



**Villanova University  
College of Engineering**

**2006 – 2007 ANNUAL REPORT**



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*On the cover: Smoke tracing is a common method of flow visualization used to study the dynamics of moving fluids. In this experiment, an undergraduate mechanical engineering student worked with Amy Fleischer, Ph.D., in the NovaTherm laboratory as part of his research to enhance understanding of the flow dynamics of impinging jets used in electronics applications.*

*This photo and photos on pages 3, 21 and 23 by James B. Wasserman.*





## Message from the Dean:

During the last year, I have had the pleasure of gaining a better appreciation of the breadth and scope of Villanova Engineering. I have come to understand the College's uniqueness and its pride in educating outstanding students who study under dedicated faculty and graduate as engineers who can be successful in any career they choose.

The College's uniqueness begins with great students who come to Villanova because of the quality of the University and the College, and the values of a Catholic, Augustinian education. Villanova engineering students learn the fundamentals of engineering while also pursuing a broad range of interests in classrooms, laboratories and in the wider world.

As you read through this report, you will see examples of students winning prestigious awards and prizes for academic excellence, and student initiative and leadership. Student leaders built up Villanova's chapter of Engineers Without Borders from four members to more than 100 and won an award from the Project Management Institute. Teams of students and faculty journeyed to remote areas of the world to design and build facilities for poor communities. You will also read about the first doctoral student to graduate from the College of Engineering, marking the College's emergence not only as a place of premier undergraduate education, but also one in which world-class research programs have steadily grown.

The success of our students would not be possible without the spirit of dedication and the depth of knowledge of our faculty. They go out of their way to provide the extra time a student at any level may need to understand the subject matter. In addition, the quality of their research can be readily seen in looking through the sponsored research awards included in this report. Engineering faculty have received major awards from government and private institutions. This research not only advances the state of knowledge of many fields of engineering, but also brings our undergraduate and graduate students into daily contact with leading-edge thinking and broadens their appreciation of the possibilities that lay before them.

As I have come to appreciate the uniqueness of Villanova's College of Engineering, I have also come to understand that not enough people know about us. As a result, we have developed several new instruments for getting our story out. The first of these was unveiled last February when our new website launched and we have found that prospective students and alumni are visiting often. The new website is updated regularly and we encourage you to visit and bookmark the site at [www.engineering.villanova.edu](http://www.engineering.villanova.edu).

The second new instrument is this Annual Report, which we intend to publish every fall. This report will focus on the major events of the past academic year and provide occasional articles to give a more in-depth look at different parts of life on campus. The third new communication vehicle is a magazine that will publish in the spring and will be more focused on stories about teaching and research in the College.

Our hope is that we will be able to give you greater insight into our goals and aspirations as a College, and you will learn about the accomplishments of the students, faculty, alumni, and friends who make the College of Engineering at Villanova an outstanding place of learning and discovery.

Gary Gabriele, Ph.D.  
Dean, College of Engineering



# Villanova Researchers See Through Walls

by Moeness Amin, Ph.D.

## Urban Sensing and Through-the-Wall Radar Imaging

One of the most challenging problems that the Center for Advanced Communications (CAC) at Villanova has undertaken since its inception is the detection and imaging of targets behind walls. “Seeing” through obstacles such as walls, doors and other visually opaque materials using microwave signals is considered a powerful tool for a variety of applications in both military and commercial paradigms. The goal of these systems is to provide detailed information in areas that cannot be seen through conventional measures and to provide situation awareness information before breaching a building or launching a military operation in urban terrain. Through-the-Wall Imaging (TWI) has been recently sought out in rescue missions, behind-the-wall target detection, surveillance and reconnaissance. In addition to the obvious application for defense purposes, TWI technology can be used in rescue missions to search for earthquake and avalanche victims, and can aid firefighters looking for survivors. This technology can also be used for detection and surveillance to support law enforcement.

The CAC embarked on a significant research effort in Urban Sensing and Through-the-Wall Radar Imaging in 2002. The CAC research in TWI is sponsored by both the Office of Naval Research and the Defense Advanced Research Project Agency, with funding to date in excess of \$8 million. Data collections and experimentation associated with this research are conducted in the CAC Antenna Research Lab and Radar Imaging Lab. The CAC TWI research efforts are focused on remotely estimating complex internal building structures, and sensing, locating and classifying moving targets including animate and inanimate objects. The CAC utilizes advances in both algorithm and component technologies and is based on radio frequency (RF) and acoustic signal emissions and receptions using arrays of sensors. Radio frequency can penetrate building structures and probe different objects inside a structure. The system emitting and receiving RF signals can be based on the use of only one antenna or an antenna array. It can be a coherent system, typically housed on the same platform, or a non-coherent system with distributed units. Whether it is a single antenna or a multi-antenna transceiver, it is important that a coherent and noncoherent system reliably function at different standoff distances for safety and logistical reasons. This puts more constraints and demands on power as well as complexity of signal analysis and processing. Although frequencies are capable of different building penetration with various degrees of power loss, the resulting observations are sensitive to a host of influences, including layout geometry, existence of doors and windows, interior and exterior wall thicknesses, and clutter objects within the building.



A view of the mobile two-dimensional scanner

Opposite page, L-R: Fauzia Ahmand, Ph.D., director of the Radar Imaging Laboratory, works with Pawan Setlur, a graduate student, to position the high-resolution two-dimensional stationary scanner for a research test.

Inset: Representatives from CAC research partners Wyle Lab, the Air Force Research Laboratory and NSWCCD set scene to be imaged by the high-resolution stationary scanner.



Figure 1

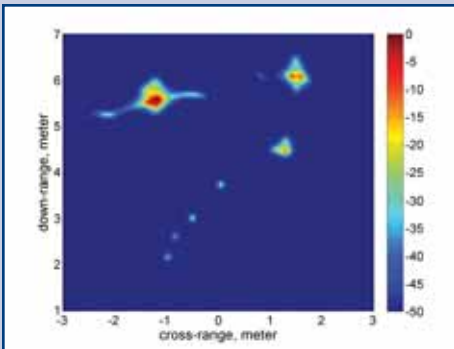


Figure 2

## TWI Technology

The CAC has conducted numerous TWI experiments and collected real data on different settings behind walls using the RF instrumentation suite at the Radar Imaging Lab. Figure 1 depicts the layout of one such scene. The scene consists of three 12" dihedrals, three 3" trihedrals, one 6" trihedral, one 3" diameter cylinder and one 12" diameter sphere. Each target is mounted at a unique range bin and angular displacement. The wall (not shown) is composed of plywood and gypsum board on a wooden frame. A 57-element line antenna array of length 49", positioned  $\frac{1}{2}$ " away from the wall, was used for data collection over the 2-3 GHz frequency band. The corresponding high-resolution through-the-wall image of the scene is provided in Figure 2. We can clearly observe that the through-the-wall imaging radar has been able to accurately locate the targets in the scene.

## Challenges for Application of Through-the-Wall Radar Imaging Technology

The CAC recognized at the onset that high quality imaging of targets behind walls requires cross-disciplinary research in electrical engineering. Fundamentally, the problem is a hybrid between radar signal and array processing on one hand, and antennas and electromagnetics on the other. The TWI broad and emerging technology area requires researchers with expertise in detection, estimation, tracking, classification, beamforming, direction finding, antenna design and computational electromagnetics. Understanding the nature of these technology applications and appreciating the end-user preferences, the CAC acknowledged from the beginning the many challenges facing universities and companies alike, when it comes to system design developments and implementations. Namely, the system should be reliable, portable, lightweight, of small size, and have both short acquisition time and set-up time. The system performance should be robust to ambiguities in exterior and interior wall characteristics and should properly function under cases of non-uniform multiple walls. Ultimately, the system should have high range (depth) and crossrange resolutions that are application specific. Finally, the TWI system must be able to detect and classify motions in a populated scene and in the presence of heavy clutter, which may include inside back and side walls, water pipes, electrical cords and various types of appliances and furniture.

## Through-the-Wall Radar Imaging Technology

The CAC has built two powerful scanners that are responsible for all data being collected toward understanding the complex phenomenology of TWI. The first scanner is a high-resolution stationary two-dimensional system that is capable of collecting high-resolution data, whereas the other scanner is a mobile two-dimensional system that is capable of collecting data at different locations. The stationary scanner has a large frame within which the transmit and receive antennas can be flexibly positioned. The mobile scanner, on the other hand, is a system with four transmit horn antennas and 64 receive low-profile antennas synthesized by the vertical motion of an eight-antenna panel. The two systems are frequently used by the CAC research members and also by our research partners.

## Partnership for Innovations

The CAC has sought partnerships with government, industry and academia in an effort to access expertise that complements that of the Villanova University faculty. These partnerships are primarily driven by the complexity, sensitivity and the diversity of the TWI problems. While TWI addresses a number of practical problems such as search and rescue and support for law enforcement, it also has obvious military applications. These factors, when combined with intellectual property issues, tend to reduce the incentive to exchange and share ideas, and can stifle innovation in the field. The CAC has developed productive partnerships with academic institutions that include the University of Pennsylvania, Colorado School of Mines, Drexel University, Lafayette College, Northeastern University, Tufts University, Temple University, Widener University and the University of Wollongong in Sidney, Australia. The CAC has supported TWI system development, integration and prototyping by subcontracting funds to BAE Systems, Wyle Laboratories and the Naval Surface Warfare Center Carderock Division (NSWCDD).

Through a grant received from the National Science Foundation, the CAC has launched "Partnership for Innovations" in wideband communication platforms involving TWI. This partnership includes three universities, three federal agencies, two community colleges, a high school and 17 companies. The CAC has played an integral and active role in promoting TWI research and development internationally.

## In the Forefront of Research

The CAC has served four times as the United States representative in the NATO Task Force for Sensing Through-the-Wall, and it has the largest number of journal publications and conference presentations in the area of TWI in the country. It has also been funded by both the Canadian and Australian governments to conduct TWI research. The CAC continues to be in the forefront of research in TWI and looks forward to contributing to the research and development of additional emerging technologies going forward.

## About the CAC

The Center for Advanced Communications (CAC) at the College of Engineering was founded in 1990 to conduct research in the area of communications. Over the past decade, the Center has broadened its research focus beyond the topics commonly tackled in wireless, cellular, smart and secure communication technologies. In addition to handling projects based on signal detection, estimation, localization, classification and identification, the CAC now houses expertise in other important and relevant research areas of geolocation, low profile antenna measurements and design, radar imaging, wireless and ad hoc networking, sensors and microelectronics.

Most of this research is performed in the CAC's four state-of-the-art labs: the Antenna Research Lab, the Radar Imaging Lab, the Wireless Communications and Positioning Lab, and the Radio Frequency Identification Lab. These labs are used for data collection, verification of theory and analyses, proof of concepts, and validation of new ideas put forward by our faculty and students; and were established by external funding from federal, state and industrial sponsors.

## Research Support at the CAC: Undergraduate through Postdoctoral

The CAC undertakes research projects that are single- or multi-disciplinary and involve faculty across all four departments in the College of Engineering. The participation of undergraduate and graduate students in different Center projects is essential to the mission of the College and University. Undergraduates participate in all levels of research engagements, ranging from small, short-term exploratory efforts underlying seed grants to large, multi-year, multi-university federal grants. Over the past three years, the CAC has involved 13 faculty, three doctoral students, 42 M.S. students, 12 undergraduate students, six postdoctoral fellows, three research associates and three research professors.

## The CAC Funding Support

The CAC has been able to attract large funding from national and international sponsors. The multi-million dollar research awards recently received by the CAC are attributed to significant funding provided by the United States government, state and private sectors (see pages 26 – 27). The CAC research has been sponsored by the Commonwealth of Pennsylvania (\$150,000) as well as several federal agencies, including the National Science Foundation (\$1,364,912), Office of Naval Research (\$4,294,749), Defense Advanced Research Project Agency (\$6,223,112), Department of Defense (\$248,539), the Air Force Office of Scientific Research (\$60,000) and two international government agencies in Canada and Australia (\$443,561). The CAC industry sponsors include large corporations such as The Boeing Company and Navmar Applied Science Corporation. In addition, the CAC has been funded by many small and mid-size companies, including Anteon Corp., AMT, Inc., VerdaSee Solutions, Inc., DRS Technologies, Inc., Purrfect Fence, Intellect Corporation and Artisan Laboratories Corporation. The benefits to industry sponsors in working with the CAC include a regional and stable base of technology expertise, economic growth and job creation, cost-effective research and development, a strategic relationship in information and communication technologies, and a pool of students to meet their need for highly qualified engineers who bring hands-on research experience to the employer.



## TWI Research Team

L-R, back row: Yeo-Sun Yoon, Ph.D., Imtiza Pasha, Ph.D., Kostya Yemelyanov, Ph.D., Fauzia Ahmad, Ph.D., Yimih Zhang, Ph.D., Moeness Amin, Ph.D., Janice Moughan, Ahmad Hoorfar, Ph.D.

L-R, front row: Christian Debes (student researcher from Germany), Chris Thajudeen, Habib Estephan, Cornel Ioana, Ph.D., (faculty researcher from France), Zach Rosenbaum, Pawan Setlur

Not pictured: Robert Caverly, Ph.D., Bijan Mobasseri, Ph.D., Clayton Bannon, Jeff Manosca, Adam Reif



Directors of the four laboratories in the CAC:  
L-R: Yimin Zhang, Ph.D., Radio Frequency Identification Lab; Moeness Amin, Ph.D., Wireless Communications and Positioning Lab; Fauzia Ahmad, Ph.D., Radar Imaging Lab; and Ahmad Hoorfar, Ph.D., Antenna Research Lab.



## Entrepreneurship Thrives in the College of Engineering

Thanks to a number of initiatives within the College of Engineering and across the campus, a growing number of Villanova engineering students are beginning to think entrepreneurially. In the past there have always been some students who have taken the risk of starting their own businesses—even while still attending college. Lately, a growing number of engineering alumni who went on to become successful entrepreneurs are spending more time on campus to help the next generation understand the perils and rewards of their path. The past year has seen a groundswell both in interest and opportunity in setting up new businesses.



## Alumni and Students Participate in Entrepreneurship Conference

In January 2007, the first “Beyond Ideas The Art of Entrepreneurship” conference was held. This event included students from all four colleges at Villanova. The students learned about intellectual property, business planning, e-commerce, product and service-based businesses, and social entrepreneurship. By the end of the day, students were more excited than ever about the possibilities of starting their own businesses. A second, expanded “Beyond Ideas” conference is planned for January 2008.

## Joint Business-Engineering Curriculum in Entrepreneurship Launched this Fall

One of the related outcomes of the first “Beyond Ideas” conference was that faculty from the College of Engineering and the Villanova School of Business (VSB) planned and developed a pilot course, launched this fall, in project management and commercialization of technology. The course, team-taught by business and engineering faculty, is open to students from every college in the University. Both engineering and business students already report they have learned new ways to approach setting up a business.

Reflecting the cross-disciplinary nature of the curriculum, the faculty teaching the new course come from both colleges: Pritpal Singh, Ph.D., Chair of the Department of Electrical and Computer Engineering; James W. Klingler, Ph.D., Director of the VSB’s Center for Entrepreneurship; William J. Hurley, Ph.D., Business Fellow in VSB’s Management Department; and Edmond Dougherty, Ph.D., ’69 EE, ’86 GS, visiting Assistant Professor in the College of Engineering and well known inventor and entrepreneur.

This team, with the support of Gary Gabriele, Ph.D., Dean of the College of Engineering, and James Danko, Dean of VSB, is now considering a minor in entrepreneurship for engineering students that would start in the sophomore year and culminate in the senior capstone project, and would involve cross-disciplinary teams of students planning their own businesses.

## Villanova Promotes Entrepreneurship Throughout the Region

Villanova is a partner in a Keystone Innovation Zone (KIZ) in Delaware County, Pennsylvania. There are 28 KIZs throughout the state, and their stated purpose is to “improve and encourage Pennsylvania’s research and development efforts, technology commercialization, entrepreneurship programs,” according to the Pennsylvania Department of Community and Economic Development, which oversees the KIZ programs. Each KIZ consists of at least one university, the local county’s economic development council and other economic development groups. The KIZs help start-up companies access technology developed within the universities. Villanova’s KIZ also provides opportunities for Villanova faculty to learn about becoming entrepreneurs. This KIZ is also a partner in the planning for the “Beyond Ideas” program.

## College Receives Grant to Develop Entrepreneurship Program

In the summer of 2007, the Kern Family Foundation, a foundation that has as one of its focuses helping engineering students develop entrepreneurial skills, invited Villanova to apply for a grant. The Foundation considered Villanova because of the excellent quality of the engineering program, the commitment to an education that emphasizes community service and its growing work in entrepreneurship. The same cross-college team that developed the pilot program in entrepreneurship wrote a successful proposal. The Foundation recently notified the University that it will receive \$50,000 to implement the Kern Entrepreneurship Education Network (KEEN) initiative at Villanova. It will fund the development of the proposed entrepreneurship minor, as well as a number of student activities. These include joint programs of the College of Engineering’s Electronics Inventors Club and VSB’s Entrepreneurship Society. These two student organizations will collaborate to bring in guest speakers and offer prizes for competitions for innovative products, among other initiatives. Some of the KEEN funding will also be used to assist students with travel expenses to



*Dean Gary Gabriele, Ph.D., speaks with students attending the “Beyond Ideas” reception in Bartley Hall in January 2007.*

*Opposite: John Ducci VSB ’09, Scott Martello CE ’07, Sharika Anderson ChE ’08 and Spence Curtis A&S ’10 at the “Beyond Ideas” conference.*

attend entrepreneurial conferences such as the National Collegiate Innovators and Inventors Association (NCIIA) annual conference.

## The Most Entrepreneurial Generation Comes of Age at Villanova

There are many reasons for the recent rise in the entrepreneurial spirit on campus. In part it is an outgrowth of prior initiatives including Entrepreneurship for Non-Business Majors, an elective course taught by VSB faculty for non-business students. In its first three years, it has grown in popularity and typically 70 percent of its students are from the College of Engineering. VSB has also provided entrepreneurial opportunities through the Center for Entrepreneurship, the StartUp Challenge, and FreshStart Challenge business plan competitions. Students who are currently attending Villanova grew up during the dot-com boom and bust. As a result many saw that it is, in fact, possible to begin a business at home and become successful. They have also learned the lessons of how to survive difficult times from alumni and others. As the country faces the challenges of rapid technological change and globalization, the lessons being learned within the College of Engineering and campus-wide will have a significant impact in encouraging young entrepreneurs.

**“Beyond Ideas” is available online at [www.villanova.edu/events/beyond\\_ideas](http://www.villanova.edu/events/beyond_ideas)**



## Students Working Around the World



Students in the College of Engineering participate in service learning projects that allow them to use their technical skills to help improve the lives of others in the United States and around the world. Above, a team of Villanova engineering undergraduate students assessed and evaluated renewable energy projects in a rural area of Ifugao, Philippines. The team partnered with a local non-governmental organization to evaluate existing rural electrification projects and assessed a number of new project sites for development. Top left, the Villanova student chapter of Engineers Without Borders constructed a water pipe to deliver drinking water to an orphanage in Baan Bo Mai village in Chiang Mai Province, Thailand. Bottom left, Villanova students relax with children from Amigos de Jesús, an orphanage for children in Honduras. Villanova faculty and students have completed eight trips to Honduras to date. These engineering students constructed a computer laboratory for the on-site school.

# Where Will We Find Tomorrow's Engineers?

## Villanova Brings Local High School Students to Campus

Building excitement among young students about becoming engineers is critical for the economic health of our nation. The country is increasingly challenged by global competition and the rapid pace of change in technology to develop a new generation of engineering talent.

To help meet that challenge, Villanova students, faculty and administration run two programs focused on increasing interest in engineering among local middle and high school students. The two complementary programs—VESTED and BEST Robotics—reach out to more than 350 students each year and let them experience the excitement of engineering and how they can plan for careers in the field.

VESTED (Villanova Engineering, Science and Technology Enrichment and Development) opens the exciting world of engineering to students who come to Villanova on Saturdays in the spring and on weekdays in the summer. Many come from environments where they have no contact with engineers, so the field is not on their list of education and career options, even though they may have the ability to succeed in the field. Through VESTED, students conduct exciting experiments in chemical, mechanical, civil, environmental, and electrical and computer engineering. Many students return from year to year to work on individualized projects.

In addition, VESTED helps with planning for college. Working professionals help students learn more about careers in engineering. The program also helps students find paid summer internships in the area through a partnership with WorkReady Philadelphia.

BEST (Boosting Engineering Science and Technology) Robotics is a national engineering competition for robotics teams from middle and high schools around the



country. Villanova partners with the School District of Philadelphia's Office of College and Career Awareness (OCCA) to host the competition among 17 teams and more than 300 students from the Northeast region of the country. They come to campus for a major kick-off event in September, where they receive robot building kits and contest guidelines. The goal this year was to build a Mars rover. Students from the College of Engineering organized the kick-off event, mentored students during their design and construction phase, and ran the final head-to-head competition in late October. The winner competes at the national level.

The BEST and VESTED programs are major contributors to the region's Science, Technology, Engineering and Math (STEM) educational programs. Such programs are a high priority for a number of industry, government and economic development agencies.

Stephen Jones, Ph.D., Associate Dean of the College of Engineering, directs this and all of the many other engineering outreach programs for middle and high



*Villanova students mentor a high school student attending the Summer Academy at Villanova.*

*Top: High school students work on their entry at the BEST Robotics competition hosted by the College of Engineering.*

schools. Speaking about the potential of the programs, he said, "BEST and VESTED are great ways to expose young people to the world of engineering. The lessons they carry away with them from these experiences will plant a seed, and hopefully the excitement they feel from this project will take hold. Maybe a student who had never thought of engineering as a possibility will become one of tomorrow's great inventors."

# Faculty Achievements



## **Ahmad Hoorfar, Ph.D., Named Outstanding Faculty Research Scholar**

Ahmad Hoorfar, Ph.D., received the Outstanding Faculty Research Scholar Award during Commencement in May. Dr. Hoorfar is a Professor in the Department of Electrical and Computer Engineering and Director of the Antenna Research Laboratory at the Center for Advanced Communications. The Outstanding Faculty Research Scholar Award is given annually to the most outstanding research scholar at the University.

Dr. Hoorfar's research is focused in the area of electromagnetic field theory including microwave and millimeter-wave printed antennas, multifunction low-profile antennas, metamaterials, artificial magnetic conductors and exotic surfaces, through-wall microwave sensing and imaging, numerical electromagnetics and evolutionary computational techniques.

Dr. Hoorfar earned his doctoral degree in electrical engineering from the University of Colorado in 1984. He spent the next two years as a postdoctoral research associate in the Electromagnetics Laboratory at the University of Colorado. He then became a research faculty member in the National Science Foundation Research Center for Microwave/Millimeter-waves Computer Aided Design in Boulder. He joined the Villanova faculty in the Department of Electrical and Computer Engineering in 1988.

## College of Engineering Welcomes New Faculty



**Pallav Gupta, Ph.D.**

*Assistant Professor  
Electrical and Computer Engineering*

- Design automation and methodologies for emerging nanotechnologies; reversible logic synthesis; and computer-aided design
- B.S. in Computer Engineering, University of Arizona
- M.S. in Electrical Engineering, Princeton University
- Ph.D. in Electrical Engineering, Princeton University



**Ani Ural, Ph.D.**

*Assistant Professor  
Mechanical Engineering*

- Computational orthopaedic biomechanics; computational fracture mechanics; solid mechanics
- B.S. in Mechanical Engineering, Bogazizi University
- M.S. in Mechanical Engineering, Cornell University
- Ph.D. in Mechanical Engineering, Cornell University



**Xiaofang "Maggie" Wang, Ph.D.**

*Assistant Professor  
Electrical and Computer Engineering*

- Computer architecture; reconfigurable computing; parallel processing
- B.S. in Microelectronics, Nankai University, Tianjin, China
- M.S. in Electrical Engineering, Beijing University of Technology
- Ph.D. in Computer Engineering, New Jersey Institute of Technology



**Rosalind Wynne, Ph.D.**

*Assistant Professor  
Electrical and Computer Engineering*

- Photonics; fiber optic devices and sensors
- B.S. in Physics, Norfolk State University
- M.S. in Electrical Engineering, Boston University
- Ph.D. in Electrical Engineering, Boston University

## Overview of Faculty Scholarship Activities

In addition to teaching and conducting research, faculty in the College of Engineering were active participants in 2006–2007 at conferences and contributed to many publications related to their expertise.

Journal Papers Published	70
Conference Papers Published	106
Conference Papers Presented	109
Other Publications, Presentations and Invited Talks	24
Research Grant Applications	122
Books or Monographs	2
Book Chapters	5

## Faculty Promotions

- Gerard Jones, Ph.D., has been named Associate Dean for Academic Affairs, effective January 2008.
- Randy D. Weinstein, Ph.D., Department of Chemical Engineering, was promoted to Professor.
- Metin Duran, Ph.D., Department of Civil and Environmental Engineering, was promoted to Associate Professor with tenure.

# Student Achievements



## **Student Profile: Sarah Arscott ME '09**

Sarah Arscott excelled in math and science at an early age. By high school, a teacher suggested she consider pursuing a degree in engineering in college. But Sarah says it was her father who encouraged her specific interest in mechanical engineering. “I had my driver’s license and really wanted my own car,” Sarah recalled. “My father told me that if I wanted a car I would have to help him rebuild an old one that had been sitting in our driveway. By the time we got it running, it was pretty clear that I was going to study mechanical engineering.”

Sarah is not only on track to graduate with her bachelor’s degree in mechanical engineering in 2009, she will also have a minor in business, a few hands-on internship experiences, and countless hours contributed to several student organizations that benefit from her passion.

When Sarah was a freshman, she was approached by the president of the Villanova student chapter of Engineers Without Borders (EWB) about whether she would take over leadership of the group. The chapter was started in 2002–2003, but had never reached the point of growing the membership to the level that it could actually execute a project. Sarah assumed leadership in spring 2006 and by December of that year she and two of her fellow engineering students had recruited new members, planned and conducted three student trips to Louisiana, and successfully completed the design and construction of a new playground in one of the communities that was ravaged by Hurricane Katrina.

As a result of their work on the Capdau Elementary School playground project, Villanova’s EWB chapter received an Honorable Mention for Project of the Year from the Project Management Institute of the Delaware Valley. EWB was the only student group recognized with an award.

*continued on next page*

## John McVay BSEE '01, MSEE '03, Ph.D. '07



John McVay has been awarded the first doctoral degree from the College of Engineering's new Interdisciplinary Ph.D. program. McVay earned his bachelor of science in Electrical Engineering in 2001, a master of science in Electrical Engineering in 2003 and completed his doctoral dissertation in June 2007.

Dr. McVay's thesis addressed the emerging field of metamaterials: materials that are designed with certain properties that have an advantage over conventional materials. Designing these materials

involves advanced physics and theory with extensive numerical simulations before there is even an attempt to fabricate the material. One of the areas he has studied includes developing a new metamaterial for airplanes that would cause radar waves to wrap around a plane rather than bounce back, making the plane virtually invisible to radar detection.

Why did he stay at Villanova for his bachelor's degree, master's degree and doctoral degree? "My experience at Villanova has been very personal—I know my professors, my education has been very hands-on, and I have had the opportunity to work on large, important projects. This experience has been consistent for my entire 11 years at Villanova," shared Dr. McVay.

Dr. McVay has accepted a position with Eureka Aerospace in Pasadena, California. He has done some consulting work with Eureka for the past two years and has decided to spend some time in industry. However, he has not ruled out a return to academia and says, "Spending time in industry can only help me better prepare engineers for the real world they will practice in."

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The Villanova student chapter of EWB now has 110 student members, a nine student executive board and two faculty advisors. Sarah is currently president of the chapter, and two friends who helped her recruit students and organize the initial trips, Ashley Ferguson and Jessi Minott, now serve in leadership roles as well. In spring 2007, Sarah attended the international conference of Engineers Without Borders in Amherst, Massachusetts.

In addition to her work with EWB, Sarah is a founding member of a co-ed service fraternity on campus, Sigma Alpha Pi. She also volunteers for Special Olympics, is a member of the student chapter of the Society for Women Engineers, and a peer counselor for the College.

Sarah spent the past summer as an intern for Gilbane Building Company, the firm that is building the new Villanova Law School facility on campus. She enjoyed the hands-on internship and had the opportunity to help them solve a problem with a stairwell design for a project in Massachusetts. "I was pretty nervous walking into the meeting where I was asked to share the mathematical models I developed to identify the problem, and tell their engineer that I believed he had made an error in the design," said Sarah. "I am not sure I would have had the confidence to do this if not for the kinds of experiences I have had at Villanova."



## Bobby Pencek EE '07 Commencement Speaker

*"Our classes foster, our studying fuels and our learning invigorates the desire and the search for academic truth.*

*It is in this way that we have experienced Veritas..."*

Excerpt from Bobby Pencek's commencement oration. To read the entire speech please visit:

[www.villanova.edu/communication/publications/magazine.htm](http://www.villanova.edu/communication/publications/magazine.htm)



## Haig Norian EE '08: Barry M. Goldwater Scholarship Winner

Haig Norian BSEE '08, Electrical Engineering, has been awarded a 2007 Barry M. Goldwater Scholarship. Norian was one of 317 Goldwater Scholars selected from among 1,110 national applicants for this prestigious undergraduate award, which recognizes excellence in the sciences, engineering and mathematics.

# Alumni Achievements



## **Alumni Profile: Adelene Perkins '81**

Adelene Perkins, a 1981 graduate of Chemical Engineering, has built a successful career that has been fueled by her love of technology, her ability to motivate and build strong teams, and her desire to create products that improve people's lives.

Perkins is currently Executive Vice President and Chief Business Officer for Infinity Pharmaceuticals, Inc., in Cambridge, Massachusetts. Infinity Pharmaceuticals is an innovative drug discovery company that focuses on best-in-class medicines for the treatment of cancer and related conditions.

Upon graduation from Villanova, Perkins wanted to experience a lot of different things in the professional environment. She went into one of General Electric's well-respected training programs and spent two years working six-month assignments in each of the four General Electric business settings, starting in a silicon plant for wastewater treatment and ending in process engineering. During her process engineering stint she enjoyed working on technical marketing. "I realized that there were many different career paths I could take," stated Perkins. "One thing I encourage people to do early in their careers is to get varied experiences so that they can evaluate their options and come to know what they love and what they do well." She believes a less structured environment, where people get to do work in many different areas, can be very beneficial to someone just starting their career.

This experience at General Electric led her to business school in Harvard's full-time MBA program. She felt that graduate school might help her focus on a particular area to pursue, and was surprised when she came out of Harvard "with an even broader perspective on opportunities I might pursue in the business environment," said Perkins. "I decided to try consulting because



## 2007 Engineering Alumni Society Awards



L-R: Gary Gabriele, Dean, College of Engineering; Robert M. Farrell, Ph.D., BEE '69; winner of The J. Stanley Morehouse Memorial Award and Pritpal Singh, Ph.D., Chair, Department of Electrical and Computer Engineering, College of Engineering.

The Engineering Alumni Society (EAS) presented the 2007 Alumni Society Awards at a reception held at the Connelly Center on June 8, 2007. The event included remarks by the Reverend Peter M. Donohue, O.S.A., '75, University president; Gary A. Gabriele, Ph.D., Dean of the College and Matthew C. Marquardt, CE '86, EAS President.

*continued from previous page*

it would allow me to take the skills I had acquired through General Electric and the education from Harvard to the corporate world. I knew I would get to work with a lot of different types of businesses and that was very appealing to me."

Perkins worked as a consultant for Bain & Co. in Boston with a variety of clients for several years and found that while she enjoyed all of the consulting projects, she enjoyed those in health care and pharmaceuticals the most. "At this point in my career I also started to focus on the fact that I wanted to do something that would have a direct and positive impact on people's lives," shared Perkins.

The burden of travel required in a consulting practice was wearing on her and her young family. She decided to move to the corporate environment at the time the biotech industry started to expand in the Boston area. She spent the next ten years in the genomics field working with

### **The J. Stanley Morehouse Memorial Award**

Robert M. Farrell, Ph.D., BSEE '69

### **The John J. Gallen Memorial Award**

Kathleen Mitchell BSChE '91

### **The Carl T. Humphrey Memorial Award**

Allesandro Perrotta MSEE '74

### **The Robert D. Lynch Award**

John C. Duda BSME '07

### **Meritorious Service Awards**

Robert J. Grossi MSCE '67

Thomas Nowlan BSChE '84, MSChE '85

William P. Dierkes, BSME '85

Arthur P. Ryan, III, BSEE '65

### **Professional Achievement Awards**

James Schuster, Ph.D., BSCE '57, MSCE '61

Luis A. Urrutia, MSChE '75

Teresa M. Bassitt, BSEE '84

George Facas, Ph.D., P.E., BSME '81

the Genetics Institute/Wyeth/American Home Products, MetaMorphix and TransForm Pharmaceuticals.

Perkins said that while she has not pursued a career as an engineer, "it has been very satisfying to combine my love of science and technology with the business, management and team building skills that I have acquired. And it is very important to me at this point in my career to be doing something that has a direct impact on helping people who have terrible diseases."

Reflecting on her time at Villanova, Perkins shared several ways that the University has impacted her professional and personal life. First, she made important friendships and remains close to several Villanovans to this day. She said she was fortunate to have wonderful faculty guide her in developing problem solving skills and still loves to take large problems and break them apart to smaller pieces to come up with effective solutions. "I still

## Engineering Alumni Society

The Engineering Alumni Society is composed of dedicated alumni who meet throughout the year to work with the engineering departments and the Villanova University Alumni Association to provide valued support for Villanova's engineering students. Through the generous support of its members, EAS helps fund projects that have become an exciting part of the students' experience. These projects, which continue to grow in complexity each year, are displayed at the Dean's Alumni Awards Banquet.

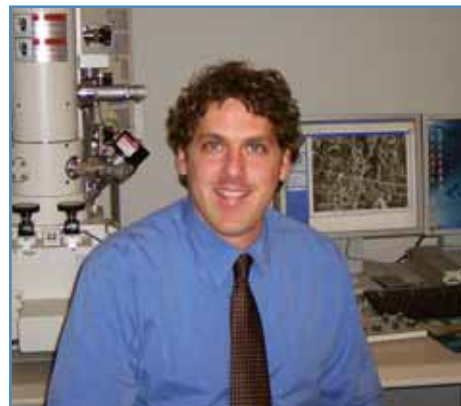
With the generosity of engineering alumni, EAS contributed \$20,000 in the 2006–2007 academic year to support over 15 student projects and activities. In addition to this contribution, EAS provided eight \$1,000 scholarships to incoming freshmen in fall 2007.

### **Award Sponsors:**

- Aegis Property Group
- Bala Consulting Engineers, Inc.
- Joseph P. Callaghan, Inc.
- The Henderson Corp. of PA, Inc.
- O'Donnell & Naccarato, Inc.
- Richter, Cornbrooks, Gribble, Inc.
- Smith Group
- Spring Garden Construction Co., Inc.
- STV, Inc.
- F. Tavani & Associates, Inc.
- Urban Engineers, Inc.
- J.J. White, Inc.

remember Dr. White saying that 'there is always an answer, and there is only one right answer,'" she shared. Finally, she recognizes that the Augustinian values that she was exposed to at Villanova are an important part of her life. "The Augustinian values of being part of a community, and of giving back, have remained with me," stated Perkins. "They have informed my thinking about my career—they lead me to think beyond a job, a profession or paycheck. It is very satisfying for me to use my skills to do something that improves people's lives."

# Chemical Engineering



**Randy D. Weinstein, Ph.D.**

Chair, Chemical Engineering

The Department of Chemical Engineering (ChemE) benefited from a renovation and expansion of laboratory facilities with the Gerald A. White Laboratory in White Hall and the new Scanning Electron Microscope (SEM), funded by the National Science Foundation for use by the entire College. The department continues to strengthen its focus in the areas of biotechnology, nanotechnology and the environment to address the increased demand for knowledge in these areas. Undergraduates in chemical engineering work closely with professors on research projects, gaining training and experience in these areas.

### Departmental

- The Gerald A. White Laboratory was dedicated in April 2007. This biotechnology research laboratory has been upgraded dramatically thanks to a generous grant from Gerald A. White '57, a ChemE alumnus, and his wife, Topsy. The equipment in the lab, primarily donated by several major pharmaceutical firms, makes it a truly world-class research facility which can investigate underlying fundamentals of phenomena that affect pharmaceutical manufacture (see page 33).

### Faculty

- C. Michael Kelly, Ph.D., stepped down as chair of the department after 19 years of dedicated service. Dr. Kelly will continue to teach as a faculty member of the department.
- Randy D. Weinstein, Ph.D., was appointed new chair of the department, effective fall 2007. Dr. Weinstein, who joined Villanova in 1998, earned his B.S. in Chemical Engineering from the University of Virginia in 1993 and a Ph.D. from the Massachusetts Institute of Technology in 1998.
- Kenneth R. Muske, Ph.D., was appointed to the Mr. and Mrs. Robert F. Moritz, Sr., Endowed Chair in Systems Engineering (see page 32).
- Dorothy W. Skaf, Ph.D., completed her sabbatical leave at the University of Qatar, supported by a Fulbright Scholar Award.

### Undergraduate

- The number of undergraduate students in the program continued to grow. The class of '08 will graduate 38 students, the class of '09 will graduate 54 students, and the class of '10 is on track to graduate 66 students in chemical engineering.
- Twelve Villanova undergraduate chemical engineering students participated in the National AIChE Student Conference in San Francisco in November 2006 and the Mid-Atlantic Regional AIChE Student Conference at Pennsylvania State University in April 2007.
- Major corporations, such as Air Products and Chemicals, Inc., DuPont, Motorola, Inc., Rohm and Haas Company, Merck and Co., and GlaxoSmithKline, increasingly seek ChemE undergraduates for summer internship opportunities and full-time employment. In addition, the department's extensive alumni network provides other internship and job opportunities throughout the country.
- Edward R. Ritter, Ph.D., with a group of undergraduate students, began new research in the area of biofuels.

### Graduate

- In addition to full-time graduate course work, the department continues to develop courses and certificates designed for working professionals in the biotech and pharmaceutical industries. Two new certificate programs were launched over the past two years: one in Biochemical Engineering and a parallel interdisciplinary certificate in Biotechnology. Currently the Biochemical Engineering Certificate is also available online.
- Donald Joye, Ph.D., developed new graduate online courses in Polymer Science and Engineering and Fluid Dynamics.



*SEM image taken of carbon nanofibers grown by chemical engineering students Mike Weiss and Sarah Barnett during their summer research project in Dr. Randy Weinstein's laboratory.*

## ChemE Research Initiatives

### DNA Plasmid Production

William J. Kelly, Ph.D., continues to lead research in DNA plasmid production that focuses on producing large quantities of plasmid for various biotechnology applications including gene therapy.

### Nanomaterials

Randy D. Weinstein, Ph.D., and Amy S. Fleischer, Ph.D., from the Department of Mechanical Engineering, are conducting interdisciplinary research on nanomaterials in the NovaTherm lab. This research, funded by the Office of Naval Research and Motorola, focuses on developing new nano enhanced phase change and thermal interface materials for the improved thermal management of electronic devices.

### CO<sub>2</sub> Emissions

Dorothy W. Skaf, Ph.D., is leading research on the use of semiconductor devices to capture CO<sub>2</sub> emissions that can then be converted for another use. This research is funded by the NSF.

### Environmental Construction Operation and Remediation Solutions, Inc.

Kenneth R. Muske, Ph.D., with Randy D. Weinstein, Ph.D., alumnus Bill Lorenz, and a team of undergraduate students, is researching the conversion of used coffee grounds into fireplace logs that are made from 100 percent recycled materials.

# Civil and Environmental Engineering



**Ronald A. Chadderton, Ph.D.**

Chair, Civil and  
Environmental Engineering

The Department of Civil and Environmental Engineering (CEE) continued to expand important strategic initiatives during 2006–2007. Undergraduate service learning and research courses had increased enrollments. Graduate students served as mentors for undergraduate research projects. Capstone design courses were made more multi-disciplinary and continue to be observed and evaluated by professional engineers from the Department Advisory Committee. The faculty continue to be recognized for their dynamic contributions to the field.

## 2006 – 2007 CEE Highlights

### Departmental

- Initiatives focused on interdisciplinary teaching and learning expanded with the addition of a course titled Construction Project Management. This course was team-taught by Frank Falcone, Ph.D., of CEE and John Cacciola, Ph.D., an engineer with the University's facilities department.
- The fifth annual CEE Day, which incorporated undergraduate research and senior design project presentations, was held in April 2007. Members of the Department Advisory Committee participated as design project evaluators.
- The number of CEE students studying abroad continued to grow in 2006–2007. Over the last five years, CEE graduates represented approximately 22 percent of each graduating class from the College, but accounted for 37 percent of engineering students who studied abroad.
- The William B. Fergusson Memorial lecture for 2006 was presented by John Durrant BSCE '76, MSCE '80 and Lawrence Roth, both of the American Society of Civil Engineers (ASCE). The lecture was titled, "The New Orleans Levees: The Worst Engineering Catastrophe in U.S. History: What Went Wrong and Why."

### Faculty

- Robert Traver, Ph.D., was recognized by the Army Corps of Engineers for his work with the New Orleans Hurricane Protection System External Review Panel of the American Society of Civil Engineers.

### Undergraduate

- High four-year graduation rates continue in the department with 86 percent of the fall 2004 sophomore CEE students graduating in May 2007.
- Internship and scholarship opportunities continue to be supported by corporate partners of the College, including Conti Enterprises and Michael Baker Corporation.
- Eighteen undergraduates were inducted into Chi Epsilon, the Civil Engineering Honor Society.
- Many CEE '07 graduates have been accepted to prestigious graduate programs at schools that include Stanford University, University of Texas and University of Delaware. Two students will attend doctoral programs; one at Columbia University and one at Pennsylvania State University.
- The eighth annual work trip to Honduras by the senior structural engineering design class was led by David W. Dinehart, Ph.D., and Shawn P. Gross, Ph.D., both CEE faculty members. Fifteen students participated in the project (see page 10).

### Graduate

- Enrollments in the graduate program remain strong. Graduate student enrollment included 12 full-time and 130 part-time graduate students, for a total of 142.
- New distance education courses for graduate programs were added, including Business Basics for Engineers, Management for Engineers, Structural Dynamics, Groundwater Hydrology and Structural Connections.
- The department saw continued growth in the five-year bachelor/master's degree program in CEE, with six students completing the program in 2006–2007.
- Eight graduate students published refereed journal articles and nine students published at conference proceedings during the year.



L-R: David W. Dinehart, Ph.D., Shawn P. Gross, Ph.D., and Joseph R. Yost, Ph.D., P.E. in the College's Structural Engineering Teaching and Research Laboratory.

## CEE Research Initiatives

### Steel Joists and Beams

David W. Dinehart, Ph.D., Shawn P. Gross, Ph.D., Rebecca M. Hoffman, Ph.D., and Joseph R. Yost, Ph.D., are continuing research in the structural performance of prefabricated steel joists and castellated cellular beams. Research funded by Commercial Metals Corporation.

Dr. Gross, Dr. Dinehart and Dr. Yost are evaluating open web steel joists with crimped web members. Research funded by the Steel Joist Institute.

### Self-Consolidating Concrete

Dr. Dinehart, Dr. Gross, and Dr. Yost are researching infrastructure applications of self-consolidating concrete. Research funded by Conti Enterprises, Inc.

### Structural Improvements to Withstand Natural Disasters

Dr. Dinehart is researching an advanced connection system for single family homes subjected to hurricanes and earthquakes. Funded by Villanova University Office of Research and Sponsored Projects.

### Microarrays

Metin Duran, Ph.D., continues research on using microarrays (DNA chips) for rapid and accurate on-site identification of pathogens in naval emergencies. Funded by Ablaze Development Corp.

# Electrical and Computer Engineering



**Pritpal Singh, Ph.D.**

Chair, Electrical and  
Computer Engineering

The Department of Electrical and Computer Engineering (ECE) has received significant recognition of its students and faculty over the past year both nationally and internationally. An ECE student was this year's commencement speaker; a class of '08 student received a prestigious Goldwater Scholarship award; and a faculty member received the University's Outstanding Research Scholar Award. Opportunities for undergraduate research, interdisciplinary learning and service learning continued to expand, and the first person to receive the College's new interdisciplinary doctoral degree was from ECE.

## 2006 – 2007 ECE Highlights

### Departmental

- This academic year about 50 percent of the ECE seniors and about 75 percent of the graduate students were involved in research with a faculty member.
- Interdisciplinary teaching and learning was expanded this year with a biomedical track, which was developed with the Biology Department in the College of Liberal Arts and Sciences. Two new courses were offered: Biomedical Instrumentation and Biomedical Signal Processing.
- Two professors in the ECE department established The Villanova Electronic Inventors Club to develop student electronic projects.

### Faculty

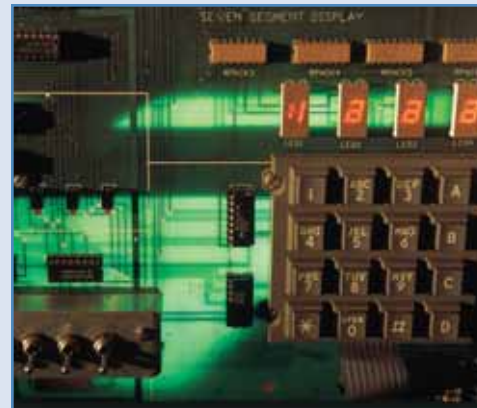
- Ahmad Hoorfar, Ph.D., received the University's Outstanding Research Scholar Award for the 2006–2007 academic year (see page 12).
- Moeness G. Amin, Ph.D., was promoted to a Fellow of the Society of Photo-Optical and Instrumentation Engineers (SPIE).
- Robert H. Caverly, Ph.D., authored a book titled "CMOS RFIC Design Principles" (Archtech House Microwave Library).
- Rosalind Wynne, Ph.D. expanded the new laboratory for photonic devices with research in the development of sensors based on microstructure optical fiber, sponsored by ONR, DARPA and NSF.
- The department hired three faculty members this year: Pallav Gupta, Ph.D., Xiaofang Wang, Ph.D., and Rosalind Wynne, Ph.D. (see page 13).

### Undergraduate

- Haig Norian BSEE '08 was a Goldwater Scholarship Recipient this year (see page 15).
- Bobby Pencek BSEE '07 was the May 2007 student Commencement speaker for the University (see page 15).
- A new internship program was established this year with Lockheed Martin's division in Moorestown, New Jersey. Several new scholarships and internships will be created through this program, which is similar to an existing program with Lockheed Martin.
- A new undergraduate program for service learning was established primarily for computer engineering students in conjunction with a non-profit organization, Team Children. This program involved refurbishing old computers and teaching people in the community how to use them.
- Edmond Dougherty, Ph.D., developed a relationship with the Overbrook School for the Blind for engineering students to work on senior design projects related to assisting blind and visually impaired students in navigation.

### Graduate

- The first doctoral candidate in the College of Engineering, John McVay of the ECE department, successfully defended his dissertation work and graduated in August 2007 (see page 15).
- ECE continued to expand partnering opportunities with area industry. A Wireless Communications certificate program was re-established with Inter-Digital Corporation this academic year. A Radar Systems graduate course was offered via distance learning for 20 employees from Lockheed Martin in Moorestown, New Jersey.
- Enrollment in the five-year bachelor/master's degree program continued to grow with five students currently enrolled.



*The ECE Department laboratory provides access to experimental systems through workstations equipped with state-of-the-art software for modeling, design, analysis and implementation.*

## ECE Research Initiatives

### Fiber Optic Sensors

Rosalind Wynne, Ph.D., is conducting research on developing fiber optic sensors based on microstructured optical fiber technology for chemical and biomedical applications. Primary applications for these sensors include detecting DNA markers, detectors for intelligent buildings and controlling robotic instrumentation for both surgical and manufacturing industries.

### High Speed, High Frequency Switching Devices

Robert H. Caverly, Ph.D., continues to lead research in modeling of high speed and high frequency switching devices for use in communication and medical technologies. Research funded by the National Science Foundation.

### Web-Based Programming for Education

Richard J. Perry, Ph.D., continues to research Web-based programming education, some of which was published at the 2007 Frontiers in Education Conference.

# Mechanical Engineering



**C. Nataraj, Ph.D.**

Chair, Mechanical Engineering

The Department of Mechanical Engineering continued to grow core initiatives in 2006–2007. The department fully integrated the service learning experience with the senior capstone design project via a newly designed course in the junior and senior years. Interdisciplinary learning expanded with a new course taught in conjunction with the Villanova School of Business, and several ME researchers continue multidisciplinary research with the other College of Engineering departments. The immediate impact on students of these and other department initiatives is an increase in opportunities for undergraduate research and internships, an understanding that the field of engineering is growing increasingly more interdisciplinary, and a very personal understanding of the ways that engineers can work to improve the lives of others.



## 2006 – 2007 ME Highlights

### Departmental

- Gerard Jones, Ph.D., stepped down as chair of the department in June after six years of outstanding service. Dr. Jones will become of Associate Dean for Academic Affairs in the College in January 2008.
- The department added a new course titled International Development: A Service Learning Course. The course focuses on the planning, design and impact of international service projects including water quality, sanitation and waste management.
- Interdisciplinary initiatives were expanded to include a new course in Project Management that is taught jointly by faculty from ME and the Villanova School of Business.
- Multidisciplinary research is conducted in the ME department with colleagues from the departments of Electrical and Computer Engineering and Chemical Engineering.
- The annual American Society of Mechanical Engineers (ASME) Student Night was again hosted on the Villanova campus this year.
- Villanova's entry in SAE MiniBaja Car Race earned third place of 64 entrants in the water competition, and placed 18th of 64 entrants overall, in the Eastern Regional Competition at the University of Central Florida.

### Faculty

- Sergey Nersesov, Ph.D., co-authored a book titled, "Impulsive and Hybrid Dynamical Systems: Stability, Dissipativity, and Control" (Princeton Series in Applied Mathematics) with Wassim H. Haddad, Ph.D., and Vijaysekhar Chelloboinu, Ph.D.
- Ani Ural, Ph.D., joined the department as an Assistant Professor (see page 13).

### Undergraduate

- Students were engaged in research and summer internships, many of which were sponsored by outside agencies including the Office of Naval Research and Naval Sea Systems Command—Philadelphia.
- Undergraduate students performed research on thermal performance of high-power electronics along side graduate students in Villanova's NovaTherm laboratory.
- In addition to earning a B.S. in Mechanical Engineering in May '07, a record number of students earned a minor in Mechatronics, an interdisciplinary minor with the ME and ECE departments. Several students earned minors in Business, Communication, Philosophy and Military Science.
- A group of five ME students was accompanied by a faculty member on a service learning trip to Thailand through the group Engineers Without Borders (see page 10).
- Nine students traveled with faculty members to Waslala, Nicaragua, to access, design, and install gravity-driven water distribution systems for the people in poor communities there.

### Graduate

- Six BSME graduates from May '07 are continuing their studies in the bachelor/master's degree program.
- Twelve MSME graduate students defended their master's theses. The department awarded a total of 16 MSME degrees during the past academic year.
- Several students who earned their master's degrees in 2007 were accepted into doctoral programs at prestigious schools including University of Virginia, Massachusetts Institute of Technology (MIT) and University of California, Los Angeles (UCLA).



*Students working on mobile robot research focused on autonomous systems with both indoor and outdoor capabilities.*

## ME Research Initiatives

### Evaluation of a Carbon Fiber Heat Sink

Amy S. Fleischer, Ph.D., is leading research in determining the heat removal rate from a carbon-fiber brush heat sink and evaluating the critical heat flux, compared to the performance of graphite foams.

### Heat Transfer and Fluid Dynamics of Circular Jets

Amy Fleischer, Ph.D., and Qianhong Wu, Ph.D., are researching the fluid dynamics and resultant heat transfer from jet impingement on porous media such as high conductivity carbon foams.

### Cellular Mechanics & Sports Engineering

Qianhong Wu, Ph.D., is conducting research focused on cardiovascular engineering with a focus on the vital role of the endothelial glycocalyx (EG) in microcirculation.

### Mini-Channel Heat Exchangers

Alfonso Ortega, Ph.D., recently completed a study for the Office of Naval Research investigating the use of water cooled small-scale silicon carbide heat exchangers for use in high power ship-board electronic systems.

### Computational Bone Fracture Risk Assessment

Ani Ural, Ph.D., is conducting research on computational modeling of mechanical behavior of human bone to develop prevention and diagnosis techniques for skeletal diseases such as osteoporosis.

# Center for Advanced Communications



The Center for Advanced Communications (CAC) had its most productive year for private and governmental research awards in 2006–2007. CAC journal publications and conference presentations remain very strong and are a testimonial to the large volume of research activities ongoing at the Center. The Center continues to gain international recognition for its research work in signal processing and communications areas, thus opening new and exciting avenues to faculty and students.

## CAC Topics of Study

- Wireless and digital communications
- High resolution imaging
- Smart antennas and space-time processing
- Interference mitigation in broad-band communication platforms
- Innovative antenna design
- Computational electromagnetics
- Microwave and RF microelectronics
- GPS technology
- Linear and nonlinear modeling of devices
- Thermal and power management of higher power electronics and wireless services

## 2006 – 2007 CAC Highlights

- CAC secured over \$5 million in award grants in 2006 – 2007.
- The Center was awarded four substantial research contracts from the government that address key problems in Urban Sensing: two contracts from the Defense Advanced Research Projects Agency (DARPA) and two from the Office of Naval Research (ONR).
- For the fourth year, CAC served as the United States representative on the NATO Task Force on Through-the-Wall Radar Imaging (TWRI). Fauzia Ahmad, Ph.D., was invited to speak at NATO, Fort Monmouth, New Jersey, on this topic.
- Moeness Amin, Ph.D., presented a lecture, “Through-the-Wall Radar Imaging,” at the IT Institute in Cairo, Egypt, and Michigan State University in East Lansing, Michigan.
- Nine full-time faculty members were involved in 26 CAC affiliated research projects during the year.



**Moeness G. Amin, Ph.D.**

Director, Center for  
Advanced Communications

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## Active Research Profile

### Through-the-Wall Target Detection and Classification for Achieving Transparent Urban Structures

- \$2,000,000 (2007–2011)
- Funded by the Office of Naval Research
- Moeness G. Amin, Ph.D.

### Through-the-Wall Radar Imaging

- \$1,092,000 (2004–2006)
- Funded by DARPA/CTC
- Moeness G. Amin, Ph.D.

### Radar Imaging for Urban Sensing

- \$585,000 (2007–2010)
- Funded by the Office of Naval Research
- Moeness G. Amin, Ph.D.

### Test and Measurement Instrumentation for Positioning and Wireless Technologies

- \$248,000 (2005–2006)
- Funded by Department of Defense
- Moeness G. Amin, Ph.D.

### RF Data Link Multi-Path Interference Mitigation

- \$50,000
- Navmar Applied Science Corporation
- Yimin Zhang, Ph.D.

### Reconfigurable Arrays and Signal Properties for Urban Sensing

- \$775,000 (2006–2007)
- Funded by DARPA/CTC
- Robert Caverly, Ph.D.

### Advanced Processing for Through-the-Wall Radar Imaging

- \$500,000 (2007–2012)
- Funded by the Australian Research Council
- Moeness G. Amin, Ph.D.

### Classification and Discrimination of Sources with Time-Varying Frequency and Spatial Spectra

- \$860,000 (2001–2006)
- Funded by the Office of Naval Research
- Moeness G. Amin, Ph.D.

### Partnership for Broadband Wireless Innovations, Development, and Commercialization

- \$600,000 (2004–2008)
- Funded by National Science Foundation
- Moeness G. Amin, Ph.D.

### An Investigation into the Application of Nano-Enhanced Phase Change Materials for Transient Thermal Management of Naval Electronics

- \$262,000 (2005–2008)
- Funded by the Office of Naval Research
- Amy S. Fleischer, Ph.D., and Randy D. Weinstein, Ph.D.

### Unmanned Surface Sea Vehicle Power System Design & Modeling

- \$150,000 (2005–2007)
- Funded by the Office of Naval Research
- Pritpal Singh, Ph.D.

### VisiBuilding—Interior Intelligence by Networked Sensing, Imaging, and Global Hierarchical Tomography (I2NSIGHT)

- \$1,950,000 (2006–2009)
- Funded by DARPA/BAE Systems
- Ahmad Hoorfar, Ph.D.

### Radio Frequency Identification (RFID) Lab

- \$50,000 (2005–2006)
- Funded by the Ben Franklin Technology Partners of Southeastern PA
- Yimin Zhang, Ph.D.

### Interference Suppression in GPS Receivers

- \$100,000 (2005–2007)
- Funded by the Office of Naval Research
- Moeness G. Amin, Ph.D.

### Novel Lo-Profile Antenna and Metamaterial High Impedance Surfaces

- \$100,000 (2005–2006)
- Funded by the Office of Naval Research
- Ahmad Hoorfar, Ph.D.

### Multi-Sensor Wireless Networks for Unmanned Surface Vehicles

- \$100,000 (2005–2007)
- Funded by the Office of Naval Research
- Yimin Zhang, Ph.D.

### Electronics System Thermes

- \$15,000 (2006–2007)
- Funded by National Science Foundation
- Amy Fleischer, Ph.D.

# Center for Nonlinear Dynamics & Control



The Center for Nonlinear Dynamics and Control (CENDAC) is composed of an interdisciplinary team of researchers who apply advanced, nonlinear, theoretical and numerical techniques to solve practical, real-world problems.

The world is full of nonlinear systems that range from natural ecosystems to complex engineering systems such as automobiles, manufacturing processes and structures. The linear theory that has traditionally been used to approximate the behavior of these systems has failed to predict some phenomena. Increasing demands for analytical accuracy and system performance have reinforced the need to consider nonlinear behavior of real devices and systems. CENDAC is recognized nationally for its expertise and research in the areas of unmanned sea vessels, emission control research and innovations in structural dynamics.

## **CENDAC Topics of Study**

- Autonomous systems, including robots and unmanned boats
- Automotive systems, focusing on emissions control and dynamic response
- Structural systems, with an emphasis on novel materials
- Material science, including composites and smart actuators

## 2006 – 2007 CENDAC Highlights

- CENDAC continues to collaborate with Naval Sea Systems Command—Philadelphia (NAVSSSES) on problems of research dealing with unmanned surface vehicles and has become one of the chief research partners for NAVSSSES.
- CENDAC is also collaborating with Naval Underwater Warfare Center (NUWC), in Newport, Rhode Island, to work on adaptive autopilots. NUWC runs tests with real boats for validating algorithms developed by CENDAC's research.
- Research on emissions control continued with support from Ford Motor Company.
- Research in nanomaterials was enhanced this year with the purchase of an Atomic Force Microscope.
- CENDAC has started a partnership with Children's Hospital of Philadelphia, the top-ranked children's hospital in the country, in the area of medical prognostics and bio-modeling.
- The Center organized a seminar by an internationally known researcher in nonlinear dynamics, Albert Luo, Ph.D., who delivered a lecture on "Quasi-Periodic Motions and Chaos in n-Dimensional Hamiltonian Systems." CENDAC co-organized a symposium on nonlinear effects in rotating systems with the American Society of Mechanical Engineers.
- Research in structural dynamics continued to expand with funding from the Steel Joist Institute and others.



**James Peyton-Jones, Ph.D.**

Director, Center for Nonlinear  
Dynamics & Control

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## Active Research Profile

### **Autonomous Systems Research, NSWCCD**

- \$1,200,000
- Funded by the Office of Naval Research
- C. Nataraj, Ph.D.

### **Nonlinear Dynamics & Control of Ships in Evolving Nonlinear Wavefields**

- \$1,100,000
- Funded by Naval Sea Systems Command
- C. Nataraj, Ph.D.

### **Impact Analysis of Water-lubricated Bearings**

- \$135,000 over three years
- Funded by Curtis-Wright
- C. Nataraj, Ph.D.

### **Advanced Combustion Feedback for PZEV Emissions, HCCI and Fuel Economy**

- \$120,000 over three years
- Funded by Ford Motor Company
- James Peyton-Jones, Ph.D., and Kenneth R. Muske, Ph.D.

### **High Fidelity Modeling of Electromagnetic Bearings with PM Bias**

- \$82,000
- Funded by the Office of Naval Research
- C. Nataraj, Ph.D.

### **Model-based Three-way Catalyst Control and Diagnostics for Super Ultra Low Emissions**

- \$120,000 over three years
- Funded by Ford Motor Company
- James Peyton-Jones, Ph.D., and Kenneth R. Muske, Ph.D.

### **Research in Support of Oceangoing Decontamination System – Phase 1 & 2**

- \$46,000 phase 1
- \$290,000 phase 2
- Funded by Ablaze Development, Inc.
- C. Nataraj, Ph.D.

### **Automotive Emissions, Control and Diagnostics Research**

- \$13,500
- Funded by EG Barry
- James Peyton-Jones, Ph.D., and Kenneth R. Muske, Ph.D.

### **Vibration-based Communication System for Smart Structures**

- \$5,000
- \$7,000 continuation
- Funded by Turbo Research Foundation
- C. Nataraj, Ph.D.

### **Verification of Hand and FEA Analytical Methods for Welded Aluminum Box Sections**

- \$16,500
- Funded by Pagnotta Engineering
- C. Nataraj Ph.D., Shawn P. Gross, Ph.D., and Rebecca M. Hoffman, Ph.D.

### **Cable Driven Monitoring and Decontamination System**

- \$11,000
- Funded by Ablaze Development, Inc., and the Office of Naval Research
- C. Nataraj, Ph.D., and Hashem Ashrafiun, Ph.D.

### **Evaluation of Sting Free Grips on Reciprocating Saws**

- \$2,340
- Funded by Sting Free Corporation
- C. Nataraj, Ph.D.

# Villanova Center for the Environment



The Villanova Center for the Environment (VCE) has become a major environmental center in the region through strong working relationships with private industry, other universities, foundations, government agencies and development councils, including the Environmental Protection Agency, The Pennsylvania Department of Environmental Protection, the Pennsylvania Department of Community and Economic Development, and the Ben Franklin Technology Partners of Southeastern Pennsylvania.

## VCE Topics of Study

- Environmental processes: physical, chemical, and biological
- Water and wastewater treatment
- Industrial and hazardous waste management
- Water quality and fate of contaminants
- Agricultural waste management
- Stormwater research and management
- Porous concrete
- Wetlands
- Retention basins
- Sustainable development
- Renewable energy and efficiency
- Industrial waste minimization
- Pollution prevention

## 2006 – 2007 VCE Highlights

- VCE became a member of the Pennsylvania Growing Greener Partnership, which also includes Carnegie Mellon University, Temple University, University of Pittsburgh, Philadelphia University and the Green Building Alliance. The partnership is funded by the Commonwealth of Pennsylvania at the level of \$2,000,000.
- The Center's partnership with the EPA on Industrial Waste Minimization and Sustainability continues to develop research that will have long-term benefits for the region and the country.
- The Villanova University Urban Stormwater Partnership continues to receive funding from the Pennsylvania Department of Environmental Protection and the William Penn Foundation to advance the evolving comprehensive stormwater management field and to foster the development of public and private partnerships through research on innovative stormwater management, directed studies, technology transfer and education.
- VCE conducted a major regional workshop on Alternative Energy, bringing together representatives from federal and state groups, private industry and academia.
- Expertise in ground water and surface water continues to strengthen VCE's international presence in Ireland, Brazil, Canada, Italy and India.
- During the 2006–2007 academic year, there were 13 faculty, one postdoctorate fellow, one research associate, and 27 students researching, teaching and studying at the Center. There were 25 research projects associated with VCE and 33 publications.
- Gangadhar Andaluri, a doctoral candidate in the Center, received a first place research poster award from the Society of Environmental Toxicology and Chemistry (Hudson-Delaware Chapter). Shashi Abburi, a master's degree student in the Center, presented her research at the Pennsylvania Water Environment Association's PennTec 2007 Conference.



### Rominder Suri, Ph.D.

Director, Villanova Center  
for the Environment

[rominder.suri@villanova.edu](mailto:rominder.suri@villanova.edu)

## Active Research Profile

### Pennsylvania Growing Greener Partnership

- \$2,000,000
- Funded by the Commonwealth of Pennsylvania
- Rominder Suri, Ph.D.

### Villanova University Urban Stormwater Partnership

- \$175,000
- Funded by the Pennsylvania Department of Environmental Protection
- Robert Traver, Ph.D.

### Partnership for Industrial Waste Minimization and Sustainability

- \$133,750
- Funded by the Environmental Protection Agency
- Rominder Suri, Ph.D.

### Consortium on Sustainable Design and Research for Southeastern Pennsylvania

- \$1,750,000
- Funded by the Commonwealth of Pennsylvania
- Rominder Suri, Ph.D.

### Watershed Impact of Stormwater Bioretention and Bioinfiltration BMPs

- \$442,787
- Funded by The Cooperative Institute for Coastal and Estuarine Environmental Technology (CiCEET)
- Robert Traver, Ph.D.

### Partnership with Maine Prudent Disposal of Unwanted Medications

- \$150,000
- Funded by the Environmental Protection Agency
- Rominder Suri, Ph.D.

### Ultrasound Treatment System for Removal of APIs at Wyeth Facility in Brazil

- \$188,000
- Funded by Wyeth Pharmaceuticals
- Rominder Suri, Ph.D.

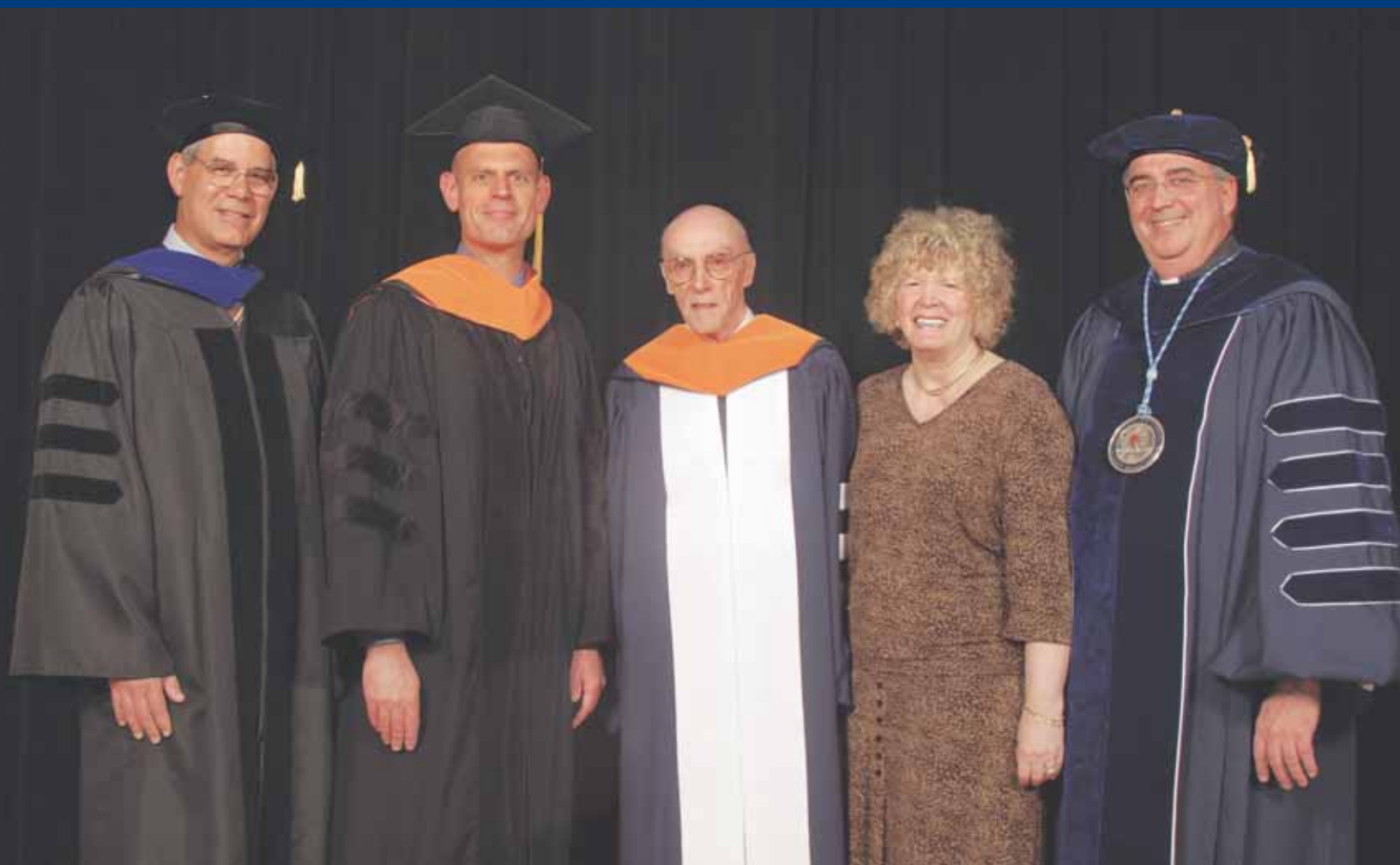
### Ozonation for Removal of APIs at Wyeth Facility in Ireland

- \$98,000
- Funded by Wyeth Pharmaceuticals
- Rominder Suri, Ph.D.

### Effectiveness of Nano-Environmental Catalysts for Indoor Air Treatment

- \$100,000
- Funded by the Commonwealth of Pennsylvania
- Rominder Suri, Ph.D.

# Development



*L-R: Gary Gabriele, Ph.D., Dean, College of Engineering; Kenneth R. Muske, Ph.D.; Dr. Robert F. Moritz; Diane Moritz; and the Reverend Peter M. Donohue, O.S.A.*

## **The Mr. and Mrs. Robert F. Moritz, Sr., Endowed Chair**

The Mr. and Mrs. Robert F. Moritz, Sr., Endowed Chair in Systems Engineering was inaugurated on October 5, 2006. The inaugural chair holder will be Kenneth R. Muske, Ph.D., a professor in chemical engineering. Robert F. Moritz, Jr., DDS, and his wife, Diane, endowed the chair in honor of Dr. Moritz's parents.

Solving problems in the real-world engineering environment has become increasingly interdisciplinary in nature. Educators must now provide new curriculum for this growing field, known as Systems Engineering. The Moritz Chair supports the College of Engineering's innovative systems engineering initiative by developing courses at both the graduate and undergraduate level that will help prepare students for the increasingly technological world in which we live.

Dr. Moritz is a 1951 graduate of the College of Commerce and Finance, now the Villanova School of Business. After serving in the Navy as an engineering officer and captain, he graduated from the Temple University School of Dentistry.

Dr. Moritz's father, Robert F. Moritz, Sr., was a pioneer in the manufacture of machinery for the corrugated container industry. Dr. Moritz and his wife have honored his parents in an enduring way with their \$1 million dollar gift to endow the Mr. and Mrs. Robert F. Moritz, Sr., Chair in Systems Engineering.



## The Gerald A. White Fund for Biotechnology Research



*Gerald A. White talks with William Kelly, Ph.D., in the biotechnology laboratory that was expanded with the gift of White and his wife, Topsy.*

College of Engineering alumnus Gerald A. White '57, and his wife, Topsy, have given a gift of \$375,000 that will significantly boost Villanova's growing biotechnology research initiative in the Department of Chemical Engineering. The Gerald A. White Fund for Biotechnology Research

will support the department's teaching environment and cutting-edge research with \$125,000 designated to expand and update the existing laboratory and create a state-of-the-art biotechnology research center. An additional \$250,000 will create an endowment that will help the College purchase equipment and fund student summer research on an annual basis. In recognition of his commitment, the Biotechnology Research Laboratory, located in the chemical engineering building, will be named in honor of Mr. White.

The Whites have a family legacy at Villanova beyond their valuable contribution to the chemical engineering department. Three of their four children and two of their grandchildren have attended Villanova. One of their grandsons, Samuel P. White '08, is now a third-generation chemical engineering major.

## The Villanova Annual Fund

Did your engineering education help shape your career and life? A contribution to the Villanova Annual Fund is a meaningful way to honor your Villanova heritage. Your gift will provide critical resources to support programs and initiatives that benefit the entire University community. You may also restrict your gift to the College of Engineering or a specific department within the College.

### Securities

To learn about year-end gifts of securities, please call Janet Duffy at **610.519.4573**.

### Online

Make a gift now through the University's secure online gift form at **[www.villanova.edu/makeagift](http://www.villanova.edu/makeagift)**.

### Call Us

Call **800.486.5244** to make a gift using your credit card. Our office hours are Monday through Friday, 9 a.m. to 5 p.m.

## NSF Grants Provide State-of-the-Art Technology



### Scanning Electron Microscope

The College received \$500,000 from the National Science Foundation to purchase a Scanning Electron Microscope (SEM). The major equipment grant was secured by the efforts of four faculty members, one from each department in the College. The SEM is capable of imaging at the 2 nanometer level. This microscope is part of a new lab, the Materials Characterization Laboratory in the Center for Engineering Education and Research (CEER), that will house the new SEM as well as an Atomic

Force Microscope and an older existing SEM. Together, these microscopes will provide a state-of-the-art imaging capability for graduate and undergraduate research from all four departments. The lab will enable graduate students to be active in several research areas of national importance, including Micro-Electro-Mechanical Systems (MEMS)-based sensors, nanostructured solar cells, drug delivery devices and nanostructured ceramics. In addition, by integrating this lab into existing materials courses and undergraduate research projects, over 100 undergraduate students a year will be able to interact with equipment that is as up-to-date as any they will find after graduation.

### Core Genomics Laboratory for Teaching and Research in Biotechnology

The National Science Foundation, through its Major Research Instrumentation (MRI) program, will also fund the analytical infrastructure of a new Core Genomics

Laboratory for teaching and research in biotechnology. The award of \$211,000 will be used to purchase advanced equipment which will allow researchers to incorporate modern genomics level experimental protocols into their current and future research and teaching activities in environmental microbiology, bioprocessing, mechanotransduction, and microstructured optical fiber spectroscopy-based biological sensors. Because of the interdisciplinary nature of the teaching and research opportunities in biotechnology, the Core Genomics Laboratory will be used by all four departments in the College of Engineering, as well as the Biology and Chemistry departments in the College of Liberal Arts and Sciences.

## Endowments for the College of Engineering

Listed below are the endowed funds, including gifts and pledges, in support of the College of Engineering, its students, faculty and programs. For information about creating an endowment, contact James Mann, Director of Development for the College of Engineering at **610.519.4564** or at **james.mann@villanova.edu**.

### Endowed Funds

George L. Aulbach Family Endowed University Scholarship  
Rosanna S. and Robert S. Ayerle, M.D., Endowed Scholarship  
James R. Birle Chair of Energy Technology  
Anthony F. Calapristi '40 Endowed University Scholarship in Engineering  
Arthur M. Carleton Endowed Scholarship Fund  
Brenda and Robert G. Catalanello Endowed University Scholarship  
Christman Family Endowed Fund  
Charles P. Collins Scholarship Fund  
Christopher J. and Frances D. Cona Endowed University Scholarship  
Mr. and Mrs. Alfonso Daloisio, Sr. Endowed University Scholarship  
Richard T. Dewling Endowed Scholarship for Graduate Environmental Engineering Study for Women  
Nance K. Dicciani '69 Endowed Scholarship for Engineering  
James A. Drobile Dean's Scholarship in Chemical Engineering  
John G. Drosdick University Scholarship  
Rev. Francis D. Dougherty, O.S.F.S. Endowed University Scholarship  
Michael Helwig Endowed Memorial Scholarship  
John P. Jones '72 Endowment in Engineering  
Carl R. Maio '49 and Mary Catherine Maio Endowed Scholarship for Engineering  
Department of Mechanical Engineering Endowment  
Professor Joseph J. Hicks Endowed University Scholarship  
Joseph T. Mooney, Sr. Endowed Scholarship Fund  
Mr. and Mrs. Robert F. Moritz, Sr. Endowed Chair in Systems Engineering  
James Robert Mucchetti Endowed Scholarship for Electrical Engineering  
William J. O'Brien Endowed University Scholarship  
Dr. and Mrs. James O'Malley '62 Endowed Scholarship  
Carolyn and Philip A. Piro '50 Endowed Scholarship for Engineering  
Donald H. Piser Endowed University Scholarship  
William J. Pratt Endowed Fund for Electrical and Computer Engineering  
Robins-O'Sullivan Family Endowed Chair in the College of Engineering  
Frank S. Scarpa Endowed Chair in Business Communications Technology  
Mary and Charles J. Volpe Dean's Endowed Equipment Fund  
Edward J. Welsh Jr. /ADCO Electrical Corporation Endowed Scholarship  
R. E. White Endowed Scholarship Fund  
Gerald A. White '57 Biotechnology Research Laboratory Endowment Fund

### Donors

George L. Aulbach  
Robert S. Ayerle, M.D.  
James R. and Mary Birle  
Estate of Anthony F. Calapristi  
Arthur M. Carleton  
Robert G. and Brenda H. Catalanello  
Mr. and Mrs. William G. Christman  
Charles P. Collins  
Mr. and Mrs. Franklin J. Cona  
James J. Daloisio and Alfonso Daloisio  
Dr. Richard T. Dewling and Dolores M. Dewling  
  
Nance K. Dicciani, Ph.D.  
James A. Drobile, Esq.  
Jack and Gloria Drosdick  
Mr. and Mrs. John G. Gilfillan III  
A. Carl and Catherine L. Helwig  
John and Denise Jones  
Mr. and Mrs. Carl R. Maio  
  
Edward V. McAssey III and Linda J. McAssey  
Margaret and Robert J. Merkert, Sr.  
Mr. and Mrs. Joseph T. Mooney, Jr.  
Robert F. Moritz, Jr. and Diane L. Moritz  
Stephen A. Mucchetti  
William J. O'Brien  
Dr. and Mrs. James J. O'Malley  
Philip and Carolyn Piro  
Donald Piser  
Mr. William J. Pratt, Jr.  
John M. Robins and Patricia S. O'Sullivan  
Frank and Gail Scarpa  
Charles J. and Mary Volpe  
Ed and Elaine Welsh  
Mr. and Mrs. Gerald A. White and alumni and friends  
Mr. and Mrs. Gerald A. White

# About the College of Engineering

For the second straight year, the College of Engineering was ranked **#9 in the country by U.S. News & World Report** for engineering schools that award primarily bachelor's degrees.

## Our Mission

Villanova University's College of Engineering provides an engineering program that emphasizes technical excellence and a liberal education within the framework of the University's Catholic Augustinian heritage.

## Degrees

- B.S. in Chemical Engineering
- B.S. in Civil Engineering
- B.S. in Computer Engineering
- B.S. in Electrical Engineering
- B.S. in Mechanical Engineering
- Five-Year Bachelor/Master's degree programs
- M.S. in Chemical Engineering
- M.S. in Civil Engineering\*
- M.S. in Computer Engineering
- M.S. in Electrical Engineering\*
- M.S. in Mechanical Engineering\*
- M.S. in Transportation Engineering
- M.S. in Water Resources and Environmental Engineering\*
- Sixteen graduate certificate programs\*
- Master of Technology Management
- Interdisciplinary Ph.D.

\*Available via distance education

## Accreditation

All five baccalaureate programs are accredited by the Accreditation Board for Engineering & Technology (ABET).



## Undergraduate Student Profile

- 900 full-time undergraduate students
- 21% female
- The middle 50% of the class of 2010 scored between 650 and 730 in the MSAT, between 590 and 650 in the VSAT, and earned a high school GPA between 3.61 and 4.00.
- The Class of 2011 consists of students from 28 states, plus the District of Columbia and Puerto Rico, as well as Bangladesh, Bolivia, Ghana, India, Japan, Mauritius, New Zealand, Switzerland, Sweden, Tunisia and Zimbabwe.

## The Student Experience

- Student/Teacher Ratio: 13:1
- All full-time undergraduate students are issued a laptop computer configured for use with the engineering curriculum.
- The engineering curriculum consists of at least 18 liberal arts credits.
- There are over 50 concentrations and minors within engineering, liberal arts & sciences, nursing and business.
- There are 24 student organizations, including engineering honor societies, student chapters of professional engineering societies and minority student organizations.

## Placement Statistics

The following statistics represent the Class of 2006, six months after graduation:

Employment	77.6%
Graduate/Professional School	20.6%
Other	1.8%

## Average Salaries for the Class of 2006

Major	Average Salary
Civil	\$48,176
Chemical	\$54,864
Computer	\$49,714
Electrical	\$55,042
Mechanical	\$51,029

## Graduate Student Profile

- 300 students
- Part time and full time
- Part-time students from regional corporations in pharmaceutical, aerospace and other fields
- Many go on to pursue doctoral study at top universities, including Carnegie Mellon University, Columbia University, Massachusetts Institute of Technology, University of Delaware, University of Pennsylvania and others

[www.engineering.villanova.edu](http://www.engineering.villanova.edu)



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