

2008 – 2009 ANNUAL REVIEW



VILLANOVA
COLLEGE OF ENGINEERING



VILLANOVA
UNIVERSITY

College of Engineering Annual Review

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News & Events

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On the Cover:

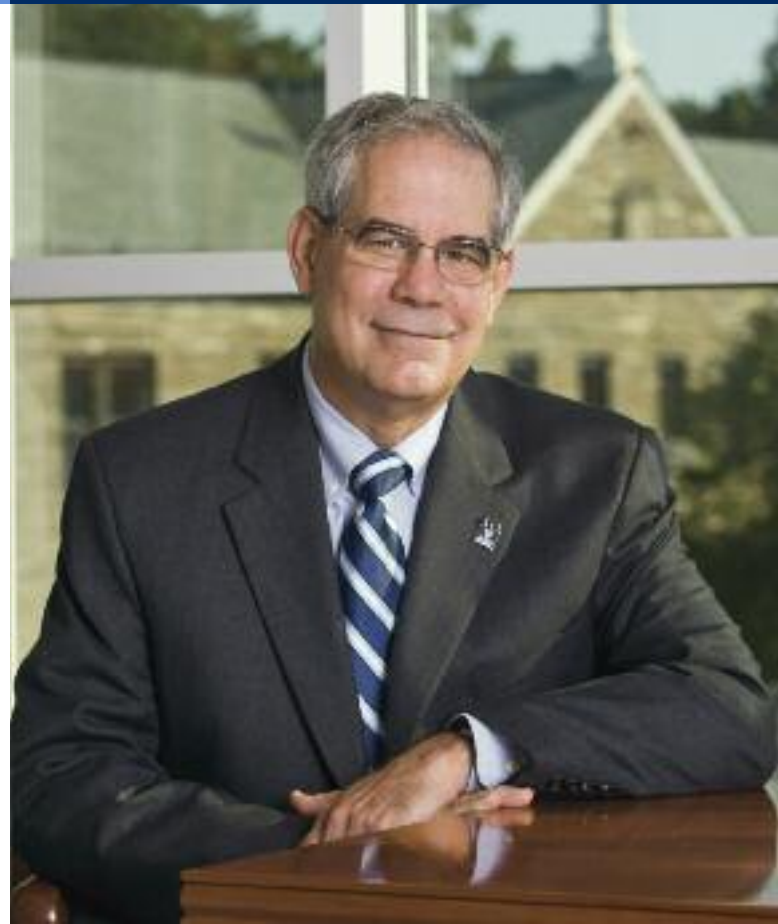
A graduate student conducts experiments in
the Water Resources Teaching and Research
Laboratory, which is used to support water
resources classes, as well as graduate and
undergraduate research.

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In December 2007, the College of Engineering unveiled a five-year strategic plan. It provided a blueprint for the College to become one of the premier engineering programs in the country while maintaining the University's Catholic values. As we enter into 2010, I'd like to update you on the progress we have made toward achieving some of the plan's goals:

- *Developing innovative courses, pedagogy, and curricula*
One of the most innovative first-year programs in the country is making students more creative problem solvers and strengthening their understanding of engineering fundamentals.
- *Providing for more interdepartmental and intercollegiate collaboration*
Interdisciplinary teams of faculty are teaching the first-year course, as well as courses in the new Bioengineering and Engineering Entrepreneurship minors.
- *Increasing the diversity of the faculty and student body*
Student gender diversity is at 25% and rising, with the incoming class at 32%. Faculty gender diversity is at 20%, twice the national figure.
- *Expanding opportunities for and recognition of research*
Faculty scholarship and research activity have increased (grant applications were up by 23% in the last year), and more undergraduates are participating in research.
- *Growing the MS and the new PhD programs*
All departments now use our distance-education infrastructure, and the College, which has awarded two PhDs already, expects to graduate about six doctoral students per year by 2012.



The College also is expanding industry interaction through funded student projects and research opportunities; implementing cross-curricular initiatives that teach students ethics and leadership skills; and developing courses and pursuing research related to sustainable engineering.

We are proud of our accomplishments, and yet we must adjust our plan in light of new challenges. The declining college-age population in the Northeast and Mid-Atlantic states; the lack of space for design projects and research activity; and the need to grow a high-quality graduate program while improving an outstanding undergraduate program: these circumstances require us to envision new possibilities—a challenge no engineer can resist.

A handwritten signature in black ink, reading "Gary A. Gabriele". The signature is fluid and cursive, with a prominent initial "G".

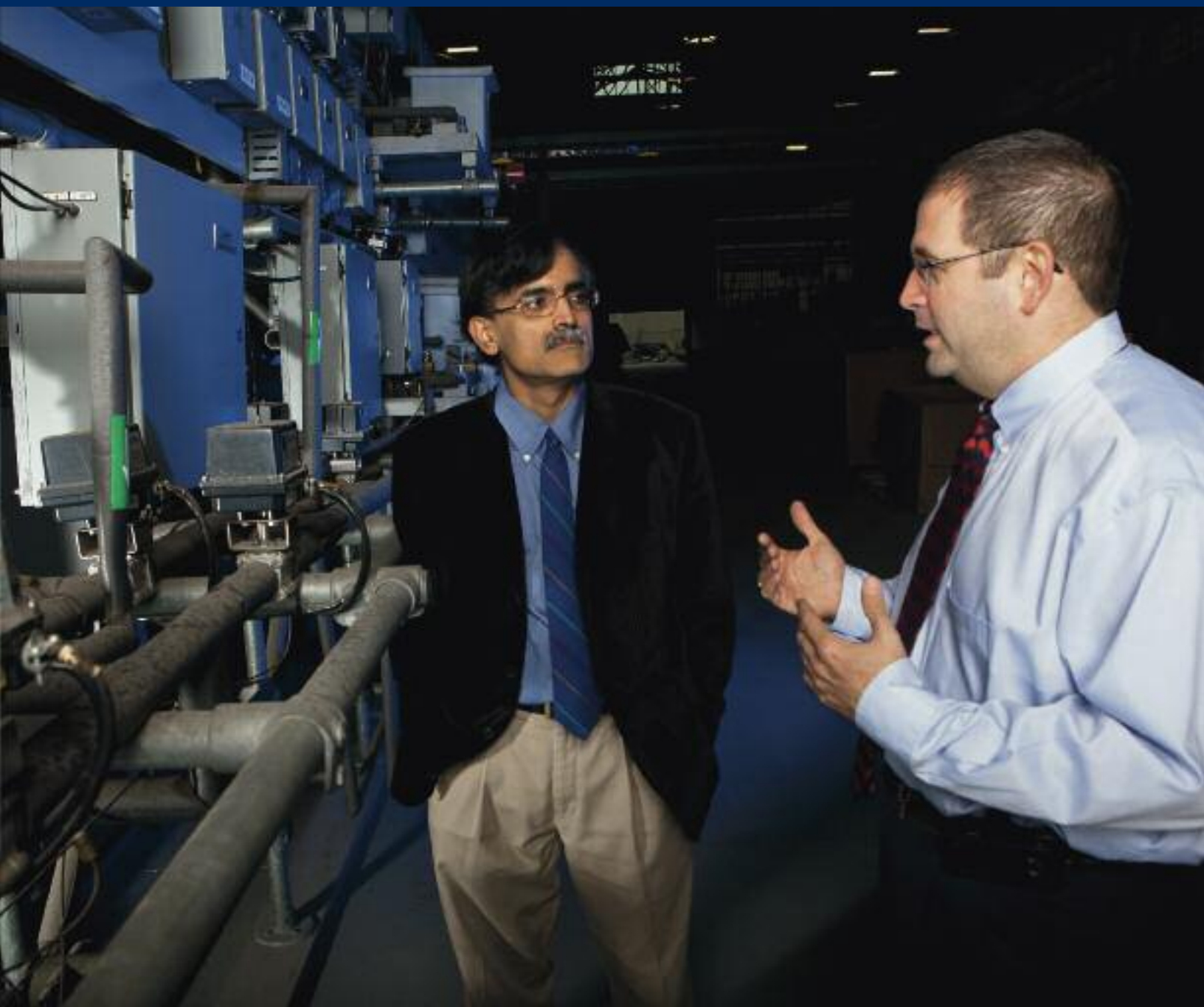
Gary A. Gabriele, PhD
Drosdick Endowed Dean of Engineering

“It is rewarding and productive to work with an institution whose culture is focused on education. That culture spills over into the research work, as faculty and students dive in and try to solve the most difficult parts of a problem.”

—Dr. Stephen Mastro, a senior engineer at the Ship Systems Engineering Station

THE WAY VALVES

Navy Grant Funds Dr. C. Nataraj’s Nonlinear Analysis and Design of Smart Valves



S WORK

One of the principal goals of the U.S. Navy is to achieve high levels of automation on ships and submarines. The use of predictive and adaptive machinery systems not only will reduce the amount of personnel—and, consequently, costs and casualties—but also will improve ship capability, ship survivability, and mission effectiveness. To investigate particular applications of this research, however, the Navy needs a university partner with expertise in nonlinear dynamics. It has found that expertise at Villanova.

Grant from the Office of Naval Research

Last year, the Office of Naval Research awarded what will amount to a \$1.2 million grant over three years to Dr. C. Nataraj, Professor and Chair of the Department of Mechanical Engineering and a researcher in the College of Engineering's Center for Nonlinear Dynamics & Control (CENDAC). Dr. Nataraj's primary area of specialty is the application of nonlinear dynamics and control to mechanical and electromechanical systems. From 2003 to 2008, he was the founding director of CENDAC.

The purpose of this grant is to fund the nonlinear analysis and design of smart-valve systems—in particular, those used in chilled-water systems. Because chilled-water systems supply cooling for a ship's electronics, radar, and other components, as well as for its environment, they are critical to a ship's operations.

Dr. Nataraj (left) and Dr. Mastro discuss innovative fluid control technologies at the Reduced Scale Advanced Demonstrator (RSAD). The RSAD is a reduced-scale, operational, land-based test site that simulates the chilled-water systems of Navy surface combatants and is used to test innovative hardware technologies and control algorithms.

Valves in Chilled-Water Systems

"The chilled water system, which provides cooling to a number of ship systems, is a closed loop with a finite amount of fluid," said Dr. Stephen Mastro, a senior engineer at the Ship Systems Engineering Station in Philadelphia, a major operating site of the Naval Surface Warfare Center, Carderock Division. "If piping breaks in a damage event and water escapes the system unchecked, the ship will be able to function for only a limited time. We need to be able to operate the electrically actuated valves, even if we don't have power, so that we can isolate the section of pipe that is broken."

To ensure that the valves—which weigh hundreds of pounds and consume a great deal of energy—function during a damage event, the Navy needs answers to important questions. How do we get energy to a valve to operate it? How much energy does it take to close and re-open a valve? Where is that energy going? Would a new, nontraditional design be more efficient?

The mission of Dr. Nataraj and his research team is to fill in these blanks. By using nonlinear theories to develop physics-based, high-fidelity models, they will be able to describe the real behavior of the smart-valve systems. Carnegie Mellon University is collaborating with Villanova to develop the control technology to work with the models.

The Work Thus Far

In this first year of the project, the researchers, including undergraduate and graduate students and a post-doc, developed a small-scale model—a solenoid-actuated butterfly valve—to verify their theoretical work. "We've been able to show that traditional, simple models are not able to predict a large number of phenomena that we actually see in practice," Dr. Nataraj said. Once the Navy adds a programmable controller, a motor, and sensors to the prototype and provides some of the experimental work, the researchers will do the theoretical modeling. In subsequent phases of the project, they will analyze other valves and actuators.

At the end of the three years, Dr. Nataraj hopes to have an optimally designed smart-valve system, as well as better insight into the electro-mechanical, electromagnetic, and fluid elements of the system. "Although the optimal design may be specific to the Navy, the phenomena that we uncover, the analysis that we carry out, and the models that we derive will be applicable to any kind of electromagnetically operated valves."

In the meantime, Dr. Mastro is pleased to have the opportunity to collaborate with Dr. Nataraj on the Navy's side of this project. "It is rewarding and productive to work with an institution whose culture is focused on education. That culture spills over into the research work, as faculty and students dive in and try to solve the most difficult parts of a problem."

TO THINK BIG,

Nano Research Leads to Innovations in Thermal Management of Electronics



In the early years of their joint research on the thermal management of electronic devices, Dr. Amy Fleischer BME '91, MME '96, Associate Professor of Mechanical Engineering, and Dr. Randy Weinstein, Professor and Chair of the Department of Chemical Engineering, succeeded in using wax to absorb heat in small electronics. However, when they ran experiments to see if this method would be appropriate for larger systems, they met with thermal resistance.

Although wax is an effective phase-change material (a substance that absorbs and releases thermal energy during transient heating) when used in small amounts, it is less effective in larger volumes because of its poor thermal conductivity. "It was apparent that the method would work in higher power applications, but we needed to change the thermal conductivity of the wax to facilitate greater heat flow into it," Dr. Fleischer said.

Since carbon has high thermal conductivity and low weight and volume, Dr. Weinstein and Dr. Fleischer added graphite nanofibers to the wax. The result: a new material that could efficiently remove heat, even in much larger systems. For the past five years, the Office of Naval Research, which is interested in the development of effective, reliable, passive, modular cooling methods for its high-power, transient electronics, has funded their studies in this area.

At the same time, their work has raised fundamental questions about which mechanisms in the nanoenhanced material were responsible for the improved thermal transport. In 2009, Dr. Fleischer and Dr. Weinstein received a three-year, \$324,709 grant from the National Science Foundation to investigate this phenomenon. Dr. Weinstein is fabricating and characterizing the nanofibers, while Dr. Aaron Wemhoff, Assistant Professor of Mechanical Engineering and a co-investigator on the proposal, is using molecular dynamics modeling to predict the nature of the energy transport in the various nanofiber styles. Dr. Fleischer is conducting the testing and heat transfer analysis.

"It is great to work on such a practical project with so many applications with a multidisciplinary team of students and faculty. It keeps you thinking and always pushing for new ideas and approaches," Dr. Weinstein said.

Dr. Randy Weinstein prepares the metallic catalysts for the growth of graphite nanofibers.

THINK SMALL

Other Advances on the Nano Front

Ceramic Nanofibers for Thermal Insulation

With funding from a Keystone Innovation Grant, the Department of Mechanical Engineering's **Dr. Sridhar Santhanam**, Professor, and **Dr. Kei-Peng Jen**, Associate Professor, have been conducting research into the use of silicon nitride nanofibers to create thermal-insulation material for applications such as furnaces and boilers. Nanofibers have a thermal capability that is superior to conventional fibers. For the first part of the project, the two researchers focused on the fabrication process. Now they are making the fibers into thin sheets and are testing their insulation capabilities.

Characterization of Nanomaterials

Dr. Gang Feng, Assistant Professor of Mechanical Engineering, has been using state-of-the-art techniques to characterize nanofibers and nanowires, which are found in electronics, optics, and other applications. By comparing his experimental measurements with the numerical results of Dr. Aaron Wemhoff's advanced computational simulations, Dr. Feng is able to better understand the properties and behavior of these nanomaterials. Dr. Feng also has been applying nanocharacterization techniques to bones to learn from nature how to design nanomaterials with optimized properties.

Nanoscale Modeling

An expert in heat and mass transfer in microscale and nanoscale systems, **Dr. Aaron Wemhoff**, Assistant Professor of Mechanical Engineering, is the go-to faculty member for molecular dynamics simulations. The code he has developed can be used as a teaching and research tool, and it complements the experimental work being done in the College. Current modeling projects include nano droplet impingement heat transfer and predicting the thermal conductivity of graphite nanofibers in phase-change materials. On the theoretical front, he has applied the theory of capillarity to advanced cubic equations of state.

SPM Nanopositioning

Scanning probe microscopes (SPMs) are essential tools for imaging, manipulating, and manufacturing at the nanoscale. However, factors such as dynamic effects and nonlinearities in the piezoelectric actuator make it difficult to control the position of these devices during high-speed operations. **Dr. Garrett M. Clayton**, Assistant Professor of Mechanical Engineering, has expertise in instrumentation and control for high-speed nanotechnologies. He is working with the Center for Nonlinear Dynamics & Control to model, calibrate, and measure nanoscale SPM motion. His goal is to make SPM processes faster while maintaining high precision and accuracy.



Dr. Amy Fleischer assists MSME student Ryan Ehid '09 with the installation of a nanomaterial property testing device.

Nanostructured Materials for Catalysis and Alternative Energy Applications

Because the small-scale structure of nanomaterials creates different chemistry, **Dr. Michael Smith MChE '99**, Assistant Professor of Chemical Engineering, is trying to understand how variations in the structure of catalysts at the nanoscale affect catalytic behavior. He has been making silica materials by means of a self-assembly mechanism and then turning them into catalysts. The well-defined nature of these materials allows for systematic investigations of catalyst performance. An additional project is to use the same self-assembly techniques to create thin films of nanostructured semiconductors for solar cells and photo-catalytic applications. His goal is to have improved catalysts for energy transformation.



Kevin Hinds EE '10 (left) and Dr. Bijan Mobasseri



From left: Dean Gary Gabriele, Prof. Jim O'Brien, and Dalmas Wambura ME '10 at the 2009 Undergraduate Research Poster Day

SIDE BY SIDE

Undergraduates Spent the Summer Engaged in Research with Expert Faculty

At the 2009 Undergraduate Research Poster Day on October 6, hosted by the Center for Undergraduate Research and Fellowships, the College of Liberal Arts & Sciences, the Department of Chemistry, and the College of Engineering, dozens of students showcased the fruits of their summer research. These undergraduates—and many others throughout the year—had taken advantage of the opportunity to collaborate with expert faculty on leading research. Here is a sampling of recent projects in the College of Engineering:

Energy Audit Business

Chemical Engineering students created a business called PowerHouse, which focuses on residential energy efficiency. Led by graduate student Sarah Barnett ChE '09, the business evolved from a 2008-2009 senior team project under the advisement of Professor Bill Lorenz ChE '68. PowerHouse provides a home energy audit, an opportunity assessment, and a project consultation. During this past summer, the students performed audits consisting of an infiltration test, an IR camera imaging to detect leaks and missing insulation, an appliance and electronics assessment, and a carbon-footprint analysis.

Urban Stormwater Toxicity

Advised by Dr. John Komlos, Visiting Assistant Professor in Civil and Environmental Engineering, Jill Pietropaolo CE '10 collected water samples from the bioinfiltration traffic island on Villanova's West Campus to see what effect depth, location, nutrients, and metals have on the toxicity of stormwater runoff. Pietropaolo also studied the nutri-

ents, especially phosphate, in the background soil near and above the collection site to determine the soil's effectiveness at absorbing nutrients. Funding was provided by the EPA, Federal Clean Water Act Section 319 (PA DEP) Nonpoint Source Pollution Management Program, PA DEP Growing Greener, and the William Penn Foundation.

Underwater Acoustic Signal Processing

Kevin Hinds EE '10 and Andrew Richardson EE '10 worked with Dr. Bijan Mobasseri, Professor, Electrical and Computer Engineering, on an underwater, acoustic signal processing project being funded by the Naval Undersea Warfare Center, Newport, Rhode Island, and the Office of Naval Research. Dr. Mobasseri's group is developing a method for authenticating sonar pings by embedding them with secure, imperceptible digital watermarks. This capability will provide the U.S. Navy with a unique, effective tool for sorting out underwater acoustic emissions.

Robotic Stingray

Dalmas Wambura ME '10 and ME graduate student Kristin Dormuth conducted a preliminary analysis for the development of an underwater, autonomous robot that mimics a stingray's undulatory motion. With the help of ChE graduate student Kevin Brodwater '09, they used ionic polymer metal composite (IPMC) for the actuator material. Not only is IPMC soft, flexible, and effective in water, but it also can be used for actuation and sensing. The Office of Naval Research supported this research. Dr. C. Nataraj, Chair of Mechanical Engineering, advised the team.



MSEE student Sukriti Jain fabricates a novel solar cell in Dr. Pritpal Singh's laboratory.

NOTCHING THE CHART

Graduate Engineering Programs Show Healthy Growth

The College of Engineering's doctoral degree program is coming of age, and its parents couldn't be prouder. Since 2003, when the program was launched, the PhD Committee has worked tirelessly to establish policies, review applications, and make administrative decisions. "We had to grow the program from its infancy to what it is today," said member Hashem Ashrafiun, PhD, Professor of Mechanical Engineering.

To date, two students have completed their PhDs. According to Dr. Alfonso Ortega, the Associate Dean for Graduate Studies and Research and the James R. Birlle Professor of Energy Technology, the College is on track to graduate about six doctoral students per year by 2012 (see Figure 1).

This growth correlates with the increase in the number and size of faculty research grants—grants that help fund PhD students. Having faculty who perform research, who publish their work, and who present at conferences also raises the profile of the program and serves as a recruiting tool.

Now the PhD Committee is identifying and developing those features that distinguish the program: the size of the institution, the low student-to-faculty ratio, the reputation for excellence in certain research areas. "Students choose Villanova over other schools, and we want to make their experience as rewarding as possible," Dr. Ortega said.

The MS program is likewise thriving. The opportunities to do research are attracting an increased number of full-time students, especially Villanova undergraduates. Meanwhile, more and more working professionals are enrolling in the part-time program.



Figure 1. PhD Program Growth Since 2004

For many, an online format is the only option. The convenience, reliability, and depth of the College's award-winning e-learning program suits their schedule and lifestyle. From 2008 to 2009, enrollment in online graduate courses was up by 25%, and half of the students now take courses online.

"The College understands the constraints that life can put on one's education," said Sean O'Donnell CPE '00, Director of Distance Education. "Thanks to the latest technologies and our commitment to providing the best education possible, we are able to offer a program that doesn't sacrifice quality and rigor for convenience."

THE INDUSTRY-MINDED

Dr. Sridhar Santhanam Gets an Inside Look at The Boeing Company



Steven Spear (left) and Dr. Sridhar Santhanam stand in front of a CH-47F Chinook helicopter at Boeing Philadelphia's flight ramp in Ridley Park.

PROFESSOR

Dr. Sridhar Santhanam, Professor of Mechanical Engineering, has spent his entire career in academia, educating future engineers and conducting critical research in the areas of materials and mechanics. This summer, he stepped out of this role and viewed his profession from a new perspective: that of the engineer working in industry.

Boeing Welliver Faculty Fellowship Program

Selected from a highly competitive, international pool of faculty, Dr. Santhanam participated in Boeing's prestigious Welliver Faculty Fellowship Program. For eight weeks, he observed, offered input to, and received feedback from professional engineers within the aerospace company. He learned about the customer-driven environment, the practice of engineering in a global economy, and the integrated relationship between manufacturing, engineering, and business.

"The program's primary mission is to expose faculty to industrial practices so that they return to their institutions better informed about the world their students will be entering," Dr. Santhanam said. "I think the program is fantastic and succeeds in achieving this goal." As Dr. Santhanam found out, the program also creates opportunities for long-term partnerships between faculty and their peers in Boeing.

The Program at a Glance

For their weeklong orientation, the nine Welliver Fellows traveled to the Boeing Leadership Center (BLC) in Missouri. They listened to presentations by high-level executives and visited several Boeing plants. As is the case with any "student," they received a homework assignment: individual and group reports that would be due when they returned to the BLC for the final week.

For the middle six weeks, Dr. Santhanam's classroom was Boeing's Philadelphia site, where the V-22 Osprey and the CH-47 Chinook are manufactured. His mentor, Steven Spear BME '93, MME '99, Senior Manager of Mechanical & Dynamic Systems Design Engineering at Boeing Philadelphia, had custom-built a program that enabled Dr. Santhanam to shadow employees working in the area of composite materials.

"This was the completion of a full circle," Spear said. "Twenty years ago, Dr. Santhanam was among my first professors at Villanova, and this was a genuine opportunity to give something back. I thoroughly enjoyed the summer with Sridhar. Yeah, I can call him that now!"

Though he was given an office, Dr. Santhanam seldom used it. Every day, he was on the move—visiting a composite manufacturing shop, touring a dynamics lab, or engaging in technical discussions with engineers.



Dr. Santhanam works with a graduate student who is using a scanning electron microscope in the the College of Engineering's High Resolution Microscopy Laboratory.

Take-Home Lessons

By the end of this immersion experience, Dr. Santhanam had learned valuable lessons that will benefit the ME Department and the College:

- To advance in their careers, young engineers must possess technical excellence, strong people skills, hands-on experience, and the ability to work as part of a team in designing and building complex systems. Although the College emphasizes these skills, Dr. Santhanam suggests that engineering students be given even more opportunities to assume leadership roles and to collaborate with nonengineering students.
- Dr. Santhanam recommends that ME students have more exposure to composite materials in their lectures and labs and that they do more solid modeling in sophomore and junior year.
- Dr. Santhanam would like to explore research collaborations with Boeing in several areas, including applications of magnetic shaped memory alloys in rotor-blade technology and nondestructive inspection of composite materials.
- Building on the relationships he either formed or strengthened during his fellowship, Dr. Santhanam hopes to bring more Boeing experts into the classroom and is holding follow-up meetings with the company to increase its involvement in capstone design projects.

Although College of Engineering faculty members engage in many forms of professional development, Dr. Santhanam is the first to participate in the Welliver program. He encourages his colleagues to follow his lead. "It's an eye-opening experience for anyone coming from the academic world."



AFFINITY AND BEYOND

The College Has a Win-Win Relationship with Air Products and Chemicals, Inc.



Thomas Gacka ME '10 (left), President of Villanova's Formula SAE Team, describes the team's car to a captive audience: alumni and Air Products employees Joe Lamack, Sarah Arcscott, and Bob Gordon (right).



Left: George Bitto, Vice President and Treasurer at Air Products, chats with students at a networking dinner hosted by the Villanova student chapter of the Society of Women Engineers.

Below: ChE alumni Trini Bruniard '06, Erika Squitieri '05, and Chris Tarsi '05 spark interest in engineering among VESTED students by volunteering to conduct liquid nitrogen experiments in CEER.



In this case, familiarity breeds success. For nearly 50 years, the College of Engineering has enjoyed an extraordinary kinship with Air Products and Chemicals, Inc., a global supplier of gases, performance materials, equipment, and services to customers in industrial, energy, technology, and healthcare markets. This relationship has benefited both entities and serves as an exemplar of industry-university interaction.

Forging the Bonds

This rapport has developed because, over the decades, graduates have consistently migrated from Villanova to Air Products, whose U.S. headquarters are in Allentown. More important than the quantity of alumni, however, is the quality. "When I was at Villanova, the top engineering students were always striving to get a job at Air Products," said Joe Lamack ChE '87, Project Development Manager, Water/Energy. "They saw it as one of the premier companies to work for."

That trend continues. For example, Melanie Malone ChE '08 and William Hanlon ChE '08, who in their senior year received the AIChE Outstanding Student Award and the American Institute of Chemists Award, respectively, both elected to work for Air Products. This year, Sarah Arscott ME '09, the winner of Villanova's Thomas J. Mentzer Award, did the same.

What clinched Arscott's decision was the company's landmark Career Development Program (CDP), in which participants rotate through different assignments during the first several years of employment. "The diversity of the CDP program allows me to see what I like or don't like about certain assignments and to grow from those experiences."

According to alumni at Air Products, Villanova graduates are a "fit" because the company hires the same kind of student that the College develops: technically proficient, well-rounded leaders. "Because there

is a skills match and a values match, we have a long history of recruiting engineers who achieve a high level of success," said George Bitto EE '81, Vice President and Treasurer at Air Products and a member of the College of Engineering Advisory Board. Luminaries in that long history include William Scharle ChE '50, Vice President (ret.); Thomas Portland ChE '69, Vice President (ret.); Gerald White ChE '57, Vice President and CFO (ret.); the late Frank Ryan ChE '53, President and COO; and John Paul Jones ChE '72, Chairman and CEO (ret.).

The Role of Alumni

Whether they have worked for Air Products for a few months or their whole careers, alumni are passionate about recruiting new engineers from their alma mater to perpetuate the cycle of success. "Villanovans who are 'lifers' at Air Products know that Villanova produces top-notch engineers. There's never a shortage of people willing to go back to recruit," said Bob Gordon ChE '80, Product Supply Team Manager, Air Separation, and a member of the ChE Department's Advisory Committee.

Being able to claim that a global company employs some of its most gifted graduates helps the College sell itself to top prospective students. In turn, such a claim ensures that companies like Air Products will have a pool of high-quality graduates from which to recruit each year. "The close working relationship has created great opportunities for many engineering graduates while supplying Air Products with the talent it needs to continue providing its customers with the best solutions anywhere in the world," former Chairman and CEO Jones said.

Besides recruiting, Air Products employees, especially alumni, interact with the College in numerous ways. By serving on advisory boards, they offer input on industry trends so that students are better prepared to enter the workforce. Through career fairs, resume-writing workshops, open houses, networking events, outreach programs, and classroom visits, they share their expertise with current students. They also stay connected to them after they graduate. For example, Lamack is President of the Lehigh Valley Chapter of the Alumni Association, and Gordon is Chair of the Engineering Alumni Society's Awards Committee. Both men also have been instrumental in promoting the College's graduate program. A number of Air Products employees have earned their MS in Chemical Engineering at Villanova.

Ties with the ChE Department

Finally, through its generous financial support, Air Products has sponsored many College events and is exploring opportunities to support design projects and various initiatives in the Mechanical Engineering Department. However, its oldest and strongest relationship is with the Chemical Engineering Department. Air Products continues to be the largest contributor to the department's restricted fund. Many alumni who have worked at Air Products personally support this tradition of giving. In 2007, for example, the department's Gerald A. White Laboratory was dedicated. The upgrades to this biotech lab were made possible in part by a grant from White and his wife, Topsy.

"Air Products has been a rock in terms of helping us," said Dr. C. Michael Kelly, who was department chair from 1988 to 2007. "I'd like to think we have been the same thing by supplying the company with good people."

FACULTY ACHIEVEMENTS

FACULTY SCHOLARSHIP

Journal Articles Published	151
Conference Proceedings Published	122
Conference Papers Presented	85
Chapters in Scholarly Books	10
Other Publications	53
Grant Applications	165
Service on Editorial Boards/ Professional Leadership Positions	101

FACULTY PROMOTIONS

- Dr. Sridhar Santhanam, Department of Mechanical Engineering, was promoted to Professor
- Dr. Alan Whitman, Department of Mechanical Engineering, achieved the rank of Professor Emeritus
- Dr. Yimin Zhang, the Center for Advanced Communications, was promoted to Research Professor

NEW FACULTY



Leslie Myers McCarthy, PhD, PE
Assistant Professor
Civil and Environmental Engineering

- Pavement design; pavement management and preservation; bituminous materials; federal aid policy; performance-related specifications; warm-mix asphalt; context-sensitive solutions; alternative contracting for construction projects
- BS, Civil Engineering, The Pennsylvania State University
- MS, Civil Engineering, University of Florida
- PhD, Civil Engineering, University of Florida

DISTINCTIONS

Dr. Jens Karlsson, →
Associate Professor of Mechanical Engineering, was the lead author of a research paper published in *Molecular Reproduction and Development* and featured on the cover of the April 2009 issue.

Dr. Randy Weinstein,
Professor and Chair of Chemical Engineering, was a semi-finalist for the 2009 Lindback Award for Distinguished Teaching. He also was elected to the Supreme Council of the professional chemistry fraternity Alpha Chi Sigma.



Dr. Robert Traver, PE, MCE '82, Director of the Villanova Urban Stormwater Partnership, testified before the House Subcommittee on Water Resources and Environment during a hearing on "Efforts to Address Urban Stormwater Runoff."



SABBATICALS

The Philadelphia Section of the IEEE presented the Member Award to **Dr. Pritpal Singh**, Chair of Electrical and Computer Engineering, for outstanding innovation in engineering education and for continuous support to the Philadelphia Section. →



Dr. Bridget Wadzuk CE '00

received the University Junior Faculty Award for Excellence in Teaching, which is presented annually to an extraordinary professor who has been in a full-time position for less than seven years.



Dr. Moeness Amin, → Director of the Center for Advanced Communications, received the European Association for Signal Processing's Technical Achievement Award at the 2009 European Signal Processing Conference, held in Scotland in August.



Dr. Ahmad Hoorfar, *Professor and Director, Antenna Research Laboratory At NASA's Jet Propulsion Laboratory in Pasadena, California*, Dr. Hoorfar collaborated with engineers and scientists on the development of advanced optimization techniques for the design of antennas for NASA's deep space

network. He also gave two invited talks on miniaturized antennas and through-the-wall imaging radar.

Dr. Kei-Peng Jen, *Associate Professor, Mechanical Engineering*

Dr. Jen conducted research at Villanova in (a) characterization of lifting forces during the rapid compaction of deformable porous media; (b) in situ permeability measurement of the mammalian lacunar-canalicular system; (c) nanoscale, high surface area, thermal conductive ceramics as support for metal oxide catalysts in alkane selective oxidation; and (d) ceramic nanofibers for thermal insulation.

Dr. Sergey Nersesov, *Assistant Professor, Mechanical Engineering*

Dr. Nersesov spent part of his time at Georgia Tech, where he worked toward completion of the research monograph "Interconnected Dynamical Systems: Stability and Control," and the rest at Villanova, where he focused on three papers and an NSF proposal titled "Energy-Based Control for Interconnected Dynamical Systems with Applications to Complex HVAC Systems."

Dr. Bridget Wadzuk, *Assistant Professor, Civil and Environmental Engineering*

Remaining at Villanova, Dr. Wadzuk focused on publishing her research and further establishing her research program. As part of her many activities, she completed and submitted three journal papers, submitted and presented four conference papers, received two grants, continued work on an active grant, advised undergraduate and graduate students, prepared proposals, and served as advisor on an Engineers Without Borders trip to Kenya.



Dr. Qianhong Wu, *Assistant Professor, Mechanical Engineering*

At the Technical Institute of Physics and Chemistry of the Chinese Academy of Sciences in Beijing, Dr. Wu worked with leading scientists to investigate mechanical and chemical properties of functionalized supra molecular porous media, from which they were trying to elucidate the mechanism that determines the structural integrity of a porous structure akin to the endothelial glycocalyx that lines the inner surface of human blood vessels. Dr. Wu also gave talks at various institutions in China.

Dr. Rosalind Wynne, *Assistant Professor, Electrical and Computer Engineering*

The Oak Ridge Institute for Science and Education Faculty Research Participation Program selected Dr. Wynne to be a Visiting Research Scientist at The Johns Hopkins University Applied Physics Laboratory (JHU/APL) in Maryland. Dr. Wynne conducted independent research to develop a photonic crystal fiber based rubidium vapor cell for applications to JHU/APL-related quantum computing projects. She also collaborated with scientists to investigate super-continuum generation in photonic crystal fibers for the development of novel sources for directed energy defense projects.



WHY SETTLE FOR EASY?

Lockheed Martin VP Robert Slegelmilch Gives Every Challenge a Try

When it comes to identifying their personal and professional goals, many people, afraid of failure, set the bar low. In the world according to Robert Slegelmilch EE '84, setting the bar low is the failure. "I always aim high and go for what is hardest," said Slegelmilch, who in 2008 was appointed Vice President of Information Technology Services, Lockheed Martin Enterprise Business Services. "I challenge myself and others to get out of the box."

This philosophy explains why the Reading, PA, native chose to study Electrical Engineering, a major that he knew would be difficult to master. But master it he did—while still finding time to play intramural sports and serve on the executive board of the student chapter of IEEE. "Robert was an exceptional scholar and, more important, a compassionate, independent thinker with refined people skills," recalled Dr. Stephen Konyk, Assistant Professor of Electrical and Computer Engineering (ECE).

Since 1984, Slegelmilch has been rising through the ranks at Lockheed Martin, tackling tough jobs outside of his technical comfort zone. His years at Villanova not only had proven that he could work through such challenges but also had helped him develop the leadership skills that would compensate for his lack of technical expertise in a given area. "Villanova taught me that no matter how impossible a situation may seem, there is a way to succeed."

In his 25 years at Lockheed Martin, Slegelmilch has had the opportunity to lead programs and organizations in excess of 6,000 people. He has dedicated himself to leadership excellence and employee development, mentoring everyone from executives to interns about their careers.

He brings this same skill set and personal attention to his role on the ECE Department's Industrial Advisory Board and on the College of Engineering Advisory Board. Strengthening the university-industry partnership and providing real-time feedback on industry trends are priorities of both boards, but Slegelmilch also contributes, whenever he can, at the student level, whether it's through mentoring, setting up an internship, or making some other personal connection. These are the interactions he values the most. "At a university, it's all about the student, just as in the workplace, it's all about the employee. It always has to be about the people."



About the EAS

The dedicated members of the EAS work with the engineering departments and the Villanova University Alumni Association to support engineering students. Through the generosity of its members, the EAS helps fund student projects and activities, as well as scholarships for incoming freshmen.



2009 ENGINEERING ALUMNI SOCIETY (EAS) AWARDS

Kathleen P. (Melton) Hanling ChE '68

We reported in the 2009 summer magazine that Nance K. Dicciani, PhD, '69 was the first full-time female student to receive a bachelor's degree in Chemical Engineering from Villanova. While Dr. Dicciani was the first to complete her degree in four uninterrupted years, Kathleen P. (Melton) Hanling, who had taken a year off between her junior and senior year, earned her ChE degree in 1968.

After holding several industry positions, Hanling began a career as an engineer for the Naval Air Development Center in 1985. In 2006, she retired from the Naval Air Systems Command Headquarters at Patuxent River, MD, having risen to senior leadership positions.

We congratulate Hanling on her many achievements!



From left: Dr. Gary Gabriele, the Drosdick Endowed Dean of Engineering; Irene Kropp; Ron DeGregorio; Sean McDermott; Dr. Thomas Hanratty; Nelson Shaffer; Maury Bayer; Bill Lorenz; Erin Vogel; Rev. Peter M. Donohue, OSA, A&S '75, President of Villanova University

The J. Stanley Morehouse Memorial Award

Thomas J. Hanratty, PhD, ChE '47

The John J. Gallen Memorial Award

Amy Kleist Holovaty BChE '97, MBA '04

The Carl T. Humphrey Memorial Award

Maury B. Bayer MSCPE '04

Meritorious Service

Anthony J. Donadeo EE '95

William K. Lorenz ChE '68

Nelson J. Shaffer MSTE '81

Erin Vogel BSME '05, MSME '06

Professional Achievement

Ron DeGregorio ME '91

Irene Kropp MSWREE '83

Sean McDermott EE '88

Janice Peterson ChE '82

EAS Award Sponsors

O'Donnell & Naccarato, Inc.

Associated Engineering Consultants, Inc.

Joseph B. Callaghan, Inc.



Among the guests at the 33rd annual Engineering Alumni Awards Ceremony and Reception were (from left) Dr. Edward V. McAssey, Jr., Professor Emeritus of Mechanical Engineering; Michael Gillin BME '99, MBA '04; and Paul Modelewski ME '78.



MAKING WAVES

Senior David Rounce Dedicates Himself to Global Water Issues

As David Rounce CE '10 fed spoonfuls of soup to a boy who was living in a Peruvian orphanage and who had multiple disabilities, he realized what he wanted to do with his life: improve the living conditions of people in developing countries.

The conviction that took hold of him on this 2008 spring break trip grew stronger when David, a native of South Windsor, CT, spent fall break of his junior year working on a community farm in Mexico and learning about the sustainable practices of local engineers. "When I returned to Villanova, I knew that I wanted to use my engineering knowledge to make a difference."

David poured himself into projects related to water resources. He was part of a group that assessed existing pipelines and collected data on new water sources in Nicaragua. After joining the executive board of the Villanova chapter of Engineers Without Borders (EWB), he helped design a sanitation system for a health clinic in Honduras and served as a project manager for a Kenyan water initiative.

His involvement in EWB led David to become a Water Ambassador for the Philadelphia Global Water Initiative, a consortium committed to

increasing worldwide access to safe water, sanitation, and hygiene services. In this role, David educates people about water sustainability and the global water crisis.

David's passion also spilled over into his academic pursuits. Under the advisement of John Komlos, PhD, Visiting Assistant Professor in the Department of Civil and Environmental Engineering (pictured above with David), David spent summer 2008 investigating the impact of microbial processes on nitrogen removal in a constructed stormwater wetland located on campus. This past summer, he traveled to the University of Pittsburgh, where he evaluated the effect of platinum thicknesses on the performance of a microbial fuel cell.

In 2009, David won four scholarships, including the Morris K. Udall Undergraduate Scholarship. He is now making plans for graduate school, and Villanova's Nationally Competitive Scholarship Committee has endorsed him as a candidate for the Rhodes Scholarship and the Marshall Scholarship. Although David does not know where he will study, he is sure about what he wants to accomplish in the long term. "My goal is to teach and do research on water allocations and the most efficient way to use water, especially in developing countries."

STUDENT ACHIEVEMENTS



At the College of Engineering Recognition Ceremony, Bryan Wagner CE '09 (pictured with Dean Gary Gabriele) received the Robert D. Lynch Award (given by the Engineering Alumni Society) and the Civil and Environmental Engineering Faculty Award.

Reza A. Soltan MSME '09 was the recipient of the College of Engineering Outstanding Graduate Student Award. →



The Villanova Formula SAE Team participated for the first time in the Formula SAE Michigan competition. Headed by President Thomas Gacka ME '10 (far left), the team placed 24th out of 120 in the Endurance and Fuel Economy Event and was one of only 39 teams to complete the 12.1 mile race.



Dr. Stephen Jones (second from left), the College's Associate Dean of Student and Strategic Programs, and members of the student chapter of the National Society of Black Engineers (NSBE) attended the organization's annual convention in Las Vegas. →



Sarah Arscott ME '09 (in the white shirt) was the winner of Villanova's Thomas J. Mentzer Award for her service in behalf of the poor and marginalized.

Sherrie-Ann Martin ChE '09 was selected from a competitive pool to be the student speaker at Commencement. →





Dr. Randy Weinstein
Professor and Chair,
Department of Chemical Engineering



CHEMICAL

E N G I N E E R I N G

The Department of Chemical Engineering (ChE) continued to bring an international, multicultural perspective to its curriculum to better equip students to solve global challenges, including energy independence and medical care. In 2008-2009, the department revised the curriculum, adding electives, increasing flexibility, and reducing the number of credits required for graduation.

Among the teaching initiatives supported by the department was the purchase of a new process control and pumps experiment. The department also instituted a new mentoring program for its faculty.

UNDERGRADUATE + GRADUATE

- The ChE Department continued to experience tremendous growth in student enrollment and diversity. The Class of 2009 included 50 chemical engineers, and the incoming freshman class was estimated to be 40% female.
- In addition to the seniors, all of whom did a full year of independent research, 21 undergraduate students participated in research projects.
- A team of seniors was one of five winners nationwide in the 2009 Transportation Innovation Acceleration Challenge. As a result, the students were invited to present to the U.S. Department of Energy Transportation Technologies Program Office an idea they had developed in a class taught by Dr. Michael Smith MChE '99, Assistant Professor.
- A senior project evolved into a student-led business that focuses on residential energy efficiency (see p. 6).
- Ten new students, the largest number in recent history, enrolled in the full-time master's program for fall 2009. Dr. Donald Joye, Professor, spearheaded efforts to increase the number of online graduate courses.
- The department added graduate courses in climate change and sustainability; impact assessment and life cycle analysis; biomaterials and drug delivery; biopharmaceutical plant design; and nanomaterials, catalysis, and energy transformations.
- Professor Bill Lorenz ChE '68 and other faculty played key roles in the College's creation of an MS in Sustainable Engineering.

FACULTY

- Dr. Randy Weinstein was again a semi-finalist for the Lindback Award for Distinguished Teaching.
- Dr. Vito Punzi, Professor, incorporated Catholic Social Teaching into a required ChE course. He plans to expand this effort next year.
- Dr. William Kelly, Associate Professor, was invited to give a talk on Education and Biology in Engineering at the 2008 AIChE annual meeting in Philadelphia.
- Dr. William Kelly also formed a partnership with the Institute of Technology, Sligo, in Ireland. In the spring, four MS students at IT Sligo successfully completed an online graduate course in Biochemical Engineering at Villanova.
- The department's two new faculty members—assistant professors Dr. Noelle Comolli and Dr. Michael Smith—began equipping their laboratories with state-of-the-art equipment and instrumentation.

Graduate student Thomas Baldassare ChE '08 takes steps to prepare vanadium SBA-15 for use as a partial oxidation catalyst.

RESEARCH INITIATIVES

Sherrie-Ann Martin ChE '09 (below, left) and Dr. Noelle Comolli work on making polymer thin films for local delivery of drugs after spinal cord injury.

Biotechnology Research

Dr. William Kelly continues to focus on improving biopharmaceutical processes. He is pursuing ways to reduce the costs of producing DNA plasmids, which are potential vectors for gene-therapy products, by developing less expensive adsorption steps for purification. He recently submitted a journal article assessing shear damage to CHO cells in lobe pumps. CHO cells are used extensively in industry to produce medicinal antibodies. Most recently, he has teamed with Dr. Jens Karlsson (ME) to better understand the cryopreservation of animal cells and thus determine the optimal freeze-thaw of CHO cell lines.

Biodiesel Fuel Production

Advised by Dr. Kenneth Muske, the Mr. and Mrs. Robert F. Moritz Sr. Chair in Systems Engineering and Professor of Chemical Engineering, seniors Adam Hoffman and Justin Yeash designed and built a production facility for converting waste cooking oil from Dining Services into biodiesel fuel, which is now powering diesel-run campus mowers. The project received funding from the Nance K. Dicciani '69 Endowed Chemical Engineering Fund for Energy Research.





Dr. Ronald A. Chadderton, PE
Chair, Department of Civil and Environmental Engineering, and the Edward A. Daylor Chair in Environmental Engineering

In 2008-2009, the Department of Civil and Environmental Engineering (CEE) revised its curriculum to provide greater flexibility and elective options; new coverage of technical, social, and ethical subjects; enhanced design course work; and more capstone project choices.

Committed not only to education but to research and scholarship, faculty received approximately \$850,000 in new grants. Students excelled in academics and service. Three new members joined the CEE Advisory Committee, which offers input on curriculum, assessment, and research topics.



CIVIL

UNDERGRADUATE + GRADUATE

- Seventeen undergraduates were inducted into Chi Epsilon, the Civil Engineering Honor Society.
- On the 10th service-learning trip to the Amigos de Jesús orphanage in Honduras, Dr. David Dinehart, Professor; Dr. Shawn Gross, Associate Professor; and students laid out the foundation for a girls' dormitory. Prof. Frank Falcone, PE, BCE '70, MSWREE '73 led a fall trip to Honduras to collect data for a water resources capstone project.
- Advised by Dr. Andrea Welker, PE, Associate Professor, 13 students studied abroad, a 30% increase from last year.
- The seventh annual CEE Day, which incorporates undergraduate research and senior design project presentations, was held April 24.
- In May, 52 students received a bachelor's degree in Civil Engineering.
- The total enrollment in the graduate program was 160; 37 students received master's degrees.
- Graduate student Cem Unlu received the 2009 Student Research Award from the Pennsylvania Water Environment Association in recognition of his work on microbial water and quality sources of indicator microorganisms in a major tributary in the Chester Creek Watershed.
- Graduate student Albana Bega and PhD student Sevda Alanya MSWREE '09 were invited to present papers at the 12th International Water Association (IWA)-Sludge Conference in China.

FACULTY

- Transportation engineer Leslie McCarthy, PhD, PE, joined the department in January (see p. 12).
- Dr. Robert Traver, PE, MCE '82, Professor, was appointed to Pennsylvania's Water Resources Advisory Committee and to the Board of Trustees of the American Academy of Water Resources Engineers. In March, he testified before a House subcommittee (see p. 12).
- Dr. John Komlos, Visiting Assistant Professor, received the College of Engineering's Farrell Award in recognition of his exemplary concern for students.
- The Board of Trustees of the American Academy of Water Resources Engineers conferred the post-license Diplomate, Water Resources Engineer on Dr. Ronald Chadderton and Prof. Frank Falcone.
- Dr. Bridget Wadzuk CE '00, Assistant Professor, received the Junior Faculty Award for Excellence in Teaching (see p. 13).

Working with Dr. Andrea Welker (left), Dr. Bridget Wadzuk, and Dr. Jennifer Gilbert of the Department of Geography and the Environment (Liberal Arts & Sciences), Kathryn Greising CE '10 (right) is studying changes in the grain size distribution of soil from the bioinfiltration traffic island on West Campus.

+ ENVIRONMENTAL ENGINEERING

RESEARCH INITIATIVES

Green Infrastructure Studies

Dr. Bridget Wadzuk and Dr. Robert Traver received a \$251,762 grant from the Pennsylvania Department of Environmental Protection to evaluate, assess, and monitor the benefits of evapotranspiration in several stormwater best management practices on campus. The results of their studies will lead to improvements in the design and regulation of green infrastructure and will promote sustainable development through education and outreach by the Villanova Urban Stormwater Partnership.

Sustainable Cement and Concrete

A research team that includes Assistant Professor Aleksandra Radlinska, PhD, and Associate Professor Joseph Robert Yost, PhD, PE, has received a \$50,000 EAGER grant from the National Science Foundation to evaluate the potential use of alkali-activated fly ash concrete as a sustainable alternative to traditional concrete in the construction of precast emergency residential shelters. The Villanova cohort is collaborating with Philadelphia University and with the manufacturer Oldcastle Precast. Dr. Radlinska also is working with Dr. Michael Barsoum from Drexel University to investigate alkali-activated slag cements. The EPA is funding the project.

Graduate student Albana Bega inspects indicator organism growth plates on optimization of the Philadelphia Water Department's biosolids digestion process.



Dr. Pritpal Singh

*Professor and Chair, Department of
Electrical and Computer Engineering*



ELECTRICAL + COMPUTER

ENGINEERING

UNDERGRADUATE + GRADUATE

Many achievements highlighted the 2008-2009 academic year in the Department of Electrical and Computer Engineering (ECE). Faculty published papers, presented at conferences, and received professional recognition. Students distinguished themselves in the classroom, through campus activities, and in the community.

The department pursued grants that promote sustainability, encouraged students to develop technologies that help others, offered technical seminars, and hosted the annual meeting of the ECE Department Heads Association, Mid-Atlantic Region (of which Dr. Singh is the leader).

- “Technology to Help Others” was the theme of the 22nd annual ECE Day. The event included senior poster presentations and talks on state-of-the-art topics.
- Dr. Frank Mercede incorporated into the sophomore year portable instrumentation circuit boards that enable students to conduct hands-on circuit analysis and design in their dorms.
- The National Science Foundation awarded a three-year, \$150,000 Course Curriculum and Laboratory Improvement Grant to a team of faculty that includes Dr. James Peyton Jones, Professor; Dr. Sarvesh Kulkarni, Assistant Professor; and Dr. C. Nataraj (Chair, ME). The MathWorks awarded \$44,000 (see p. 29).
- The inaugural cohort of students in the Engineering Entrepreneurship minor—taught by ECE and Villanova School of Business faculty—completed two courses. Dr. Singh received a second-phase, \$69,000 Kern Family Foundation grant to expose all engineering undergraduates to entrepreneurship education.
- The IEEE student branch renovated computers for TeamChildren, which provides computers to families in need.
- Softball player Meghan Morese received the Villanova Senior Female Scholar-Athlete Award; Ken Koncilja delivered the student address at the College’s Recognition Ceremony.
- The National Collegiate Inventors and Innovators Alliance awarded a \$49,000 Sustainable Vision Grant to a Villanova team headed by Dr. Pritpal Singh to enable engineering and business students to work with entrepreneurs in the Philippines to design low-cost, sustainable solutions for the region.



FACULTY

- Dr. Pritpal Singh was the PI on Villanova's second Keystone Innovation Grant, this one for \$150,000, to foster technology transfer.
- The Office of Naval Research awarded a \$70,000 Small Business Technology Transfer Phase I contract to Ablaze Development Corporation, founded by Visiting Assistant Professor Edmond Dougherty BEE '69, GS '86, to develop blast-protection structures. The company is partnering with the College and M5 Industries, owned by *Mythbusters'* Jamie Hyneman.
- Dr. Moeness Amin, Director of the Center for Advanced Communications, was the recipient of the European Association for Signal Processing's Technical Achievement Award (see p. 13).
- Dr. Pritpal Singh received the Member Award from the Philadelphia Section of the IEEE (see p. 13).
- Dr. Frank Mercede, Assistant Professor, was a semi-finalist for the Lindback Award for Distinguished Teaching.

Dr. Robert Caverly, Professor, reviews the results of high frequency circuit prototyping by graduate student Christine Grispino EE '09 (left). The project is being carried out in conjunction with the Ben Franklin Technology Partners of Southeastern Pennsylvania.

RESEARCH INITIATIVES

Micro-Electro-Mechanical Systems (MEMS)

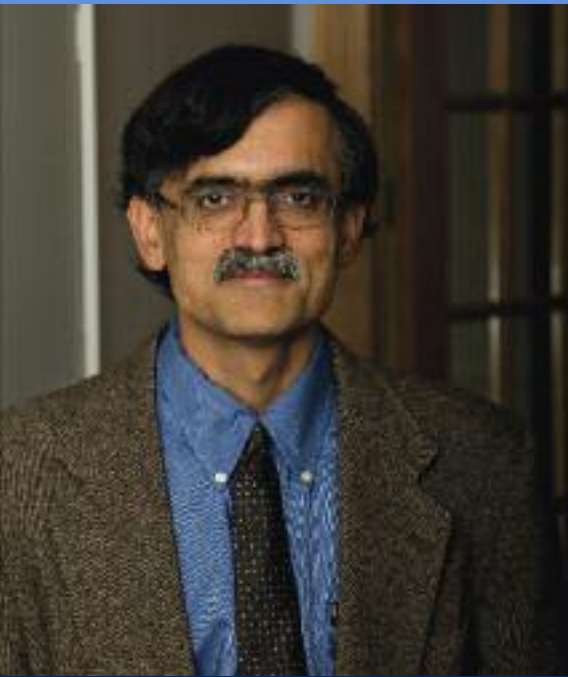
Dr. Mark A. Jupina, Assistant Professor, continued his research in MEMS sensors and actuators. Currently, his research focuses on the development of a patent-pending MEMS sensor for the detection of nuclear magnetic moments in Magnetic Resonance Force Microscopy (MRFM). Ultimately, the goal of this microscopy technique is to achieve imaging on the scale of a single proton. Gene sequencing, drug development, analysis of storage media, and many other commercial applications involving spintronics and quantum computing will likely benefit from the application of MRFM.

Microstructured Photonic Fibers

Dr. Rosalind Wynne, Assistant Professor, has been researching the development of microstructured, fiber-based rubidium vapor cells for quantum computing, as well as microstructured fibers as a platform for stimulated Raman scattering to provide THz to deep UV coherent light sources for chemical and biological material detectors. Future collaborative efforts with UMBC and Princeton University will focus on fiber devices with multiple solid cores for chemical and strain sensing, with primary applications for intelligent buildings and environmental pollution prevention.



Graduate student Ken Schmieder EE '07 measures the cell-to-cell voltage in a fuel cell stack in Dr. Singh's laboratory.



Dr. C. Nataraj
Professor and Chair,
Department of Mechanical Engineering



MECHANICAL

ENGINEERING

Following an ambitious curriculum revision by the Department of Mechanical Engineering (ME), students now have even more flexibility to specialize in ME areas and to pursue minors. Internships were plentiful, and more students participated in research projects.

The research output in terms of grants and published papers almost doubled, and the number of PhD students involved in ME research increased. The department hosted 18 seminars and explored teaming opportunities with institutions in the U.S. and abroad.

UNDERGRADUATE + GRADUATE

- Students participated in service-learning projects in the U.S., Thailand, Kenya, the Philippines, Nicaragua, and elsewhere. Many projects involved the evaluation, design, and installation of water distribution systems.
- Approximately 25 students were employed as undergraduate research assistants, and 12 students studied abroad.
- A multidisciplinary team of undergraduates advised by Dr. C. Nataraj won an award at the first annual International Autonomous Surface Vehicle Competition in August 2008.
- Support for capstone projects came from, among other sources, IBM, Gates Corporation, and the Engineering Alumni Society. In addition to providing financial support, NAVAIR Lakehurst proposed two projects that resulted in innovative tools and methods to speed up maintenance on aircraft carrier catapult launch systems.
- Seventy students received bachelor's degrees; 18 earned master's degrees.
- Graduate students Ron Warzoha ME '08 and Timothy Montalbano ME '08 were one of five winning teams nationwide in the Transportation Innovation Acceleration Challenge, sponsored by the U.S. Department of Energy Transportation Technologies Program Office.
- Doctoral students Kevin Woods BSME '07, MSME '08 and Steven Miller received prestigious fellowships from the Science, Mathematics and Research for Transformation (SMART) Scholarship for Service Program.



Dr. Qianhong Wu (above, right), Director of the Cellular Biomechanics and Sports Science Laboratory, and graduate student Robert Crawford ME '08 discuss their research on super-lubrication theory.



FACULTY

- Dr. Sridhar Santhanam was promoted to the rank of Professor; Dr. Alan Whitman achieved the rank of Professor Emeritus.
- Dr. C. Nataraj gave a keynote speech at the International Union of Theoretical & Applied Mechanics Conference in March.
- Dr. Jens Karlsson, Associate Professor, was an invited speaker at the 3rd International Cell Banking Conference. He also was the lead author of the cover story of the April 2009 issue of *Molecular Reproduction and Development*.
- Dr. C. Nataraj and Dr. Alfonso Ortega, the Associate Dean for Graduate Studies and Research and the James R. Birlle Professor of Energy Technology, were appointed to the editorial boards of *Advances in Vibration Engineering* and the ASME's *Journal of Heat Transfer*, respectively.
- The National Science Foundation awarded a \$324,709 grant to Dr. Amy Fleischer, Associate Professor; Dr. Aaron Wemhoff, Assistant Professor; and Dr. Randy Weinstein (Chair, ChE; see p. 4).

RESEARCH INITIATIVES

Micromechanical Simulations of Crack Growth in Osteonal Bone

Microstructural features of bone, such as osteons and cement lines, play an important role in determining the crack growth trajectory in cortical bone. Dr. Ani Ural, Assistant Professor, and her team are carrying out research to develop a better understanding of the effect of bone microstructure on its fracture risk. Their studies employ cohesive finite element modeling and explicit representation of the microstructure to identify the crack growth trajectory in the bone.

From Red Cells, to Snowboarding, to Super Lubrication

Dr. Qianhong Wu, Assistant Professor, is focused on the experimental, theoretical, and numerical studies of multi-scale transport phenomena: from cellular biomechanics, to lift mechanics of skiing and snowboarding, to fluid dynamics, especially porous media flow. Much of these works grew out of discoveries of the endothelial glycocalyx that lines blood vessels and its roles in microcirculation. For example, the insights gleaned from the motion of red cells gliding on the glycocalyx and of humans snowboarding on fresh snow powder have motivated Dr. Wu's team to design next generation, super-lubrication facilities that provide maximized lifting force from transiently trapped fluid in a soft porous layer and thus reduce the sliding friction.

Dr. Kei-Peng Jen (left), Associate Professor, supervises two students as they prepare a metallurgical sample for microstructure analysis in the Material Sciences Laboratory.

Established in 1990, the Center for Advanced Communications (CAC) serves the industrial community and conducts innovative research that has clear applications and meets pressing consumer needs. The CAC is a recognized leader in testing new ideas and exploring emerging technologies in wireless communications, radar imaging, satellite navigation, wireless networking, and acoustics. In 2008-2009, nine full-time faculty members were involved in 33 CAC-affiliated research projects sponsored by state and federal agencies, as well as by industry. New research awards totaled \$1,416,375.

CENTER FOR ADVANCED COMMUNICATIONS



Dr. Moeness Amin
 Director, Center for Advanced Communications,
 and Professor, Electrical and Computer Engineering

Topics of Study

- Acoustics and ultrasound
- GPS technologies
- Low-profile antenna modeling and measurements
- Microwave and RF
- Multimedia and video compression
- Radar imaging
- Sensor technology
- Signal processing for communications
- Smart antennas
- Thermal management

CAC Highlights

- For the seventh year, Dr. Moeness Amin was the U.S. representative on the NATO Task Force on Through-the-Wall Radar Imaging.
- In a first-time partnership with the U.S. Army, the CAC received \$70,600 as part of a contract with the Army Research Laboratory to fund a project titled "Signature Exploitation Techniques for Detection of Weapons behind Walls."
- The European Association for Signal Processing selected Dr. Moeness Amin to be the recipient of its Technical Achievement Award (see p. 13).
- The CAC established the Distinguished Lecturer Series. Speakers gave seminars and engaged in technical discussions on emerging research and technology with professors and students.
- At the Association of Egyptian American Scholars' annual conference, Dr. Moeness Amin presented a paper he had coauthored with Richard Thompson, PE, EE '64 on the collaboration between the CAC and the Ben Franklin Technology Partners of Southeastern Pennsylvania.
- In April, the CAC and the Franklin Institute sponsored a symposium honoring Dr. Lotfi Zadeh, 2009 winner of the Benjamin Franklin Medal in Electrical Engineering.
- Dr. Yimin Zhang was promoted to Research Professor.
- In June, the CAC signed a memorandum of understanding with the University of Montenegro.

CAC Laboratories

Radar Imaging Laboratory
 Director: Dr. Fauzia Ahmad (left)

Antenna Research Laboratory
 Director: Dr. Ahmad Hoorfar (center)

Wireless Communications and Positioning Laboratory
 Director: Dr. Yimin Zhang (right)

Radio Frequency Identification Laboratory





RESEARCH INITIATIVES

Ultrasound

The CAC expanded its research capabilities in the area of signal processing for acoustics and ultrasound. It recently purchased state-of-the-art ultrasound equipment that enables nondestructive evaluation and testing of materials, separation of multiple and mixed acoustic and ultrasound emitters, high-gain beamforming for position estimations, and other important applications across electrical, mechanical, and civil engineering practices. The funds to purchase this equipment came from a Department of Defense University Research Instrumentation Program Grant.

Airborne Radar Imaging of Urban Terrain

With the focus of the CAC research on urban sensing shifting to airborne platforms, there is a need to fully understand all scattering and diffraction effects from the exterior of buildings, which are often ignored in the conventional ground-based through-the-wall radar operation. To this end, the Antenna Research Laboratory is developing a millimeter-wave-based antenna array scanner that will be used in conjunction with scale models of typical buildings to emulate different unmanned-aerial-vehicle-based radar-imaging scenarios in a laboratory environment. The Defense Advanced Research Projects Agency (DARPA) is funding these research efforts.

Dr. Wenji Zhang, post-doctoral research fellow, and PhD student Chris Thajudeen BSEE '06, MSEE '07 discuss testing of an antenna array that is under development for implementation in a portable through-the-wall imaging radar.



Dr. James Peyton Jones
 Director, Center for Nonlinear
 Dynamics & Control

The Center for Nonlinear Dynamics & Control (CENDAC) performs advanced research across a broad range of application areas and disciplines, applying nonlinear identification, analysis, and control techniques to solve the complex problems associated with today's highly integrated engineering systems. CENDAC continues to create research partnerships while strengthening existing ones. In 2008-2009, primary research partners included the Office of Naval Research; NAVSEA, Philadelphia; the National Science Foundation; The MathWorks; Ford Motor Company; Cummins Inc.; Ablaze Development Corporation; and the Ben Franklin Technology Partners of Southeastern Pennsylvania.



CENTER FOR NONLI

CENDAC Highlights

- Center members published more than 60 journal and conference articles. An IEEE Transactions paper by Drs. Muske and Peyton Jones was nominated for Best Paper Award.
- Funding for the more than 30 CENDAC-affiliated projects included \$711,936 in new awards and \$882,830 in continuing grants.
- Six PhD and 18 MS students pursued their thesis research within the Center on projects as diverse as medical prognostics, spherical robots, and combustion control.
- Center professors developed new courses for the graduate controls curriculum, offered undergraduate research experiences to 35 students, and introduced robotics into the new freshman curriculum (see "Research Initiatives").
- The Center hosted Dr. Danilo Bassi from the Universidad de Santiago de Chile. He contributed to several projects, including the development of an unmanned aerial vehicle.
- The Center expanded its research in ad-hoc wireless networking, which is essential for the inter-robot communication of autonomous vehicles.
- The Center secured new funding from Cummins Inc., a manufacturer of diesel engines.



RESEARCH INITIATIVES

Mobile Robots in Research and Education

An interdisciplinary team of professors led by Dr. Peyton Jones received a \$150,000 National Science Foundation award to exploit the increasing power of handheld computing devices to develop a low-cost, fully autonomous, wirelessly networked mobile robotic platform for integrated research and education. The project will enable the behavior of single and multiple-robot groups to be programmed at a high level using automatic code generation from MATLAB/Simulink. A \$44,000 grant from The MathWorks and hardware donations from Nokia also are supporting the project.

Computational Intelligence to Prevent Brain Damage in Preterm Infants

Periventricular leukomalacia (PVL) is part of a spectrum of cerebral white matter injury associated with abnormal brain development in preterm infants. Because risk factors for the occurrence of PVL are poorly understood, Dr. C. Nataraj and Dr. B. Samanta (an ME research faculty) have been collaborating with The Children's Hospital of Philadelphia to study the problem. The group is applying computational intelligence techniques to identify potential hemodynamic risk factors for PVL occurrence in neonates with complex heart disease.

CENDAC Laboratories

Autonomous Systems Laboratory

Unmanned Surface and Underwater Vehicles Laboratory

Automotive Emissions Laboratory

Graduate student Abhijit Deokar (left) and PhD student Ramesh Thimaraya work with visiting professor Danilo Bassi, PhD, on an unmanned aerial vehicle.

NEAR DYNAMICS & CONTROL

CENDAC Faculty Researchers

Electrical and Computer Engineering

Dr. James Peyton Jones,
CENDAC Director and Professor

Dr. Stephen Konyk, Assistant Professor
Dr. Sarvesh Kulkarni, Associate Professor
Dr. Pritpal Singh, Professor and Chair

Mechanical Engineering

Dr. Hashem Ashrafiuon, Professor
Dr. Garrett Clayton, Assistant Professor
Dr. C. Nataraj, Professor and Chair
Dr. Sergey Nersesov, Assistant Professor

Chemical Engineering

Dr. Kenneth Muske,
the Mr. and Mrs. Robert F. Moritz Sr. Chair
in Systems Engineering and Professor

Focus Areas

Autonomous systems, including robots, unmanned surface vehicles,
and ad-hoc networking

Automotive systems, with a focus on emissions control and nonlinear dynamics

Nanomaterials and mechanics

Core Skills

Control-oriented nonlinear modeling and identification

Nonlinear analysis and design

Nonlinear control methodologies

Prognostics and diagnostics

The College of Engineering gratefully acknowledges the following alumni, parents, friends, foundations, and organizations that have contributed to the College during the 2008-2009 fiscal year. Contributions have been in the form of either individual endowed funds or annual giving funds designated to the College or to its various programs or departments. The list does not include gifts that donors made to other programs at Villanova University.

Endowment Gifts

Robert S. Ayerle, MD

The Rosanna S. and Robert S. Ayerle, MD, Endowed Scholarship

Robert G. and Brenda H. Catalanello

The Brenda H. and Robert G. Catalanello Endowed Engineering University Scholarship

Mr. and Mrs. William G. Christman

The Christman Family Endowed Scholarship

Mr. Ryan W. Cunningham; Ms. Susan M. Ward

The CDR Patrick J. Cunningham and Susan M. Ward '80 Endowed Lecture Series in Engineering

Delaware Community Foundation; Lisa Speicher

The James A. Drobile Dean's Scholarship in Chemical Engineering

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The Dewling Family Endowed Scholarship for Graduate Environmental Engineering Study for Women

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The Nance K. Dicciani '69 Endowed Chemical Engineering Fund for Energy Research

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Brenda Catalanello, Rev. Peter M. Donohue, OSA, and Robert Catalanello at the President's Club Reception

"Brenda and I support the College of Engineering for two reasons. First, my experience in the College had a profound effect on my life. Second, we feel we have a duty to give back to Villanova. We hope our endowment will help give students the same opportunity for advancement that we have enjoyed."

— Robert Catalanello EE '86

"Villanova has given me the foundation for achieving my career goals in engineering and business because of my many professional and personal relationships with fellow alumni. My contributions over the years have been a small repayment for providing me with that foundation and those relationships."

— E. B. Walsh CE '73



Rev. Peter M. Donohue, OSA, Maryann Walsh, and E. B. Walsh at the President's Club Reception

Endowments: Creating a Perpetual Legacy

Endowment gifts create a lasting legacy in support of a college, department, program, professorship, or scholarship. Endowed funds may be named for the donors or in honor or memory of someone, such as parents or a cherished professor. These gifts are fundamental to the health of the University and the College. They reduce Villanova's dependence on tuition revenues, provide a predictable source of income, enable the development of innovative programs, and attract exceptional students and faculty. To learn more about creating an endowed fund, contact the Development Office for the College of Engineering at 610.519.6973.

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A contribution to the Villanova Annual Fund is a meaningful way to honor your Villanova heritage and help the University deliver a quality education to those following in your footsteps. An annual fund gift supports programs and initiatives that benefit the student community. You also may restrict your gift to the College of Engineering or a specific department. Make a gift now through the secure online gift form at <http://www.villanova.edu/advance/develop/makeagift.htm>. Or call 1.800.486.5244 to make a gift using your credit card (M-F, 9 AM to 5 PM).

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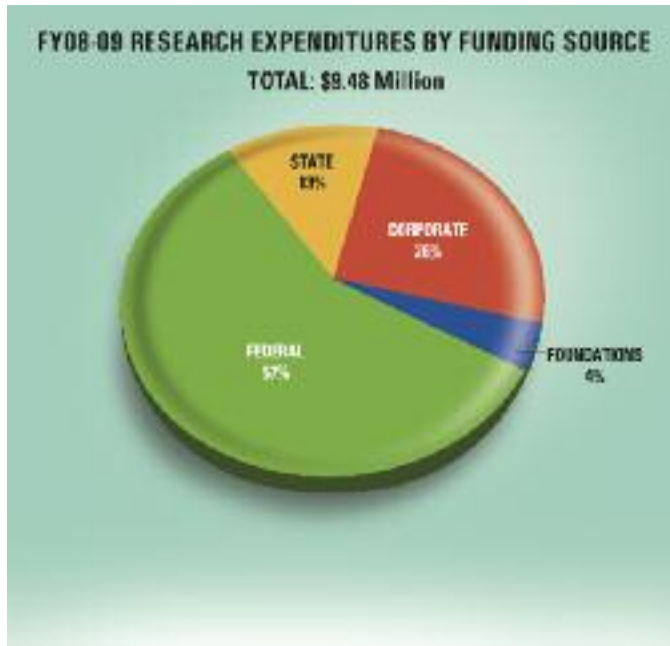
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TEACHERS AND SCHOLARS

Embracing the University's teaching mission, dedicated faculty teach all undergraduate classes and labs and make time for individual instruction and advising. These are the same faculty who are nationally recognized in their areas of expertise. Students, both undergraduate and graduate, benefit from their instruction and participate in their research. In fact, the expanding and highly regarded MS and PhD programs are drawing more and more students who want to deepen their technical expertise on either a part-time or full-time basis.

Thus, the College of Engineering, which has built a reputation for having one of the best undergraduate programs in the country, is now esteemed for the strength and diversity of its research capabilities. It continues to secure new funding from and to create partnerships with industry and government agencies. With the hiring in recent years of even more high-caliber faculty who are involved in cutting-edge research, the number of grant applications in 2008-2009 increased by 23% from the year before.





The Center for Advanced Communications and the Franklin Institute sponsored a symposium to honor Dr. Lotfi Zadeh, winner of the 2009 Benjamin Franklin Medal in Electrical Engineering and a pioneering researcher in the field of fuzzy logic.



↑ Faculty, students, and administrators traveled to Waslala, Nicaragua, and other locations around the world to provide engineering services to those in need.

Students and professional engineers gathered for a networking dinner hosted by the Villanova Chapter of the Society of Women Engineers and funded by Air Products and Chemicals, Inc.



← During Commencement Weekend, students and faculty processed onto Mendel Field for the 2009 College of Engineering Recognition Ceremony.



VILLANOVA UNIVERSITY

COLLEGE OF ENGINEERING

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OUR MISSION

Villanova University's College of Engineering is committed to an educational program that emphasizes technical excellence and a liberal education within the framework of the University's Augustinian and Catholic traditions. As a community of scholars, we seek to educate students to pursue both knowledge and wisdom, and to aspire to ethical and moral leadership within their chosen careers, their community, and the world. We value a spirit of community among all members of the College that respects academic freedom and inquiry, the discovery and cultivation of new knowledge, and continued innovation in all that we do.

ABOUT VILLANOVA UNIVERSITY

Villanova University is the oldest and largest Roman Catholic university in the Commonwealth of Pennsylvania. Founded by the Augustinian Order in 1842 and located on a picturesque 254-acre campus, it comprises the College of Liberal Arts & Sciences, the Villanova School of Business, the College of Engineering, the College of Nursing, and the School of Law. With its rigorous, well-rounded curricula and its commitment to the Augustinian ideals of pursuit of knowledge and service to others, Villanova is recognized as a premier institution of higher education. **For more than a decade, Villanova University has been ranked No. 1 in the North region** (North – Masters) by *US News & World Report*.

DEGREES

BS in Chemical Engineering
BS in Civil Engineering
BS in Computer Engineering
BS in Electrical Engineering
BS in Mechanical Engineering

Five-year bachelor's-master's degree program

MS in Chemical Engineering
MS in Civil Engineering
MS in Computer Engineering
MS in Electrical Engineering
MS in Mechanical Engineering
MS in Sustainable Engineering
MS in Transportation Engineering
MS in Water Resources and Environmental Engineering

PhD Program (part time or full time)

Certificate Programs

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ACCREDITATION

All five undergraduate programs are accredited by the Accreditation Commission (EAC) of ABET (Accreditation Board for Engineering and Technology), 111 Market Place, Suite 1050, Baltimore, MD 21202-4012.

RANKING

Once again, *US News & World Report* ranked Villanova's College of Engineering in the top 10 in the nation in the Best Undergraduate Engineering Programs category among schools that award primarily bachelor's and master's degrees.