

"I have a variety of projects surrounding the study of biological motors," says Lang, explaining how this work could open new vistas for treating disease. "If you approach cell division as machinery, you can explore ways to alter an action—for instance, preventing cancer cells from dividing."

Lang studies malfunctioning groups of proteins called amyloid fibers that are linked to neurodegenerative disorders such as Alzheimer's and Parkinson's diseases. "We're looking at the strength of these fibers, at what makes them so strong, and looking for ways to understand their underlying structure and weaken them," he says.

Lang also uses instruments he built to create automated optical traps. They enable researchers to probe the signaling machinery of the immune system. The outcome could be molecular-level ways of altering or enhancing immune response.

Nano in Biology

Lang says that developing the tools for measurement at the single-molecule level and using mathematical approaches to model structures inside cells are key to developing unprecedented advances in health care.

"The ability to visualize and measure activity at a molecular level has the potential to affect how we treat disease," he says. "Nanotechnology offers a framework from which to understand and move forward in new ways. Biology has its own nanotechnology and it's going on right before our eyes. It's fascinating and superior in many ways to anything humanity has created."

His research in biomolecular systems is international in scope. Building on relationships he established while at MIT, Lang has a lab at National University of Singapore, which emphasizes global partnerships. Lang collaborates with scientists there on biosystem and micromechanic projects; the affiliation also provides research opportunities for his students.

Matthew Lang

- Associate Professor of Chemical and Biomolecular Engineering, with tenure
- Ph.D. Chemistry, University of Chicago, Chicago, ILL.
- B.S. Chemistry, University of Rochester, Rochester, N.Y.
- Recipient: National Science Foundation CAREER Award; two National Institutes of Health grants

From left, Lang, senior Richard Stroder and Ph.D. student Juan Carlos Cordova in the Lang Lab in the basement of Olin Hall.

> "If you approach cell division as machinery, you can explore ways to alter an action—for instance, preventing cancer cells from dividing."
>
> —Matt Lang

Inciting Inspiration

Lang's first year at Vanderbilt was intense as he installed his instruments and established his Nashville lab. Adding to that intensity was the arrival of his first child, Phoebe Garden Lang. "At first, it took two of us to change a diaper," Lang jokes about himself and his wife, Hilary, a synthetic organic chemist turned patent attorney. Lang hopes to inspire Phoebe's blooming curiosity in a scientific direction. "I haven't gotten her into the lab yet, but I am looking forward to teaching her what I know about how things work," he says. "I showed her how to jump-start my car the other day but I'm not sure she'll remember."

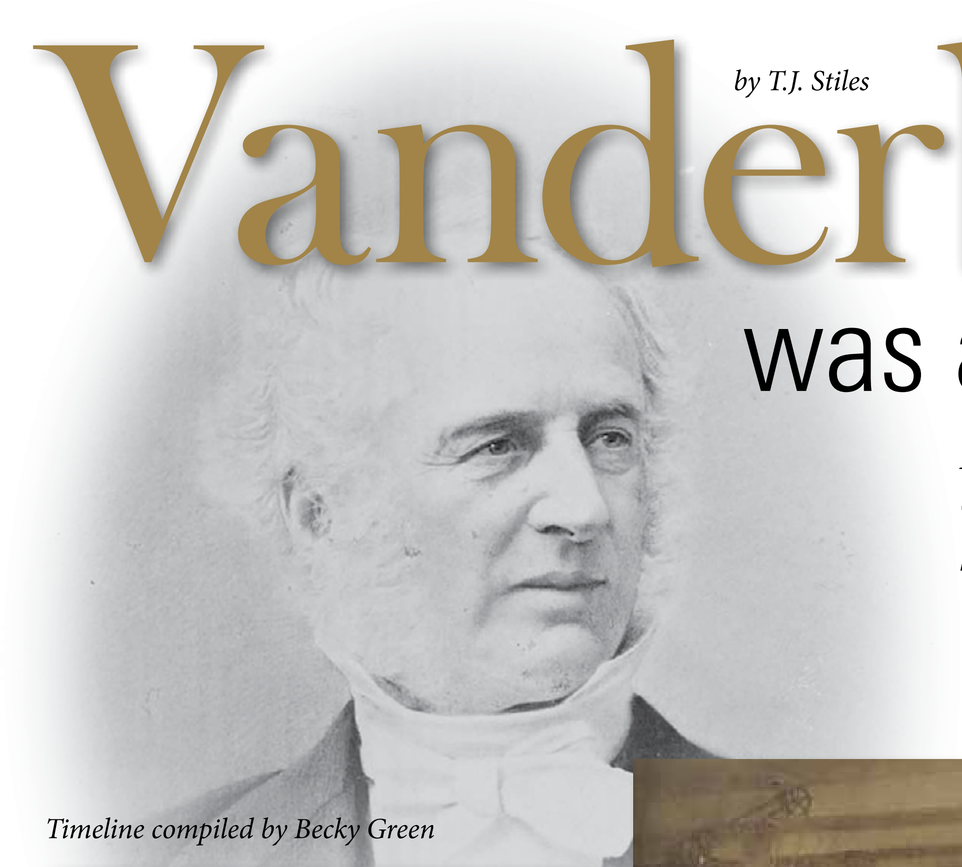
Lang is passionate about nurturing emerging scientists and supervises both undergraduate and graduate researchers in the Lang Lab. "If I just wanted to do research, I'd be in industry. I like mentoring undergraduates," says Lang, who credits mentors at the University of Rochester and University of Chicago with inciting his scientific curiosity and providing the lab experiences that have inspired him.

He hopes to draw motivated undergrads into their own research as well as find funding to underwrite the grooming of a new generation of researchers. For one recent project, Lang and his students built a high-velocity pingpong ball launcher that can drive the lightweight ball through a soda can. "Part of the fun of working with undergraduates is teaching them how to approach a problem, to be an experimentalist," Lang says. "Doing so means I get to have fun in the lab."

Vanderbilt was an Engineer

by T.J. Stiles

Before founding a university, Cornelius Vanderbilt established his engineering credentials



Timeline compiled by Becky Green

1880-1889

1886
Vanderbilt University Board of Trust votes to create Engineering Department. Olin H. Landreth appointed dean.

1888
Cornelius Vanderbilt, grandson of the Commodore, donates funds to build an engineering building, the first in Tennessee designed for teaching engineering. Mechanical Engineering Hall cornerstone is laid.

1889
Engineering divided into civil engineering, mechanical engineering and mining engineering departments.

1890-1899

1894
Department of Electrical Engineering formed.

1895
William H. Schuerman named dean and serves 37 years.

1899
Facilities for instruction in steam engineering enlarged and electric generating capacity is increased. John Lawrence is employed as electrician and assumes all shop instruction.

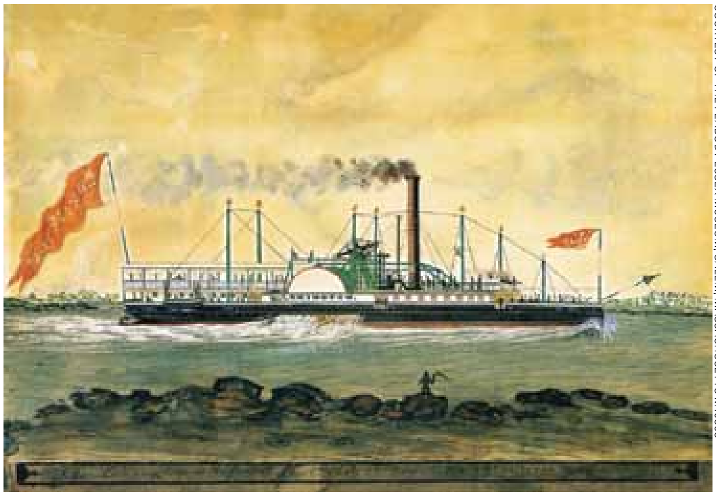
1900-1909

1903
Department of Chemical Engineering created.

History remembers Cornelius Vanderbilt as a businessman—the first to be compared to the medieval German robber barons, and a man popularly called the Commodore for ownership of a steamship fleet. But he deserved another title as well: engineer.

With almost no education, young Vanderbilt mastered steamboat design when steamboats were a new technology. As early as 1818, the 23-year-old studied with James P. Allaire, who had purchased the engine works of inventor Robert Fulton. When Vanderbilt began to build his own boats a decade later, he sought to combine speed and comfort with strength and fuel efficiency. Being a businessman, not a professional shipwright, he often defied conventional wisdom.

The *Lexington*, for example, won acclaim as the first of "an entirely new class of steam vessels" when launched in 1835. "Her shape was very peculiar," Vanderbilt noted. He made it



COURTESY OF THE PEABODY ESSEX MUSEUM, SALEM, MASSACHUSETTS M10868

Vanderbilt's *Lexington* was unique and hailed as the first of "an entirely new class of steam vessels" when launched in 1835.

1910-1919

1915
Board of Trust officially renames Engineering Department as School of Engineering.

1920-1929

1926
First student chapter of ASCE chartered.

1927
Fred J. Lewis starts a summer surveying school at Bon Air Mountain. The camp's land was sold in 1960.

1928
Paul A. Cushman establishes the first student chapter of ASME.

1930-1939

1933
Fred J. Lewis is named dean. In Chancellor Kirkland's terms, Lewis could "conserve what we have, prudently and faithfully."

1939
Civil engineering, electrical engineering and mechanical engineering curricula accredited by the Engineer's Council for Professional Development; VUSE becomes one of only four Southern institutions accredited.

unusually long and narrow for the era: 205 feet by 22, making it fast and efficient. To address the tendency to "hog," or bend lengthwise, he designed an arched deck, adapted from a "patent for bridges," he explained. This small but startling fact suggests that he read a wide array of technical literature as he perfected his designs.

In the 1850s, Vanderbilt built oceangoing steamships for his own lines. Like most contemporary naval architects, he used side paddlewheels, not propellers, but he broke with custom by retaining the overhead walking-beam engine seen in riverboats. For the first ocean steamers, engineers had developed the side-lever engine. Entirely below decks, it was protected from the elements and maintained a low center of gravity. But this involved more moving parts than the walking-beam engine, making it less efficient; it had narrower tolerances, too, requiring more precise machining of parts and a reinforced engine compartment. The results were lower speeds, heavier and more expensive ships and greater fuel consumption. Vanderbilt proved that the simpler, older design could succeed at sea and built some of the fastest and most fuel-efficient ships of the antebellum era.

During the Civil War, Vanderbilt gave the Union navy his largest and fastest ship, the *Vanderbilt*. He personally supervised its conversion into a warship intended to sink the Confederate ironclad *Virginia* (or *Merrimack*). "Her steam machinery has been protected by rails in the most ingenious way," the London *Times* reported, "and also by cotton bales and hay. Her prow has been armed with a formidable nose [of steel], with the intention to poke right into the side of the *Merrimac* [sic]." To enable the ship to survive the ramming of the ironclad, the interior was reinforced, "so as to be little else for many feet (say 50) from the prow than a mass of solid timber," wrote Salmon P. Chase after an inspection. The Confederates declined to risk their ironclad against it.

Mackey

1940-1949

1941-42
VUSE benefits from military-related courses, contracts and programs. The school provides special government training programs to prepare workers for war industries and offers early preflight training for military pilots.

1943-44
War takes its toll. Enrollment reaches 370 in 1943, but drops to 156 in 1944, with only 11 graduating.

1945
Chemical engineering student Vera Jane Jones Mackey, BA'44, BE'45, is the first woman to receive a degree from VUSE. Enrollment boom begins with returning GIs.

1946
Tennessee chapter of Tau Beta Pi is installed, replacing Tau Delta. First master of science degree bestowed in chemical engineering.

1950-1959

1950
New Engineering Building completed. It houses all offices and classrooms, but chemical and mechanical engineering laboratories remain in old quarters.

1952
Chemical engineering accredited by E.C.P.D.

1958
Mechanical engineering wing is added to Engineering Building. William H. Rowan Sr. employed as acting dean.

1960-1969

1960
Robert S. Rowe appointed dean.

1961
VUSE boasts an enrollment of 661 undergraduate and 17 graduate students.

1967
Engineering science division created to administer interdisciplinary programs. First undergraduate courses in systems and information science—the start of computer engineering—are offered.

1968
School of Engineering starts biomedical engineering division.

1969
Wing added to engineering building to house biomedical engineering and materials science and engineering. Moses Taylor, BE'69, becomes the first African American to receive B.E. degree from the school. Sanitary Engineering department created; later named environmental and water resources engineering.

In the 1860s and '70s, as Vanderbilt concentrated on railroads, he stepped back from technical details while serving as a kind of chief systems engineer for his lines. The New York Central & Hudson River Railroad, his main company, ran the width of New York state, and it had two tracks for simultaneous movement in both directions.

Even so, Vanderbilt said, "We have to run freight trains so rapidly to get them out of the way of the passenger trains that . . . it uses up the rolling stock, knocking the cars to pieces without really carrying the freight any faster." His engineer's mind had a solution. If he built dedicated freight and passenger tracks in each direction—making an unprecedented four-track railroad—he calculated that he would save much more than the interest on bonds issued to pay for construction. Vanderbilt overrode his own advisers to do it and was proved right again. It gave his railroad an advantage that allowed it to thrive even in the depression that followed the Panic of 1873.

Cornelius Vanderbilt has often been underestimated. In 1853, a credit reporter dismissed him as "illiterate" (not to mention "boorish" and "offensive"). True, he lacked education, but that makes his technical prowess all the more remarkable. He was one of the finest engineers of his day, as self-made in that respect as he was in business. ●

T.J. Stiles is the author of The First Tycoon: The Epic Life of Cornelius Vanderbilt, *which won the 2010 Pulitzer Prize for biography and the 2009 National Book Award for nonfiction. This article was sparked by a conversation between Stiles and Dean Ken Galloway during the author's visit to campus last fall.*

1970-1979

1970
Paul Harrawood employed as acting dean.

1971
Howard L. Hartman selected as dean. Engineering Alumni Association is formed. The bachelor of science degree is approved.

1974
Olin Hall completed. It houses chemical engineering, engineering science and materials science and engineering. Master of engineering degree is approved.

1977-78
Engineering undergraduate enrollment reaches 1,040; graduate enrollment reaches 140.

1979
Paul Harrawood appointed dean.

1980-1989

1980
Charlotte Fischer becomes the first woman tenured in Vanderbilt School of Engineering. Of 1,100 undergraduate engineering students, 23 percent are women.

1986
Edward A. Parrish Jr. appointed dean. Graduate enrollment increases to 207.

1988
Biomedical engineering established as a department.

1989-90
Externally funded research grows to $8,666,351.

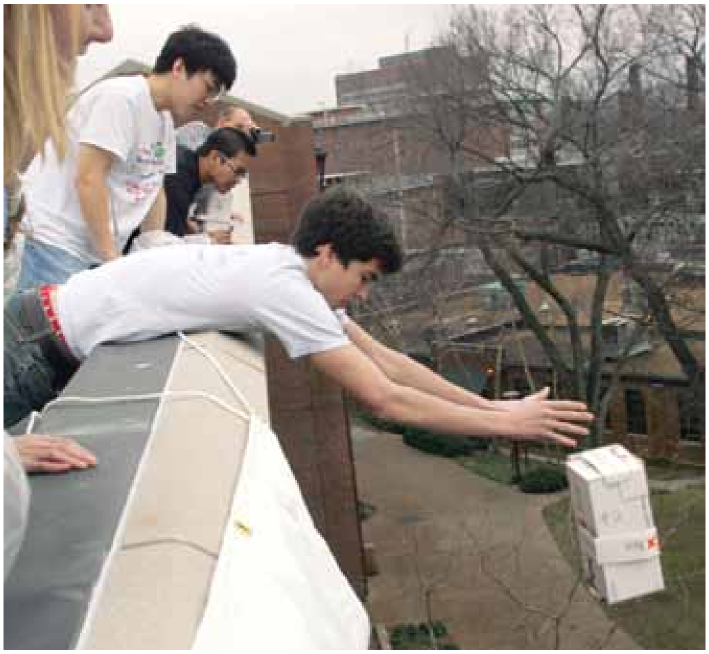
1990-1999

1995
The New Engineering Building is renamed Jacobs Hall in honor of former faculty member Dillard Jacobs, BE'32. The school acquires several floors in building 5 of the Stevenson Science Center complex.

1996
Kenneth F. Galloway named dean.

1998
Institute for Software Integrated Systems (ISIS) created.

1999
The merger of the electrical and computer engineering department with the computer science department into the Department of Electrical Engineering and Computer Science becomes official July 1.



2000-2009

2000
VUSE becomes the leading institution for the Consortium for Risk Evaluation with Stakeholder Participation (CRESP). A $28 million construction project begins on the new VUSE complex.

2001
Vanderbilt Institute for Integrative Biosystems Research and Education (VIIBRE) and Vanderbilt Institute of Nanoscale Science and Engineering (VINSE) formed.

2002
New building complex complete. It includes Featheringill Hall, the Jacobs Believed in Me Auditorium and renovations for Jacobs Hall.

2003
Institute for Space and Defense Electronics (ISDE) launches. VUSE research awards grow from about $7.5 million in 1996 to around $28 million in 2003.

2008
VUSE acquires space to house ISIS and ISDE. Chemical engineering department renamed chemical and biomolecular engineering department.

2009
Total research expenditures reach $50.2 million.

2010-2019

2010
The Division of General Engineering, managing the engineering science major, engineering management minor and the first-year program, is established. Olin Hall benefits from a $1 million-plus interior renovation.

2011-12
The school celebrates 125 years of Insight, Innovation and Impact. Undergraduate enrollment is 1,261 and graduate is 401 (spring 2011). It has 85 tenure/tenure-track faculty and awards bachelor's, master's and Ph.D. degrees in five major departments and a general engineering division.

Sources

History of the Vanderbilt Libraries (webpage); "Blacks at Vanderbilt: A Timeline of Our History on Campus," a presentation by the Bishop Joseph Johnson Black Cultural Center delivered February 2010; *102 Years*, Dillard Jacobs, 1975; *113 is a Prime Number*, Dillard Jacobs, 2001; *Gone with the Ivy*, Paul Conkin, 1985.

Back issues for various incarnations of *Vanderbilt Engineering* magazine/newsletter for 1925, 1959-2002, Vanderbilt University Special Collections.

Building on 125 Years

by Brenda Ellis

In 1886 President Grover Cleveland dedicated the Statue of Liberty and New York City celebrated with its first ticker-tape parade. Closer to Nashville, a pharmacist in Atlanta invented Coca-Cola. Closer still, in Memphis an inventor patented a typewriter ribbon. In Nashville, by vote of the Board of Trust, Vanderbilt University created the School of Engineering. That act separated mechanical and civil engineering from a larger academic unit into an engineering department.

Two years later, a cornerstone was laid for Mechanical Engineering Hall, a handsome building still, and today affectionately dubbed Old Mechanical.

After a precipitous dip in enrollment to 18 students in 1898 (possibly due to a lingering economic depression and the start of the Spanish American War), the school entered the 20th century—transitioning from the practical training of mechanical and civil engineers to educating engineering professionals and enjoying a steep rise in enrollment after World War I and again after World War II.

More buildings were needed: Olin Hall in 1974. New Engineering, built in 1950, became Jacobs Hall in 1995. Also in 1995, the school acquired several floors in building 5 of the Stevenson Center complex. After a $28 million renovation/building project in 2002, Jacobs Hall and the new, cojoined Featheringill Hall made impressive additions to the engineering campus and provided an attractive central gathering place for faculty, students and alumni. The newest engineering building was acquired in 2010 and houses two institutes, 130 personnel, and offers about 40,000 square feet of lab, office and conference space on Nashville's famed Music Row.

Absent a ticker-tape (obsolete since the 1960s) parade, the Vanderbilt University School of Engineering is planning a yearlong quasquicentennial celebration with special commemorative events on campus and stories in *Vanderbilt Engineering* magazine during the 2011-2012 academic year.

To mark the 125th anniversary, the school's annual distinguished lecture—the John R. and Donna S. Hall Engineering Lecture—will bring four notable engineering leaders to campus, one each in October, November, February and March. A special Engineering Celebration Dinner is set for October 20 during the university's Reunion weekend.

National Engineers Week in February 2012 will offer opportunities for students and alumni to celebrate, too. Later in May, the quasquicentennial will wrap up with a party for engineering faculty and staff.

Vanderbilt University School of Engineering is moving to the next level after 125 years of growth and transformation. Its alumni, students, parents, faculty, staff and friends have much to celebrate and a strong foundation on which to build for the future.

Here's to the next 125 years.

Unforgettable

by Gregory N. Tragitt, BE'78

When I was asked to write about Dean Overholser, I knew I could not adequately describe or know all his qualifications and accomplishments. I was greatly honored to be asked, although I think one of his Ph.D. students would be more qualified to write about this longtime professor and dean than me.

What I can do is describe how he influenced me when I was a young, disillusioned chemical engineering major. Professor Overholser was a gifted classroom teacher and was able to transfer his passion for his profession to me. This passion continues to serve me well as a practicing chemical engineer.

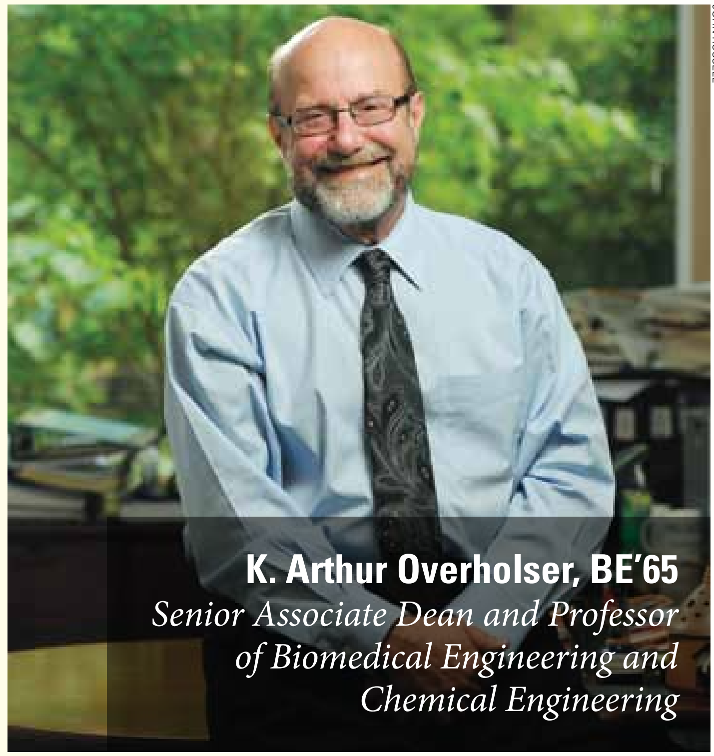
When I arrived at the Vanderbilt School of Engineering, I was certain that I wanted to be a chemical engineer. I was disappointed that I would not be able to take my first chemical engineering course until the second semester of my sophomore year. Taking it, I found the area of stoichiometry to be practical and so much fun. When I experienced more advanced chemical engineering courses, I did not appreciate their less practical aspects—these were courses that delved more deeply into the theoretical aspects of the curriculum. I began to wonder if chemical engineering really was for me.

In one such class, Dr. Overholser used a theoretical text for transport phenomena written by professors at the University of Wisconsin, where he obtained his Ph.D. He was a superb teacher and made this material interesting. I started to enjoy the course and found the homework to be fun. I also greatly appreciated how he had a genuine interest in helping his students. I perceived that he was passionate about his work, and that he had a great desire to continue his professional growth. I developed significant respect for him.

In retrospect, I realize that the transport phenomena class I took from Dr. Overholser in my junior year truly rekindled my interest in chemical engineering. The interest became a passion that I largely attribute to him and his teaching. Later in my work experience as a chemical engineer, I discovered that it was quite valuable to have a theoretical understanding of chemical engineering. Many of my peers received more practical training and are at a disadvantage when they encounter situations that they have not previously encountered.

I also took a chemical engineering lab from Dr. Overholser. Unlike the transport phenomena course, I never enjoyed the lab and really despised the long laboratory reports. He expected professional documents, and he encouraged me to meet his expectations. Dr. Overholser was tough, but he was fair.

When I began working in industry, I learned quickly how written communication is tremendously important. An engineer can



JOHN RUSSELL

K. Arthur Overholser, BE'65
Senior Associate Dean and Professor of Biomedical Engineering and Chemical Engineering

have great ideas or work, but ideas will never get implemented or noticed if they are not communicated to those who make the decisions. I was a young engineer in an oil refinery and an advanced engineer told me that it was rare for engineers to be able to communicate as concisely and effectively as I did. I can thank Dr. Overholser for pushing me to write those painful reports—I learned to communicate professionally from him and those documents.

I have stayed in contact with Dr. Overholser since graduation, and I consider him a friend. Today, as a member of the School of Engineering Alumni Council, I continue to be in touch with Dr. Overholser. The longer I know him, the more I respect and admire him.

One thing I have also discovered through our friendship: he is much too modest, and he understates his impact. He has made a difference in the education, lives and careers of many students—now engineers—which is why he's truly unforgettable.

Thank you, Dr. Overholser, for all you are and all you've done.

Gregory N. Tragitt, BE'78, is a senior staff consultant for KBC Advanced Technologies Inc., an international technical consulting firm that provides strategic and engineering expertise to the global energy business and other process industries. In addition to chairing the career and corporate relations section of the Engineering Alumni Council, Greg is a fellow of AIChE. He resides in Houston.

Get a check from Vanderbilt!

Establish a charitable gift annuity with Engineering and we'll pay you for life.

BENEFITS ON A $10,000 SINGLE-LIFE CHARITABLE GIFT ANNUITY*

Age	Annuity rate	Yearly payment	Tax deduction
65	5.3%	$530	$2,659
70	5.8	$580	$3,289
75	6.5	$650	$3,923
80	7.5	$750	$4,508
85	8.4	$840	$5,326
90	9.8	$980	$5,965

**minimum age of 65 and gift amount of $10,000. Deductions as of September 2011.*

How it helps you
- Fixed payments for life
- Immediate income tax deduction
- Partially tax-free payments
- Possible capital gains tax savings

How it helps Engineering
- Scholarships
- Research funding
- Faculty chairs
- Facility improvements

Learn more by contacting Linda Ray Miller in Vanderbilt's Office of Planned Giving at (615) 343-3113, (888) 758-1999 or plannedgiving@vanderbilt.edu. **www.vanderbilt.edu/alumni/plannedgiving**

"This scholarship is allowing me to fulfill my potential."

Sam Hooke, Class of 2012, GKW Scholarship

VANDERBILT UNIVERSITY

Change a life—Support Opportunity Vanderbilt

In software engineering, determining your goal is the first, and most important part, of the process. Choosing to attend Vanderbilt was like that for Sam Hooke. His goal: to get here. Opportunity Vanderbilt was a key component in reaching that goal.

"This scholarship is allowing me to fulfill my potential," he says. "I like the idea that someone says they want a problem solved, and I make something that gives them the solution to their problem."

Supporters like you help provide solutions for students like Sam, making certain that access to a Vanderbilt education is based on ability, not ability to pay. Consider a gift through Opportunity Vanderbilt to support the university's initiative to replace need-based undergraduate loans with scholarships and grants. Be a part of this year's goal to raise $20 million. Help us change their lives so they can change the world.

OpportunityVanderbilt

Make a gift to Vanderbilt online—www.vanderbilt.edu/givenow. Questions—David Bass, david.m.bass@vanderbilt.edu, (615) 322-4934.

VANDERBILT
SCHOOL OF ENGINEERING

PMB 407703
2301 Vanderbilt Place
Nashville, TN 37240-7703

Nonprofit Org.
U. S. Postage
PAID
Nashville, TN
Permit No. 1460

Engineering's True Cornerstone

Although the Vanderbilt University School of Engineering was established in 1886, this cornerstone marked construction for the school's first building, the Mechanical Engineering building (now part of the Vanderbilt Owen Graduate School of Management). Yet even 125 years later, it's evident that the true cornerstone of the School of Engineering is its people, past, present and future.

We invite you to memorialize the history of the school by sending us stories of your recollections, personal experiences and historic events relating to the school. We hope to publish them in a future issue or in commemorative articles. We'd also be interested in individual tales of your careers as engineers and accounts of multiple generations or family members sharing a tradition of attending Vanderbilt School of Engineering. Go to *www.engineering.vanderbilt.edu/anniversary* for more details. You can also send a statement by emailing *vuse125@vanderbilt.edu* or writing to:

VUSE at 125
Vanderbilt University School of Engineering
VU Station B #351826
Nashville, TN 37240-1826

JOHN RUSSELL