

# VANDERBILT

## SCHOOL OF ENGINEERING



VANDERBILT  
UNIVERSITY

[engineering.vanderbilt.edu](http://engineering.vanderbilt.edu)

Vanderbilt appeals to engineering students who want to put their careers and lives into a rich context. You will learn to be a creative thinker and a problem solver.

These skills will be valuable throughout your life—not only when you are solving engineering problems.

Our curriculum allows you to examine various engineering majors from multiple perspectives before you declare a specific major. As an engineering student, you will explore engineering fundamentals and the responsible use of technology.

All of our students study in state-of-the-art classrooms and laboratories, and you may choose to conduct original research by working with outstanding faculty members. Professors and students collaborate on projects that span the spectrum of engineering from robotics and computer animation to biomedical optics and environmental engineering.

Our engineering graduates are valued for their expertise, intellectual independence, communication skills, and leadership ability. Professional demand for graduates with this background is intense. Graduates are actively recruited, not only for engineering careers but also for careers as diverse as consulting, medicine, law, and finance.

Vanderbilt's School of Engineering offers the depth and breadth of education required to solve real-world problems. Understanding how to solve these problems will give you an edge in any endeavor.

cover: Mechanical engineering professor conducts research measuring thermal and electrical transport properties of individual nanowires—microscopic, electrically conducting wire also known as quantum wire—with a unique microdevice (the chip in the photo) in the Micro/Nanoscale Thermal Fluids Laboratory at Vanderbilt.

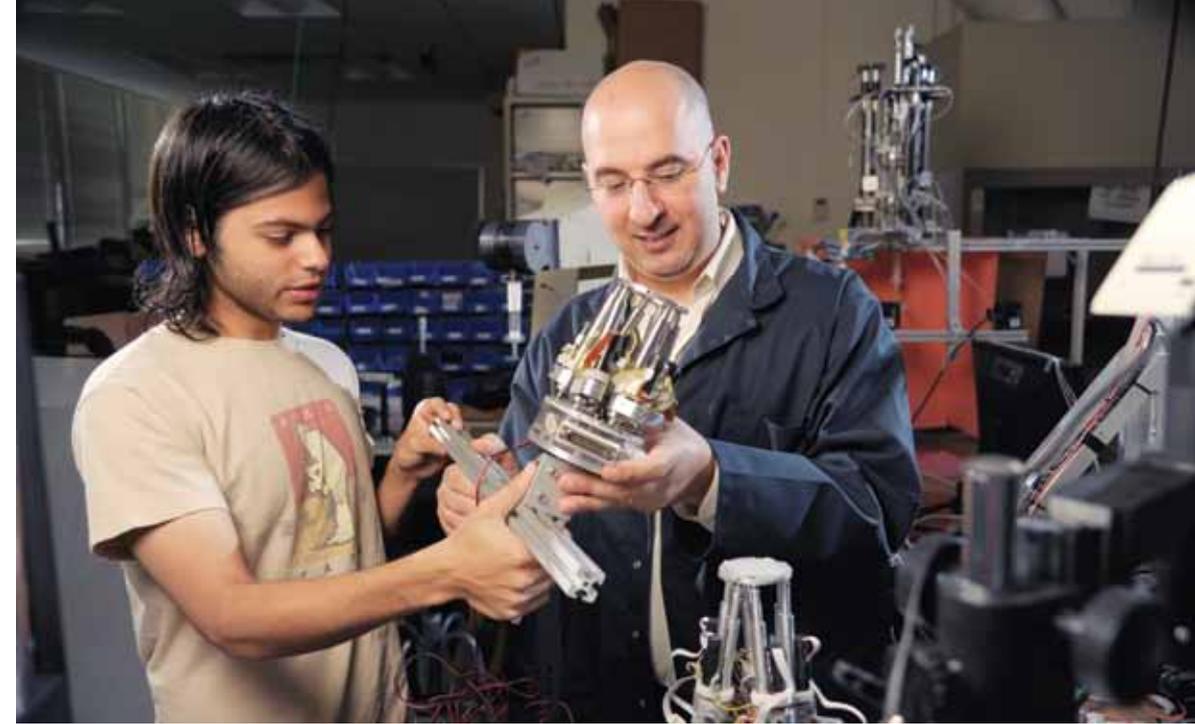


**Insight.**  
**Innovation.**  
Impact.

The School of Engineering offers the bachelor of engineering degree in biomedical, chemical, civil, computer, electrical, and mechanical engineering and the bachelor of science degree in computer science and engineering science. The school also confers master of engineering, master of science, and doctoral degrees.

All full-time faculty members hold doctorates and teach undergraduate students. Our research centers and labs investigate topics from nanoscale materials, technology-guided surgery, and robotics to environmental management, intracellular engineering, and combustion diagnostics.

Many engineering students choose double majors, minors, or concentrations in complementary disciplines. In addition to training in engineering science, mathematics, physics, and chemistry, you will take liberal arts courses in the College of Arts and Science. You may also choose selected courses from Vanderbilt's other undergraduate or graduate schools or round out your academic experience with an honors program, internship, study abroad, or accelerated degree program.

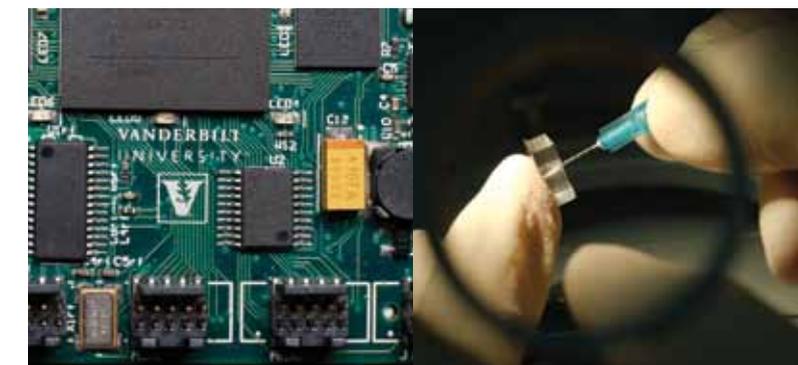


Our multimillion-dollar engineering complex combines advanced technologies in a student-centered environment. Featheringill Hall features a three-story atrium for student interactions and contains more than 50 teaching and research laboratories brimming with the latest equipment. The design studio, model shop, and a project room showcase student ideas from concept to prototype to final product.

All programs leading to the bachelor of engineering degree at Vanderbilt are accredited by the Engineering Accreditation Commission of ABET, Inc. Vanderbilt also encourages students to take the Fundamentals of Engineering examinations, coordinated by the Tennessee State Board of Architecture and Engineering Examiners. Vanderbilt University is accredited by the Commission on Colleges of the Southern Association of Colleges and Schools and is a member of the Association of American Universities.

**School of Engineering  
Academic Departments**

- Biomedical Engineering
- Chemical and Biomolecular Engineering
- Civil and Environmental Engineering
- Electrical Engineering and Computer Science
- Mechanical Engineering
- Division of General Engineering





“In the biomedical engineering department at Vanderbilt, we put a very strong emphasis on **the importance of teaching in research.**”

#### ONE ON ONE

#### **Anita Mahadevan-Jansen**

Professor of Biomedical Engineering,  
Professor of Neurological Surgery

She may not fit the traditional ideas of pioneer, but Professor Anita Mahadevan-Jansen continues to prove herself worthy of the title. As part of a small group of biomedical engineers exploring biophotonics, she researches the applications of light for tissue physiology and pathology, especially cancer detection.

Currently, Professor Mahadevan-Jansen, along with her husband, Professor Duco Jansen, are part of a nationwide collaboration exploring how a low-power infrared laser beam can stimulate peripheral nerves and allow amputees not only to control but also to feel the movement of prosthetic limbs. Yet, she still has a true passion for teaching.

“In the biomedical engineering department at Vanderbilt, we put a very strong emphasis on the importance of teaching. We encourage our students, especially those interested in academia, to get some experience in the art of teaching—most notably through the Biomedical Education Research REU (Research Experience for Undergraduates) program and undergraduate projects in biomedical engineering education.” As Professor Mahadevan-Jansen has found,

the collaborative nature of both teaching and research often leads to surprising breakthroughs.

“Two or three years ago, a surgery resident who was doing an endocrine surgery rotation noticed that all the surgeons were having a tough time finding the parathyroid. It’s a very small gland, about the size of a grain of rice, and if you remove it accidentally, there are a lot of long-term effects.”

“She and I looked at all available technologies and started off using a Raman spectrometry system, but we kept saturating the detector. At first, we thought it was an artifact. It turned out that the parathyroid actually has a strong infrared fluorescence signal. It glows ten, twelve times stronger than everything else around it, so you can use some very simple infrared light sources to find it.”

“Ultimately, there are two kinds of scientists. There are scientists who build new technologies and then look for an application to use it for, medical or otherwise. Then there are some of us who are more problem solvers. Light can do a lot of things but you need to find the right matches for it. Don’t use a hammer to look for a nail to hit.”



# Engineering Programs

[engineering.vanderbilt.edu/academics/undergraduate.aspx](http://engineering.vanderbilt.edu/academics/undergraduate.aspx)

In addition to foundations in math, chemistry, physics, and the liberal arts, our eight academic majors provide depth of study in a wide variety of traditional engineering disciplines and some that can be customized based on individual interests. Minors as well as electives should be selected carefully to fulfill a specific purpose and in consultation with your academic adviser.

## Biomedical Engineering

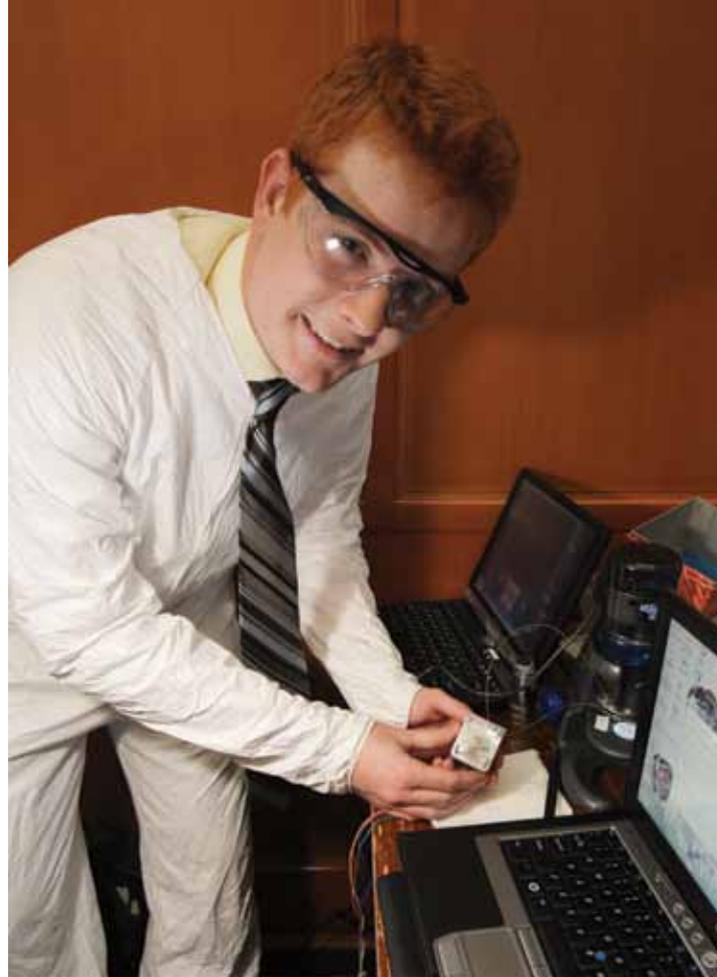
*Bachelor of Engineering*

Biomedical engineering applies engineering concepts to specific and practical problems in biology, medicine, and health care. It attempts to quantify biological events for the purpose of creating and improving upon diagnostic practices and treatment protocols. The main areas of study in our biomedical engineering program include biophotonics, biomaterials, medical imaging, gene therapy, and technology-guided surgical devices.

## Chemical Engineering

*Bachelor of Engineering*

Chemical and biomolecular engineering plays a key role in the development and production of pharmaceuticals and bioengineered materials for medical applications. Chemical engineers are also concerned with process control techniques and production in the development of high-strength composites and specialty polymers, semiconductors and microelectronic devices, and a variety of other products.



## Civil Engineering

*Bachelor of Engineering*

Civil and environmental engineering prepares professionals to repair our nation's decaying infrastructure and in the use of engineered materials for stronger, lighter, more reliable buildings, bridges and transportation systems. Civil and environmental engineers address problems with land-use, sustainability, risk management, increasing population, nuclear waste management, environmental quality, and construction management.

## Computer Engineering

*Bachelor of Engineering*

Computer engineering acts at the interface of software and hardware and deals with problems related to the organization, design and application of digital processing systems as general purpose computers or as components of information processing, control and communications. Computer engineering allows students to specialize in embedded systems, computing systems and networks, or intelligent systems and robotics.

# insight



## Computer Science

*Bachelor of Science*

Computer science blends scientific and engineering principles, theoretical analysis, and computing experience. Program emphasis is on computing activities of both practical and intellectual interest, and on theoretical studies of efficient algorithms and the limits of computation. Students may major or minor in computer science. A finance track prepares students for a career in finance through a five-year program ending with a Master of Science in Finance from the Owen Graduate School of Management.

## Electrical Engineering

*Bachelor of Engineering*

Electrical engineering focuses on hardware involved in electrical and electronic systems and how electrical components interact with each other. Students study mathematics, physics, and computer science and develop a foundation in circuit analysis and electronics. Students choose an area of further study in computer engineering, microelectronics, signal and image processing, robotics, and networking and communications.

## Engineering Science

*Bachelor of Science*

Engineering science combines engineering with specialized knowledge from a concentration in applied physics; engineering management; communication of science, engineering, and technology; or materials science and engineering. Individual programs can be created within this interdisciplinary offering in areas such as engineering mathematics, environmental engineering, business administration, teaching, technical communications, and entrepreneurship, among many others.

## Mechanical Engineering

*Bachelor of Engineering*

Mechanical engineering prepares students to become practicing engineers who design systems to control engineered products and solve problems through manufacturing processes, energy management, and hardware design. Strengths of the department include robotics, intelligent mechatronics, combustion and propulsion, nanostructures, fluid physics, and laser diagnostics of combustion and space experimentation.

## Minors

Minors in computer science, scientific computing, environmental engineering, and energy and environmental systems may be combined with various majors, as can minors offered through the College of Arts and Science. Students may also choose a minor or concentration in engineering management or materials science and engineering.

### *Engineering Management Minor*

This interdisciplinary program links engineering, science, and management. Students study entrepreneurship, management of high-tech enterprises, engineering economics, public policy, business psychology, finance, communications, and manufacturing.

### *Materials Science Minor*

High-performance materials are in demand throughout the engineering world, and there is equal demand for specialists who understand the relationship between properties and structure, the thermodynamics of materials, and the physics and chemistry of solids and liquids. In specialized laboratories you'll test the properties of materials and consider new applications of derived information.



A student records data about her moods which will be transferred to a robot.

# Engineering Research

[engineering.vanderbilt.edu/research.aspx](http://engineering.vanderbilt.edu/research.aspx)

Our engineering professors, all dedicated teachers, are also committed to ongoing scholarship and research. Faculty and students collaborate across disciplines to address critical research initiatives that characterize the school's commitment to developing technological solutions with real-world impact.

## Energy and Environment

The School of Engineering at Vanderbilt is recognized as an international research leader in areas of structural reliability and risk, nuclear waste management, and teaching assessment approaches to environmental decision making.

## Health Care

Critical research initiatives are ongoing in cellular dynamics in immunology, cardiology, cancer, as well as MRI and imaging systems to guide surgery. Other research efforts include laser-tissue interaction, biomedical optics, and bionanotechnology.

## Defense and National Security

A large number of faculty and students engage in leading-edge research of significant importance to critical commercial and government systems, including model-based design of trustworthy information systems, diagnostics of complex systems and tools for the design of embedded systems.

## Information Technology

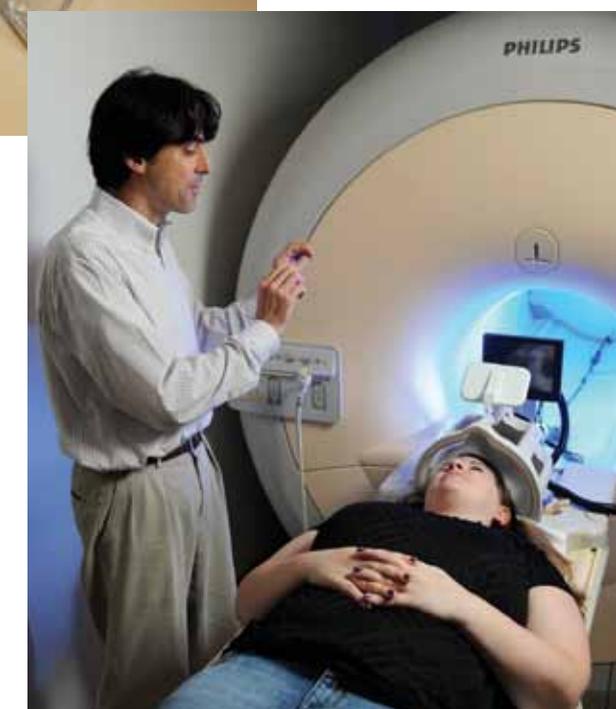
Research focus includes computer networking and network security, human-machine teaming, machine learning, and software engineering.



Multidisciplinary capability is a particular strength of the school. Through programs funded by the National Institutes of Health, the National Science Foundation, the Department of Defense, the Department of Energy, and others, the School of Engineering participates in multidisciplinary collaborations with many top-25 universities and national laboratories.

The school plays a leading role in transinstitutional collaborations in nanoscience, nanoengineering, environmental, and integrative biosystems research. Additional transinstitutional centers in which the school plays an important role include learning sciences, environmental management, and cognitive neuroscience.

Engineering faculty members are engaged in a diverse collection of research projects, such as embedded information systems and smart materials, robotics, laser surgery equipment, intelligent transportation systems, genetic therapy techniques, thin films, integrated computer systems, machine learning, renewable energy systems, and power conversion.



# innovation



### Research Internships

Students have the opportunity to perform independent research with engineering faculty as well as with other professors from across the entire university. Research interests may be identified by utilizing the school's Web site, working with academic advisers, or talking to course instructors. You may choose to do research for up to six hours of course credit.

You may also apply to participate in one of two paid summer research programs at Vanderbilt: the university-wide summer research program (VUSRP) or the engineering school-sponsored summer research program. Students also may wish to take advantage of National Science Foundation-sponsored Research Experiences for Undergraduates (REU) that are available across the United States.

Internships teach invaluable lessons. Graduating senior survey data indicates that approximately 59% of students typically have had at least one summer internship experience during their time at Vanderbilt. Our students take advantage of internship opportunities posted in the Career Center as well as utilizing their own networks and that of their professors.

### Centers and Institutes

- Center for Intelligent Mechatronics
- Center for Intelligent Systems (CIS)
- Center for Technology-Guided Therapy
- Consortium for Risk Evaluation with Stakeholder Participation (CRESP)
- Institute for Software Integrated Systems (ISIS)
- Institute for Space and Defense Electronics (ISDE)
- Vanderbilt Center for Environmental Management Studies (VCEMS)
- Vanderbilt Engineering Center for Transportation Operations and Research (VECTOR)
- Vanderbilt Institute for Energy and Environment (VIEE)
- Vanderbilt Institute for Integrative Biosystems Research and Education (VIIBRE)
- Vanderbilt Institute of Nanoscale Science and Engineering (VINSE)
- Vanderbilt University Institute for Imaging Science (VUIIS)



## Other Academic Opportunities

### Merit Scholarships

Each year, the School of Engineering awards honor scholarships to incoming freshmen through the Cornelius Vanderbilt Scholarship program, one of Vanderbilt's three signature scholarship opportunities. Awards are made on the basis of leadership and merit. Cornelius Vanderbilt Scholars receive full tuition, plus a one-time stipend to be used towards a summer study abroad or research experience. Scholarships are renewed each year as long as the recipient maintains at least a 3.0 GPA. Students may also apply for scholarships awarded through Vanderbilt's two other signature scholarship programs: the Ingram Scholarship and the Chancellor's Scholarship programs. To be considered for any of our three signature scholarship programs, students must submit the appropriate forms from the Vanderbilt Application Packet for Merit-Based Scholarships.

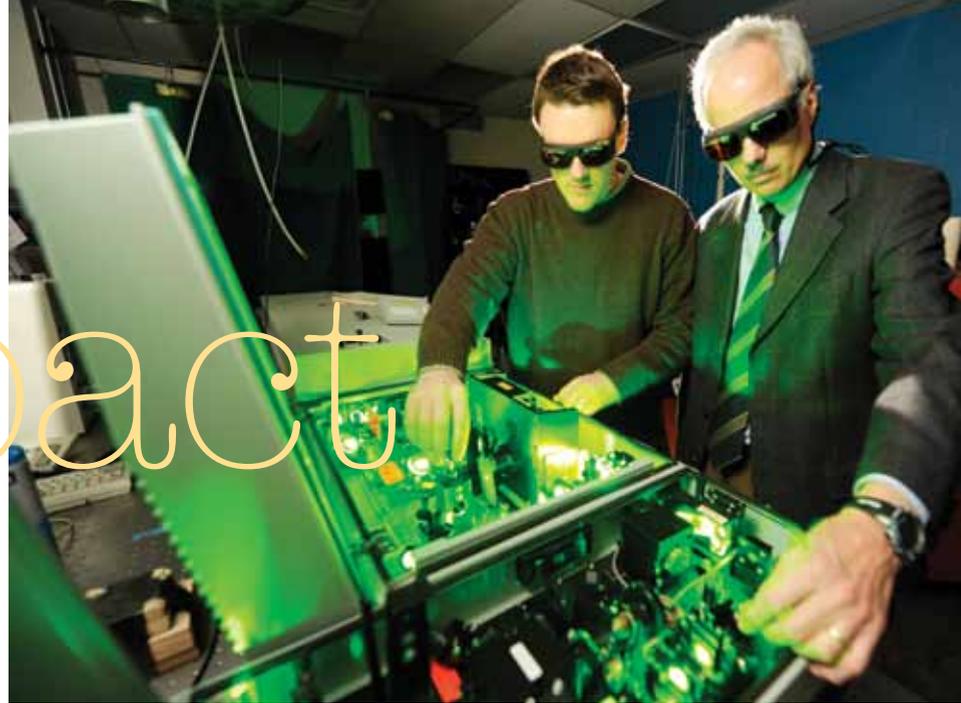
### First-Year Seminars

First-year seminars introduce students to the expectations of the university—a high level of scholarship and a participatory style of learning. Optional seminars through the School of Engineering or through The Ingram Commons offer freshmen opportunities to work in small groups with seasoned engineering professors. By creatively applying engineering concepts to real-world problems, students improve their communication skills and become more certain in their selection of a specific engineering major.

### Honors Programs

Qualified engineering juniors and seniors may participate in departmental honors programs that emphasize independent study and research. Honors students may also take selected graduate courses in Vanderbilt's graduate and professional schools.

# impact



## Internships

Undergraduate students often choose to apply their knowledge and skills in an internship, testing levels of competence and clarifying career choices. Vanderbilt's Career Center places high priority on helping students find rewarding internships. A recent student, for example, served as a biomedical industrial intern for Lockheed-Martin at the Johnson Space Center in Houston, writing user guides for medical test hardware for the International Space Station Alpha. An intern majoring in computer science, math, and economics developed web applications for UnumProvident, Inc., in Chattanooga. Another intern created a website and a customer kit for medical applications for National Instruments in Austin. In addition to valuable experience beyond technical application, many internships provide an entrée into professional engineering positions.

## Study Abroad

Qualified engineering students may study abroad during the summer or academic year at one of 24 different universities in England, France, Germany, Scotland, Mexico, South Africa, Ireland, Australia, and New Zealand. A growing number of exchange programs exist and currently include National University of Singapore, City University of Hong Kong, Hong Kong University of Science and Technology, Budapest University of Technology, and Politecnico di Torino.

## Integrated Bachelor of Science/ Master of Business Administration

Selected engineering undergraduates may be accepted into an integrated engineering program through which both bachelor's and master's degrees are earned. You may earn a bachelor of science in engineering science and an MBA through Vanderbilt's Owen School of Management.

## Integrated Bachelor/Master of Engineering

Selected engineering undergraduates who have completed at least 75 hours with a B average or higher may be accepted into an integrated engineering program through which both bachelor's and master's degrees are earned. The last two years, generally of five, are planned as a unit. You may earn bachelor's and master's degrees in engineering through this program.

## Financial Engineering— B.S. Engineering/M.S. Finance

Computer science students interested in a career in business and finance may opt for this track. With judicious planning, computer science majors are able within four years to earn a B.S. in computer science, an optional minor in engineering management or math, and participate (optionally) in a study abroad experience and/or a senior design experience. During the fifth year, students take all courses in the Owen Graduate School of Management and may obtain an M.S. in finance after the fifth year.

## Dual Degree with Fisk University

Students may earn an A.B. degree in biology, chemistry, physics, or mathematics from Fisk and a B.E. or B.S. in engineering from Vanderbilt, generally within five years.

## Academic Advising

Each student is assigned a faculty adviser in his or her major department. This adviser remains with the student all four years as long as he or she does not change majors. These advisers guide course selection, direct students toward academic and research opportunities, and provide information on careers after graduation. Advisers meet with students throughout each semester and are readily available for consultation.

## PAVE

PAVE, or Preparatory Academics for Vanderbilt Engineering, is a six-week summer engineering program for high school students who have completed eleventh grade. With a multidisciplinary approach, the program involves problem solving, computer skills, laboratory experiments, and technical writing in an engineering/science environment. Participants have access to all campus academic and recreational facilities.

## Teacher Licensure

The School of Engineering and Vanderbilt's Peabody College offer a teacher education program that leads to licensure as a secondary school teacher in physics or computer technology. Students major in engineering science in the School of Engineering and complete a second major in education at Peabody. The Office of Teacher Licensure at Peabody provides guidance and information on this option.

## Accelerated Graduate Program

Students who enter with 20 to 30 hours of credit—earned through Advanced Placement tests or in college courses taken during high school—may be eligible for the Accelerated Graduate Program in Engineering. A student may earn a bachelor's degree in four years and an M.S. by completing a master's thesis the following summer.





## ONE ON ONE

### Bob Webster

Assistant Professor of Mechanical Engineering

Smaller. Less invasive. More flexible. Those aren't just directives from physicians regarding medical devices—they're the goals that Assistant Professor of Mechanical Engineering Robert Webster III has set for his research and lab.

"The thing that drives me to continue to work really hard is the end product medically," he says. "Will it do something that doctors can't do today? Will it be less invasive? Will it make things better for the patient? If it's just academic and I can't see how it's going to help, I'm not as interested."

Needles are one of the most useful medical devices. Webster built and co-patented a steerable needle from telescoping precurved tubes that are flexible and can rotate inside each other, controlling shaft shape. Several types of Webster's steerable needles already provide safer, less invasive, and more accurate ways for physicians to make diagnoses and deliver treatments to patients. Despite initial successes, however, he continually pushes to improve by enhancing medicine through novel interventional tools, robots and guidance systems.

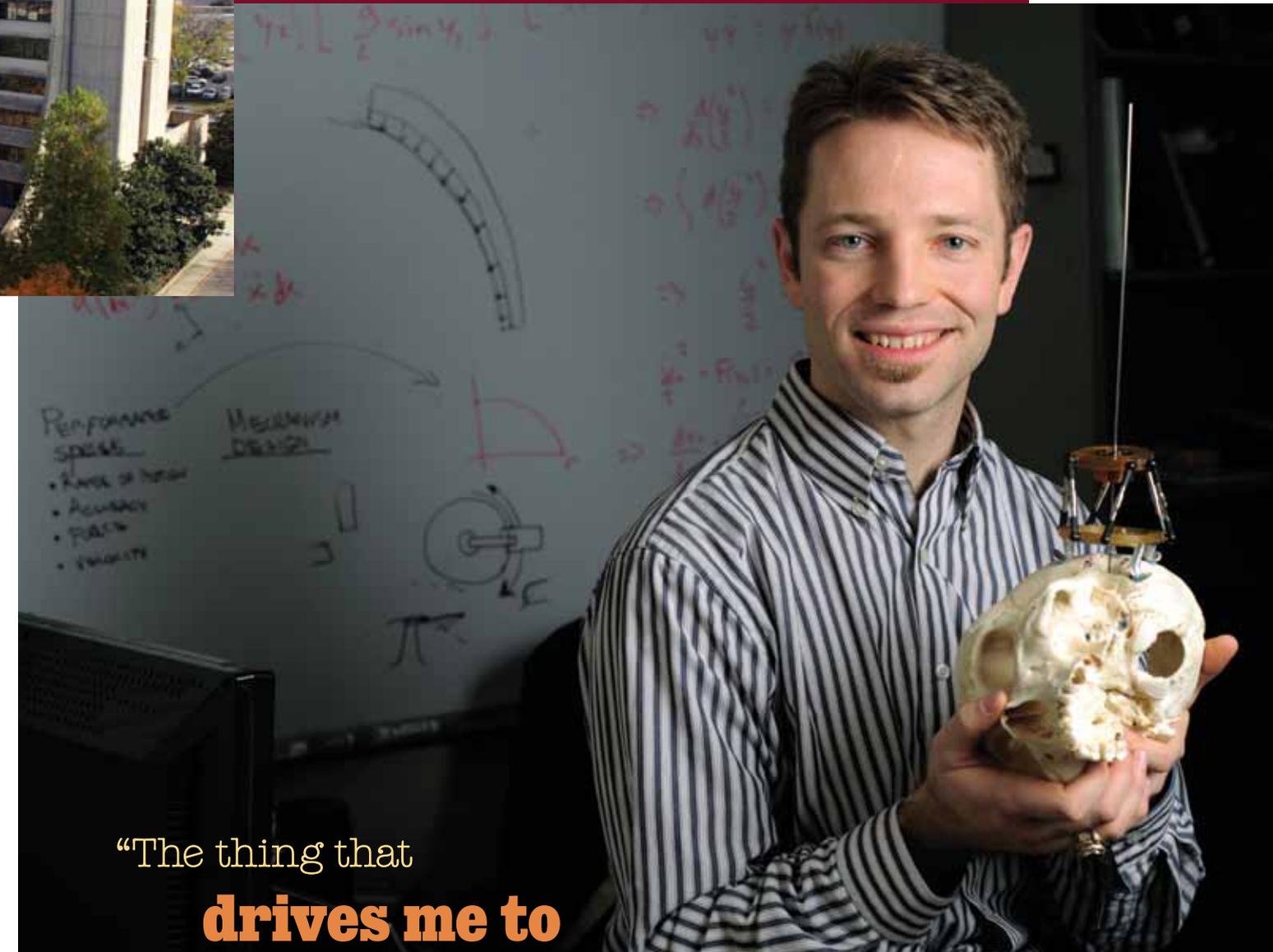
Webster partners with a number of Vanderbilt's leading researchers, including Dr. Robert Labadie, associate professor in the Vanderbilt University Medical Center's Department of Otolaryngology, and J. Michael Fitzpatrick, professor of computer science, computer engineering, and electrical engineering. They are working on a procedure to make cochlear implants—devices implanted inside the ear to help those with profound hearing loss—less invasive.

In Webster's Medical & Electromechanical Design (MED) lab, undergraduate and graduate student researchers work on a variety of projects. One current project involves undergraduate students investigating improvements to a swallowable medical robot that Webster first worked on during graduate school. The next phase, Webster believes, is capsule robots that do more than provide a view inside the body.

"The best path forward is having the capsule do a clinical intervention," Webster says. "You have a spot that's bleeding and you apply a clip to it or a powder that causes it to clot. Or you have the capsule find the tumor and clip it off or just take a biopsy sample. That's where I see it going."

The steering technology has other applications, as Robert Galloway, professor of biomedical engineering, discovered. Galloway pioneered the field of interactive image-guided surgery. Soon after arriving at Vanderbilt, Webster joined in the research, attempting to develop a laparoscopic method for image scanning before surgery; the work allows surgeons to have a three-dimensional image prior to incision.

"Prior to having Bob's expertise, any flex in any of our objects constituted a targeting error," Galloway says. "He brings an important piece to the next step. He understands the incredible challenges with working in engineering development for the purposes of making people better. We have a world-class team of people here who do that and so we have a high bar for acceptance of anyone new. Bob has stepped right in."



"The thing that  
**drives me to**

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is the end product medically.**

...If it's just academic and  
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I'm not as interested."

# For More Information



Vanderbilt University School of  
Engineering  
PMB 351826  
2301 Vanderbilt Place  
Nashville, Tennessee 37235-1826  
(615) 322-2762  
Web: [enginnering.vanderbilt.edu](http://enginnering.vanderbilt.edu)

Office of Undergraduate Admissions  
Vanderbilt University  
2305 West End Avenue  
Nashville, Tennessee 37203-1727  
(615) 322-2561 or (800) 288-0432  
Email: [admissions@vanderbilt.edu](mailto:admissions@vanderbilt.edu)  
Web: [admissions.vanderbilt.edu](http://admissions.vanderbilt.edu)

Office of Student Financial Aid and  
Undergraduate Scholarships  
Vanderbilt University  
2309 West End Avenue  
Nashville, Tennessee 37203-1725  
(615) 322-3591 or (800) 288-0204  
Email: [fnaid@vanderbilt.edu](mailto:fnaid@vanderbilt.edu)  
Web: [www.vanderbilt.edu/financialaid](http://www.vanderbilt.edu/financialaid)

**Accreditation** Vanderbilt University is accredited by the Commission on Colleges of the Southern Association of Colleges and Schools to award bachelor's, master's, education specialist's, and doctor's degrees and is a member of the Association of American Universities. Vanderbilt University is an equal opportunity/affirmative action institution.

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## Dates to Remember 2011/2012

- August** Part I Supplement and Common Application available at [www.commonapp.org](http://www.commonapp.org)  
Application packets available from Office of Undergraduate Admissions
- October 1** Earliest deadline to submit the College Scholarship Service (CSS)/Financial Aid PROFILE to processors
- November 1** Application deadline for Early Decision I
- December 15** Early Decision I notification
- January 1** Earliest deadline to submit the Free Application for Federal Student Aid (FAFSA) to processors
- January 3** Application deadline for Early Decision II and Regular Decision
- February 5** CSS PROFILE and FAFSA due to addresses indicated
- February 15** Early Decision II Notification
- April 1** Regular Decision Notification
- May 1** Postmark deadline for matriculation deposit



Senior engineering undergraduates show off their Anti-Tip System design for wheelchairs during Senior Design Day.



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Office of Undergraduate Admissions  
2305 West End Avenue  
Nashville, TN 37203-1727

[admissions.vanderbilt.edu](https://admissions.vanderbilt.edu)



come  
visit

Featheringill Hall, the hub of School of Engineering activities