A Distinctively Defined Education

Inside IIT’s IPRO Program

Alumni Profiles in Excellence
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Armour Research
- Biomedical Engineering
- Chemical and Biological Engineering
- Civil, Architectural, and Environmental Engineering
- Electrical and Computer Engineering
- Mechanical, Materials, and Aerospace Engineering
A priority task for Armour College of Engineering is to develop and implement a strategic plan that subscribes to Many Voices, One Vision, IIT’s new strategic plan, approved by the Board of Trustees in May 2009. Areas where engineering is immediately building upon existing efforts include the Interprofessional Projects (IPRO) Program and interdisciplinary curriculum and research.

I cannot stress enough the impact of the IPRO Program on Armour students. One of the distinctive educational icons of IIT, IPRO prepares our students for their chosen engineering disciplines. As we make the IPRO Program one of the top Armour priorities, we will be committed to continued excellence in technology-focused training while placing renewed emphasis on the entrepreneurial and ethical aspects of engineering. A feature on the IPRO Program appears on page 9 of this magazine.

It is critical that we expand our research enterprise in areas of leading-edge engineering and applied science. Central to this is seeking out and encouraging interdisciplinary collaborations. While interdepartmental and cross-college endeavors promise to enhance Armour’s research profile, a key pursuit is innovation and knowledge creation. We are currently engaged in efforts to identify research areas that are not only of national priority but also consistent with our strengths, in order to strategically focus our growth and investment. It is also imperative that we grow our doctoral program; increasing Ph.D. student enrollment will be essential if we are to increase the impact of IIT’s research and to elevate engineering’s reputation to international stature.

By crossing traditional academic boundaries, we are committed to providing our students with new and richer educational experiences. We have already begun to work in partnership with our fellow IIT colleges to develop co-terminal (B.S./M.S.) programs and other opportunities at the undergraduate and graduate levels that link engineering with other disciplines. Programs that provide engineering students with knowledge in subjects such as management, entrepreneurship, and intellectual property will offer students a distinctive and relevant education, and better prepare them to drive change in emerging technologies that have the potential to impact society.

Entrepreneurship will play a more central role in Armour education for both undergraduates and graduate students. In 2009, we were pleased to announce IIT’s new Kern Innovation and Entrepreneurship Academy, which enrolls 25 top engineering students per year in a program that provides them access to successful area entrepreneurs. As the IPRO Program also works to expand its entrepreneurial component, we will be able to provide our students with more opportunities to make the jump from engineer to entrepreneur.

Each of these new endeavors will increase our visibility. “Elevating engineering’s reputation to international stature” is one of IIT’s five strategic priorities. Achieving it will be a tremendous task, but through hard work and a commitment to innovation, including new programs to incentivize excellence, we will build a more competitive educational and research platform. We are committed to making strategic decisions that, in spite of this difficult current financial time, will support our efforts to educate intellectually diverse engineers and foster new discoveries in technology.

We are proud to be the organizer, along with the Chicago Council on Science and Technology, of one of the National Academy of Engineering’s Grand Challenges for Engineering summits. The NAE Grand Challenges for the 21st Century: Chicago Summit 2010 (April 21–22) will discuss some of the most important global issues of our time: clean water; carbon, energy, and climate; urban sustainability; and global health. This exciting opportunity will allow Armour College students and faculty to participate in a forum that will provide public awareness of contemporary issues and the significant role that engineering plays in their resolution. For more information about the Chicago summit, see page 2.

Armour’s alumni and friends, students, faculty, staff, and Board of Overseers play an important role in our progress. The development of the Armour strategic plan—and more importantly, its implementation—is a team effort. I look forward to working with each of you in the coming months and thank you for your partnership and contributions to continue the advancement of Armour’s educational and research programs.

Natacha DePaola
Carol and Ed Kaplan Armour College Dean of Engineering
Students at the fall 2009 IPRO Day exhibit their projects to the IIT community, sponsors, industry leaders, area high school students, and other guests.
Armour College Accreditation Renewed

The Engineering Accreditation Commission of the Accreditation Board for Engineering and Technology (ABET) renewed its accreditation of IIT Armour College of Engineering this year. Re-accreditation was granted to all programs in engineering. This was the first time that the biomedical engineering program—Armour’s youngest—went through the accreditation process, and it was accredited. ABET representatives examined all aspects of the undergraduate programs in engineering, visiting laboratories and classrooms; interviewing faculty, students, and alumni; examining student work; and visiting the supporting departments and university administration. “Accreditation demonstrates that all of IIT’s undergraduate engineering programs meet the high standards set by the national accrediting body,” says Professor John Kallend, Armour College associate dean, who coordinated the review and hosted the ABET team. “Only graduates from accredited engineering programs can go on directly to qualify as licensed professional engineers, and employers know that these graduates have met the standards.”

IIT to Provide Leadership for Grand Challenges Summit


The NAE’s five-city 2010 Grand Challenge Summit Series aims to draw public attention to the challenges the United States faces regarding security, sustainability, and quality of life. Highlighting the role of engineering in helping the country to maintain excellence in these areas, the series will also build future collaborations of scientists, engineers, policymakers, and researchers in business, law, social sciences, and humanities that are needed to successfully address these complex issues. Information gleaned from summit dialogue will be used to better educate students about how to address these challenges in the years ahead.

The Chicago summit—organized by IIT in partnership with C2ST and Northwestern University, the University of Chicago, the University of Illinois at Chicago, and the University of Illinois at Urbana-Champaign—will be held April 21–22, 2010. Among the 14 grand challenge topics that the NAE has identified, the four topic areas to be discussed at the Chicago summit include global health; carbon, energy, and climate; clean water; and urban sustainability. Confirmed speakers or moderators at the Chicago summit (as of December 15, 2009) include Roger Frechette, director of building services and sustainable engineering for Skidmore, Owings & Merrill; John Holdren, assistant to the president for science and technology, and director of the Office of Science and Technology Policy; Blair Kamin, architecture critic for the Chicago Tribune; Bill Kurtis, acclaimed journalist and conservationist; Ray LaHood, U.S. Secretary of Transportation; Lord Ernest Ronald Oxburgh, member of the House of Lords and member of the Parliamentary Office of Science and Technology; John W. Rowe, chairman and chief executive officer of Exelon Corporation, and chair of the IIT Board of Trustees; Charles Vest, president of the National Academy of Engineering; and Tachi Yamada, M.D., president of the Global Health Program for the Bill & Melinda Gates Foundation. For updated information about the Chicago summit, visit www.iit.edu/grand_challenges or email grandchallenges@iit.edu.

Nationwide Search for ECE, ChBE Chairs Launched

In August 2009, IIT Armour College of Engineering initiated a national search for chairs of both the Department of Electrical and Computer Engineering and the Department of Chemical and Biological Engineering.

“Armour College is committed to advancing in line with the university’s strategic plan, and these searches are a good opportunity to bring additional outstanding senior faculty to these departments at a time when we are moving forward with a new strategic plan for the college,” says Dean Natacha DePaola. “We remain grateful for the services of our outgoing chairs, both for their leadership and continued efforts as faculty members.”

IIT Vice President for International Affairs and Motorola Chair Professor of Chemical Engineering Darsh Wasan is chairing the ECE chair search committee. ECE faculty participating on the committee include Alex Fluetsch, Miles Wernick, Geoffrey Williamson, and Yang Xu. Armour Board of Overseers member Leonard Reiffel (EE ’47, M.S. ’48, Ph.D. ’53), chairman and chief executive officer of Exelar Corporation, is also serving on the committee.

Russell Betts, dean of IIT College of Science and Letters, is heading the search committee for the new ChBE chair. ChBE faculty who are serving on the committee include Hamid Arastoopour (M.S. GE ’75, Ph.D. ’78), Fouad Teymour, Darsh Wasan, and Don Chmielewski (EE ’90). Sangtae Kim, executive director of Morgridge Institute for Research, is representing the Armour board in the search.

New Advancement Officer Joins Armour

In October 2009, IIT Armour College of Engineering welcomed Stuart H. Gold as the new senior major gifts officer for the college. He will work closely with Dean Natacha DePaola, the Armour Board of Overseers, and other volunteers to secure philanthropic commitments to support the engineering program.
Armour Recruitment and Enrollment Surpasses Goals

Last fall, IIT Armour College of Engineering welcomed an increased number of undergraduates and new transfer students compared to academic year 2008–09 figures. This includes 260 new first-year students, an increase of 7 percent over the previous year.

Gerald Doyle, vice provost for undergraduate admission and financial aid, credits Armour College faculty and staff for their role in contributing to recruitment, which included writing letters to and phoning students, referring students, and participating in outreach activities such as recruitment symposia for high school students. Faculty and staff were also an important part of student retention.

“Faculty members and faculty advisors were very involved in the outreach process to students beginning as early as fall 2008, especially with our currently enrolled students who were experiencing financial challenges as a result of the slowdown in the United States and global economy,” says Doyle.

While graduate student numbers were down slightly, the number of credit hours in which these students enrolled was up compared to the previous year.

Armour College would like to thank its faculty and staff as well as colleagues in IIT undergraduate and graduate admission for their continued efforts to increase enrollment and enhance retention at the college.

Students and faculty celebrated the start of a new academic year at the fall 2009 Armour College Cookout.

student accomplishments

- MMAE undergraduate Anthony Castaneda was selected as one of 24 student leaders nationwide to participate in the Society of Automotive Engineers 2009 Leadership Development Program. The Leadership Development Program recognizes some of the most promising SAE student leaders and works to further develop their leadership skills for application to future roles in SAE International and their professional careers.

- ChBE Ph.D. candidate Andrey Ivankin received the 2009 Ludo Frevel Crystallography Scholarship award from the International Centre for Diffraction Data. The scholarship is presented annually to 10 students working in the area of crystallographic research.

- Third-year ChBE student Omaditya Khanna won second place in the 2009 Annual Meeting of the Biomedical Engineering Society’s undergraduate research competition. Khanna, who gave the talk, “The Synthesis of Multilayered Alginate/Poly-L-Ornithine/Alginate Microcapsules and the Sustained-Release of Fibroblast Growth Factor-1 from the Outer Alginate Layer,” conducts research with BME graduate student Monica Moya and BME Assistant Professor Eric Brey.

- Omer Onar, EE doctoral student, won two international fellowships from the Institute of Electrical and Electronics Engineers. The Joseph J. Suozzi INTELEC Fellowship is awarded to electrical engineering graduate students studying power electronics as applied to communications systems. One student worldwide receives this fellowship annually. Onar’s second award, the IEEE VTS Transportation Electronics Fellowship, is given to a single graduate student worldwide every two years.
IIT to Receive Up to $8 Million for Wind Energy Research

In October, IIT was one of three academic institutions selected to receive up to $8 million in total funding from the United States Department of Energy to support an extensive wind energy research, education, and workforce development project. Under the leadership of Electrical and Computer Engineering Chair and Bodine Professor Mohammad Shahidehpour, the project taps a university-industry consortium to install a test turbine, a GE 1.5 MW turbine, at an existing wind-generation site owned by consortium partner Invenergy, LLC, located in Marseilles, Ill. Additionally, IIT will purchase up to two turbines that will be used to perform reliability studies.

Advanced concepts for rotor control and drive-train control, robust sensors for blades, and improved aero-elastic models to improve wind turbine performance and reliability will be tested at the site. Because IIT’s test turbine will be installed near an existing wind farm, this arrangement will facilitate the study of turbine-to-turbine wake interaction, wind farm interaction, and wind energy efficiencies. To further enhance research and education, IIT will develop and offer wind energy courses that address the technical, operational, social, and environmental aspects of wind energy in consultation with industry. The university will also offer annual fellowships for undergraduates and master’s students studying in wind energy engineering fields.

The project is a collaboration between IIT researchers, six other universities, and more than 20 industry partners. The consortium advisory board included the late IIT professor Henry Linden (Ph.D. CHE ’52) and current members Richard Gowen, former president of the Institute of Electrical and Electronics Engineers; Robert Galvin, IIT regent and founder of the Galvin Electricity Initiative; and Michael Polsky, president and chief executive officer of Invenergy, one of the top-five largest owners of wind generation assets in the United States.

IIT’s interdisciplinary representation on this endeavor includes faculty members from electrical and computer engineering; mechanical, materials, and aerospace engineering; business; architecture; and Wanger Institute for Sustainable Energy Research.

Shahidehpour and ECE Associate Professor Zuyi Li (Ph.D. EE ’02) were also the recipients of a separate $750,000 DOE grant for their project “WINS: Market Simulation Tool for Facilitating Wind Energy Integration,” which will use specially designed software to decipher the best way to integrate wind energy into the U.S. electric power grid.

Roadway Safety Project
Funding Extended

The Department of Civil, Architectural, and Environmental Engineering renegotiated its $1 million contract with the Federal Highway Administration to investigate safety issues on roadways during construction seasons. IIT will continue as the prime project contractor for this project under the leadership of Professor David Arditi and Assistant Professor Zongzhi Li.
FDA Contract to Aid in Drug Development

The United States Food and Drug Administration awarded a $1.19 million contract to the National Institute for Pharmaceutical Technology and Education, a consortium of 11 leading pharmaceutical technology research universities, including IIT, to develop guidance on process design, scale-up, and validation for drug manufacturers. An active member of NIPTE since its founding in 2005, IIT is currently the only Illinois university participating in this project. IIT received funding to use computational fluid dynamics for the design and optimization of the fluidized-bed drying process with consideration for product stability. Henry R. Linden Professor of Energy Hamid Arastoopour (M.S. GE ’75, Ph.D. ’78) is the IIT researcher participating in the NIPTE project.

In November 2009, IIT was awarded a second project to develop dynamic models of bioreactors used in manufacturing biological pharmaceuticals and to build simulation software for research and education. ChBE Professor Satish Parulekar (M.S. CS ’91) is leading this project with assistance from Vice Provost for Research and Professor Ali Cinar.

IIT hosted the semiannual NIPTE Board of Directors meeting in December 2009. Cinar is a member of the NIPTE board.

uCoSM Receives Seven Grants in Past Year

The Center for Molecular Study of Condensed Soft Matter, part of IIT’s Pritzker Institute of Biomedical Science and Engineering, received seven grants since November 2008 totaling in excess of $3.1 million. The interdisciplinary center conducts research into the connection between molecular structure and macroscopic properties of condensed soft matter, both synthetic and biological, and is under the leadership of Jay Schieber, ChBE professor. www.iit.edu/ucosm

Grant to Support Modeling of Blood Clot Growth

BME Chair and Director of the Pritzker Institute of Biomedical Science and Engineering Vincent Turitto is the lead investigator on a subcontract for a project that will model the growth of complex blood clots on vascular and prosthetic surfaces. His research group will measure the kinetic parameters important in this process and correlate the behavior with mathematical models developed by the principal investigator, Professor Aaron Fogelson at the University of Utah. The project, titled “Multiscale Modeling of Platelet Deposition and Coagulation in Flow,” was awarded a four-year, $1.3 million R01 grant, and will help lead to a better understanding of thrombotic deposits that lead to heart attacks and strokes. The total costs at IIT are about $620,000 (50 percent of the grant).

Grant to Support Study of Optimal Scaffolds for Blood Vessel Growth

Georgia Papavasiliou (CHE ’96, Ph.D. ’03), assistant professor of biomedical engineering, is the recipient of a two-year, $375,000 grant from the National Institutes of Health to support the project “PEG Hydrogel-Enabling Technologies for Guiding Endothelial Cell Function.” The project focuses on computational modeling and experimental design of polyethylene glycol diacrylate hydrogels—nontoxic, water-soluble polymers used in tissue engineering—to optimize scaffold properties that enable the formation of blood vessels from cells in vitro.

Co-investigators of this project are BME Assistant Professor Eric Brey and ChBE Professor Fouad Teymour. The grant also includes a subcontract with the Chicago Association for Research and Education in Science with co-investigator Howard P. Greisler, M.D., of Loyola University Medical Center. The study will provide quantitative tools for predicting desired biomaterial outputs using a rigorous engineering as opposed to an empirical approach, and will be used to design scaffolds for rapid vascularization of engineered tissues.
**Appointments**

- **Roberto Cammino** (CHE ’95, M.S. MAE ’98, Ph.D. MAE ’01) was appointed as a lecturer in mechanical engineering. He was most recently a principal staff engineer at Motorola and MMAE adjunct professor at IIT.

- **Nancy Karuri** joined IIT as assistant professor of chemical engineering. Karuri was previously a postdoctoral fellow at Princeton University.

- **Cindy Menches** will join IIT this spring as assistant professor of civil and architectural engineering. She was most recently a CAEE assistant professor at the University of Texas at Austin.

- **Aleksandar Ostrogorsky** was appointed professor of materials and aerospace engineering. Prior to joining IIT, Ostrogorsky held a joint appointment in the Department of Materials Science and Engineering and the Department of Mechanical and Nuclear Engineering at Rensselaer Polytechnic Institute.

- **Shawn Shadden** was hired as assistant professor of mechanical and aerospace engineering. From 2006–09, he pursued doctoral research at Stanford University’s School of Medicine under a Mathematical Sciences Research Fellowship from the National Science Foundation.

**Promotions and Endowed Appointments**

- **Professor Hamid Arastoopour** (M.S. GE ’75, Ph.D. ’78) was named Henry R. Linden Professor of Energy.

- **Provost and Senior Vice President for Academic Affairs Alan Crumb, MMAE professor, was named a fellow of ASM International and appointed as an honorary member of the American Institute of Mining, Metallurgical, and Petroleum Engineers.**

- **Harris Perlstein Professor of Electrical and Computer Engineering and Director of the Electric Power and Power Electronics Center Ali Emadi was named as one of 15 “Chicago Matters” Global Visionaries who “are leading our region into the next century and putting our city on the global map.”

- **Ralph Muehleisen**, CAEE assistant professor and director of the Miller Acoustics Lab, was elected a fellow of the Acoustical Society of America.

- **Professor of Materials Engineering and Director of the Thermal Processing Technology Center Philip Nash** was named a fellow of ASM International.

- **Jai Prakash**, acting chair and professor of chemical engineering, received the 2009 Research Award from the Energy and Technology Division of the Electrochemical Society.

- **Bodine Professor and ECE Chair Mohammad Shahidehpour** received an honorary doctorate from the Polytechnic University of Bucharest in Romania.

**Awards and Honors**

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**Vijay Ramani**, assistant professor of chemical engineering, was awarded a 2009 National Science Foundation Faculty Early Career Development (CAREER) Award. Given to the country’s most promising junior faculty, the CAREER award recognizes faculty-researchers whose work supports the educational mission of their institutions. Ramani’s work focuses on fuel cell technology, specifically component durability.

Ramani has developed mitigation strategies that lower degradation rates during fuel cell operation. Further study and research, supported by the award, will allow him to develop a non-corrosive, mixed conducting material that will improve efficiency and durability by conducting both protons and electrons on its surface simultaneously. The applications of this research range from automobiles to consumer electronics.
Sammy Tin was promoted to associate professor of materials engineering with tenure.

Professor David Venerus was named Hyosung S. R. Cho Endowed Chair in Chemical and Biological Engineering.

ECE Professor Miles Wernick was named Motorola Endowed Chair Professor.

Dean Natacha DePaola was invested as the Carol and Ed Kaplan Armour College Dean of Engineering. At the October 2009 investiture ceremony, IIT Trustee Ed Kaplan (ME ’65) and his wife, Carol, [above] were recognized for their generosity and dedication to the university.

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Publications and Editorships

MMAE Professor Sudhakar Nair published a new textbook, *Introduction to Continuum Mechanics* (Cambridge University Press, 2009). The book is intended for graduate and senior undergraduate students majoring in mechanical, aerospace, civil, and chemical engineering, and applied mathematics. Nair was the recipient of the Distinguished Alumnus Award of the Department of Aerospace Engineering at the Indian Institute of Science during its Centenary Year Celebrations in May 2009.

Biomedical Engineering

**Mark Anastasio**—$157,393 from the National Science Foundation (NSF) for “CAREER: Development of Biomedical X-Ray Phase-Contrast Tomography” (2006); $97,689 from the NSF for “Novel X-Ray Imaging of Carotid Plaque Microstructure” (co-PIs Eric Brey, Miles Wernick)

**Konstantinos Arfanakis**—$388,873 from the National Institutes of Health (NIH) for “Development of a Brain Template for Diffusion-Tensor MRI” (co-PIs Gady Agam, Mark Anastasio)

**Eric Brey**—$216,732 from the NSF for “REU Site: Summer Engineering Research Experiences in Diabetes for Undergraduates” (co-PI Vincent Turitto); $63,209 from CARES for student support (co-PI Georgia Papavasiliou); $55,000 from the NIH and Wake Forest University Baptist Medical Center for “Bioengineering a Bioartificial Pancreas”

**Derek Kamper**—$59,232 from the NIH for “Mechanisms Impairing Finger Extension Following Stroke”; $53,856 from the NIH for “Development of a Hand Exoskeleton for Rehabilitation Following Stroke”

Chemical and Biological Engineering

**Hamid Arastoopour**—$101,288 from the United States Department of Energy (DOE) for “Dense Multiphase Flow Simulation: Continuum Model for Poly-Dispersed Systems” (co-PIs Dimitri Gidaspow, Matteo Strumendo); $320,029 from the DOE for “Integrated Advanced Energy Systems Research at IIT” (co-PIs Matteo Strumendo, Ken Zdunek)

**Ali Cinar**—$219,936 from the NIH for “Multivariable Closed Loop Technologies for Physically Active Young Adults with Type 1 Diabetes”

**Jai Prakash**—$88,000 from Brookhaven National Laboratory for “‘Metal Oxide Electrocatalyst’ New Acid-Stable Catalytically Active Thin-Layer and Nanoparticle Oxides with and Without Pt Deposits”; $68,008 from Argonne National Laboratory for “Thermal Studies of Li-ion Cell Electrodes and Components”

**Jay Schieber**—$260,000 from the NSF for “Determining the Relation Between Molecular Structure and Macroscopic Heat Transport in Oriented and Stressed Polymers” (co-PI David Venerus)

**David Venerus**—$50,000 from the NSF for “SGER: Flow-Induced Anisotropic Thermal Energy Transport in Elongational Flows of Polymer Liquids” (co-PI Jay Schieber)
# ARMOUR Research Awards (continued)

**Civil, Architectural, and Environmental Engineering**

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<tr>
<th>Name</th>
<th>Project Description</th>
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<tr>
<td>Zongzhi Li</td>
<td>$57,000 from University of Illinois at Chicago Urban Transportation Center for “Rapid Replacement/Construction of Bridges”</td>
<td>(co-PI Jamshid Mohammadi)</td>
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**Electrical and Computer Engineering**

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<tr>
<td>Yongyi Yang</td>
<td>$347,642 from the NIH for “A Suite of Diagnostic Aids Based on Image Retrieval”</td>
<td>(co-PI Miles Wernick)</td>
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<td>Chi Zhou</td>
<td>$140,408 from the Air Force Office of Scientific Research (AFOSR) for “Performance Analysis of Wireless Multimedia Communications Systems Under Dynamic High Interference”</td>
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**Mechanical, Materials, and Aerospace Engineering**

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<tr>
<td>Boris Pervan</td>
<td>$418,656 from the Federal Aviation Administration for “Global Navigation Satellite System (GNSS) Evolutionary Architectures for Civil Aviation”; $197,935 from I3 Communications/Electrodynamics, Inc. for “Precision GS [PGPS] Navigation for the Unmanned Combat Aerial System (UCAS)”; $127,424 from The Boeing Company for “Technology Concept Demonstration (TDC) in Support of the iGPS Program (PGPS Program/RFP) Letter”</td>
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<td>Ganesh Raman</td>
<td>$50,302 from the AFOSR for “High-Frequency Excitation for Cavity Flow Control: Combined Experiments and Linear Stability Analysis”</td>
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<td>Matthew Spenko</td>
<td>$133,000 from the Army Research Office and Massachusetts Institute of Technology for “Design and Control of Ultra-High Mobility Unmanned Ground Vehicles”</td>
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<td>David Williams</td>
<td>$134,984 from the AFOSR for “MURI Proposal”; $204,362 from the AFOSR for “Understanding the Flow Physics of Energy Extraction from Gusting Flows to Enhance Micro Air Vehicle Performance”</td>
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<td>Benxin Wu</td>
<td>$100,000 from the NSF for “Collaborative Research: Mathematical Modeling and Experimental Study of Femtosecond Laser Machining of High-Aspect Ratio Structures”</td>
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**Award Collaborations**

Armour College faculty were co-principal investigators on the following interdisciplinary research projects that were awarded $50,000 or greater last year. Some amounts are totals for separate disbursements on the same award:

- **Darsh Wasan (ChBE)**—$7 million from the United States Food and Drug Administration to Support “Cooperative Agreement to support Illinois Institute of Technology” at IIT’s National Center for Food Safety and Technology; PI is Martin Cole, outgoing NCFST director
- **Eric Brey and Vincent Turitto (BME)**—$92,025 from the NSF and the University of Illinois at Chicago for “Chicago Transformation Teacher Institutes” in IIT’s Department of Mathematics and Science Education; PI is Norman Lederman, MSED chair
- **Eric Brey (BME)**—$308,229 from the NSF for “Addressing Ethics in the Natural Course of Research: A Joint Research Course for Philosophy of Science, Engineering, and Science Graduate Students” at the IIT Center for the Study of Ethics in the Professions, PI is Vivian Weil, CSEP director
DISTINCTIVE EDUCATION:
IT TAKES A TEAM

IIT’S INTERPROFESSIONAL PROJECTS (IPRO) PROGRAM
A challenge is at hand. A medical device company has developed a novel product with the potential to change lives worldwide. After nearly two decades of engineering research and development, the product is ready for market. The important decisions the company makes now will affect the success of the product sales and, ultimately, the company itself. Has the product been tested sufficiently? Where will it be manufactured? Are consumers aware of the personal and social implications of using the product?

This is the type of real-world situation IIT’s Interprofessional Projects (IPRO) Program challenges its students to address, and specifically, the problem that Biomedical Engineering Associate Professor Phil Troyk’s IPRO students are investigating in his course, IPRO 334: Planning for Human Implantation of a Cortical Visual Prosthesis, which Troyk co-instructs with Margaret Huyck, professor of psychology.

IIT launched the IPRO Program in 1995 with the goal of teaching students relevant professional skills by exposing them to real-world team situations that they may not experience in a research setting or traditional courses. An IPRO project joins 10–15 students of a variety of majors and backgrounds to study a problem—defining its scope and determining viable paths forward on their own—along the way building and testing their teamwork, problem-solving, entrepreneurship, innovation, and communication skills. Oftentimes corporations, small businesses, community organizations, and entrepreneurs—including IIT alumni—sponsor IPRO projects, benefiting from fresh perspectives of students and their faculty instructors.

Through a choice of 40–50 unique and contemporary IPRO team projects each semester, all upper-level undergraduates fulfill their general-education requirements by completing two semester-long IPRO courses.

For many engineering students, the IPRO experience is their first brush with the reality of what it means to be an engineer.

“IPRO is the first time when we get hit with certain aspects like cost, time, and ease of manufacturing. Even though an idea may seem logical it may not be practical; even though an idea will work it may not be efficient. It seems very overwhelming at first; it is like nothing we have seen before,” says Carlos Sardi (ME, 4th year).

At the end of each semester-long course, IPRO teams present the results of their work to the greater Chicago-area community—including volunteer professionals who serve as judges, IPRO sponsors, employers, and area high school students, teachers, and counselors—at a formal IPRO Day conference. Over its 15-year history, the IPRO experience has become a signature component of undergraduate education at IIT and a required part of the curriculum, and has inspired similar programs at other universities across the country.

For Troyk, the IPRO Program is an opportunity to engage students in a study and assessment involving his own work. Since 1983, he has been leading a National Institutes of Health-funded team,
also supported by private funds, that has developed a prototype intracortical visual prosthesis. The device uses miniature electric stimulators that rest on a patient’s brain, under the skull, to produce the tiny currents needed to drive 1,024 miniature electrodes implanted in the visual cortex. The stimulators are linked wirelessly to a video camera mounted on a pair of glasses that serve as the patient’s “eyes.”

While the technology behind Troyk’s device is nuanced and highly technical—well beyond the expertise of engineering students, he says—the types of issues that his project team, who is sponsoring the IPRO, will face in taking its device to clinical deployment present students multiple avenues for investigation. This includes a study of the product’s technology, market viability, and ethical and social implications.

“We researched similar visual prosthetic devices and brain implants to understand how the IIT team’s device compares to ones that have already received FDA approval and studies in human volunteers. We are trying to offer our sponsor a critical recommendation of both its progress thus far and direction toward testing in a human volunteer,” says David Bern (BME, 3rd year).

Troyk says the IPRO Program addresses a nearly universal problem in the workplace: the smart engineer who lacks communication skills. “Few people in their careers work in isolation. Their work usually involves issues that are much more complicated than just the technology. IPRO asks students to expand their minds and to think of things that are outside of their normal thought process,” he says.

“If, as an engineer, you can’t recognize contributions from other people with different specialties, then you can’t really work productively with a team,” says Mary DeRoo (EE, 4th year), a student in Troyk’s course. “Through IPROs, students learn to figure out things outside of their major because they have to. This means later on in life, they won’t have to confront their employer and say, ‘I haven’t learned this’ or ‘this isn’t part of my job description.’”

Similarly, students in Professor Kevin Meade’s course, IPRO 309: Orthotics and Prosthetics Education for Latin America and the United States, are researching a problem whose solution is aimed at enriching the quality of life for physically challenged individuals. This project is an extension of Meade’s own work developing orthotics and prosthetic devices and teaching technicians in Latin America, specifically in the area of spine trauma and deformities.

“IPRO asks students to expand their minds and to think of things that are outside of their normal thought process.”  

Associate Professor Phil Troyk
the medical insurance the patient needs in order to get the device, understanding why there are landmines in the first place, and the social and political implications of requiring this type of device,” says Sardi, a native of Colombia, who participated in Meade’s IPRO in 2008. “We learn that there are many different faces regarding the same issue. Many further questions arise, and students therefore appreciate the larger scope of life.”

“Students can look at photos and videos of patients all they want, but when they are in a room with a kid whose leg has been amputated, the mom, and the dad, it’s a much different story,” says Meade. “The driving factor behind this IPRO project is people helping people and that we are helping to create a new career path that wasn’t there before.”

During the IPRO project course this fall, the team researched ways to make the educational program at Centro Don Bosco more fiscally sustainable while enhancing its training curricula. IPRO students developed a business model for a program that would teach CDB’s students how to fabricate custom-made-to-measure orthotics and prosthetic devices. The CDB students would learn under the watchful eyes of professionals, patients whose limbs have been amputated, and whose objectives are not always easily identified.

“The driving factor behind this IPRO project is people helping people and that we are helping to create a new career path that wasn’t there before.”

Over the course of the semester, students worked in two groups to tackle a project that involves students from a variety of different engineering majors and whose objectives are not always easily identified.

“You don’t know who you’re going to meet in the workplace, so IPRO brings that different aspect of real life to the class,” says Shahmeer Khaliqdina (EE, 4th year), referring to the mix of students in the course. “In that way, IPRO gives you a head start.”

“IPRO has helped me to articulate a project’s deliverables,” says Thomas Hotz (ME, 4th year). He adds that IPRO offers practical experience that goes beyond internships and co-ops, which are valuable but may not come with significant responsibilities. “At my internship, there were no opportunities for presentations. I know that I will be ready if I am ever called upon to sell a product at my job, because IPRO has given me an opportunity to do that.”

“In IPRO, I’m not just answering the questions professors are giving me, I’m learning how to come up with new ideas and to be a leader.”

Thomas Hotz (ME, 4th year)
the lab, enriching their understanding of engineering and rapid prototyping principles, and to develop projects for the guests to try. This semester, students studied how to make the lab more user-friendly and worked to build a matrix of sample projects that meet science and mathematics education goals as published by the State of Illinois and the National Science Foundation.

Sample projects the IPRO students have created instruct visitors on how to develop their own planetarium, a rubber-band-powered train, and integrated circuits.

“Understanding the needs of these students and their teachers requires input from multiple disciplines, not just input from engineering students,” says David Gatchell, BME senior lecturer, who teaches the course with Blake Davis (CRP ’79, M.A.S. ’92), INTM faculty member. “By gaining exposure to other disciplines, the engineering students gain insight into the strengths and weaknesses of their own preparation. They realize that other disciplines have skill sets that complement their own—skills that they want to develop for themselves.”

For some IPRO students, it is their first hands-on experience with sophisticated design-build equipment.

“Because engineering students entering the Fab Lab are not typically experts in rapid prototyping, they have to climb several learning curves. This process tends to bring the students together,” Gatchell says. “One student may have a stronger background in electronics whereas another may have more experience using AutoCAD or SolidWorks. It is fun to see groups of students forming natural collaborations to facilitate understanding of how the machines work, the capabilities of the machines, and how the machines interface with the software.”

“The machines in the Fab Lab are very useful and common at many jobs. Gaining the experience of learning how they work and using them is very helpful for a future job,” says Carl Stelcel (BME, 4th year).

By the time the students—primarily architecture, biomedical engineering, and other engineering majors—complete the IPRO, they have mastered the Fab Lab’s equipment, which gives their performance in other courses at IIT an extra boost.

“This semester alone I have over a dozen BME students who have used the Fab Lab to create mock-ups for their BME design course. This has never happened before. As a result of using the tools in the Fab Lab, their mock-ups are created faster and are more accurate than the mock-ups created in past years,” says Gatchell.

“Diagramming circuits is something that engineering students have to get used to before we feel comfortable with it. IPRO 333 gave me the opportunity to design then synthesize circuits, and the hands-on experience went a long way toward helping me gain that comfort,” says Jered Diego Linares (BME/CS, 5th year).

Beyond the practical application of engineering theory, they’re also learning through teaching—which, as Stelcel describes it, “helps students figure out what they don’t know”—and enriching the museum and its guests, something that is not lost on the students.

“The best part is probably seeing kids walk into the lab and seeing the wheels in their minds start cranking,” says Robert Boyer (BME, 4th year), who works on the team’s marketing subgroup and built an IPRO Fab Lab Wikipedia site. “Once you say, ‘Here, you can build practically anything you want!’ they start to think about everything they could build and how they would do it. It’s one thing that this IPRO really excels at; it lets your imagination flourish, for kids and grownups alike. This is really about creating your own solution, not rewriting someone else’s solution.”

For more information about IPRO, please contact Thomas M. Jacobius (MAE ’71), director of Interprofessional Studies and the IPRO Program, at 312.567.3986 or jacobius@iit.edu.

IPRO Program at IIT: http://ipro.iit.edu
Fab Lab Wikipedia site: http://en.wikipedia.org/wiki/Fab_Lab_MSI
n October 1957, the successful launch of the Soviet Union’s Sputnik satellite ushered in a new phase of the Cold War—the Space Race. Up until this date, most people in the United States believed the U.S. was the world leader in space technology, and many were alarmed that the country was falling behind the rest of the world in this area. Though Sputnik was harmless, the prospect of the Soviet Union’s ability to launch objects into space sent the U.S. into a near panic.
Less than a year after Sputnik’s launch, a group of women in Los Angeles founded the Achievement Rewards for College Scientists Foundation, Inc., a national women’s organization aimed at helping the U.S. regain supremacy in the technology race. For more than 50 years, ARCS has continued its mission to provide talented undergraduate and graduate students with selective scholarships in the natural sciences, medicine, and engineering. The organization currently has 1,600 members in 16 chapters in 13 states, and has bestowed more than $70 million in scholarships to 12,000 U.S. students.

The Chicago Chapter of ARCS was established in 1977. IIT is one of four institutions of higher learning in the Chicago area selected to participate in its scholarship program, the criteria for which includes a comprehensive evaluation that considers the strength, size, and quality of degree programs, the number of published scientific articles, test scores, research grants, and faculty membership in professional organizations at each university. Joining scholars from Loyola University of Chicago Stritch School of Medicine, Northwestern University, and the University of Chicago, IIT’s most promising students are granted $10,000 in annual support.

Sue Dindia, president of the Chicago ARCS Chapter, believes the missions of ARCS and IIT are aligned. “IIT’s strong tradition of excellence in engineering is very unique,” she says. “IIT is focused on cutting-edge research to benefit the world, making it a great partner for ARCS.”

Since 1985, 30 IIT students have received ARCS scholarships. These students have maintained a cumulative grade point average of 3.5, are engaged in high-level research, and have received the recommendations of their respective departments. This year’s IIT ARCS scholarship recipients are pursuing degrees in the mechanical and aerospace, biomedical, and chemical engineering disciplines.

IIT’s ARCS scholars agree the award is invaluable towards their graduate studies. For many, it has allowed them to concentrate their energy on research, rather than juggle research and a job. For others, it has allowed them to attend conferences and has decreased their amount of student loans. Robert Dawe, a biomedical engineering Ph.D. candidate, adds, “The ARCS scholarship has been a godsend in that it provides me with discretionary funds for a variety of expenses.”

In addition to the scholarship, ARCS recipients throughout Chicago gather annually for the ARCS Awards Luncheon. IIT President John Anderson delivered the keynote speech as the invited speaker at the 2009 Awards Luncheon. Other representatives from the university who joined Anderson in support of IIT’s honorees included Provost and Senior Vice President for Academic Affairs Alan Cramb, IIT Armour College of Engineering Dean Natacha DePaola, and the students’ faculty mentors.

The event gives students the opportunity to showcase their latest research endeavors to fellow ARCS members and other leaders in the science and engineering professions in Chicago. Marta Bastrzyk (AE/AMAT ’07, M.S. MAE ’09) welcomed the chance to share her research, noting, “I found it very useful to present my research to the ARCS members during the annual luncheon. I had to step out of the typical engineering comfort zone and present my research concepts in a clear and simple way for those not familiar with my field.”

Whether studying MRI imaging to help identify Alzheimer’s disease in patients or developing clean coal-processing technology, IIT’s ARCS scholars are poised to make a difference in society. With the help of the ARCS Foundation, they can focus their journey on research and development, and ultimately, on future success as professional engineers.

**Armour College Current ARCS Scholars**

**Richard Duncan** (AE ’05, M.S. FIN ’07, MMAE Ph.D. Candidate)

Richard Duncan is currently studying turbulent boundary layers, especially those under complex pressure gradients. In simple terms, he is interested in how moving fluids, such as water and air, interact with solid boundaries, such as pipes, buildings, planes, and boats. The studies he conducts, while very theoretical, represent idealized models of everyday applications that can
help engineers better understand the mathematics and physics of complex problems. Duncan hopes to produce a data set beyond the capabilities of those at other research facilities, to have a great impact on simulations and modeling in the aerospace, meteorology, and biological fields. He adds that in many of these fields, even a relatively small improvement in the accuracy of computer simulations can produce large gains in efficiency and predictability.

Robert Dawe
(BME '06, BME Ph.D. Candidate)

Robert Dawe has a personal connection to his research, having two grandparents who suffer from neurodegenerative diseases. He is focusing on early, non-invasive detection of Alzheimer’s disease using new MRI techniques. Dawe hopes to understand the ways in which Alzheimer’s pathology affects the diffusion of water molecules within specific pathways of the brain. This work could provide researchers with biomarkers of Alzheimer’s disease, allowing doctors to identify the pathology at an early and potentially treatable phase. Dawe hopes to work in a hospital, where he can bring the latest MRI technology to patients while continuing his research.

Michael Walker
(ChBE Ph.D. Candidate)

Michael Walker’s research focuses on the analysis of gasification-based power and chemical-production systems. This includes applications such as flexible-feed systems, flexible product generation, clean coal technologies, hot gas cleanup, and process integration. He uses computer-aided design techniques to create models and perform analysis on commercially available process-simulation software. His work aims to provide accurate, predictive, non-processor-intensive models of advanced gasification-based power and chemical plants. These models can be used to aid in process development, operational streamlining, and economic analysis. Walker hopes his research will promote clean coal-processing technology to reduce power plant emissions.

The Sky is the Limit

M arta Bastrzyk (AE/AMAT ’07, M.S. MAE ’09) graduated from IIT with the goal of finding a position in which she could contribute to groundbreaking research in the aerospace engineering field. Just a few months later, she finds herself employed by the University of Akron as a senior research associate working at the NASA Glenn Research Center. She’s applying the research skills she obtained working with MMAE Associate Professor Ganesh Raman to her current project, the “Development of a Low-Impact Docking System Main Interface Seal.” Bastrzyk is working with a team of researchers to test and develop seals that are responsible for ensuring astronaut safety by keeping breathable air inside a spacecraft and preventing it from escaping to the space vacuum.

Bastrzyk is one of many Armour College alumni who have benefited from undergraduate research. During her second year at IIT, Raman recruited her to work in his lab, providing her the opportunity to work on a variety of projects in different areas within aerospace engineering. Bastrzyk chose to continue her studies at IIT after earning her undergraduate degree because of her interest in Raman’s research area and her positive experiences within the MMAE department.

In the coming years, Bastrzyk sees herself as a researcher overseeing a team of scientists and engineers working to advance aircraft and spacecraft technologies.

Track Injury Leads to a Career in Rehabilitation Technology

In high school, Kristen Triandafilou (EE ’04, M.A.S BMI ’09) suffered a knee injury at a track meet that sent her to physical therapy for several weeks. The experience inspired her interest in rehabilitation research and medicine. Now, Triandafilou is combining her interests with her education while working at the Rehabilitation Institute of Chicago as a research engineer in BME Assistant Professor Derek Kamper’s Hand Rehabilitation Laboratory. She played an active role in research there while pursuing her master’s degree in biomedical imaging and signals in the ECE department, working on projects involving the mechanisms associated with hand impairment following stroke. Specific areas of her research include investigation of upper-extremity weakness following stroke through the quantification of muscle atrophy using ultrasonography to directly measure the size of the muscles controlling the index finger.

Her experiences at RIC have introduced Triandafilou to the life-changing effect that hard-working scientists and engineers can have on stroke survivors. She hopes to dedicate her career to neural engineering research toward the advancement of knowledge, treatments, and ultimately, cure of disorders and diseases pertaining to the central nervous system.

Triandafilou has a sincere desire to help both the individuals benefiting from her research and the next generation of engineers. She says, “I plan on mentoring young individuals interested in neural engineering research. I hope to share my experiences and expertise with the upcoming generation to preserve and promote the advancement of scientific knowledge in neuroscience and neuroengineering.”

Past Armour ARCS Scholars
Continue to Excel

ARCS Chicago:  www.arcsfoundation.org/Chicago
NASA Glenn Research Center:  www.nasa.gov/centers/glenn/home/index.html
Rehabilitation Institute of Chicago: www.ric.org
There are many things that make IIT unique, such as a campus designed by an architectural genius and a breathtaking view of downtown Chicago. A special part of the university’s research landscape is the innovative work being conducted in the area of biomedical engineering, despite the absence of a university medical center. Leading the way in breakthroughs in the field are IIT Armour College of Engineering faculty members conducting research as part of the interdisciplinary Pritzker Institute of Biomedical Science and Engineering. Through five research centers under the umbrella of the institute, advancements in breast and prostate cancer screening, Alzheimer’s disease research, brain mapping, diabetes modeling, and tissue engineering are executed on IIT’s Main Campus in collaboration with top medical research centers.
The Pritzker Institute was founded in 1982 through the generosity of Robert A. Pritzker (IE ’46, Hon. Ph.D. ENG ’84), an IIT trustee and university regent. At the time, Pritzker had the foresight to recognize the importance of biomedical engineering well before it became a major research focus at United States universities.

The institute has grown significantly since 2001, the year Vincent Turitto assumed leadership as its director. At the time, relatively few IIT faculty members were engaged in biomedical research. Turitto says, “I had three goals when I joined IIT: expand the foundation of the Pritzker Institute, build strong relationships with leading medical centers in the Chicago area, and get more IIT faculty involved in biomedical research.”

Tasked with growing the institute and its reputation, IIT secured $2 million in grants from the Whitaker Foundation and $1 million in private donations to help establish a new Department of Biomedical Engineering. “The money enabled the department to hire eight faculty members over the course of four years and to begin offering undergraduate and graduate programs in 2003. There are now 10 tenure-track faculty members in the department, six of whom have achieved the rank of associate professor. More than 170 students, including 33 Ph.D. candidates, are currently enrolled in the program, which is accredited by the Engineering Accreditation Commission of the Accreditation Board for Engineering and Technology (ABET).”

With the growth of the BME department came the expansion of the Pritzker Institute. Its five centers, involving 25 IIT faculty members as part of their core research groups—Medical Imaging Research Center, Engineering Center for Diabetes Research and Education, Center for Integrative Neuroscience and Neuroengineering Research, Center for Molecular Study of Condensed Soft Matter, and the Biophysics Collaborative Access Team—started the year with a collective annual research budget of $6.4 million. Researchers within each center partner with organizations such as the University of Chicago Medical Center, Rush University Medical Center, Rehabilitation Institute of Chicago, and Argonne National Laboratory to conduct work related to their field.

“The centers within the Pritzker Institute receive significant funding from external sources to help support high-level research,” adds Turitto. These sources include the National Institutes of Health, the National Science Foundation, various other government agencies, and other private entities. “This funding helps to provide financial packages to top graduate and postdoctoral students interested in biomedical research,” he adds.

One example of a center that reflects the successful activities at the Pritzker Institute is the Medical Imaging Research Center. Medical imaging is a discipline of great importance in biomedical engineering. Over the past 50 years, medical imaging has grown from simple X-ray technology to mature techniques that are changing the way doctors diagnose diseases. The field has expanded from radiological X-ray images of dense bone to include complex techniques that are able to produce images of brain function. Medical interpretations that were once based solely on specialized knowledge are now supported by vast databases of information. Sophisticated imaging technology allows specialists to examine organs and other functions within the body to pinpoint abnormalities that would not otherwise be visible without surgery.

MIRC represents IIT’s expertise in the medical imaging field. The center, directed by Motorola Endowed Chair Professor Miles Wernick and housed in the state-of-the-art University Technology Park at IIT, is receiving peer recognition and noteworthy funding for its research. The center’s faculty recently secured $6.3 million in grants to support research in X-ray imaging, photoacoustic imaging, computer-aided diagnosis, diagnostic accuracy assessment, and a new effort with the Chicago Police Department to predict crime. The center seeks to develop new imaging modalities and techniques for the acquisition, processing, and analysis of medical images to advance research and diagnoses for brain disorders, heart conditions, cancer, and other conditions.

To say medical imaging has revolutionized the health care industry would be an understatement. Before these technological advances, invasive, exploratory surgeries were required to determine an ailment in the body that traditional imaging could not reveal. Today, a patient can undergo an MRI, for example, allowing doctors to locate cancers clearly within the brain. As the developments in medical imaging have progressed, doctors can rely on diagnostic software programs and comparative image...
to gain experience in medical environment for IIT students members provides an ideal conducted by MIRC faculty MRI technology. Advancements in tomography for nuclear of diffusion-tensor MRI for tractography. Yetik is developing an cardiology and cardiac imaging techniques Alzheimer's disease, development of an X-ray imaging and photoacoustic imaging. Anastasio (EE '92) and Konstantinos Arfanakis, and ECE assistant professors Jovan Brankov (M.S. EE '99, Ph.D. '02) and Imam Samil Yetik. The group's credentials speak for themselves: one NSF CAREER Award, three Sigma Xi Awards for Excellence in Research, hundreds of publications, conference presentations, and invited lectures. The six faculty members collaborate with researchers around the globe to pursue advancements in medical imaging technology.

In addition to the recently funded projects highlighted on page 4, MIRC researchers are engaged in a multitude of subject areas. Wernick's most recent endeavors focus on advancements in mammography and cardiac imaging. Yang is developing diagnostic software and techniques for finding deadly plaques in coronary arteries. Tomography is at the center of Anastasio's research, most recently in the area of phase-contrast X-ray imaging and photoacoustic imaging. Arfanakis' latest projects concentrate on MRI techniques for early diagnosis of Alzheimer's disease, development of an atlas of the human brain, and optimization of diffusion-tensor MRI for tractography. Advancements in tomography for nuclear cardiology and cardiac imaging techniques are at the core of Brankov's current research projects. Yetik is developing an approach to imaging prostate cancer using MRI technology.

The breadth of research conducted by MIRC faculty members provides an ideal environment for IIT students to gain experience in medical imaging. Arfanakis is the advisor for Robert Dawe (BME '06), a BME Ph.D. candidate. Dawe says that his coursework has provided him with a broad, solid foundation for understanding biomedical engineering concepts; however, the laboratory experience he has gained from working with Arfanakis has been the conduit to his goals. Dawe says, “In a given month, I may scan postmortem human brain specimens in a clinical MRI scanner, process the images to obtain data relevant to what we are studying, and present the findings at an MRI or medical imaging conference.”

Through the outstanding research of faculty involved in MIRC and the other centers affiliated with the Pritzker Institute, Turitto says, the institute is well positioned to significantly increase its research budget and expand the scope of its activities in 2010. The total amount of funding to faculty in the Pritzker Institute that is anticipated for grants that were awarded in 2009 or were in their first year in 2009 is in excess of $17 million. IIT faculty and students at the Pritzker Institute will further impact advancements in biomedical research, making significant contributions to the way doctors detect, diagnose, treat, and eventually, cure patients with diseases or abnormalities.

BioCAT Joins Pritzker Institute

The Biophysics Collaborative Access Team (BioCAT) is the latest research group to join the Pritzker Institute. The center is an X-ray facility located at the Advanced Photon Source at Argonne National Laboratory. Funded by the NIH, the group studies the structure and dynamics of partially ordered biological systems of biomedical importance. BioCAT is also a part of the Center for Synchrotron Radiation Research and Instrumentation; Thomas C. Irving, professor of biology and physics, directs the operations of both centers.

For more information, visit www.bio.aps.anl.gov.
CLEAN COAL TECHNOLOGY AT
WISER

Coal-fired power plants generate 50 percent of the electricity used in the United States, but they are also one of the primary sources of CO₂ emissions. From 2007 to 2008, CO₂ emissions jumped by 671 million tons worldwide, according to the U.S. Department of Energy’s Oak Ridge National Laboratory. Coal-fired plants are also the largest source of mercury pollution globally.
Coal won't disappear from the energy mix anytime soon—indeed, the DOE refers to coal as “one of the true measures of the energy strength of the United States.” While CO₂ emissions have slowed slightly in the past year, a trend during times of a recession, they are expected to continue to increase globally alongside a growing population and energy demand.

The United States has taken steps to reduce CO₂ emissions from coal-fired plants stateside. In October 2009, the Environmental Protection Agency announced that it will establish new limits on the emission of dangerous byproducts from coal-fired plants by November 2011. This marks a shift in policy established by the 1990 Clean Air Act, which set limits on the amount of toxic materials that entities could emit into the air but did not subject power plants to those rules.

Clean coal technology—and its necessary role in power generation as defined by the American Recovery and Reinvestment Act—will help to drive a clean energy future. Such innovations as gasification-based power-generation plants, and CO₂ separation and sequestration, are among the leading contenders for power generation in projects such as FutureGen, a public/private collaboration to design, build, and operate the world’s first coal-fired, near-zero-emission power plant. Compared to coal combustion-based power plants, for example, the gasification-combined cycle processes have higher plant efficiencies. The gasification processes are capable of using various feedstocks, such as coal, residues from refineries and petrochemical plants, and biomass. In short, they are more versatile, efficient, and cleaner alternatives.

Clean coal technology is one of the key focus areas of research at IIT’s Wanger Institute for Sustainable Energy Research. Several projects are currently underway, addressing the efficient and advanced design of coal and solid waste gasification and CO₂ separation processes, hot gas cleaning including desulfurization, and mercury remediation.

WISER Director and Henry R. Linden Professor of Energy Hamid Arastoopour (M.S. GE ’75, Ph.D. ’78) and Distinguished Professor Dimitri Gidaspow (Ph.D. GT ’62) are pioneers in the advanced design of gasification processes from the laboratory and pilot level to the commercial level.

Using kinetic theory, Arastoopour has developed a theory and model for the flow of multi-sized particles that is being used in the design of processes for coal gasification and separation of hydrogen from CO₂. His research is being incorporated in the DOE’s MFIX (Multiphase Flow with Interphase eXchanges) computer program.

His research is also leading to a new approach for predicting particle size distribution variation in the fluid/particle and fluidized-bed processes due to particle reaction, agglomeration, and breakage by linking population balance equations with CFD. His approach includes using the method of moments in a finite-sized distribution. It is a major yet fundamental step in enhancing the design and simulation of fluid/particle systems such as gas separation and coal gasification.

For Gidaspow, coal cleanup is happening on a small scale, figuratively. He has been using a different concept for the production of electricity from coal using molten carbonate fuel cells. This involves feeding fine coal particles, such as nanoparticles, with steam into the anode compartment of the fuel cell in which...
the waste heat from the fuel cell is used to produce synthetic gas, which reacts electrochemically. Gidaspow has developed a CFD model for the gasifier fuel cell.

In FutureGen, the heat for the gasification reaction is obtained from additional combustion of coal with oxygen. Since molten carbonate and solid electrolyte fuel cells produce more than sufficient heat for coal gasification, Gidaspow has developed a concept to combine the endothermic gasifier and the exothermic fuel cell into one unit to ideally achieve 100 percent efficiency. In this concept the product will be nearly pure CO₂. The water needed for gasification will be recycled, and the impurities in the coal will be removed from the CO₂ stream and from the electrolyte through recycling.

Gas Technology Institute Associate Professor Javad Abbasian (M.S. GE ’78, Ph.D. ’86) is conducting research directed toward the development of high-temperature regenerable sorbents for removal of pollutants and greenhouse gases from advanced power processes, as well as improving and optimizing gasification-based processes. Abbasian’s team at IIT has succeeded in developing a number of highly reactive, durable, and attrition-resistant sorbents to remove H₂S, SO₂, NOₓ, and CO₂ from gas streams at high temperatures, essentially eliminating solid wastes and the energy penalty associated with low-temperature processes. The economics of the advanced gasification-based processes can significantly improve with utilization of these sorbents and the selection of the optimum process configuration and operating conditions predicted by the simulation models.

Industry is already benefiting from one IIT study that shows coal has a way to go before it passes the white-glove test. Associate Professor of Mechanical and Aerospace Engineering Herek Clack is researching how to remove mercury emissions from coal-burning processes and developing more reliable emission-control systems. He leads the Advanced Thermal and Environmental Systems Research Laboratory, which focuses on mass transfer associated with pre- and post-combustion phenomena. As a member of the United Nations Environment Programme’s Global Mercury Partnership, which aims to reduce global mercury emissions, Clack is helping to distribute best practices that can be implemented by plants worldwide.

The leading practice for reducing mercury emissions is to inject a powdered adsorbing material into the flue gases just before the emissions enter an electrostatic precipitator, where coal ash particles are charged and extracted from the flue gas using an electric field. While ESPs can process large volumes of gas efficiently, Clack’s review of DOE data on the effectiveness of ESPs—which involved a first-of-its-kind computer model of mercury capture by suspended particles—found that the amount of mercury removal was exaggerated. The reason: powders injected at increasing levels coagulate, rendering them less effective at filtering out the mercury, something that industry experts have suspected but not verified in large-scale tests. Using a laser-light extinction technique to detect coagulation, Clack’s team verified the onset of coagulation in his research lab.

Clean coal is just one part of the country’s energy future. IIT’s Wanger Institute for Sustainable Energy Research was founded in 2007 to unite energy and sustainability research activities at the university under one multidisciplinary umbrella. Involving more than 40 faculty-researchers, WISER activities are divided into three primary areas:

**Energy production**
- Clean coal technology
- Production of methane from hydrates and unconventional sources
- Biofuels
- Renewable energy (solar, hydrogen storage, wind, fuel cells, and batteries)

**Energy Efficiency, Conservation, and Sustainability**
- Hybrid systems
- Sustainable built environments (integrated photovoltaics and wind)
- Innovative recycling solutions

**Power**
- Installing a Perfect Power System on IIT’s Main Campus, a smart grid project
- Enhancing power market operations with coordinated wind/hydro/gas energy
- Small hydroelectric

WISER: www.iit.edu/wiser
ATESR Lab: www.mmae.iit.edu/atesr_lab
More than 60 years ago, Ben Loper (CHE ’50) took his first steps onto IIT’s campus to pursue his bachelor’s degree in chemical engineering. This past August, his grandson, Michael Keane, took those same steps in pursuit of his own bachelor’s degree in aerospace engineering.

Both Ben and Michael’s interests in engineering flourished at a young age. Ben excelled in chemistry and physics in high school, fueling his desire to study chemical engineering. He attended Mississippi State College for a year before enlisting in the Army Air Corps to fight in World War II. After returning from the Southwest Pacific, he enrolled at IIT and briefly considered switching to aeronautical engineering but decided to remain with chemical engineering.

Always fascinated by airplanes, aerospace engineering is a natural fit for Michael. “Ever since I was a little kid, flying has always fascinated me,” he explains. “Aerospace engineering is the perfect major for me. It goes into a depth about aircrafts that, right now, I can only imagine.”

Michael, a licensed pilot, also shares his grandfather’s aspiration to serve his country and hopes to be a pilot or engineer in the United States Air Force. He is attending IIT through an Air Force ROTC scholarship, and was attracted to the university because of its large ROTC detachment. He was already well aware of the school through conversations with Ben. “My grandfather mentioned going to IIT quite a few times. Whenever he would talk about getting an education, he said he was quite fortunate to receive an education from a school like IIT,” he adds. “I knew that for the major I was looking at doing, IIT would be one of the best colleges where I could receive my degree.”

Ben is thrilled his grandson is attending his alma mater. “When I learned Michael was accepted and intended on enrolling at IIT, I was ecstatic. He knows that the school will be tough, but his dedication to learning and the help he gets at IIT should enable him to succeed,” Ben says.

Long retired, Ben still fondly remembers many of his teachers from IIT, especially those who sparked his interests in oil refinery processes and heterogeneous catalysts. After graduating in May 1950, Ben accepted a position with American Cyanamid. He started out in research, was promoted to plant operations and plant engineering, and then to technical service in the company’s refinery chemicals group. As his career continued with American Cyanamid, he held various high-level positions, including assistant general manager of the plastics division, president of Cyanamid Canada, president of the organic and inorganic divisions, and president of the international divisions. As president international, he was responsible for one-half of Cyanamid’s sales and manufacturing. He adds with a smile, “I was very fortunate with the company.”

Since retiring, Ben has remained an active IIT alumnus. He served on the Department of Chemical and Biological Engineering’s Industrial Advisory Board, and has met all of the IIT presidents since Henry Heald. On a recent visit to campus to visit his grandson, he added President John Anderson to his list. Ben’s pride in his university and the education he received at IIT is evident.

Michael’s alumni story is yet to be written, but if he’s anything like his grandfather, he’ll soon become another proud IIT graduate.

Air Force ROTC at IIT: www.iit.edu/~recruiting
As a young girl growing up on the South Side of Chicago in the 1970s, Sherita Ceasar (ME ’81, M.S. ’84) dreamed of achieving the most out of life. Her early interest in mathematics and science, and a knack for problem solving, led Ceasar to IIT to pursue a degree in mechanical engineering. Today, the determined girl from 38th and Wells sits near the pinnacle of corporate success as vice president of product engineering, cross platform applications, and engineering services for Comcast Cable, Inc.

Ceasar is no stranger to adversity. She is the eldest sister to four brothers, and gained a tremendous work ethic by helping her working mother with the household. At home, Ceasar loved to fix things; at school, she loved math and science, soaking up every opportunity to learn. A schoolteacher once called her a “smart mouth,” a term she concluded meant that being different was cool.

Her enthusiasm and motivation as a student made her instantly stand out, so much so that an IIT representative at a college fair determined her to be an excellent fit for the university’s Early IDentification Program (EID Program). The program was designed in the 1970s to attract minorities to the disciplines by engaging them in projects focused on skills development, education, and practical applications of engineering fundamentals. Ceasar excelled in the program and scored the second highest in the mechanical aptitude exam, prompting her to enroll at IIT and major in mechanical engineering. The summer before her first year at the university, she participated in her first corporate internship with General Electric as a direct result of her performance in a mock interview through the program.

Once on campus, Ceasar found herself within an immediate community of African-American students, many of whom also participated in the EID Program. She remembers, “It was a great experience as we had come to know each other over several summers, making it easy to get into the campus life.” Ceasar continues, “The experience was very welcoming because the current African-American students became our big brothers and sisters to help us navigate within IIT.”

In her last semester as an undergraduate, Ceasar applied for and received the Graduate Engineering Minorities Scholarship, which allowed her to choose between three colleges for graduate studies. After receiving encouragement from then mechanical engineering professor Lois Graham (M.S. ME ’49, Ph.D. ’59), Ceasar decided to stay at IIT to pursue her M.S. degree. Graham became her thesis advisor. “At a time when one of her sex and color was rare in any engineering program, Sherita had her mother’s inspiration and support to succeed to a level and in an area new to her family,” says Graham.

While earning her degree, Ceasar worked part-time as a mechanical technician at IIT Research Institute and gained full-time employment there after completing her master’s degree. The experience proved invaluable to her, exposing Ceasar to engineering mentors who helped make theoretical problems taught in the classroom more realistic by allowing her to put them to practical use. “The lessons learned at the research institute gave me insights about delivering results when promised, navigating in a corporate culture, and the importance of having a mentor,” she says.

In 1988, Ceasar joined Motorola, Inc. as a staff engineer and quickly rose through the ranks, eventually becoming director of manufacturing for the North America Subscriber Paging Division in the Paging Products Group of the company. At the time, she was the highest-ranking African-American female engineer out of 10,000 associates worldwide in the company’s paging group. Ceasar was part of the leadership team that led the division’s increase in revenue from $400 million to $3 billion in four years in executive roles in quality and manufacturing.

Ceasar left Motorola in 1996 to assume the position of vice president of quality and then vice president and general manager of SciCare Broadband.
Services of Scientific-Atlanta, Inc. There, she expanded her already stellar résumé with the responsibilities of new product development, manufacturing operations, quality assurance, and service business management. She left the company in 2004 to join Charter Communications, Inc. as vice president and general manager for the state of Georgia.

Now, Ceasar sits at the near top of the telecommunications industry as a vice president at Comcast Cable, Inc. Her duties include the design, implementation, and deployment of cross-platform applications; and the development, implementation, and support of engineering analysis, product trial and evaluations, product security, engineering development tools, and engineering product lifecycle processes requirements for PE video, data, voice, and cross-platform products supporting Comcast markets. The company has more than 24 million cable subscribers, making it the largest cable company in the United States.

As a direct result of her management skills, business savvy, and technical prowess, Ceasar often appears on the lists of top leaders in the telecommunications industry, especially those recognizing women and minorities. “It gives me great pleasure to see Sherita’s accomplishments, and I am glad to have had the opportunity of working with her,” reflects Graham. “Sherita is a hard worker and richly deserves the recognition she has been given.”

Her path to success hasn’t always been easy. Throughout her career, Ceasar says, she has faced stereotyping, gender discrimination, and racism, but has learned quickly to diffuse it with humor and education. Her commitment to providing Comcast’s customers with the best products possible drives her to strive for excellence each day.

She is also actively involved at IIT. Ceasar is a member of the Board of Trustees and a member of the IIT Alumni Relations Board of Directors. For the past five years, she has served on the Advisory Board for the Department of Mechanical, Materials, and Aerospace Engineering. In this role, she collaborates with other engineering leaders to contribute to the strategic planning for the growth and success of the department. She welcomes the opportunity to help with the direction of the department, remarking, “I am very proud of the mechanical engineering department at IIT. I enjoy staying engaged with the department and knowing my contributions are making a difference.”

Jamal Yagoobi, chair of the MMAE department, adds, “Sherita is an extremely valuable member of MMAE’s Advisory Board, taking her responsibility seriously and always contributing keen industry insight and constructive input toward the growth of the department.”

Despite her busy schedule, Ceasar makes time to contribute to nonprofit organizations dedicated to advancing women in technology. She is a past president and senior life member of the Society of Women Engineers. Additionally, Ceasar is on the board of Women in Cable and Telecommunications, driving an initiative called Tech It Out. The program was developed to build awareness of the gaps between men and women employed in cable technology professions, to promote the cable technology profession and its opportunities, and to help empower women to enter these professions. Ceasar comments, “I’m very passionate about increasing the number of women in technical careers.”

Her advice to women seeking a career in engineering: focus on delivering results, find a mentor to help navigate the company’s culture, and build relationships within and outside your team to build a network for assistance and guidance. “If you are passionate, all of the opportunities will come to you,” she adds.

Ceasar is driven by solving tough problems and accomplishing results. She has grown from a child who enjoyed fixing things to a well-respected businesswoman bestowed with numerous professional accolades. Yet, she considers one thing to be her greatest motivation. She says, “I know that the things I do affect the lives of many. At the end of the day, I know I’ve made a difference.”

Sherita Ceasar biography, Women in Technology International Hall of Fame:
IIT MMAE department: www.iit.edu/engineering/mmae
Comcast: www.comcast.com
Selig and his wife, Rae, recently made the generous gift of $105,000 to establish an endowed fellowship to help current and future students in the Department of Civil, Architectural, and Environmental Engineering achieve their highest career aspirations.

Selig came to IIT after earning his bachelor’s degree in mechanical engineering from Cornell University, in a five-year program that emphasized mechanics, industrial engineering, and business. He was attracted to IIT’s graduate programs because of the opportunity to combine engineering practices with coursework through IITRI. He adds, “Having IIT in the center of Chicago has the added advantage of being able to meet with experienced professional engineers working at the highest levels in the major firms of the world.”

While Selig intended to pursue a master’s in applied mechanics, his career took a different path after he arrived on campus. Keith McKee (CE ’50, M.S. ’56, Ph.D. ’62), Selig’s supervisor at IITRI and current director of IIT’s Industrial Technology and Management Program, approached him with a new challenge: become an expert in soil mechanics. McKee indicated that IITRI needed someone with this capability to meet the requirements of its research sponsors. He proceeded to give Selig a pile of books and instructed him to see what he could learn.

“The primary focus of the research being done in our group when Dr. Selig arrived was the behavior of structures under dynamic loads; to be more specific, how buildings were affected by a nuclear explosion,” adds McKee. “Soil mechanics was a significant part of this group’s research for two reasons. First, many of the structures of interest were buried in the ground, and second, for above-ground structures, foundation failure was a major challenge.”

As Selig’s interest in the subject area grew, he approached former IIT professor Eban Vey about switching his major to civil engineering to continue his studies in soil dynamics. Selig remembers, “This turned out to be a good decision all around. My career was very rewarding and exciting, and took me in different directions, each step of the way providing new interests.”

The opportunities presented to Selig while working at IITRI during his studies and early in his career as manager of soil mechanics research gave him the best possible classroom to develop his skills. On a visit to NASA, he learned the agency was concerned about what kind of landing conditions spacecrafts would encounter on the Moon. Selig asked if NASA would like the researchers at IITRI to look into the question, leading to Selig’s important contributions to the United States’ mission to land on the Moon. He was responsible for laboratory tests that created simulated moon dust and atmosphere in a replicated space chamber to conduct penetration and weight-bearing experiments. This was the first research conducted on the subject and was critical to the development of a lunar-landing module. Selig’s work helped determine how much weight could be supported upon landing on the Moon.

Back on Earth, Selig also made contributions to Chicago’s skyline, helping to pinpoint problems with the John Hancock Center’s foundation during construction. Developers of the sixth-tallest building in the United States had experienced shifting within the foundation below ground. Selig and his fellow IITRI
Selig was also heavily involved in professional organizations. In addition to those mentioned above, he was active in the American Railway Engineering and Maintenance-of-Way Association, the International Committee for Railway Geotechnology, and the International Society of Soil Mechanics and Foundation Engineering. In many of these groups, Selig served in leadership roles such as division or committee chairman and editorial board member.

Throughout his career, Selig received great recognition from his peers for his contributions to the geotechnical engineering profession. He is a fellow of the American Society of Civil Engineers and the American Society for Testing and Materials, and an emeritus member of the Transportation Research Board committees on railroads and pipelines. Selig is also the recipient of many national professional awards, including the Stephen D. Bechtel Pipeline Engineering Award, the Award of Special Merit from the American Concrete Pipe Association, the James L. Tighe Civil Engineering Distinguished Teaching Award, the Charles B. Dudley Medal Award from ASTM, and the Corrugated Polyethylene Pipe Association Award.

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Sidney Guralnick, IIT Perlstein Distinguished Professor of Engineering Emeritus in the CAEE department and Selig’s colleague at IITRI, asserts, “Dr. Selig has always impressed me as a dedicated research worker, and as a most congenial and friendly colleague. His research has won him many honors and accolades, and I am proud to call him a friend.”

Regarding the gift that Selig and his wife made to support an endowed fellowship in IIT Armour College of Engineering, Selig adds, “I’ve had a very successful career, and IIT and IITRI had a major role in this achievement. I felt that some of this benefit could be returned by the support of current students through this gift.”

The fellowship will provide support to one CAEE graduate student each year who is interested in soil mechanics, geotechnical engineering, transportation, or structural engineering. Selig hopes the recipients will also become involved in professional societies, travel to conferences, and involve themselves in interdisciplinary activities. These were opportunities Selig was able to partake in during his graduate studies, and he believes they helped him tremendously as he started his career.

“The growth of the CAEE department in the past five years has prompted a need for additional resources,” remarks Jamshid Mohammadi, CAEE chair. “Dr. Selig’s generous gift was welcome news and certainly arrived at the right time to help us meet our needs in educational objectives. The CAEE faculty and students are fortunate to benefit from this gift, and would like to express their gratitude to Dr. and Mrs. Selig for their generosity.”

Selig is a firm believer in professional experiences to help mold a career. Now, through his and his wife’s kindness, CAEE students will have the chance to seek similar opportunities to further benefit their education.

IIT Research Institute: www.iitri.org
IIT CAEE department: www.iit.edu/engineering/cae
Zalman Lavan
Zalman Lavan (M.S. ME ’62, Ph.D. ’65), who served on the IIT faculty from 1965–1991, was MMAE professor emeritus and a pioneer in the fields of heat and mass transfer, solar energy, and computational fluid dynamics. He earned international recognition for his work in alternative energy sources and held multiple United States patents for his groundbreaking research.

During his time with MMAE, he supervised a multitude of master’s and Ph.D. dissertations, was a member of several professional societies, and consulted for many energy companies throughout the country. In 1976, Lavan and a small team of his students won the top prize in an international university competition on alternative energy in Albuquerque, N.M., beating out 37 entries including those of Massachusetts Institute of Technology, the University of California Berkeley, and other major institutions, with a groundbreaking prototype for efficient solar energy conversion. With the global energy crisis of the 1970s, he was a sought-after, dynamic speaker throughout the world, firmly at the forefront of finding new solutions for alternative energy sources.

Henry R. Linden
Henry R. Linden (Ph.D. CHE ’52) was an icon at IIT and a global authority in energy research and policy. An IIT faculty member since 1954, Linden most recently was the Max McGraw Professor of Energy and Power Engineering and Management, director of the IIT Energy + Power Center, and a member of the advisory boards for IIT’s Wanger Institute for Sustainable Energy Research and Department of Chemical and Biological Engineering.

Linden served the Institute of Gas Technology in various management capacities for 30 years, including 17 years as director and four years as president and trustee. He was instrumental in establishing the Gas Research Institute, the United States natural gas industry’s cooperative research and development arm, and served as its first president and member of the board of directors from 1977–1987. In 2000, IGT and GRI merged to form the Gas Technology Institute.

After retiring from GRI, he turned his energy and attention to establishing a comprehensive research and education program in sustainable global energy development at IIT. As interim president of IIT from 1989–1990, Linden oversaw a year of important developments, including an $8 million grant from the Robert R. McCormick Tribune Foundation to upgrade...
the residential and athletic facilities of the university and to begin work on the university's Downtown Campus.

Linden was a member of the National Academy of Engineering and a fellow of the American Association for the Advancement of Science, the American Institute of Chemical Engineers, and the Institute of Energy. He served on several federal advisory bodies dealing with energy policy, technology, and regulation, beginning with the Kennedy administration, and held a presidential appointment during the Ford administration. An author or co-author of more than 240 publications and 27 patents, he wrote and lectured extensively on U.S. and world energy issues throughout his lifetime. In 2008, AIChE named him to its One Hundred Engineers of the Modern Era list in celebration of the organization’s centennial anniversary.

John T. Rettaliata

John T. Rettaliata was IIT’s second president following the merger of Armour Institute of Technology and Lewis Institute, and oversaw the greatest growth period in the history of the university. Rettaliata served as president of IIT between 1952-1973, during which time Main Campus was built, Chicago-Kent College of Law was added, and Stuart School of Business was founded. During his tenure, IIT grew to be the biggest engineering school in the United States, a period IIT historians refer to as a “golden age” for the university.

Before joining IIT, Rettaliata, a fluid dynamicist, was employed by Allis-Chalmers, where he worked building steam turbines for military destroyers, earning a position on the United States National Advisory Council’s subcommittee on aeronautics gas turbines. He worked during and after World War II in consultation with the U.S. Navy and Air Force on gas turbines and other projects.

While president of IIT, Rettaliata held a seat on the National Advisory Council on Aeronautics, and then was appointed by President Dwight D. Eisenhower to the National Aeronautics and Space Council, the planning body of the newly formed National Aeronautics and Space Administration. Attending bi-monthly meetings in the White House cabinet room, Rettaliata and the other council members drew up plans for what would be the United States space program.
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If you know a talented prospective first-year or transfer undergraduate engineering student, please email or call Jerry Doyle, vice provost for undergraduate enrollment and financial aid (doyle@iit.edu, 312.567.5203). The student will receive a letter indicating that you referred him/her, along with our viewbook about the undergraduate programs at Armour. We will also send the student, free of charge, a copy of “Engineering: Go for It!” an informative 64-page guide to a career in engineering and technology published by the American Society for Engineering Education for high school students, their parents, and their guidance counselors.

ALUMNI SCHOLARSHIP APPLICATION
Children and grandchildren of alumni, and siblings of currently enrolled students at IIT are eligible to apply for the Alumni Undergraduate Scholarship (awards range from $1,000–$2,500). For more information, please contact Jill Sifuentes, associate director for undergraduate enrollment and recruitment, at sifuentes@iit.edu.

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http://iit.edu/undergrad_admission