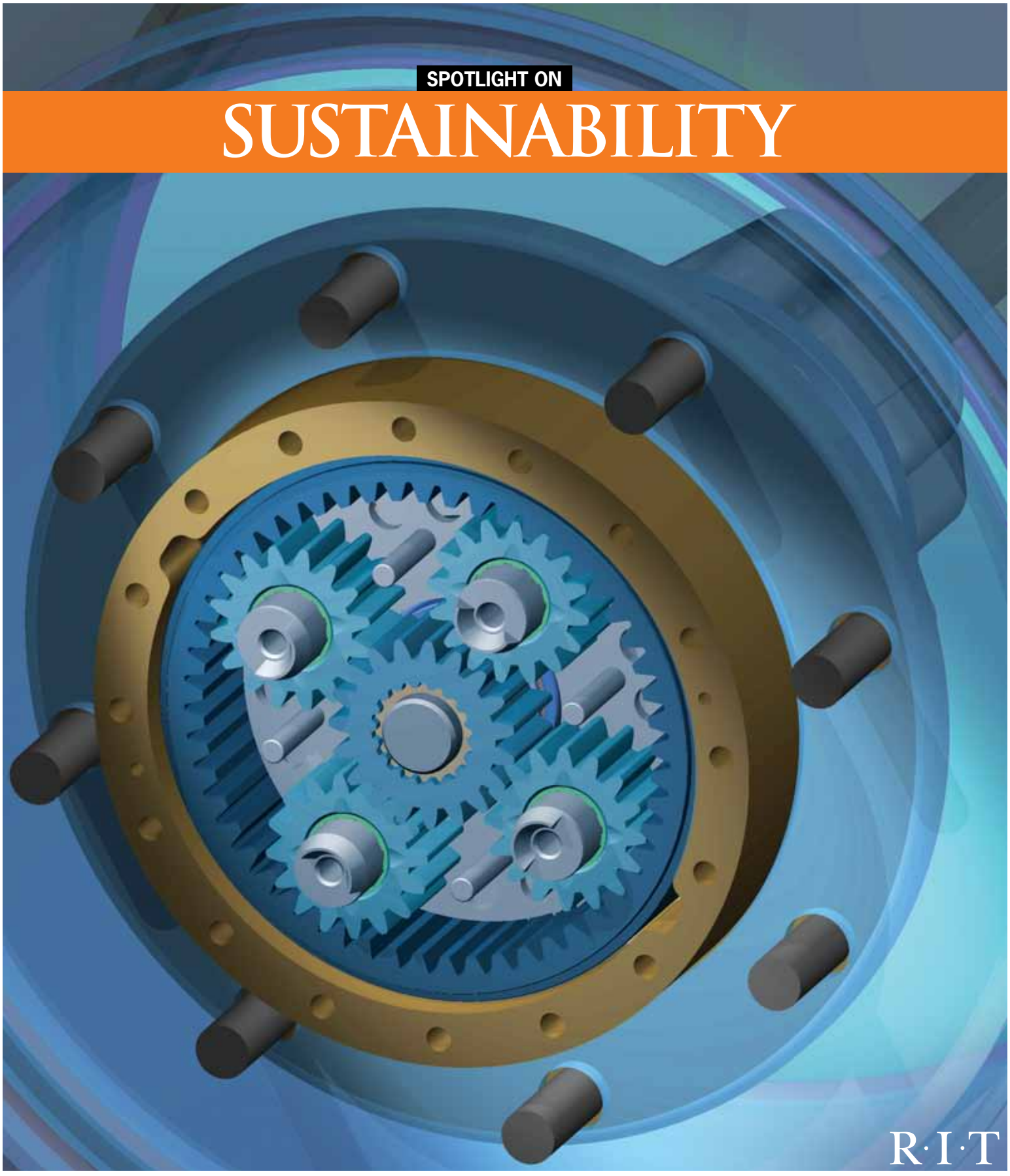
RESEARCH at RIT

The Rochester Institute of Technology Research Report

Fall/Winter 2009

SPOTLIGHT ON

SUSTAINABILITY



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RESEARCH at RIT

The Rochester Institute of Technology
Fall/Winter 2009

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Vol. 2, No. 1
10M-P0687-01/09-PAL-JSA

Preserving the Planet

From developing sustainable mobility innovations to methodologies that preserve the world's most precious artifacts, RIT researchers are working to preserve the planet.

The focus of this second issue of *Research at RIT* is sustainability. It is commonly understood that the United States, and indeed the world, is facing major challenges:

- **reducing dependency on oil**. We must find alternative sources of clean and renewable energy while reducing overall energy consumption;
- **ending global warming**. We must stop contributing to ozone depletion and begin to stabilize our climate;
- **preserving the environment**. We must eliminate wastefulness and preserve our natural resources, while
- **maintaining the United States' world leadership**. We must retain and grow an educated populace with the skills and willingness to lead and innovate.

At RIT, we take seriously our mission to educate our students in the fundamental disciplines with the ability to ask questions, think critically about opportunities and challenges, and find innovative real-world solutions through the applications of new technologies and discoveries.

Our feature article in this issue is sustainability, in which you can learn how RIT's Center for Integrated Manufacturing Studies is addressing many of these challenges through its research in sustainable mobility; and our latest Ph.D. program in sustainability offered through the new Golisano Institute of Sustainability.

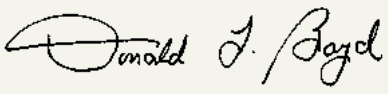
Speaking of sustainability, what about sustaining our culture and memories through the preservation of photographs, films, documents, and other artifacts? You will be introduced to RIT's Image Permanence Institute and its long history of testing, researching, and diagnosing the causes of image deterioration.

Undergraduate research demonstrates RIT's commitment to innovative education by providing our students experiential learning by participating in and contributing answers and innovations to difficult problems. You will read about students working with their faculty to apply their knowledge, discoveries, and critical thinking to confront difficult real-world problems.

Finally, RIT is working with the City of Rochester, New York, to address a major issue of public safety by finding the causes and ways to reduce violent crime in the community. This partnership between RIT's criminal justice department and the city holds the promise of a model for other communities across the country.

These articles are just examples of RIT's growth toward becoming a world-class innovation university through the education it provides and the research of its faculty, students, and staff. Please read on to learn more about the sustainability initiatives and collaborative research now being undertaken at RIT.

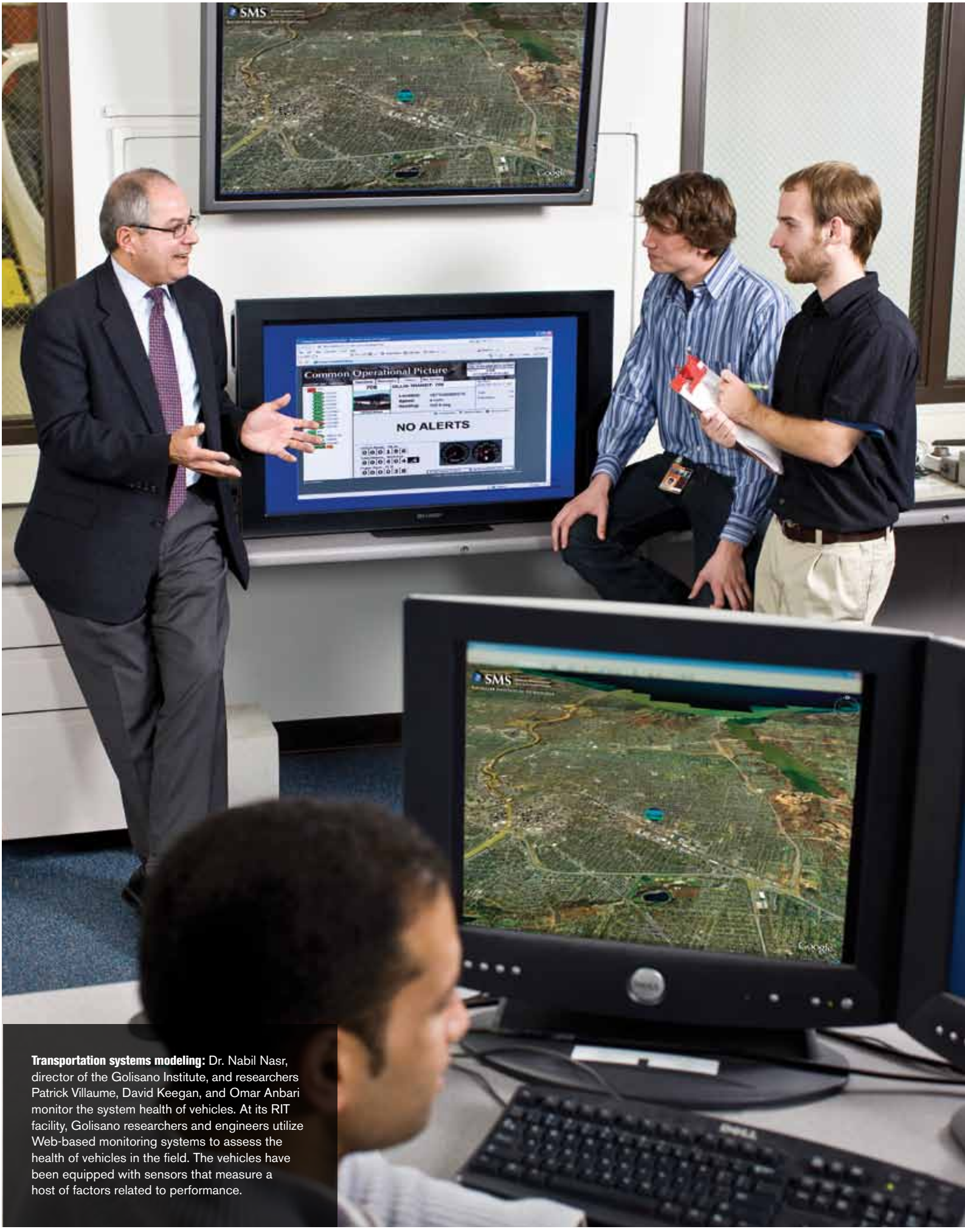
Best regards,



Donald Boyd, Ph.D.
Vice President for Research

Inside this Issue

On the Cover
Computer simulations of planetary gearing used in the wheels of heavy equipment are executed to conduct finite element analyses as part of the Golisano Institute for Sustainability's sustainable mobility research. Simulations test motion, stress, and thermal pressures to develop improved designs that increase performance and energy efficiency, while enhancing the overall sustainability of vehicle systems.



Transportation systems modeling: Dr. Nabil Nasr, director of the Golisano Institute, and researchers Patrick Villaume, David Keegan, and Omar Anbari monitor the system health of vehicles. At its RIT facility, Golisano researchers and engineers utilize Web-based monitoring systems to assess the health of vehicles in the field. The vehicles have been equipped with sensors that measure a host of factors related to performance.

Sustainable Mobility

by Staff Writer

Rising fuel prices and increased attention to climate change and carbon footprint concerns have made the subject of *sustainability* front-page news worldwide. It has also helped focus attention on innovative research conducted at the Golisano Institute for Sustainability (GIS) at RIT.

The Sustainable Concept

Simply stated, sustainability is *meeting the needs of the present without compromising the ability of future generations to meet their own needs*. This broad definition embraces virtually any human activity that aims to mitigate negative human impacts on the global environment by drastically reducing our intake of natural resources and production of harmful wastes.

At GIS, researchers are working on applying the principles of sustainability to industrial development (*Sustainable Products and Cleaner Production*) and transportation systems (*Sustainable Mobility*). Their objective is to construct innovative and economically viable systems that will enable sustainability through alternative energy sources, breakthrough product designs that simplify and encourage remanufacturing and recycling, and innovative industrial processes that "close the loop" by transforming waste products into raw materials for the manufacturing sector.

RIT founded the Golisano Institute for Sustainability in 2007 to create a comprehensive research, education, and technology transfer center dedicated to promoting the advancement of sustainability with a focus on industrial development. A $10 million donation from B. Thomas Golisano, founder of Paychex Inc., and an RIT trustee, provided the groundwork for GIS. Additional funding was provided by the Chester and Doris Carlson Charitable Fund, Xerox Corporation, and the New York State legislature.

A Cutting-Edge Initiative

"The Golisano Institute for Sustainability grew out of RIT's efforts to promote industrial development with reduced environmental impact through the Center for Integrated Manufacturing Studies (CIMS)," notes Dr. Nabil Nasr, director of the Golisano Institute. "In conducting applied research in cleaner production technologies, we soon realized that a broader approach was needed to address all aspects of industrial development, from material extraction, manufacturing and product end-of-life disposition, through how products are used by consumers and the associated resource or energy consumption during use."

Foundational research undertaken at CIMS involved the development of new technologies and processes for remanufacturing and recycling. Research on product end-of-life issues

Sustainability Education

RIT's efforts in developing comprehensive programs in sustainability include new academic initiatives that are at the cutting edge of education in the field. Leaders in these programs believe that a combination of education, training, outreach, and research is essential to the full implementation of sustainable principles in society.

"We can do all we want today to advocate for sustainability practices, but the true measure of our success will be how completely we are able to imbue our next generation of professionals with an understanding of and expertise in sustainable concepts and methodologies," notes Harvey Palmer, dean of the Kate Gleason College of Engineering.

The Kate Gleason College offers one of the nation's first master's degree programs in sustainable engineering as well as a minor in sustainable product development. The college also has joined forces with the department of public policy in the College of Liberal Arts to offer a unique cross-college BS/MS program in mechanical engineering and public policy.

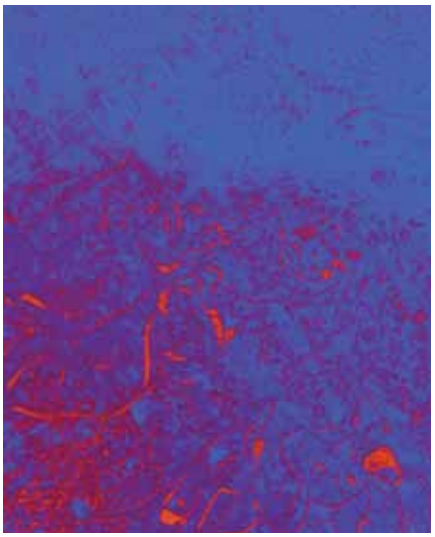
"Product designers require a better understanding of the policy implications of engineering decisions that have significant social and cultural implications. On the other hand, policy makers benefit from a stronger foundation in science and technology," adds Robert Ulin, dean of the College of Liberal Arts.

The Golisano Institute for Sustainability has created the world's first Ph.D. program in sustainability, focused on industrial development, including production, mobility, and energy systems. This new program will provide education in environmentally conscious engineering, environmental science, and green business management and policy.

"The Ph.D. program includes students from a wide variety of undergraduate backgrounds, including imaging science, environmental science, industrial engineering, mechanical engineering, business management, and public policy," notes Ryne Raffaelle, academic director for the Ph.D. program. "By bringing these disciplines together and developing programs that reach a wide range of areas we can imbue our students with a better understanding of the interconnections that are essential to making true sustainability possible."

RIT also offers an MBA concentration in environmentally sustainable management through the E. Philip Saunders College of Business; BS and MS degrees in environmental science through the College of Science; BS in environmental management and technology and a MS in environmental health and safety management in the College of Applied Science and Technology.

Life Cycle Engineering: Golisano engineer David Fister utilizes an electron microscope to examine how a material performs throughout its life cycle. The process is used to enhance performance and design while assessing the feasibility of implementing new technologies.



Finite Element Analysis: FEA is used in remanufacturing to analyze the strength of materials. Above, FEA determines how much damage a weld procedure caused to cast iron. The red indicates the heat-affected zone; a smaller zone is desired. (Color modified to enhance visible damage.)

led to interest in product design practices for improved end-of-life product disposition. Major research initiatives in life cycle design and engineering were supported by the New York State Energy Research and Development Authority (NYSERDA), the U.S. Department of Defense, and industry sponsors, including Hewlett Packard, Xerox, Caterpillar, Detroit Diesel, and others.

At the same time, scientists, non-governmental organizations, business and political leaders, and environmental activists were increasingly concerned about the impact of industrial activities on the health of the global environment, as well as over-consumption of non-renewable natural resources. CIMS' participation in the global debate, and the growing international movement toward sustainable development, led to the expansion of the CIMS research agenda into sustainability, and the formation of GIS and the Sustainability Ph.D. program at RIT (described in the Sustainability Education sidebar).

Next Step in Transportation

A key research focus for GIS is sustainable mobility. This effort builds on previous remanufacturing and life cycle engineering research for passenger, commercial, and military vehicles. GIS' sustainable mobility research concentrates on long-term environmental and economic impacts of production, use, and disposal of transportation systems. A focus of the research is product design, which has an amplified effect on the other life cycle stages.

The GIS Sustainable Mobility research program includes the following areas of current research:

- life cycle engineering and sustainable design
- system health management
- smart products
- advanced propulsion systems
- fuel cell technology
- remanufacturing and recycling

Life cycle engineering and sustainable design

Life cycle engineering and sustainable design covers the product life cycle, with an emphasis on the design phase. Sustainable design practices consider the entire product life cycle, including sustainable materials selection, clean production, design for end-of-life disposition (recovery, disassembly, reuse, remanufacturing, and recycling), and advanced product support and logistics systems. The development of sustainability metrics and assessment methods is a further element of this research.

System health management

System health management uses vehicle usage data, together with sensor or inspection data, to diagnose the current state of a vehicle or to prognose the future state of a vehicle. A goal of system health management is optimization of vehicle maintenance, resulting in improved performance and efficiency over the product life cycle. System health

Photo submitted by the Center for Integrated Manufacturing Studies

System Health Management: Caseyann Sarli, '06 (mechanical engineering), tests model-based prognostics technology developed at RIT to assess the health of vehicle components. Sarli served as a cooperative education student with the Golisano Institute in 2006, conducting research to improve the performance and environmental quality of large vehicle fleets.

management can also enable increased component remanufacturing and reuse by triggering maintenance before unrestorable product damage occurs. Increased material reuse results in lower energy consumption and waste associated with the product life cycle.

Key research areas that support system health management are: material aging, physics of failure, signature analysis, and model-based prognostics. The Office of Naval Research has funded a number of research initiatives in this area, including a $150 million program in which GIS developed a health monitoring system for Marine Corps ground vehicles that is currently deployed by Lockheed Martin in 12,000 Marine Corps vehicles.

Smart products

Smart products have embedded data or intelligence that allow for improved decision making throughout the life cycle. For example, an alternator may have product information embedded that describes the material content, such as recyclable materials, rare high-value materials, and/or hazardous materials that need special disposal. The usage data (e.g., hours of operation) or maintenance history (reason for removal) or system health data can also be embedded. When the product goes into the end-of-life material recovery system, this information enables the optimal end-of-life distribution process to be quickly determined (remanufacture versus recycle, etc.).

With embedded intelligence and networked capability, more sophisticated products can provide collaborative behavior, optimize the efficiency of operation, and request updates to algorithms or software. General Motors' OnStar™ system is an example of smart product technology in mobility. This type of system can detect evolving vehicle degradation and schedule maintenance autonomously. GIS is working with GM to integrate more sophisticated system health monitoring technologies into their vehicles.

The College of Applied Science and Technology building—LEED Gold Certified

Sustainable Campus

RIT's sustainability efforts also apply to campus operations where the university has undertaken two major projects to reduce energy use and waste generation. The first of these initiatives is the multi-million dollar effort to consolidate and modernize the campus heating and cooling system. The project includes the implementation of new equipment and piping throughout campus, as well as the creation of two heating and cooling facilities, or "satellite plants," one for the east side and one for the west side of campus.

RIT estimates that the new systems will reduce natural gas usage by 45 percent and result in a total annual energy cost savings of $1.2 million.

A second major project is the recent construction of the new College of Applied Science and Technology building. The facility, opened in 2008, has received gold certification from the Leadership in Energy and Environmental Design (LEED) Rating System of the U.S. Green Building Council, the most widely accepted rating system for evaluating sustainable, high-performance buildings.

The building features controls that monitor building occupancy and reduce power demands accordingly. The improved systems provide an approximate 21.4 percent savings in electrical energy. It also includes two 1,500-gallon cisterns that were installed to collect rainwater from the roof to flush toilets in the restrooms and provide water to the outside wall hydrants. Rainwater is also used to irrigate plantings in the main lobby, where a vertically landscaped wall improves air quality.

Alternative Fuels: An alternative fuel test vehicle being filled with hydrogen at a county refueling station. Golisano Institute researchers are currently testing the performance of hydrogen vehicles in partnership with General Motors.

Advanced propulsion systems

There is a major need for *advanced propulsion systems* to improve the sustainability of current systems for personal mobility. A variety of challenges must be overcome to the current gasoline internal combustion engine baseline. These challenges include: improved efficiency for production of bio-fuels, production and distribution of alternative fuel sources (hydrogen and electric), and advanced powertrain technologies (electric vehicle batteries, fuel cells). GIS research focuses on the evaluation of life cycle engineering issues associated with different alternative powertrain options. These include environmental and economic impact, reliability, durability and maintainability of alternatives, end-of-life material recovery, and component reuse.

Some of the current research initiatives in this area include: assistance to local companies in ethanol production; a $1 million hydrogen hybrid internal combustion vehicle demonstration and education hydrogen project funded by NYSERDA; researching alternative fuels and engine modifications for small unmanned aircraft engines, through a $750,000 project sponsored by the U.S. Army; and evaluating short- and long-term alternative fuel options (ethanol, biodiesel, plug-in hybrid, fuel cell technologies, and all electric vehicles) through a four-year $4 million project sponsored by the Department of Transportation and in partnership with New York State's Monroe County.

Fuel cell technology

GIS also has a broader research program in *fuel cell technology* research. This program includes partnerships with Plug Power, General Motors, and Delphi. The goal of the Delphi research program is to accelerate the development of solid oxide fuel cell technology for auxiliary power in military vehicles and is funded by a $5 million grant from the Department of Defense. This initiative is analyzing material aging mechanisms via accelerated testing protocols, utilizing design and failure mode data to assess remanufacturability, developing embedded sensors and associated health monitoring (prognostic) algorithms, developing clean production processes, and development of service strategies over the product life cycle.

Remanufacturing and recycling

Remanufacturing and recycling are well established in the United States for automobile technologies. However, there are still business and technology barriers to achieving significantly higher remanufacturing and recycling rates. GIS research efforts target overcoming remanufacturing technology barriers. These include the development of condition assessment and restoration technologies, design for remanufacturing methodologies, reverse engineering, and restoration in automotive systems electronics. GIS is completing a multi-year joint research project with the Korean Institute of Technology and Hyundai Motors to develop enhanced condition assessment and prognostic technology for alternators. This project will increase the percent of alternator components that are remanufactured and improve remanufactured product quality.

GIS Research's Overall Impact

"The current transportation system is not sustainable in the long term, the GIS research team is convinced this research will contribute to more environmentally friendly and sustainable mobility options in the future," says Michael Thurston, technical director of the System Modernization and Sustainment program at GIS. "At the same time, the goal is more sustainable options that are also cost effective and economically sound."

"Implementing more sustainable processes and technologies will not always be quick or straightforward," cautions Dr. Nasr. "It will demand close collaboration between industry, government, and academia over the long term and around the globe. Still, research like that being conducted at GIS is moving the concept of sustainability steadily closer to everyday reality.

"In the past, conventional thinking held that environmental quality and environmental efficacy were mutually exclusive. Our research shows that you *can* have both if you design the right kind of industrial production and transport systems. Helping industry create the new technologies and processes that those systems will require is the heart of the sustainable development mission of the Golisano Institute."

National Park Energy Partnership

James J. Winebrake

The University-National Park Energy Partnership Program (UNPEPP) is a national program working to partner university students and faculty with national parks throughout the country who are working to reduce energy use at their facilities.

Through these partnerships, parks gain assistance in implementing sustainable energy projects, while students obtain real-world problem-solving experience in the energy field. This program was created through a partnership between the National Park Service (NPS) and RIT, and is directed by James J. Winebrake, chair of RIT's department of science, technology, and public policy.

UNPEPP project work includes energy assessments of park facilities, training of NPS personnel on sustainable energy practices, and designing and implementing energy management plans and renewable energy systems at National Parks sites. Park visitors also benefit by witnessing and learning from NPS' commitment to sustainable energy use.

Since its inception, UNPEPP has supported dozens of projects at national parks throughout the country, including Alaska and Hawaii. This year, RIT students have been involved in developing sustainable energy systems for Ft. Stanwix National Monument in New York. At Ft. Stanwix, RIT students are developing and testing new energy efficiency and solar energy systems that will be integrated into the park's energy management system.

Ft. Stanwix National Monument: Renewable energy system installed through the University-National Park Energy Partnership Program.

Global Access to Sustainable Technology

Margaret Bailey

Andres Carrano

Rob Stevens

Brian Thorn

The incorporation of sustainability in society takes many forms, from reducing the environmental footprint of industry to enhancing access to clean technology throughout the world. RIT's Kate Gleason College of Engineering's multidisciplinary senior design program is working to address global access to sustainable technology through its sustainable design track. Through the program, students and faculty conduct a host of projects related to energy efficiency and alternative energy development, in support of the greening of the RIT campus and the implementation of sustainability in the developing world.

In a recent project, a team led by Rob Stevens, assistant professor of mechanical engineering, designed and built a solar-powered pasteurizer for reducing pathogens in drinking water. The device was targeted for use in rural villages in developing countries that often do not have access to clean drinking water or electricity.

The device includes an integrated collector to capture the solar energy, and heat exchanger, which collects waste heat and reuses it in the process. This type of design decreases the overall cost of the pasteurizer and reduces material use. The design is able to pasteurize on average more than 20 liters per day, which would provide adequate drinking water for a family.

The project team also includes Margaret Bailey, Andres Carrano, and Brian Thorn. Funding was provided by the U.S. Environmental Protection Agency and was selected for inclusion in the EPA's National Sustainable Design Expo, held in the spring of 2007 in Washington, D.C.

Photo submitted by Rob Stevens

Solar-Powered Pasteurizer: Developed by a team of engineering students selected for EPA's National Sustainable Design Expo in Washington, D.C.

Professor, Researcher, Mentor: Dr. Suzanne O'Handley, associate professor, Joshua Thomson, junior biochemistry student, and Alessandra Lof, freshman biotechnology student, work side-by-side exploring potential novel antibiotic targets. Dr. O'Handley provides her students with the knowledge and experience to excel in their field, and the opportunities to distinguish themselves from their peers.

Learning through Research

by Kara Teske

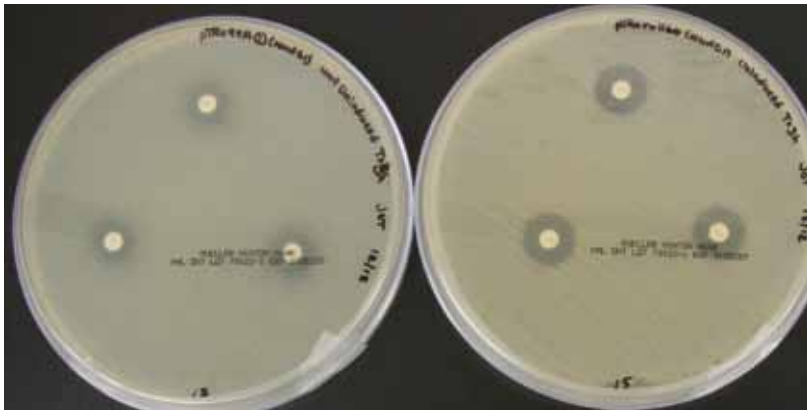
When you turned 16 did you suddenly know how to drive? Of course not. It takes time, practice, and experience; but you have to take the wheel to learn. In the College of Science at RIT, faculty believe the same goes for learning through research.

Early Research Opportunities

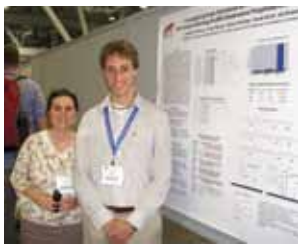
Undergraduate students have jumped into the driver's seat and are conducting research assignments that students at most universities would not have the opportunity to participate in until graduate school. This hands-on experience at all undergraduate levels is consistent with RIT's history as an experiential learning institution, exemplified through its world-renowned cooperative education program. Undergraduate research is now further enhancing the university's efforts through the development of basic research programs in a host of fields.

Even before their first freshman class, students have the opportunity to work side by side with experienced researchers to explore their major and learn through the application of science. During the summer, RIT offers a four-week Summer Research Scholars Program to select incoming freshmen. The program provides top-tier students with the opportunity to get a jump start on their college degree and receive hands-on experience working in a lab. Students who participate complete two classes and work in the lab up to 30 hours per week.

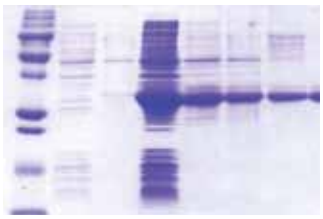
The Summer Research Scholars Program started at the College of Science as a pilot program in 2006, under the leadership of Catherine Mahrt-Washington, assistant dean honors advocate and program director. Since then, the program has expanded to include the College of Applied Science and Technology, the College of Liberal Arts, and the College of Business, and will be welcoming the B. Thomas Golisano College of Computing and Information Sciences for 2009.



A Potential TB Drug Target: Shown above is a complementation study of an M. tuberculosis homolog and an E. coli mutant. Dr. Suzanne O'Handley's research team hopes to find new drug targets for MDR TB (multidrug resistant tuberculosis).



Presenting Research Nationally: Joshua Thomson shares his research findings at the 234th National Meeting of the American Chemical Society in Boston, Mass.



Antibiotic Study: Polyacrylamide gel electrophoresis showing the purification of a virulence factor. The research team is attempting to uncover a potential novel antibiotic target.

The university has been able to leverage the resources it already has in place to create a premier program for incoming students. "Everyone on campus has been extremely supportive, especially the faculty, from providing lab space to volunteering time with students. I am truly pleased with the faculty we have here and their willingness to participate," says Mahrt-Washington.

Joshua Thomson, a junior biochemistry student, says, "the summer research program was the single most important thing that started my research and placed me with my mentor Dr. Suzanne O'Handley. It wasn't until I started to do the research that I realized this is what I wanted to do. Being able to see how science is applied in the lab has also helped me with my course work."

Investigating Potential Novel Antibiotic Targets

Since the summer before his freshman year, Thomson has been working alongside Dr. O'Handley, conducting research that entails the characterization of potential novel antibiotic targets from M. tuberculosis. They have been investigating enzymes Orf135 from E. coli and Rv1160 from M. tuberculosis. To establish Rv1160's role in the cell, they performed complementation studies in the Orf135 knockout mutant with Rv1160. "If we can cure the Orf135 knockout mutant with Rv1160, then we can ascertain true functional homology for these enzymes," says

Photo submitted by Dr. Suzanne O'Handley

Students Inspired by Einstein: Dr. Suzanne O'Handley's research students, Amanda Sitterly, Julian Ramos, and Joshua Thomson (left to right), travel to Washington, D.C. to present their research at the 2007 Annual Meeting of the American Society of Biochemistry and Molecular Biology.

Thomson. Proving the significance of Orf135 and Rv1160 will help establish the potential of these enzymes as novel antibiotic targets in pathogenic E. coli and M. tuberculosis.

O'Handley stresses the importance of basic research. "Until the bacterial genome projects were completed, scientists didn't realize how little we knew. It is basic research like this that may help us find new cures."

Thomson has presented their results at several national meetings, including those of the American Society of Biochemistry and Molecular Biology, the American Chemical Society, and the American Society for Microbiology. "This opportunity has given me not only experience in presenting, but exposure to the other work that is going on—it gives me a renewed excitement for my research."

RIT is transforming into a university that has innovation as its main focus. For undergraduates that means infusing creativity and innovation into undergraduate programs through research. Dr. Lynn Wild, assistant provost for faculty success, adds, "Every student should have the chance to learn by doing. We are a university that is grounded in theory and the application of theory. We use research to inform our practice, and to me that's beautiful."

Examining VSV

Nathan Haseley, junior bioinformatics student, has been conducting research with Dr. Maureen Ferran since his freshman year after taking Ferran's introduction to biology lab. When deciding which school to attend, Haseley realized the opportunity to be more involved at RIT. Haseley says, "At RIT, they let us work with really fun tools, really early on, and you won't find that everywhere."

Through funding by the National Institutes of Health (NIH), Haseley and Ferran have been using Vesicular Stomatitis Virus (VSV) as a model system to determine how viruses bypass important antiviral defense systems. The research team uses comparative sequence analysis and many molecular biology techniques to study the mechanisms used by VSV to evade the antiviral interferon system and they hope to identify the viral proteins responsible. To date, they have uncovered sequence differences between viral strains and believe that by blocking activation of a cellular protein called NF-kB, the virus is able to prevent production of interferon, giving the virus an advantage over the cell.

Haseley has presented his work at several conferences across the state, starting with the Wednesday Research Seminar, hosted by the College of Science each Wednesday throughout the year. "The Wednesday Research Seminar provides students with an hour of opportunity," says Catherine Mahrt-Washington, coordinator of the event. "It's an hour to practice your presentation skills, influence your peers, and collaborate with faculty." Each Wednesday, 60-90 students gather to hear their peers present their research and just maybe discover their own passion.

Student-designed Experiment

Jillian Lund, senior biotechnology student, began her research career after being inspired by a lecture given by Dr. Harvey Pough in her introduction to biology class freshman year. The spring quarter, Jillian enrolled in Pough's reading course, where she had the opportunity to

Photo submitted by Dr. Maureen Ferran

Solving Real Research Challenges: Nathan Haseley performs comparative sequence analysis to study the mechanisms used by VSV to evade the interferon system.

Leading Innovation: Catherine Mahrt-Washington, director of the Summer Research Scholars Program and co-ordinator of the Wednesday Research Seminar, is one of the many catalysts for undergraduate research at RIT.

Hour of Opportunity: Emily Schreiner, a junior biomedical NTID student, presents research at a Wednesday Research Seminar in the College of Science.

design an experiment with classmate Kevin Posman.

The pair explored the possible correlation between antibiotic use in agriculture and reservoirs of antibiotic-resistant bacteria in the environment, which could pose a health risk to humans and animals. An increase in the incidence of antibiotic-resistant enteric bacteria has been observed in wild vertebrate species that have never had direct contact with humans. Lund and Posman believe that in the United States, livestock farms may be contributing to this problem through their use of antibiotics to promote growth and prevent infection.

To test their hypothesis, they chose *Lithobates clamitans*, the wild green frog, as their indicator organism. They compared the antibiotic resistance of the enteric bacteria of frogs from three locations: a location expected to be protected from livestock waste, Mendon Ponds Park; an intermediate location that may have some exposure, the RIT campus; and an exposed location, a dairy farm in Clifton Springs, N.Y.

As predicted, their research found elevated levels of tetracycline and erythromycin resistance found in the isolates from the dairy farm. Exposure to these antibiotic-resistant strains of bacteria is a health risk for humans and animals.

Lund has continued her research throughout her undergraduate career, working full-time in the lab during the

Hands on Research: Jillian Lund holds a *lithobates clamitans*, the wild green frog used to detect antibiotic resistance.

-80° Deep Freeze: Regina Puts, a biochemistry student from Russia, removes bacteria from a freezer used to preserve the lab's substrate library, bacterial stock collection, and purified enzymes.

Photo submitted by Dr. Suzanne O'Handley

Team Work: Dr. Suzanne O'Handley's student research team presents their research at the 2007 Annual Meeting of the American Society of Biochemistry and Molecular Biology in Washington, D.C. (Front row: Jacqueline Hill, Amanda Strassner, Dr. Suzanne O'Handley, Teressa Leiker, Rachel Pleuthner. Back row: Joshua Thomson, Sarah Denial, Julian Ramos.)

summer semester and about 8-10 hours a week during the rest of the year. "My experience in the lab has given me confidence and I am able to proceed faster," says Lund. "With just a few hours a week in a lab you can accomplish something significant."

"Research is an important part of development as a scientist. Undergraduate students who do research are as well prepared as most students who have been in graduate school for a year; it gives students a real head start," adds Pough.

Sarah Denial, a 2007 biochemistry graduate who worked in Dr. Suzanne O'Handley's biochemistry lab throughout her undergraduate career, explains, "You don't learn how to be a good scientist by reading out of a book. Experience in a lab is the most important thing. My undergraduate research experience allowed me to intern at AMGEN the summer before my senior year and has set me apart from my peers at Cornell, where I am pursuing my Ph.D."

Value of a Black Hole

Nicholas Battista, senior applied mathematics and physics major, has been conducting research in RIT's School of Mathematical Sciences and the Center for Computational Relativity and Gravitation. One of his projects consisted of solving non-linear, elliptic partial differential equations that describe the initial space-time surrounding black holes, which requires the knowledge of partial differential equations, conformal mappings, spectral numerical methods, asymptotic methods, as well as a foundation of general relativity.

Battista presented his findings at the 2008 Undergraduate Research Symposium, which resulted in an invitation to present at the Joint Mathematics Meeting, the largest annual mathematics conference between the American Mathematical Society and the Mathematical Association of America. "Presenting my research at the Undergraduate Research Symposium was one of the most fulfilling moments of my undergraduate study thus far," says Battista.

The Undergraduate Research Symposium started in 1998 with a mere four attendees. It has since grown to over 200 attendees this year; next year the event will span two days and other universities will be invited to participate. Each year, the event is held at the conclusion of the summer quarter. All students conducting undergraduate research are encouraged to participate, including incoming freshmen participating in the Summer Research Scholars Program. Students may display a poster or give an oral presentation of their research and awards are given to the best poster and presentation.

Dr. KSV Santhanam, director of the symposium, says, "The symposium provides students with good training in how to approach scientific problems and it builds their confidence. They boldly face a problem and work to find an answer. Our students are better trained to face an audience and scientific problems."

National Recognition

Undergraduate research is an integral role in the learning experience at RIT. Last spring, the four students featured—Nicholas Battista, Nathan Haseley, Jillian Lund, and Joshua Thomson—each received the Barry M. Goldwater Scholarship, the most prestigious award for undergraduate students interested in pursuing careers in mathematics, the natural sciences, or engineering. Only four students from any given university can apply, and all four students that applied from RIT were awarded the scholarship in 2008. This is a feat many historical research universities are not able to achieve and a true testament to the quality of education and research that is being done at RIT.

"At RIT, we get undergraduates involved. Students are not only learning, they are getting experience so when they leave, they can get jobs and get into some of the best graduate programs in the country. These students are wildly employable," says Dr. Lynn Wild.

DigEnt Examines Virtual Business

Victor Perotti

Digital Entrepreneurship represents a convergence of traditional entrepreneurship with an emphasis on new technologies, new business forms, and the opportunities created by this environment.

DigEnt, a digital community developed by RIT business professor Victor Perotti and his digital entrepreneurship class, explores how new media changes the way business is done. The site, which includes both informational and social networking components, is currently #1 on Google™ when searching the term *digital entrepreneurship*.

Through the class, students—mostly third-year undergraduates—complete a business plan to advance a digital business venture, including research and analysis of electronic marketplaces. Students collaborate through DigEnt with their peers and experienced entrepreneurs. Jamy Nigri, Head of Games, New Media & Entertainment for Aria Systems based in Silicon Valley, is a member of DigEnt and regularly interacts with students and provides feedback on their business ideas. "The future of education is no longer contained within the confines of a classroom. Involving professionals to participate creates a cool two-way learning opportunity for the students and allows me to stay abreast of what the next generation of great minds is thinking," notes Nigri.

DigEnt: A digital community that explores digital entrepreneurship. (digent.rit.edu)

DigEnt breaks down the barriers between faculty and students, university and industry by fostering a virtual community of collaboration and learning. "Learning is often viewed as a one-way process from faculty to student, but learning goes very much the other way, too," says Perotti, associate professor of management information systems in RIT's E. Philip Saunders College of Business.

Colby Jordan, fourth-year industrial design student, enrolled in the digital entrepreneurship class to explore his virtual business idea and gain insight on the technical side of running a business. Jordan says, "The class helped me to understand current trends and where to focus my Web business. I had an idea, but the class was really the catalyst I needed to get started and allowed me to meet a great business partner."

Perotti's goal is to expand DigEnt by bringing together other universities and further examine the phenomena of digital entrepreneurship.

The Digital Entrepreneurship initiative was funded with a grant from the National Collegiate Inventors & Innovators Alliance (NCIIA).

Partnering to Enhance Communication Security and Education

Marcin Lukowiak

Andreas Savakis

Ken Smith Jr. and Jacob Czapeczka, both fifth-year BS/MS computer engineering students, are working on a major research project with Harris Corporation to improve the performance and efficiency of encrypted Bluetooth technology.

The team, under the guidance of Marcin Lukowiak, assistant professor of computer engineering, and Andreas Savakis, head of the department of computer engineering, are looking to expand the use of secure Bluetooth communication with multiple devices that can be modified in the field, enhancing the flexibility and efficiency of communication systems.

They are developing and testing a secure Bluetooth evaluation platform using the 256-bit key Advanced Standard (AES) with Galois Counter Mode (GCM). This will be part of an FPGA-based Single Chip Crypto (SCC) Architecture with full RED/BLACK separation implemented using a hardware-software approach. Architectural strategies are being investigated for efficient hardware implementations on the target FPGA to achieve either higher performance or smaller area.

Photo courtesy of RIT University News

Secure Bluetooth Evaluation Platform: The platform was developed by Jacob Czapeczka and Ken Smith Jr. under the supervision of Professor Lukowiak, in partnership with Harris Corporation.

The platforms could be integrated with communication networks used by the military and national security organizations.

"This opportunity has allowed me to gain a large amount of knowledge and experience that you can't receive in class," says Smith Jr. "Because of this experience, I have the confidence to take a leadership role and collaborate to reach decisions."

From preserving images to preserving archives: James Reilly, director of RIT's Image Permanence Institute, is well known for his research on the effects of temperature and humidity on library archives, and museum collections. Here, Reilly works in the IPI laboratory to analyze deterioration of documents under accelerated light exposure.

Preserving the World's Artifacts

by Paul Stella

For precious artifacts and cherished documents, time is the enemy. As the years pass, deterioration becomes an inevitable consequence, and the toll is often quite severe. Through the work of the Image Permanence Institute (IPI) at RIT, museums, libraries, and archives around the world are finding the means to slow the progression of decay.

Incorporating Technology and Preservation

James Reilly has served as IPI director since the institute's formation as a department of RIT's School of Photographic Arts and Sciences in 1985. Beginning with research on the preservation of 19th century photographs, IPI's mission initially focused on serving the imaging industry as its primary client, providing information on sustaining photographic materials through advancements in technology.

"It's only natural that with RIT's history and the presence of so much photographic technology in Rochester, if there's anyplace in the world that you could have an institute whose focus is on image preservation, it's logical to think that it would be here in Rochester," Reilly says.

Over the years, IPI broadened its focus to serve a wide range of institutions. Archivists at national and international libraries and museums were acknowledging an ongoing struggle in managing storage conditions, a fundamental variable that most impacts the long-term viability of all kinds of collectibles. In many cases, archives were proving ill-equipped to withstand the ages.

"The stewardship of those collections depends in large part on the environmental conditions they're kept in," explains Reilly. "They could do their collections a lot of good with the proper conditions; they could do them a lot of harm with the wrong conditions. The area we work in is the creation of technology in the form of software, hardware, and websites that assist in determining what the conditions are and analyzing what they mean. In other words, we are helping clients identify adjustments that can be made either to improve the preservation quality of the environment or to deliver a good environment through more sustainable solutions that use less energy in the process."

Environmental Monitoring and Assessment

Environmental monitoring and assessment are the primary focus of IPI research. Its staff of nearly 20 professionals—including chemists and imaging experts—focuses on increasing awareness to the impact of internal climate changes, as well as intelligent management of conditions to help

The Library of Congress: With more than 12.5 million photographs and 32 million books, the Library of Congress works with RIT to preserve its collections.

New York Public Library: James Reilly, IPI Director, presents a progress report to the staff of the New York Public Library on environmental improvements using IPI Technology.

institutions identify and achieve optimal storage solutions.

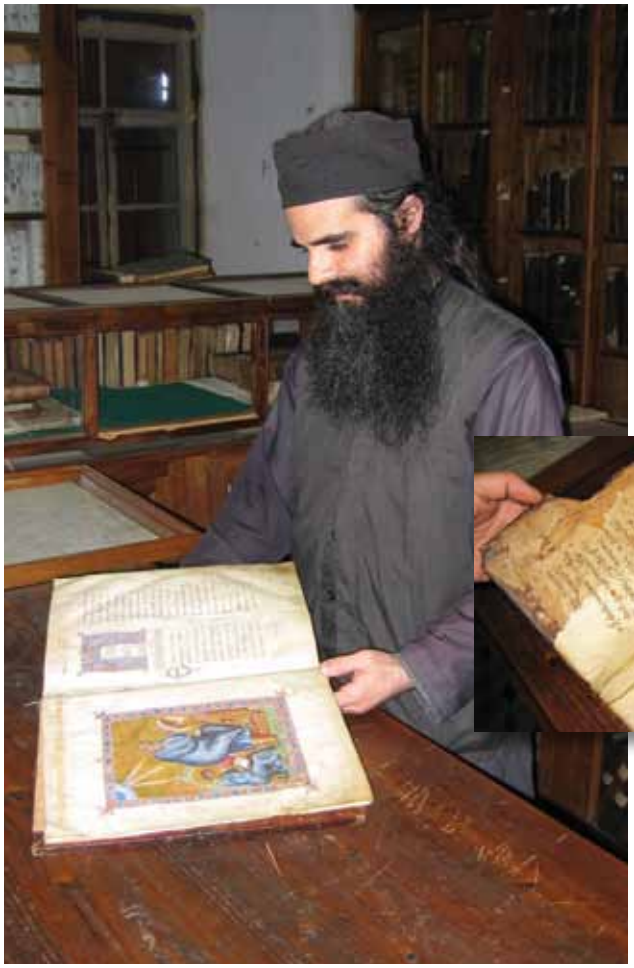
Temperature and humidity are the fundamental drivers of decay, but finding a balance to adequately address both of these can result in some level of compromise. To help institutions strike that balance, IPI provides its clients with Preservation Environment Monitors. Now in its second generation, this device retrieves and transfers data that is interpreted through an online software package.

Reilly indicates the key advantage to IPI's system is the opportunity to generate algorithms that can quantify outcomes. Archive managers can then react to statistics that showcase the potential risks and benefits resulting from specific environmental conditions.

"Suddenly, you have a set of six or seven numbers to manage that are similar to what happens in medicine, when the doctor gets a report back on your blood work that lays out aspects such as blood sugar and cholesterol. It gives them numbers that indicate where things really stand in a quantitative way, providing a better way of zeroing in on problems that the doctor would need to manage. Our approach, what we call preservation metrics, provides us with numbers that are linked to specific types of decay that lets the doctor, in this case the collection manager or conservator, see what's good or bad and to what extent, and manage incremental improvements." (See the Metrics Make the Difference sidebar.)

Support from federal and private foundations is instrumental in the development and distribution of IPI preservation technology. The National Endowment for the Humanities, the Institute of Museum and Library Services (IMLS), and the Andrew W. Mellon Foundation are the primary sources for funding and outreach. The institute also benefits from long-term contracts with important institutions like the Library of Congress, which has been affiliated with IPI for more than 20 years, and the National Archives.

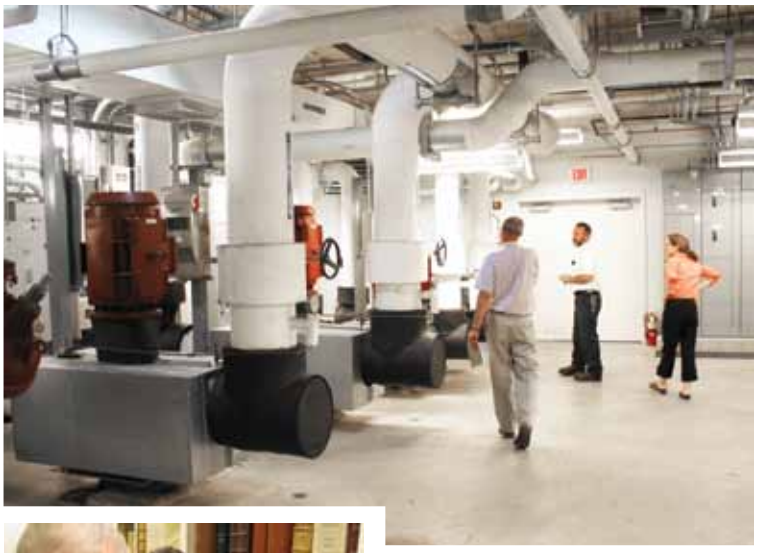
PEM in use at Museum in Denmark: South Pacific collection objects in Denmark's National Museum are monitored closely using IPI's Preservation Environment Monitor and tracked using IPI Web-enabled data analysis.



Improving Archival Conditions of Ancient Texts in Greece: Pater Chrystostomos, librarian at Koutloumoussiou Monastery in Mt. Athos, Greece, examines a 1,100-year-old manuscript. The library uses IPI's PEM monitors to ensure survival of the collection.

Environmental Damage: The ravages of insects and exposure to unfavorable conditions take their toll on a Greek religious text.

National Archives:
The U.S. National Archives and Presidential Libraries are the largest user of IPI's environmental assessment tools and technology.



Managing Environmental Conditions:
Head of preventive conservation, Nancy Lev-Alexander and IPI staff tour the mechanical rooms of the Library of Congress' brand-new National Audio-Visual Conservation Center in Culpeper, Virginia.

IPI on Location:
IPI staff discuss deterioration of a rare book with New York Public Library curatorial staff.

The Library of Congress

Nancy Lev-Alexander, head of preventive conservation for the Library of Congress, credits IPI for helping her team better organize all aspects of climate control, including a more thorough understanding of the institution's air handling system and overall building maintenance. That knowledge provides added synergy to the intelligence being supplied by the preservation technology.

"We need some way to prioritize the amount of information we're getting," explains Lev-Alexander. "In order to make wise decisions on where to make our requests, where to focus our efforts, we need to be able to see what collections are in greatest jeopardy. So the tool that IPI created allows us to take a relative number and apply what we know about collections and make some informed choices. For institutions that have large collections, if you can get your arms around that, it keeps you from spinning your wheels."

Digital Print Preservation

The proliferation of digital technology is providing IPI with some additional focus areas relating to preservation. With support from the Mellon Foundation and IMLS, the institute has introduced the Digital Print Preservation Portal, also known as DP3. The website is intended as a resource to explore aspects of digital printing and publishing. Since technologies like inkjet, dye fusion thermal transfer, and digital electrophotography are relatively new, many archivists remain uncertain as to the potential longevity of newer submissions to their collections.

"You can buy an inkjet printer, and you can make a beautiful photographic quality prints using pigment inks on an inkjet paper, and permanence-wise it's very good," says Reilly. "It won't fade in the dark. It won't fade in light. It may be sensitive in ozone, although that quality is getting better. But it may be sensitive to things that a photograph wasn't. For example, surface abrasion may be a problem or the image might crack because the layers are different than what we're expecting."

DP3 provides clients with the means to compare aspects of newer technologies in relation to major deterioration issues. From the resulting matrix, they can synthesize the information into an overview that offers practical advice.

The Center for the Legacy of Photography

As traditional photography processes gives way to digital, IPI is teaming up with the George Eastman House International

Dataset	HSSL-3-Prints Storage.DBF
Risk Summary	
Natural Aging	OK
Mechanical Damage	Good
Mold Growth	Good
Metal Corrosion	OK
Preservation Metrics	
TWPI	**74**
MRF	**0**
% DC Max	**0.35**
% EMC Min	**7.3**
% EMC Max	**8.5**
% EMC Mean	**7.94**
Data Overview	
Start	**2006-12-31**
End	**2007-07-31**
T °F mean	**63.7**
% RH mean	**41.4**
DP °F mean	**39.7**

Decay risk metrics: Metrics for a collection space in the New York Public Library for the 2007 calendar year.

Metrics Make the Difference

Many tools are available to cultural institutions to gather temperature and humidity data. The greater challenge is to find meaning in the data, to relate it to specific collections and to make meaningful changes in mechanical systems in order to extend collection life. The revolutionary aspect of the IPI data collection and analysis system is that it automatically assesses environmental conditions and the degree of risk in each kind of decay for specific collection materials.

One example of this process occurred during an Andrew W. Mellon Foundation funded project with the New York Public Library. Preservation metrics based on data gathered from a number of storage and exhibition areas were used to compare spaces and provide an overview of conditions for collections. Review of these results allowed IPI and library staff to immediately identify areas of concern and develop key strategies related to the mechanical systems that produced the problematic environments.

The primary recommendation to NYPL was to optimize the central chilled water plant. Summertime chilled water temperature is the single most important factor in shaping the preservation quality of the environment. It determines the dew point of the air leaving the cooling coils, which in turn determines the temperature to which air must be reheated to keep the relative humidity from rising above 50 percent. IPI's suggestion was acted on by the senior project manager of Capital Planning and Construction at NYPL, and the resulting lower summertime chilled water temperature significantly improved the environmental conditions in collection storage areas in NYPL's Humanities and Social Sciences Library. In this way, the preservation metrics had a direct, positive impact on the institution and the collections.

Seminars: The new IPI-George Eastman House partnership, known as the Center for the Legacy of Photography, will expand an already successful program of education seminars about photography and film preservation.

Museum of Photography and Film in Rochester to launch the Center for the Legacy of Photography. The center, made possible by a $2 million grant from the Mellon Foundation, will focus on collecting and sharing knowledge about photographic materials from the previous two centuries.

The goals of the Center for the Legacy of Photography are to articulate the importance of understanding silver halide photography, ensure the study of its uniqueness as a fine art and visual communication medium, and document its technology and materials.

The center's work began this fall at the conclusion of the 10-year Advanced Residency Program in Photograph Conservation, which is building awareness among conservators as to the urgent need for advanced education and training opportunities in photograph conservation. One of the intended outcomes is to create a clear distinction between digital imaging and silver halide photography.

Grant Romer, director of the Eastman House's Advanced Residency Program, says this current partnership with IPI relates directly to rapid changes in photographic technology. He says the line between photography's past and what it has become needs to be drawn.

"The art of photography and the enormous archival record created by means of traditional photography represent a legacy that must be understood and preserved," states Romer. "As silver halide photography passes into history, with it will pass its industrial technology, its aesthetic and commercial context, and nearly all first-hand knowledge of its chemistry, materials, and processes. We must understand and define the ways in which the material nature of silver-based photographs differs from that of digital images and to make clear that the preservation and interpretation of the two pose distinctly different challenges, originating in different material and cultural contexts."

A dedicated Center for the Legacy of Photography website will promote the knowledge and activities of the Center and offer scholarly resources, access to original research, downloadable educational materials, and announcements of the Center's events and activities.

As time marches on, IPI will retain its focus on environmental initiatives as the building blocks for its preservation activities. But Reilly also sees the institute becoming more connected through educational ventures, serving as a hybrid between the tactical and applied aspects of its craft—a strategy that plays well into RIT's combined right-brain, left-brain proficiencies.

"We really live in this middle ground between technology and art and culture, and when it comes to the survival of the physical objects of art and culture, that's where you need the middle ground."

Preserving Virtual Worlds


Andrew Phelps


Heather Arbiter


Christopher Egert


Elizabeth Lawley

Interactive media, such as video games, provide significant insight into our culture and norms and could assist future generations in gaining a deeper understanding of our society. However, these types of media are highly complex and at a high risk for loss as technologies become obsolete.

In response, a team of researchers in RIT's B. Thomas Golisano College of Computing and Information Sciences (GCCIS) is exploring methods for preserving digital games and interactive fiction through the Preserving Virtual Worlds project.

The group, led by Andrew Phelps, director of the game design and development program at GCCIS, is developing basic standards for metadata and content representation, while also conducting a series of archiving case studies for early video games, electronic literature, and Second Life.

"Addressing the problem of their preservation means preparing for a future in which an increasing proportion of what we create will be born digital and will take fuller advantage of networked, new media environments," notes Phelps. "These virtual worlds are actualized in user experiences that are sometimes unique, often social, and always necessary for understanding these worlds."

Just as an archived book is of limited use if researchers cannot open its cover and read it, an archived world will be of limited use if researchers cannot visit it. Unless solutions for preserving user experiences are developed, future generations will have no way to understand how these experiences became such an important part of our culture.

The Preserving Virtual Worlds project team also includes Elizabeth Lawley, director of the lab for social computing, Christopher Egert, assistant professor of information technology, and graduate student Heather Arbiter. It is funded by the Preserving Creative America initiative under the National Digital Information Infrastructure Preservation Program (NDIIPP), administered by the Library of Congress.

Preserving Gaming History: Second Life (top) and Tetris (bottom) are among the many games being archived in the Preserving Virtual Worlds project.

Image Restoration: Archimedes Set Free


Roger Easton

The Archimedes Palimpsest is a 10th century Byzantine manuscript that contains a transcription of seven treatises by Greek mathematician Archimedes (287-212 B.C.), including "On Floating Bodies" and the only extant copy of his "Method of Mechanical Theorems," which combined mathematics and physics. In April 1229, a monk scraped away Archimedes' theories and drawings, cutting and rebinding the parchment for use as a prayer book, a common practice resulting in an overwritten book or "palimpsest."

Palimpsests were often bound from random pages of discarded manuscripts, making for occasional surprises during document recovery. Scholars now attribute 10 pages of the Archimedes Palimpsest to the Greek orator Hyperides.

The Archimedes Palimpsest was acquired in 1998 and entrusted to the care of the Walters Art Gallery in Baltimore for conservation and study. Roger Easton, professor of imaging science, became part of an international team of scholars, conservators, and scientists invested in the recovery of the overwritten document.

The RIT team used a variety of ultraviolet, visible, and infrared wavelengths to separate the script and drawings from the liturgical text. According to Easton, the ongoing project has successfully extracted approximately 90 percent of the text using multispectral imaging. The findings of this team have been recently revealed as Archimedes is "Set Free;" see their website at www.archimedespalimpsest.org/.

The Archimedes Palimpsest: The manuscript as it appears in normal light (left); as it appears with UV light revealing the underwriting (right). (Copyright resides with the owner of the Archimedes Palimpsest.)

Transforming Crime Analysis

by Marcia Morphy

Through criminal justice research and innovation, Rochester has become a model for how universities and cities can provide strategic crime-fighting solutions through the use of technology.

A Partnership that Saves Lives

Two years ago, the City of Rochester and Rochester Institute of Technology collaborated to create the Public Safety Initiatives Center (PSIC), charged with developing an anti-violence master plan that would involve law enforcement, government services, and community assets. The center, is located at RIT and has a presence in City Hall and police headquarters.

At the helm is PSIC director John Klofas, professor of criminal justice in RIT's College of Liberal Arts and chairperson of the department—who continues to serve as loaned executive to the city.

As Klofas says, "It's a great honor to work with such strong leaders in this community, but for me, my colleagues, and our students, there is an overwhelming sense of responsibility with

Analyzing crime in real time: Robert Duffy, Mayor of Rochester, NY and Professor John Klofas are collaborating to make communities safer. Klofas leads a multi-agency partnership designed to enhance the use of technology in crime analysis, providing quicker, more accurate data for use by public safety officials. Klofas' research is serving as a model for local and national efforts to reduce crime. Duffy states the efforts of Klofas and RIT have "literally saved lives in our community."

RIT's efforts to reduce violence and to improve the quality of life for our neighbors in Rochester and across the country."

With $3.5 million in grants from the U.S. Department of Justice and New York state, all designated to help support local criminal justice, RIT has utilized its research capabilities in helping the Rochester Police Department's (RPD) Crime Analysis Unit in identifying crime patterns, hot spots, and trends, and also provides deputies and investigative officers with information necessary to identify criminal offenders. The city's Crime Analysis Unit consists of police officers and civilians working together to not only monitor the level of crime in the city, but proactively identify crime prevention opportunities.

Research Helps to Reduce Homicides

In charge of the "civilians" is Christopher Delaney, crime research specialist at RPD's Special Investigations Unit. After graduating from RIT's criminal justice program in 2001, Delaney was enlisted by Klofas to serve as his graduate research assistant under the Strategic Approaches to Community Safety Initiative (SACSI) federal grant.

"I focused on how qualified research could help reduce homicides in Rochester, and while I was pursuing my master's degree in public policy, I spent time in the RPD's Homicide Unit conducting research on the characteristics of homicide in Rochester and the implications for prevention," Delaney says.

But as he explains about his current position, "the Crime Analysis Unit is not like CSI or forensics." Instead, his team focuses on tactical analysis—responsible for the coding of crime data through a computerized reporting system while looking for "patterns and more patterns" in homicides, robberies, burglaries, larcenies, and youth gangs.

"The center acts as a force multiplier for our existing resources, and more importantly for what we are currently developing to be housed in RPD, the Monroe Crime Analysis Center,

Rochester Chief of Police David T. Moore (center) and Professor Klofas at a Public Safety Meeting:
Professor Klofas confers with Rochester and public safety officials during a recent meeting. Klofas serves as an advisor to the city chief of police and the county district attorney and sheriff's offices on issues related to crime analysis and assessment.

which is a single source for crime analysis for the entire county."

Rochester Mayor Robert Duffy says it's a good example of working smarter, not harder, and the police department "would never have had someone like Delaney 20 years ago, who now is literally running the show."

"He really gets it and so does his team," Duffy says. "It's a seamless operation and works as one by taking theory and putting it into practice. When you look at crime analysis, maybe a police officer or a detective is very good at investigating and interviewing people, but as for analyzing complex data, they are not equipped to do that."

"The past two years of our partnership have been an effort that comes down to one thing, one thing I care about deeply—it saves lives, it has saved lives, and it will save lives. Looking at what we do, we should have five homicides a year, not 30-plus."

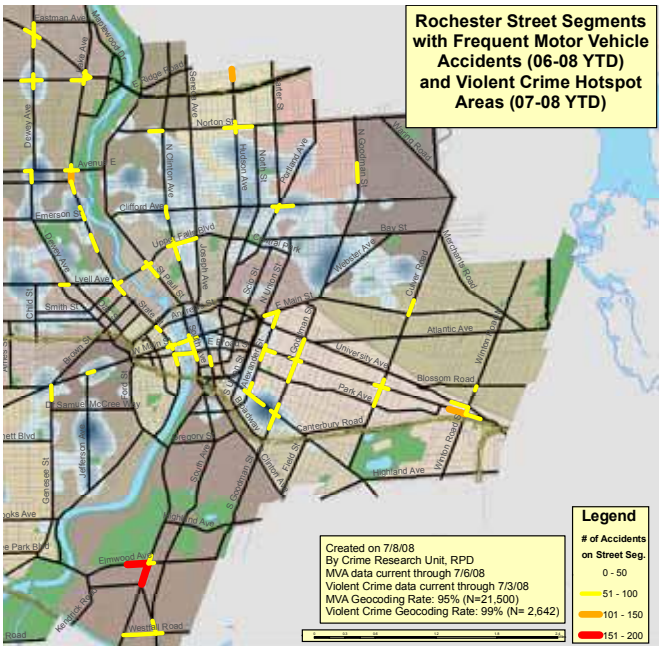
Data Speaks

Adding to Duffy's continued frustration is the knowledge that many single crimes in the city are committed by high school dropouts. "There's data to prove there's an incredible connection between educational failures and crime. Right now we have 52 percent of kids dropping out of school and 40 percent graduating—and these statistics become a feeder chain for crime."

On the other hand, the PSIC collaborative effort has been an instrumental resource for crime convictions, according to Monroe County District Attorney Michael Green. Since he took office in 2004, Green has been busy combating violent crime and homicides by targeting armed violent felons, drug dealers, and those illegally carrying guns.

"When I took over as D.A., I changed some policies on how we handled gun cases, how we handled non-violent felony cases, and changed procedurally some of the ways we handle felony cases such as

Monroe County Crime Analysis Unit: Focusing on tactical analysis, the unit, led by RIT alumnus Chris Delaney, is responsible for the coding of crime data through a computerized reporting system, analyzing homicides, robberies, burglaries, larcenies, and youth gangs. The unit advises the public safety community on trends in local crime.



Violent Crime and Motor Vehicle Hotspots: Working with the National Highway and Traffic Safety Administration, the Monroe Crime Analysis Center has examined the links between violent crime and motor vehicle accident hotspots. The chart above illustrates overlap between high traffic accident areas and violent crime hotspots (shown in gray).

not doing preliminary hearings or taking the cases to the grand jury," Green says. "Anecdotally I would always hear, 'Gee, you are losing more trials, you're getting more acquittals, you're indicting too many cases.' But when you take 5,000 felony cases a year, and the conviction percentage goes down from 96 to 90 percent, but the overall number of convictions goes up 300—I needed some accountable data based on research to study the effectiveness of my plan, and that's where John and his students came in."

The end results showed that Green's policies were doing exactly what he wanted them to do. "The reason we were losing more cases is that we were being much more aggressive as far as the cases we were seeking convictions on—convicting and sending more violent felons to prison, particularly those with handguns. These were tough cases, and we weren't winning every one, but we were holding a lot more people accountable and also getting more prison sentences on non-violent felons."

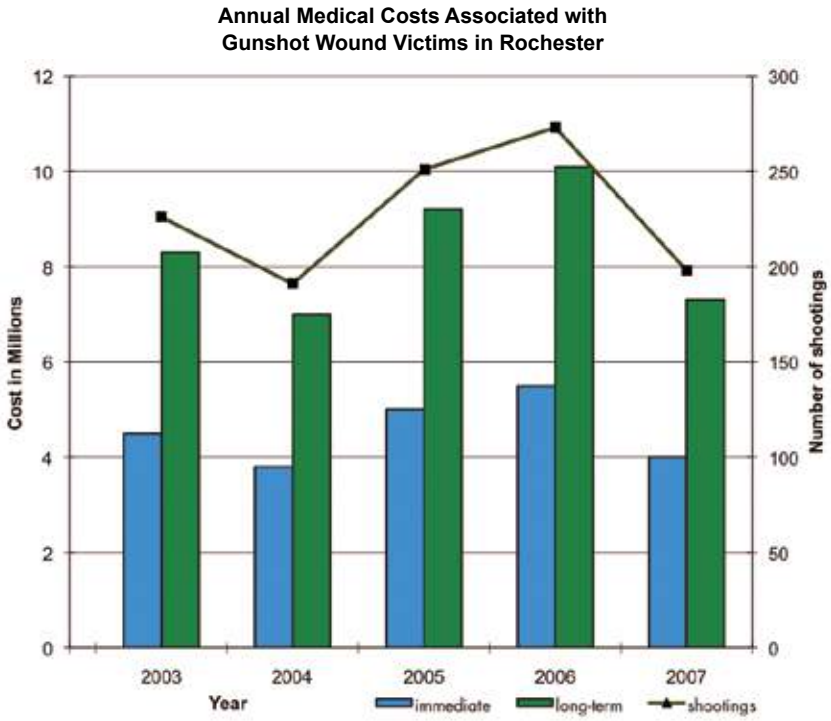
As Green admits, it's hard to evaluate the effectiveness of a policy after it's been implemented, even when the goal is to make the community safer by keeping armed felons, drug dealers, and repeat offenders off the streets. "We were testing the waters to see if stiffer sentences and limited plea bargaining would work, and John's feedback on the changes we made—including comparisons of felony cases in Syracuse, Buffalo, and Albany—showed positive results that we were measuring up."

Violence and Medical Costs

Janelle Duda is a new researcher recently hired by Klofas to join the RIT center's team, and the crime data she is working on is something Klofas has been interested in studying and examining for many years.

"I'm working on violence in the Rochester community and specifically

Analyzing Hospital Data: Janelle Duda, an RIT graduate student, is currently working with Professor Klofas to assess the medical costs of violent crime.



Crime Data–Gunshot Wounds and Medical Costs: Preliminary findings on the medical costs attributed to treating gunshot wound survivors in Rochester. A correlation can be observed between the number of gunshot wound victims and the costs of long-term care in Rochester. The current research is working on obtaining more precise cost and charge data associated with local medical treatment for gunshot wounds.

on the medical costs associated with the violence," says Duda.

"It's something people don't think about: the aftermath of street violence when victims are treated at area hospitals and medical facilities. Do they have insurance to cover the cost of emergency care and rehabilitation?"

Working with local hospitals and agencies, Duda is gathering information on gunshot wound victims, victims of stabbings and blunt trauma, and assault victims—tabulating those who have commercial insurance like Blue Cross Blue Shield or Preferred Care, those on Medicaid, and those with no insurance at all. "Part of our data will include how hospitals are recouping their losses for those without insurance," Duda explains.

A Revolution in Law Enforcement

This kind of data can only add to the bigger picture, Klofas believes. "There's been a revolution in law enforcement, policing, and criminal justice overall because of the use of analysis, information, and data. It's a form of intelligence, building a database on who the serious criminals are in town, what places are crimes more likely to occur, the temporal patterns, the geographic patterns, and what kinds of individuals are involved."

As Mayor Duffy affirms, "Looking at all the citywide crime, shootings, victims, and breaking it all down, it's become a great merging of highly technical skills in this field. RIT is our MIT—and to have talented kids who are doing research in criminal justice and groom them to make a difference—it's why RIT is a great research-building university."

As part of RIT's commitment to experiential learning, Klofas, who has been teaching at RIT for 20 years, is currently working on establishing a master's degree program in criminal justice to "continue on in this tradition of locally relevant policy research."

"We want to be the model for university and community relationships in addressing areas of local violence," Klofas says. And according to Rochester's mayor, Klofas has accomplished just that.

"I am proud to call John Klofas a friend as well as a colleague and he is one of the shining stars in this community who has never received enough credit for what he has done. Here he has a national profile, and travels across the country, but still attends weekly meetings with Police Chief David Moore. In essence he's almost an adjunct crime-analysis leader with the police department. With John and the center on my team, I never get discouraged, because we are all rowing forward together."

Cybercrime Starts Young

Samuel C. McQuade

RIT research on cybercrime by and among youth and young adults is shedding new light on the types of offenses and activities our children are engaging in.

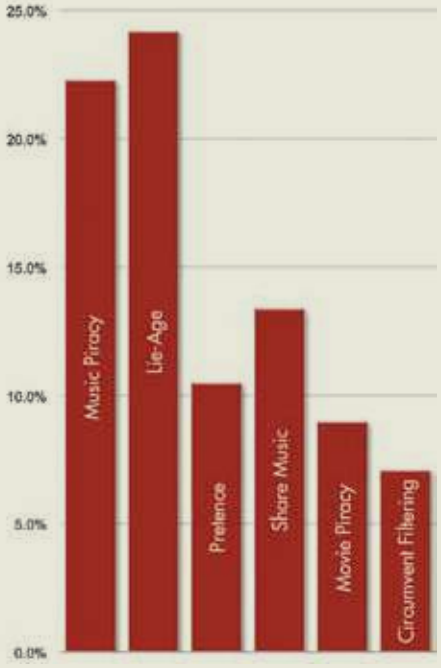
According to Samuel C. McQuade, graduate program coordinator in the Center for Multidisciplinary Studies, "The old paradigm of computer criminals being only insider employees or hackers who cracked passwords and defeated firewalls is no longer exclusively true. Today's high-tech offenders include millions of youth who grow up using portable electronic devices and the Internet in often abusive, harmful, or criminal ways."

Research findings from RIT's *Survey of Internet and At-Risk Behaviors* of over 40,000 K-12th grade students reveal that victims and offenders of cybercrimes often know each other in advance through social computing and/or in-person interactions. The data collected also reveals that cyber bullying begins in the 2nd grade; pirating of music, movies, and software begins in 4th grade; students in grades 7-9 experience all known forms of cyber offending and abuse, and they begin to specialize in committing certain forms of high-tech offending; and in grades 10-12 all but cyber bullying increase.

"Implications related to our youth and use of the Internet, as well as for protecting our critical information infrastructures, are huge," says McQuade.

McQuade is now partnering with the National Center for Missing and Exploited Children, the FBI's InfraGard program, the Information Systems Security Association (ISSA), along with school districts throughout the region in the RIT-led Cyber Safety and Ethics Initiative. The collaborative effort seeks to utilize the data developed to address needed policy, professional training, and curricular reforms, as well as to engage industry support in these areas. Initial funding for the effort has been provided by Time Warner, Inc., Symantec Corporation, Arbor Networks, and several school districts.

Learn more at www.bcybersafe.org.



Offenses: 7th-9th graders reported committing the above offenses in the past year.

Cracking Counterterrorism with Mathematical Methods

Bernard Brooks

Anthony Harkin

If the science of WWI was chemistry and the science of WWII was physics, then mathematics is the most influential science in today's global security efforts.

Since 2001, tremendous amounts of information have been gathered regarding terrorist cells and individuals potentially planning future attacks. There is a pressing need to develop new mathematical and computational techniques to assist in the analysis of this information, both to quantify future threats and to quantify the effectiveness of counterterrorism operations and strategies.

RIT's School of Mathematical Sciences has made a number of contributions to this field through their education and research efforts and is currently leading a counterterrorism consortium of academic institutions and industry partners. The Consortium for Mathematical Methods in Counterterrorism seeks to enhance the use of mathematical sciences in counterterrorism and global security analysis, while helping to improve course work and training for intelligence analysts and counter-terrorism researchers.

Mathematical Analysis of a Communications Network: Mathematical and computational algorithms are used by intelligence agencies to monitor and analyze vast amounts of data flowing through large communications networks. These algorithms can uncover patterns which help reveal the structure of a terrorist organization.

The collaboration was launched last year at the fourth conference for Mathematical Methods in Counterterrorism (CMMC), hosted at RIT, and drew researchers from around the world, including Denmark, England, Canada, and the United States. Some of the themes that emerged were the use of social network theory, lattice theory, and game theory to model terrorist organizations.

Anthony Harkin and Bernard Brooks, both professors of mathematics at RIT who led the founding of the consortium, have focused their efforts on simulations of large-scale evacuations, which will improve disaster planning and improved mathematical modeling to analyze rumor flow in a social network, respectively.

This year's CMMC conference will be held at the American Association for the Advancement of Science in Washington, D.C. (cmmc.rit.edu).

Research Awards and Honors

RIT values the research contributions of its faculty, staff, and students and honors these accomplishments with an annual Principal Investigators Reception. Below we highlight members of the RIT community who have received significant national and international recognition this year.

Trustees Scholarship Awards

The Education Core Committee of the RIT Board of Trustees awards up to three Trustees Scholarship awards each year to RIT faculty who demonstrate outstanding scholarship. Three were awarded in 2008:

David Axon, chair of the physics department in the College of Science, is considered an international expert in the physics of active galactic nuclei and black holes. He is currently a member of the issues and program committee for the University Space Research Administration. Prior to joining RIT, Axon served as a European Space Agency Scientist with the Space Telescope Science Institute in Baltimore.

Rick Hirsch, professor of ceramic arts in the School of American Crafts in the College of Imaging Arts and Sciences, has spent over three decades as a ceramic artist and teacher. He has received a fellowship from the New York Foundation for the Arts and was also the subject of a national touring exhibition, "The Uncommon Denominator: A Tribute to Rick Hirsch."

Santosh Kurinec, head of the microelectronic engineering department in the Kate Gleason College of Engineering, focuses her efforts on electronic materials research and the further development of outreach efforts to elementary and high school students. Kurinec has twice won Texas Instruments' Douglas Harvey Award and is a senior member of the Institute for Electrical and Electronics Engineers.

Fulbright Scholars

The Fulbright program, sponsored by the U.S. Department of State, is the nation's largest international exchange program offering advanced research and teaching opportunities for students and scholars. RIT faculty member Joseph Fornieri received a Fulbright award in 2008.

Joseph Fornieri, an associate professor of political science in the College of Liberal Arts, used his Fulbright award to travel to Prague, Czech Republic, where he served as a Fulbright cultural ambassador, taught courses on American politics at Charles University, and conducted research comparing Czech democratic institutions with those of the U.S.

National and International Recognition

Margaret Bailey, Kate Gleason Endowed Chair in the College of Engineering, received the 2008 Women in Science Award from the Maria Mitchell Association, a national science education center and museum named for America's first professional woman astronomer. Bailey was honored for her work as director of the Women in Engineering program at RIT. In addition, Bailey and We@RIT received the 2008 Women in Engineering Program Award from the Women in Engineering Proactive Network, or WEPAN.

Manuela Campanelli, the director of the Center for Computational Relativity and Gravitation in the College of Science, has been elected an officer of the American Physical Society's Division of Computational Physics. The Division of Computational Physics seeks to enhance the use of supercomputers in physics research, while also utilizing physics concepts to improve computer performance.

Wendell Castle, artist-in-residence at RIT's School of American Crafts, has been awarded the Modernism Lifetime Achievement Award from the Brooklyn Museum. Castle is considered the father of the art furniture movement and his works are featured in the Metropolitan Museum of Art and the Smithsonian Institute. The Brooklyn Museum is one of the oldest and largest art museums in the nation.

Edith Hemaspaandra, professor of computer science in the B. Thomas Golisano College of Computing and Information Sciences, has received the Friedrich Wilhelm Bessel Research Award from the Humboldt Foundation. The Bessel award goes to emerging scientists who demonstrate significant development of cutting-edge research early in their careers. Hemaspaandra will utilize the award to advance her work in the area of computational social choice.

Joel Kastner, professor of imaging science in the Center for Imaging Science, was named a Visiting Astronomer at the Astrophysics Laboratory of Grenoble, also known as LAOG, which is affiliated with France's Joseph Fourier University. Kastner's year-long sabbatical with the lab focused on research related to new techniques and developments in X-ray and radio astronomy.

Robert Manning, research professor and director of consumer financial services in the E. Philip Saunders College of Business and author of Credit Card Nation, has been named a Research Fellow of the Filene Research Institute. The Filene Research Institute is a non-profit organization dedicated to analysis of the consumer finance industry.

Marc Marschark, director of the Center for Education Research Partnerships at the National Technical Institute for the Deaf, has been named an honorary professor at the University of Edinburgh, Scotland. Marschark's efforts with the university focus on enhancing educational access for deaf and hard-of-hearing students, examining the cognitive and social foundations of learning by deaf students, and fostering teaching practices that better support deaf students in all aspects of their development and learning.

Stephanie Maxwell, chair of animation in the School of Film and Animation, was the subject of a 2008 DVD retrospective entitled Stephanie Maxwell, Animated Works 1984-2007. The project, produced by the iotaCenter, chronicles Maxwell's groundbreaking animation style, which includes the use of painting and hand engraving directly on 35 mm film. Maxwell is also the co-founder of the Rochester-based Image-MovementSound performing arts festival.

John Morelli, the Russell C. McCarthy Chair in RIT's College of Applied Science and Technology, has been named head of the Environmental Management Leadership Initiative, an international university collaborative designed to enhance education and training for environmental managers. The effort includes a series of academic symposia held in the U.S., Europe, and Asia and the development of the website environmentalmanager.org, an online resource for professionals and researchers in the field.

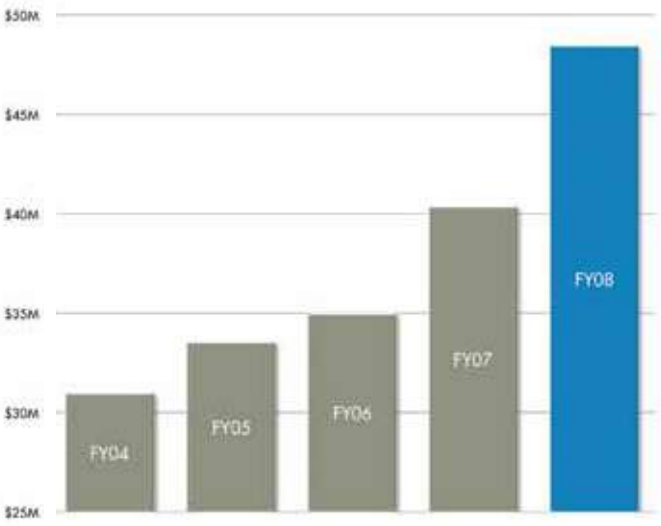
An RIT student team composed of **Ziyan (Joe) Zhou, Adam Risi,** and **Zachery Shivers** won an Engineering Excellence Award at the 2008 Microsoft Imagine Cup World Finals. The team programmed and configured a network of sensors to take readings of environmental variables such as temperature and humidity, and set the system up to be accessible via cell phone. The team's design previously won the Software Design Invitational at the U.S. Imagine Cup finals. The Microsoft Imagine Cup, founded in 2003, is one of the premier student design competitions in the world, featuring teams from a host of international colleges and universities that compete in nine categories related to science, engineering, and computing.

About This Section

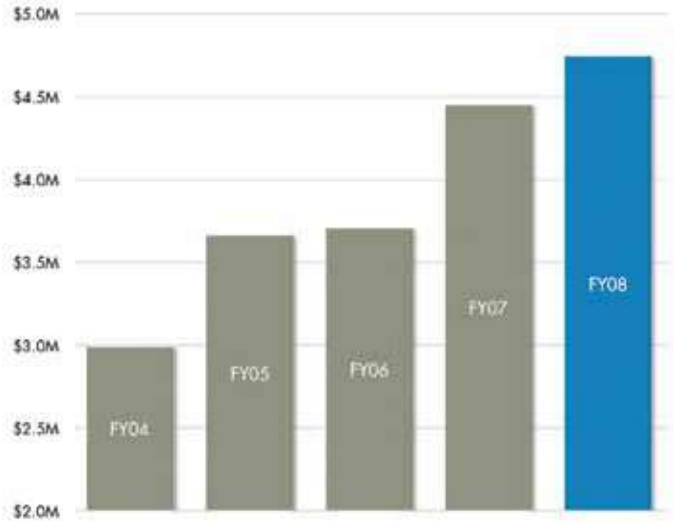
This listing is a sample of awards and honors that have been received by RIT faculty and staff over the past year. For more information, please visit www.rit.edu/news.

Financials

RIT continued to grow its research portfolio in the fiscal year ending June 30, 2008, receiving a total of $48.5M in research funding. In the past five years, NSF grants have grown by 60%, representing a significant expansion in fundamental science and engineering research at RIT.



Value of Awards Received



National Science Foundation Awards

Building Research Collaboration

These awards reflect the combined efforts of 232 principal and co-principal investigators, along with numerous research personnel and supporting staff. Although federal and state agency programs have become significantly more competitive and many agency research budgets have declined, RIT has continued to grow research in several areas.

In December 2007, President Destler called together a task force, led by Vice President for Research Donald Boyd, to develop RIT's strategy to grow annual research awards to $100M. The task force concluded that growth would necessarily involve increased collaboration across colleges to address the complex research questions facing the world and the academy today.

The task force identified six interdisciplinary research programs where RIT leads the field or is poised for significant growth:

Sustainability

The establishment of the Golisano Institute for Sustainability demonstrates RIT's commitment to sustainability as a major interdisciplinary research thrust. Across RIT, researchers are tackling complex problems related to fuel cells, nanopower, and the product life cycle.

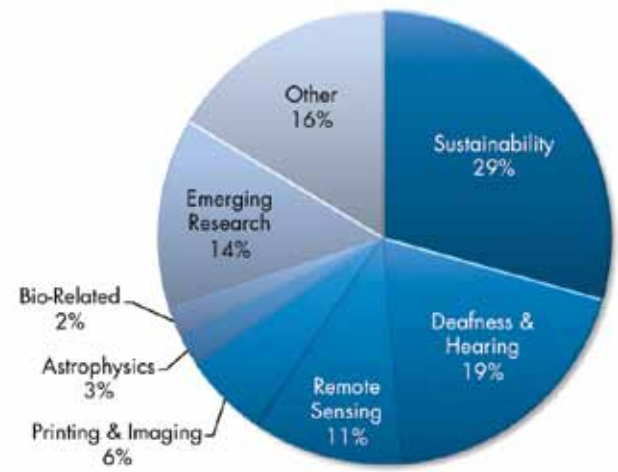
The New York State Department of Environmental Conservation made a $2M award to RIT to host and implement the New York State Pollution Prevention Institute, a research and development center that will design and test green manufacturing methods and give technical support to business to reduce pollution.

RIT received over $14.3M in new awards related to sustainability this year.

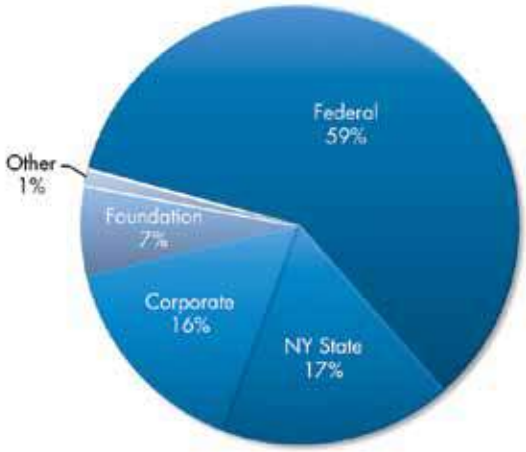
Deafness & Hearing

Researchers at NTID and in other units are engaged in a variety of sponsored projects involving hearing enhancement, deaf education research, assistive technology and outreach, and deafness and

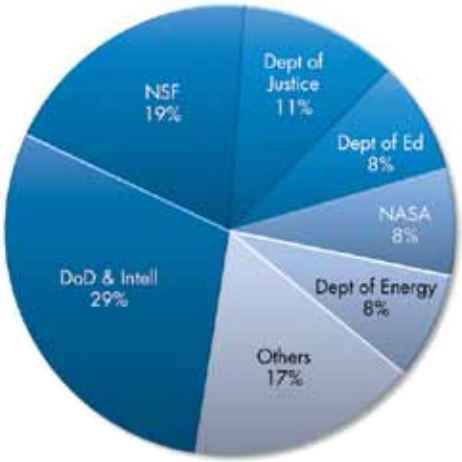
FY08 Awards by Research Area



FY08 Awards by Funding Source Type



FY08 Awards from Federal Sponsors



hearing research this year.

The Nippon Foundation of Japan awarded $1.1M this year for NTID to expand its role in improving deaf education and career opportunities for deaf people around the world.

Remote Sensing

In the College of Science's Chester F. Carlson Center for Imaging Science, RIT has labs dedicated to the development of hardware and software tools to work with remotely sensed data; research and implementation of data processing algorithms; and the design, development, and implementation of advanced sensor technologies. RIT received $5.2M in new awards related to remote sensing this year.

Printing and Imaging

Researchers from multiple colleges are engaged in projects related to the world of print in various ways. Overall, RIT received $3.0M in FY08 research awards from foundations, federal agencies, and private companies for work in this area.

Astrophysics Science

RIT has steadily gained a reputation as a leader in astrophysics and received $1.2M in new sponsored research awards this year for projects in areas including theoretical research, observational astronomy, and sensor and instrument development.

Bio-Related

Bio-related research comprises interdisciplinary investigations in the life sciences. Although RIT does not have a medical school, significant research in the life sciences is emerging in distinct areas. In the last fiscal year, RIT researchers received nearly $1 million in new research awards focused in some way on the life sciences and the human body.

Emerging Research

In addition to these established research areas, RIT has received $6.6M in funding for emerging research areas, including microsystems, criminal justice, and computing.

Other Research

Naturally, RIT has a broad range of researchers working in other diverse fields. These areas have received $8.0M in funding.

Funding Source

RIT continues to build relationships with New York state agencies, foundations, and corporations. In FY08, RIT received research awards of $8.3M from New York state, $3.2M from foundations, and $7.6M from private corporations.

Federal Sponsors

Federal agencies continue to support the diversity of research at RIT. Defense and intelligence agencies funded $7.3M in new awards, as did the National Science Foundation ($4.8M), NASA ($1.9M), the U.S. Department of Energy ($1.9M), and NIH ($1.0M).

R·I·T

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Rochester Institute of Technology
RIT is one of the largest private universities in the world. With a unique blend of rigor and imagination, of specialization and perspective, of intellect and practice, RIT is a vibrant community of ambitious and creative students from more than 95 countries.

Rochester Institute of Technology is internationally recognized for academic leadership in computing, engineering, imaging technology, and fine and applied arts, in addition to unparalleled support services for students with hearing loss. Nearly 16,500 full- and part-time students are enrolled in more than 200 career-oriented and professional programs at RIT, and its cooperative education program is one of the oldest and largest in the nation.

For two decades, *U.S. News & World Report* has ranked RIT among the nation's leading comprehensive universities. RIT is featured in The Princeton Review's 2009 edition of *The Best 368 Colleges* and in *Barron's Best Buys in Education. The Chronicle of Higher Education* recognizes RIT as a "Great College to Work For."

Contact Information

We conduct research to advance the body of knowledge, enhance student and faculty learning, and build our reputation in the scientific and technical communities while providing positive returns to our sponsoring partners. Please send your feedback directly or through the RIT research website at **www.rit.edu/research**.

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