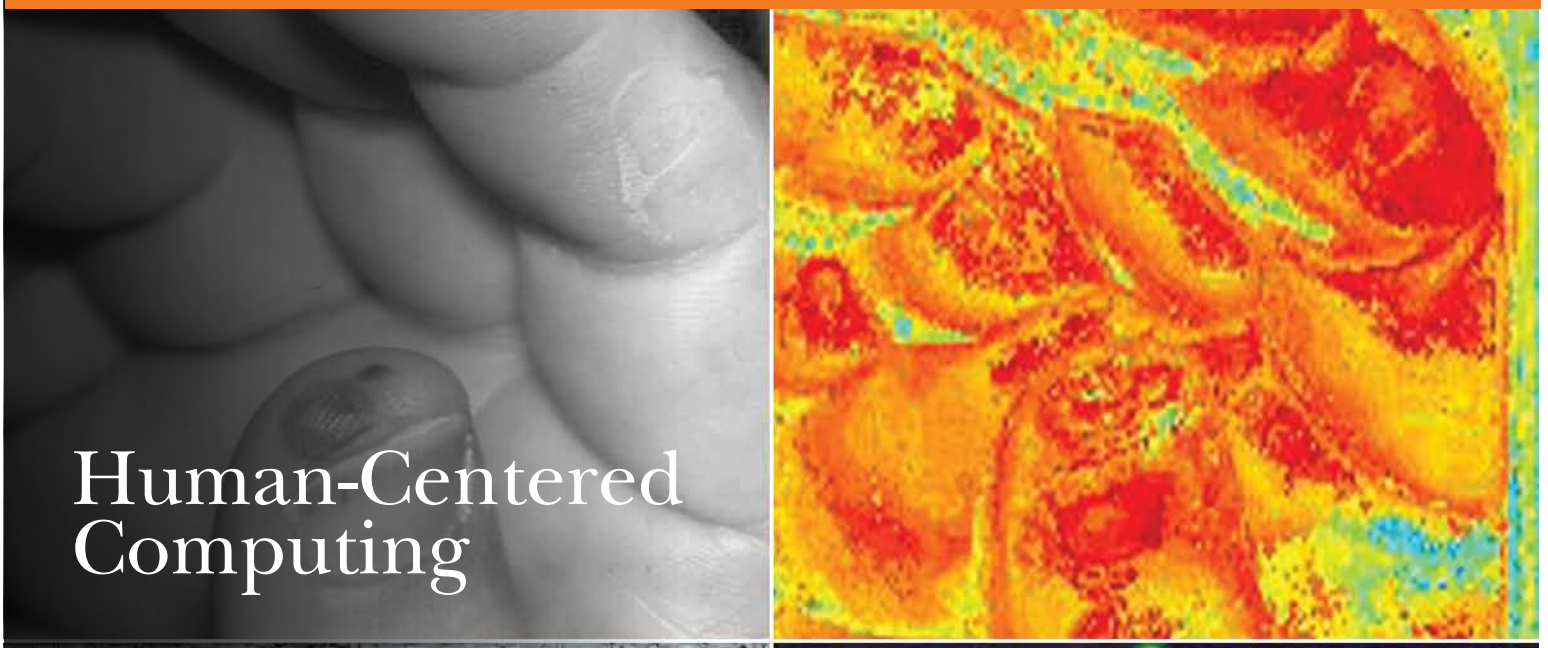
RESEARCH at RIT

The Rochester Institute of Technology Research Report

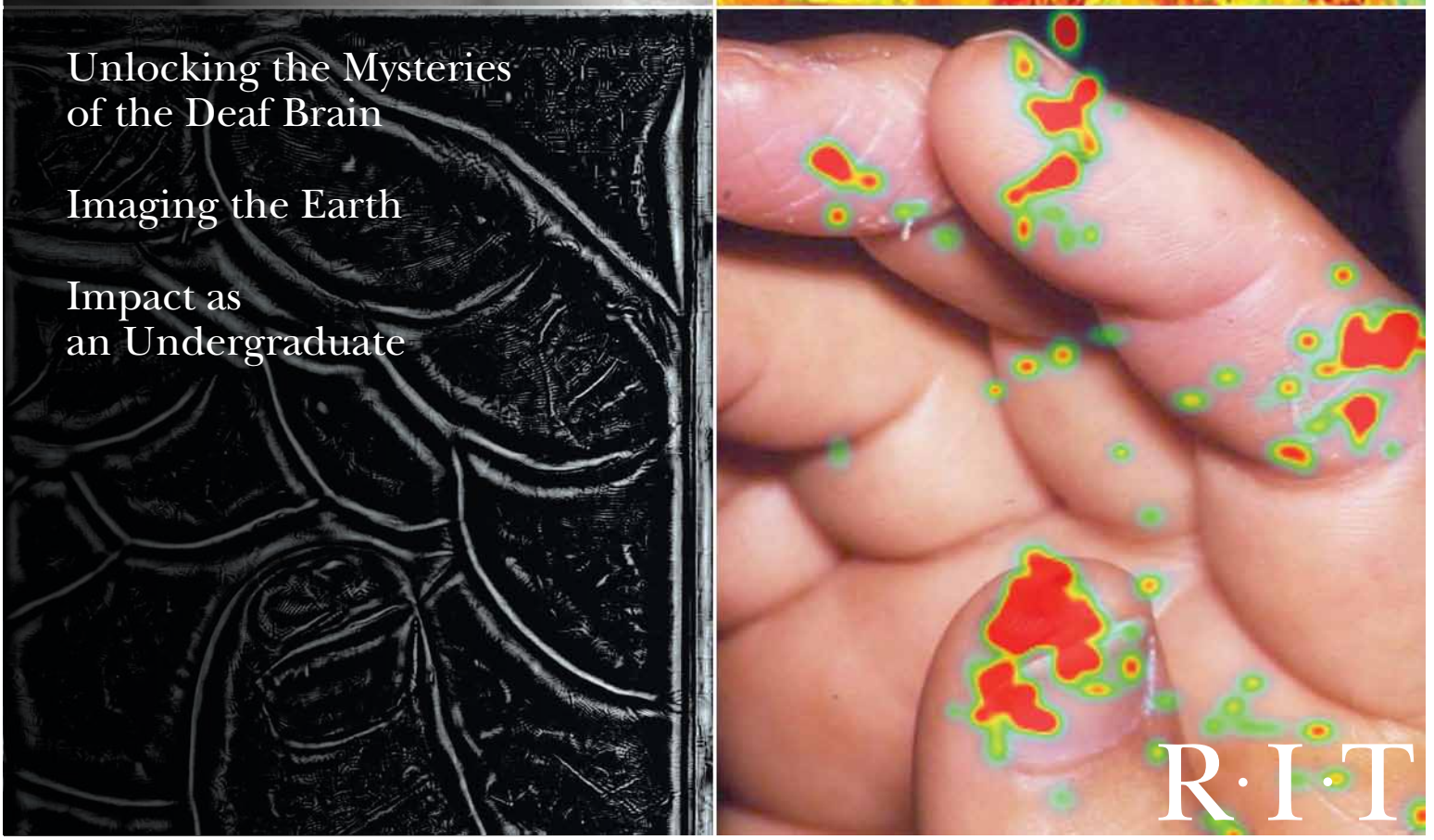
Fall/Winter 2012

SPOTLIGHT ON

COGNITION



Human-Centered Computing



Unlocking the Mysteries of the Deaf Brain

Imaging the Earth

Impact as an Undergraduate

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RESEARCH at RIT

The Rochester Institute of Technology
Fall/Winter 2012

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Advancing Cognitive Science

Rochester Institute of Technology is building on its traditional expertise in imaging, engineering, and experiential learning to create innovative programs and research initiatives that bring new ideas and technologies out of the lab and into society. As the new Vice President of Research I am extremely pleased to be able to continue to advance these efforts and promote the tremendous research accomplishments of our faculty, staff, and students.

RIT researchers are currently producing innovative results with substantial real-world impact in our key aras of strength including imaging science, sustainability, bio-x, and deaf research and education. The university is also expanding its research infrastructure and capabilities through the creation of the Institute for Health Sciences and Technology and the construction of a research facility for the Golisano Institute for Sustainability and NTID's first dedicated research building, Sebastian and Lenore Rosica Hall.

It is my hope that the continued expansion of research on campus will further our mission of providing high-quality, experience-based education to our students while advancing scientific discovery and innovation.

In the 8th edition of *Research at RIT*, we focus on efforts that are advancing what we know about the brain and how cognition can be better modeled to improve everything from human-computer interaction to understanding deafness.

A multidisciplinary team led by Anne Haake, professor of computing and information sciences, is seeking to advance the use and quality of biomedical image databases by modeling the expert knowledge of doctors to make image retrieval systems more "human." The work could ultimately improve the diagnosis and prognosis of a host of diseases from skin cancer to heart disease. In addition, psychologist Peter Hauser is working to uncover how cognitive processes and executive function operate differently in deaf and hard-of-hearing individuals and the impact this can have on everything from reading comprehension to medical diagnosis.

This edition also highlights RIT's 30-year contribution to NASA's Landsat satellite imaging program, which is providing integral data on changes to the Earth's temperature and climate. Finally, we spotlight four undergraduate students who are conducting cutting-edge research while also gaining experience and training that would not be available in the classroom.

I value your feedback and support as we continue to expand research on campus. Please feel free to contact me regarding these stories or other issues related to research at RIT.

Enjoy the breadth and the depth of *Research at RIT*!

Best Regards,

Ryne Raffaelle, Ph.D.
Vice President for Research

Inside this Issue

On the Cover

Calculated from an original medical image are, clockwise from bottom left, a phase-congruency map, a luminance-image, a color-based image segmentation, and an eye-tracking record. The first three in the series illustrate techniques for extracting information from an image while the fourth, using eye-tracking technology, shows how a physician examined the image. (Clinical images provided by Logical Images.)

Thinking like a Dermatologist: When collecting, retrieving, and analyzing complex biomedical images, many dermatologists are now using computer databases to assist with managing and manipulating large amounts of data. However, these systems often do not provide the same level of nuanced assessment or have the experiential advantage of human analysts. *Left to right*: Cara Calvelli, Anne Haake, Pengcheng Shi, and Jeff Pelz are leading an RIT team that is seeking to advance the use of these systems by modeling the expert knowledge of dermatologists and using it to make image retrieval systems more "human."

Human-Centered Computing

by William Dube

VIDEO LINK

A key problem in biomedical imaging is the difficulty of combining human expertise with the power of advanced computing. Researchers at RIT are attacking this problem by utilizing visual perception techniques, computer modeling, and computational linguistics to infuse human expertise into content-based image retrieval systems.

Creating Human-Centered Image Retrieval

Several years ago Anne Haake, professor in RIT's Golisano College of Computing and Information Sciences, undertook a sabbatical at the National Library of Medicine that included user research in Content-Based Image Retrieval (CBIR). The computer-based technique, which catalogs and retrieves images from a database of defined characteristics, is considered a potential technical improvement over current image databases used in medical diagnosis and prognosis.

"The images taken from an individual patient could be compared to previous images taken by that medical center or other centers around the world," says Haake, who was trained in biology and software development and now studies human-computer interaction and biomedical informatics. "Thousands of images could be handled and analyzed quickly and previous data about how tumors progress or how a particular disease may look at different stages could be easily transmitted to doctors."

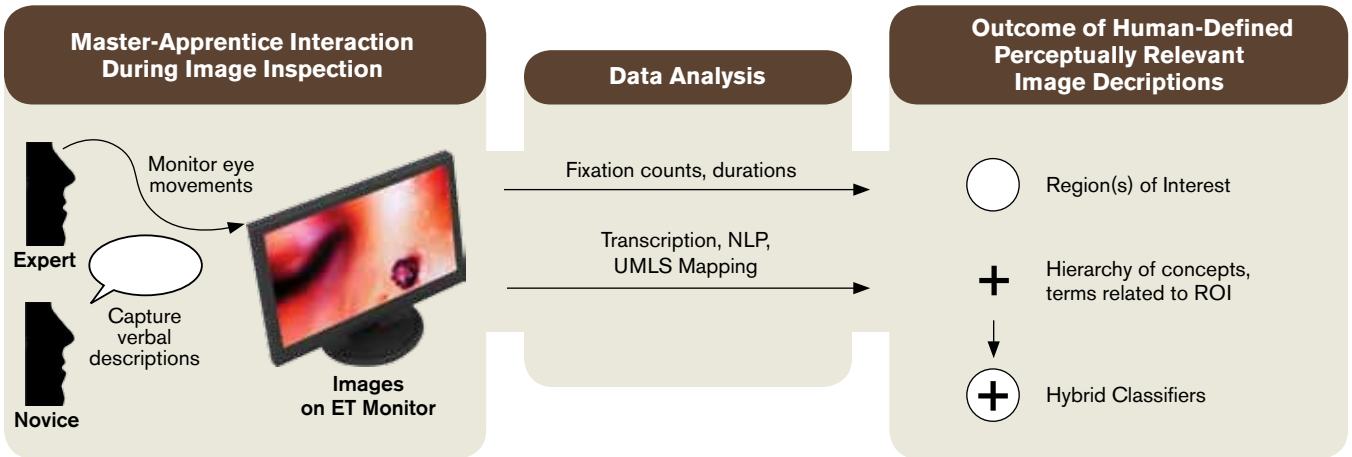
However, in reviewing different CBIR systems as part of her NLM research, Haake noted that the technology was hindered because it did not effectively take into account human analysis of the images themselves or the expertise of the analyst during the early design stages.

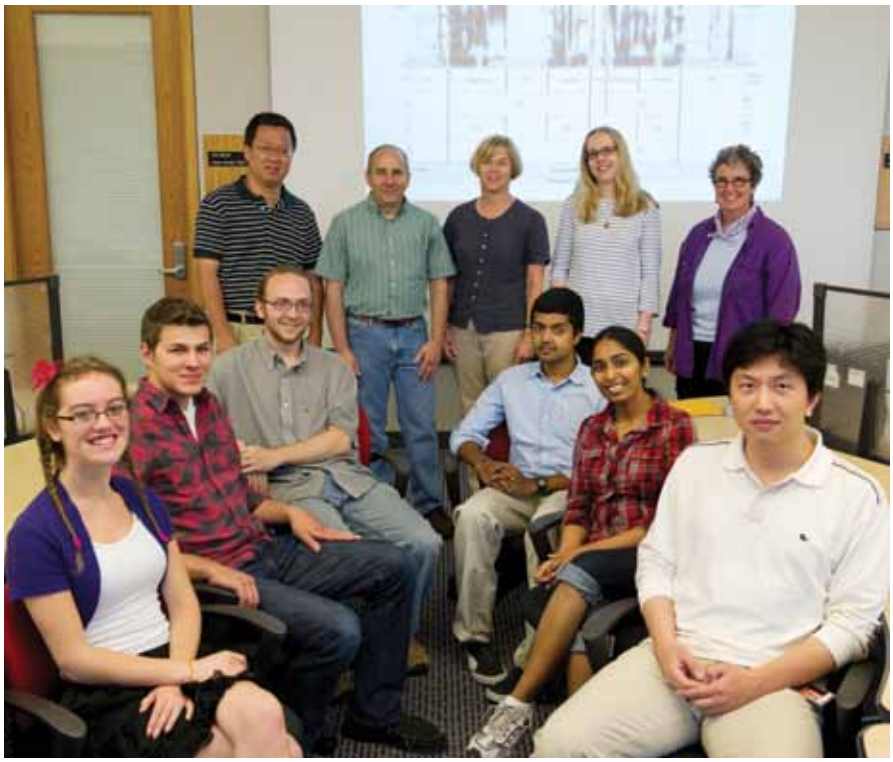
Analyzing Biomedical Images: The team is working with a group of dermatologists to develop a Human-Centered CBIR system for dermatology databases that has the potential to greatly enhance diagnosis and prognosis of diseases from skin conditions to cancer.

"CBIR assumes a certain level of uniformity in the viewer, that every person looking at the image sees it the same way, uses the same terminology to describe what they see, and has the same level of expertise," she adds. "However, this does not take into account expert knowledge and past experience, which are crucial in image semantics, making content retrieval and comparison problematic at best and impossible in some cases."

Haake has sought to address this issue by developing specific models of human expertise and tacit knowledge that can increase the overall "intelligence" of CBIR systems.

Through a multidisciplinary research team with imaging scientist Jeff Pelz, computer scientist Pengcheng Shi, dermatologist Cara Calvelli, and computational linguist Cecilia Ovesdotter





Multidisciplinary Research: To create a system that better models human decision-making, Haake assembled a multidisciplinary team of imaging scientists, linguists, computer scientists, and medical doctors. Together they are using eye-tracking and language analysis tools to collect domain knowledge and incorporate it into the design of the computer algorithms that power CBIR systems.

Collecting Expertise: Cara Calvelli, a trained dermatologist, discusses a series of biomedical images with Prati Date, a high school intern with the Center for Imaging Science. By monitoring the eye movements and language used as images are viewed, the team can create models of how both experts and students view and describe dermatological images.

Alm, Haake is seeking to create a next-generation, human-centered CBIR system that more directly incorporates expert cognitive processes. In addition, the team hopes to better model human-computer interaction to enhance overall system usability.

Enhancing the Human Component

"For many years computer designers argued that the algorithm itself was the end point," says Shi, director of RIT's Ph.D. program in computing and information sciences. "But the community has started to realize that equations themselves are not going to do the job. At the end of the day we need to more carefully consider the human in technology systems such as CBIR to make the data we are producing more useful."

To develop human-centered CBIR, the team has sought to objectify domain knowledge, the means by which experts in the field view, discuss, and analyze information, and incorporate it into the design of the databases and search functions that power CBIR systems.

"Through the use of machine learning, visual perception, and linguistics, we can better account for how people perceive and categorize images and incorporate this data into the computer algorithms used in CBIR systems," notes Shi. "Human-centered CBIR will ultimately produce more robust data that more accurately simulates human analysis."

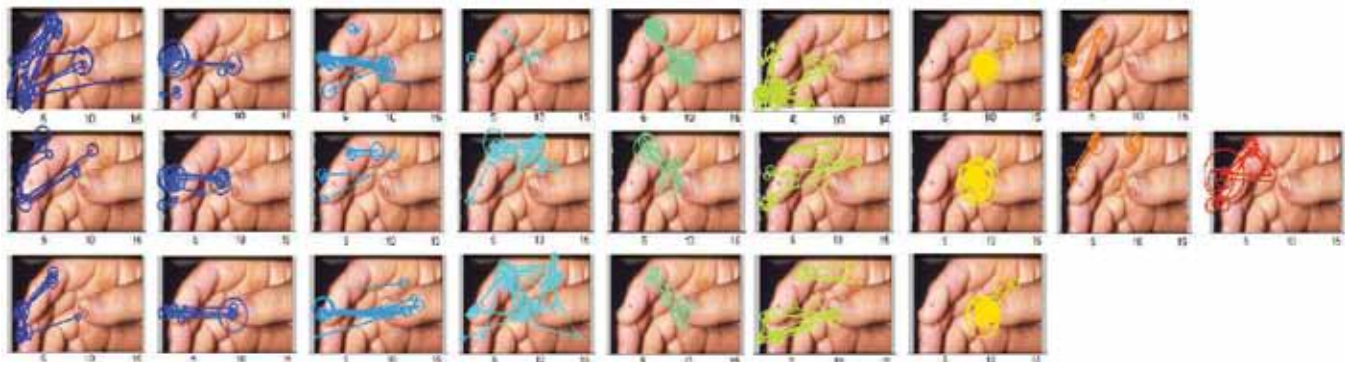
With support from the National Institutes of Health and the National Science Foundation the team is currently working to advance image understanding and develop a prototype CBIR system for analyzing dermatology images.

Led by Calvelli, a trained dermatologist who currently serves as an associate professor in the physician assistant program in RIT's College of Health Sciences and Technology, the team is working to analyze and collect expertise from dermatology experts, technicians, and students.

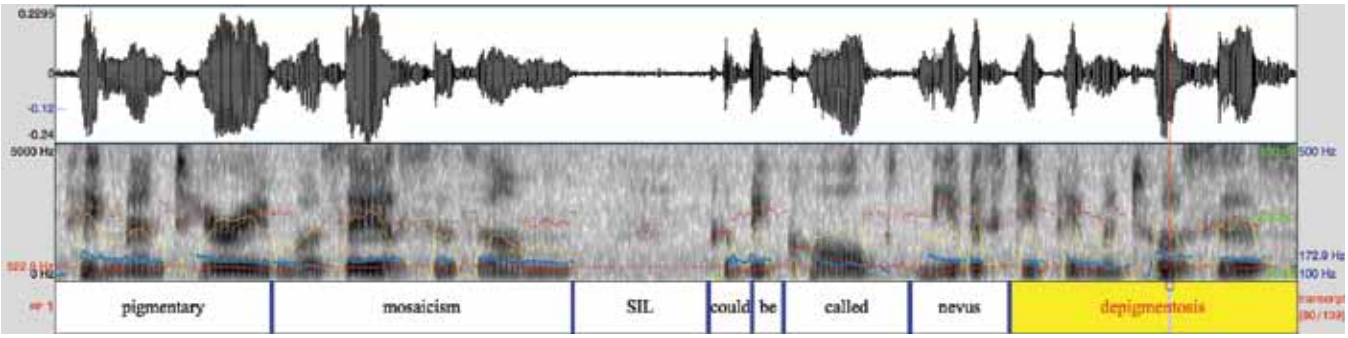
Utilizing probabilistic models and learning algorithms, the data collected will be used to develop multi-modal, interactive content-based image retrieval systems that take into account perceptual learning and cognitive processing in how images are categorized and retrieved.

The resulting CBIR system will be more usable, with a more robust search function and enhanced analysis capabilities. More importantly, it will better mirror the knowledge and expertise of the users utilizing the system.

"Through the collection of eye-tracking and linguistic data we can build models that account for the semantic and visual inputs that affect how an expert perceives an image, simulating the uncertainty inherent in human decision-making,"



Modeling Sight: Eye-tracking technology recorded the eye movements of dermatology experts and students, noting where they lingered on an image and the path the eyes took as they moved across a scene. These visual Areas of Interest (AOI) have been shown to accurately illustrate a user's cognitive process.



Utilizing Computational Linguistics: Team member Cecilia Alm mines the physicians' spoken explanations to their students to characterize meaningful language behaviors common in the dermatology community. She is developing a linguistic model, which will be incorporated into the CBIR system.

Haake says. "In other words, we can make CBIR decisions more 'human.'"

Modeling Sight and Language

The team, with the assistance of undergraduate and graduate students in imaging science and computing and information sciences, utilized a remote, video-based eye-tracking system to discover what dermatologists found perceptually important about images. Sixteen dermatologists viewed skin conditions in 50 different images displayed on a monitor as they explained their diagnoses to physician assistant students. A device recorded the participants' eye movements as they lingered on the critical regions in each image. These data points, referred to as visual Areas of Interest (AOIs), have been shown to provide more objective evaluations of images and reveal the users' cognitive processing.

The eye-tracking data was also used to compare how different physicians analyzed the images, based on expertise, color, contrast, size, shape, and visual versus verbalized conceptual characteristics.

Preliminary results indicate that participants made their decisions based on perceptual information from multiple relevant regions in the image and people with comparable expertise had similar eye movement patterns. Pelz, co-director of the Multidisciplinary Vision Research Laboratory, says this will enhance the development of workable probabilistic models because it shows there is a correlation between domain knowledge and image perception.

"By categorizing the AOIs and perception differences between participants, we can create a set of common markers that can better inform how images are categorized and retrieved," he adds. "This will ultimately allow the CBIR system to 'perceive' the images in the same way they are perceived by the dermatologists using the system."

In addition to the eye-tracking data collection, team member Cecilia Ovesdotter Alm, a linguist and visiting assistant professor of English at RIT, is utilizing the interactions between the experts and their students during the sessions to develop a computational linguistics model related to the image analysis. Alm is mining the physicians' spoken explanations to characterize meaningful language behaviors commonly used in the dermatology community. This linguistic model will be incorporated into the CBIR system.

Alm says, "By fusing data from different sources we can create a more robust system built on the end-user's knowledge."

The team hopes the data collected will enhance general research into visual perception and linguistics, providing additional insights on how the brain

Creation of RIT's Ninth College: RIT President William Destler (left) and Mark Clement, CEO of Rochester General Health System, announced the creation of the Institute of Health Sciences and Technology (IHST) at a ceremony last spring. IHST grew out of the strategic alliance between RIT and RGHS and will focus on education, research, and community outreach in the health care sciences.

RIT and RGHS Create Institute of Health Sciences and Technology

RIT and Rochester General Health System (RGHS) opened the Institute of Health Sciences and Technology in September 2011.

The institute is designed to channel the strengths and expertise of the RIT-RGHS Alliance, which was formed in 2008 to produce technological solutions to health care delivery and improve the efficiency of the "smart hospital."

The institute addresses three aspects of health care development: educating the next generation of professionals, cultivating innovative research, and addressing workforce development and community health needs. It includes the College of Health Sciences and Technology, the Health Sciences Research Center, and the Center for Outreach.

"This is another tremendous milestone for the university and Rochester General Health System," says RIT President Bill Destler. "Our partnership creates a climate for the kind of innovative problem-solving that will improve quality health care delivery. The unlimited possibilities of technology drive the collaborative research of our physicians, faculty, and students."

The College of Health Sciences and Technology is RIT's ninth college and includes undergraduate and graduate degree programs and research in physician assistant studies, diagnostic medical sonography, biomedical sciences, clinical chemistry, nutrition/management, health systems administration, and medical illustration.

The Health Sciences Research Center will focus on infectious diseases and immunology, cancer vaccines and blood disorders, cardiovascular disease, biomedical imaging, and deaf technologies. Current projects through the center include a vaccine candidate that could prevent ear infections in children, the development of an artificial bicep and the creation of non-invasive methods of monitoring women in labor.

The Center for Outreach will focus on workforce development and supporting community health initiatives.

"The launch of the Institute of Health Sciences and Technology is a unique collaboration that allows RGHS and RIT to innovatively respond to the growing convergence of medicine and technology in the advancement of clinical practice as well as the unprecedented changes expected to come from health care reform," says Mark Clement, president and CEO of RGHS. "By combining institutional strengths of clinical medicine, research, and technology, the institute will train a growing number of future health care professionals while advancing technology-based research that will benefit our community locally and the health care delivery system nationally."

processes images and how they are described verbally.

"Most of what we know about visual perception is based on carefully designed experiments performed in the laboratory where conditions can be carefully controlled," Pelz adds. "By analyzing real-time image analysis between doctors and students in the master-apprentice model, we can more accurately assess how perception works in 'real world' environments."

The Potential of CBIR and Machine Learning

Design of the prototype system will be completed over the next year and Calvelli and her students will assist in evaluating its effectiveness and identifying areas of improvement. The group will also seek to identify potential utilization opportunities for the finished product, including through RIT's partnership with Rochester General Health System (see side bar).

"It is our hope that this system can ultimately be implemented by laboratories and medical centers to enhance the overall effectiveness of dermatological imaging, and ultimately increase the quality of teaching and medical diagnosis," adds Calvelli.

In addition, Haake sees the current research as a model for similar applications of human-centered CBIR as well as broader efforts to enhance machine learning and human-computer interaction.

"When you are managing thousands of images with complex data points, technology is a necessity to make sense of it all," she adds. "But you cannot become so reliant on the technology that you lose the necessary human touches needed to provide appropriate meaning.

"Human-centered CBIR is one mechanism for restoring some level of human decision-making to the system, and we hope it can serve as a model for improving human-computer interaction in multiple fields and disciplines."

On the Web

For more information about human-centered computing visit www.cis.rit.edu/mvrl.

RFID applied to hygiene


Edward Walsh


Gill Tsouri

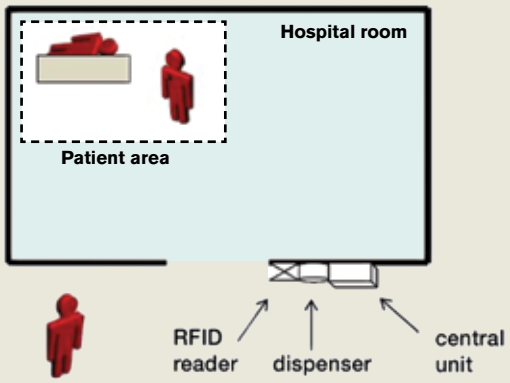
Frequent washing of the hands is one of the best ways to stop the spread of germs and prevent infection. In the sterile realm of a hospital, hand washing is an especially crucial routine for personnel in order to prevent the spread of diseases to patients who may have an increased susceptibility to germs.

An RIT-Rochester General Health System (RGHS) Alliance research team has been working on a project to monitor compliance with hand hygiene procedures. The project utilizes Radio-Frequency Identification (RFID) technology in order to create a database to be used for evaluating the rates of compliance with hand hygiene procedures. These rates will then be correlated with the spread of diseases in the hospital. RFID is an electronic tag that is incorporated into an ID badge that can be sensed using radio waves for the purpose of identification and tracking.

Gill Tsouri, assistant professor of electrical engineering and director of the Communication Research Laboratory at RIT, and Dr. Ed Walsh, head of infectious diseases at Rochester General Hospital, have developed and tested a prototype system for use at RGH. They hope ultimately to use the technology to create a hospital-wide database of hand hygiene compliance as well as investigate additional applications for RFID systems in the health care industry.

"RFID systems are currently being deployed in health care facilities primarily for the purpose of equipment tracking," says Tsouri. "However, by modifying the algorithms and statistical tools used in the technology, we were able to track human behavior, in this case hand washing compliance, and collect data that could be used to improve hygiene procedures."

The project was a finalist for the 2011 RFID Journal Awards, which recognize projects that illustrate successful use of RFID technology or the introduction of a valuable new RFID product or service.



RFID technology, applied to a hospital environment, allows medical personnel to be tracked when they come in close proximity to the tag reader. This creates a record of hand washing and contact with the patient for future analysis.

Improving Global Vaccine Affordability


Ruben Proano

Combination vaccines for young children are commonly used in industrialized nations because they provide protection for multiple diseases in one single injection. However, combination vaccines are prohibitively expensive for developing countries and may not be available until several years after they are commercialized in industrialized countries, when market prices become more affordable.

As a result, the choice of vaccines used by the developing and industrialized world to immunize children against similar pediatric diseases is rapidly diverging.

Ruben Proano, assistant professor of industrial and systems engineering at RIT, together with Sheldon Jacobson, professor of computer science at the University of Illinois, and Wenbo Zhang, a graduate engineering student at RIT, are working to reduce the cost of combination vaccines and increase their use in the developing world. Through the utilization of optimization models, Proano is seeking to determine conditions that would make the vaccine market financially more attractive.

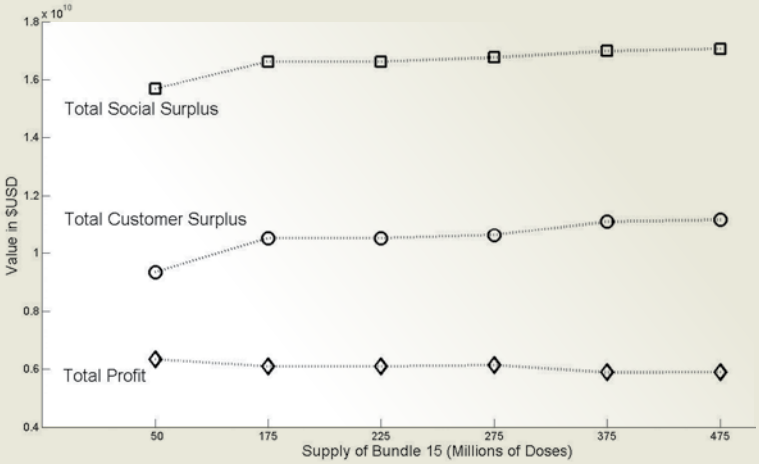
Optimization models are used to assess the best possible choice from a set of alternatives. Proano's team used the technique to determine the most affordable and profitable price for combination vaccines that can be offered to different market segments.

"We can recommend how many vaccine doses each market segment should buy, the vaccine producers that best meet particular demand, and the range of prices available per dose," he adds. "Using optimization modeling and considering the vaccine market as a whole can allow for a more efficient negotiation between buyers and sellers in which both can come out ahead."

The research was funded in part by the National Science Foundation and results were published in *Omega*, an international journal of operations management.

Proano has also sought to enhance global understanding of vaccine supply problems and promote the use of optimization models as a potential solution. This includes presenting his research at the United Nations in New York City and serving as a member of an Institute of Medicine expert panel on how to model vaccine prioritization.

"It is my hope this work will lead to the implementation of optimization modeling in vaccine supply, demand, and pricing both by individual producers and by international bodies such as the World Health Organization, ultimately increasing combination vaccine use and lowering its cost," he adds.



Ruben Proano is utilizing optimization models to help make combination vaccines affordable to developing nations through the better management of supply. The graph above measures the change in total social surplus (or total well being), total profit for vaccine manufacturers, and total savings for vaccine buyers as the supply of the most expensive and complex vaccine (bundle 15) becomes more available.

Studying the Deaf Brain: Peter C. Hauser, a deaf clinical neuropsychologist and associate professor in the American Sign Language and Interpreting Education Department at NTID, is uncovering how visual attention and executive function differ in deaf individuals. The research is shedding new light on how the deaf brain develops and is assisting in the creation of new assessment methods and learning modules specifically designed for the deaf.

Unlocking the Mysteries of the Deaf Brain

by Greg Livadas

Although studied for centuries, much remains unknown about the human brain. The deaf brain in particular is still a mystery in part because this population often uses different cognitive and communication processes than hearing people. RIT's Peter Hauser is a leader in analyzing the deaf brain, how it differs from the hearing brain, and the effect of sign language on cognition.

The Deaf Brain vs. The Hearing Brain

Hauser, a deaf clinical neuropsychologist and associate professor in the American Sign Language and Interpreting Education Department at NTID, is investigating how the brain adapts and takes on different functions based on new parameters. In other words, how does deafness itself change how the brain operates?

"We really understand so little about the human brain," Hauser says. "Through my research I am seeking to uncover which cognitive processes are hard-wired, which are plastic, and how deafness or sign language may impact them."

Hauser argues the difference between deaf and hearing brains can have significant clinical impacts that can affect diagnosis and treatment of numerous diseases.

"Suppose a deaf person has a stroke, which impacts his or her communication functions," Hauser adds. "Because deaf people communicate differently and use different parts of the brain in that process, you can't assume he or she will have the same symptoms or respond to the same therapies as a person who is hearing."

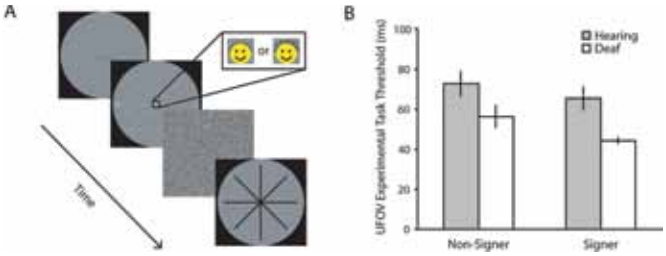
Testing Cognition: Hauser's team has developed a series of tests to assess the differences in how deaf and hearing people gain knowledge and process information. Data has been gathered from test subjects all over the world in multiple written and sign languages. More than 1,000 people participated in this testing so far.

Analyzing the Cognitive Process

"Peter is regarded nationally as one of the foremost experts in studies comparing deaf and hearing people's brains and function," says Daphne Bavelier, a professor of brain and cognitive sciences at the University of Rochester who has collaborated with Hauser for close to a decade. "In particular, he is leading the way in characterizing how growing up deaf or hard of hearing impacts executive functions—a set of skills that is central to academic achievements."

Much of the previous clinical research involving deaf individuals focused on restoring hearing or adjusting learning style to mirror hearing peers. Instead, Hauser focuses on deaf individuals themselves, how they learn, how they think, and how deaf brains process and use information.

Through partnerships with Gallaudet University's NSF Science of Learning Center on Visual Language and Visual Learning (VL2) and the University of Rochester's Brain and Vision Laboratory, he has developed comprehensive



Analyzing Visual Attention: Visual attention is the cognitive process by which a person selectively concentrates on an object or scene while ignoring other things and is a key component of learning. To analyze differences in attention between the deaf and hearing, participants were asked to discriminate a briefly presented face in the center of the display and to indicate the location of a peripheral target (a five-pointed star in a circle) via a touch screen.

The Deaf Studies Laboratory at RIT: Peter Hauser (third from top left) and his team have worked with numerous students, collaborators, and educational and scientific agencies to promote better understanding of deaf cognition and the need to modify testing and assessment to better meet the need of deaf learners.

testing procedures designed to analyze cognition in hearing and deaf individuals. His research includes studies of visual attention, the act of focusing on an object, and executive function, the part of the brain that controls behavior regulation and metacognition.

Hauser's team, which includes students and faculty through NTID's Deaf Studies Laboratory as well as faculty and students at Gallaudet and the University of Rochester, collects data on research participants from all over the world and conducts assessments in multiple written and sign languages. More than 1,000 people have participated in this testing so far.

"We conduct tests when we go to schools and camps for deaf children and academic conferences all over the world—Israel, Turkey, Germany," Hauser says.

"Seeing" Differently

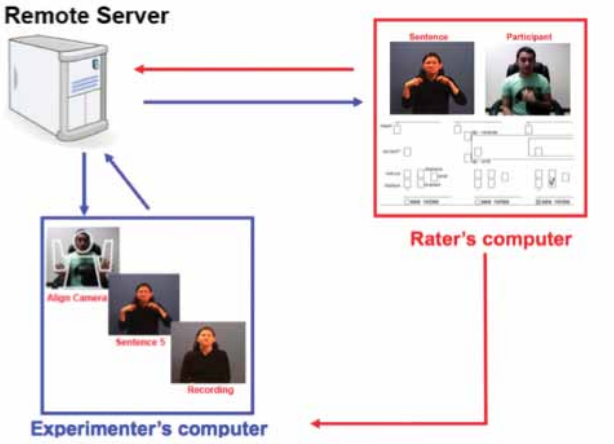
Results garnered through the research, which has been funded primarily by the National Science Foundation and the National Institutes of Health, show clear differences between deaf and hearing individuals in how information is processed.

In one project, Hauser's team studied spatial visual attention in elementary school-aged children and adults to compare differences between populations. They found that elementary aged deaf children perform similarly to their hearing peers. However, as people age, differences in attention grow wider, as deaf adolescents and young adults were more attentive to peripheral events. Hauser explains, "this seems to be an important adaptive ability that makes deaf individuals more aware of what is happening around them, to increase their incidental learning, and to prevent them from dangers."

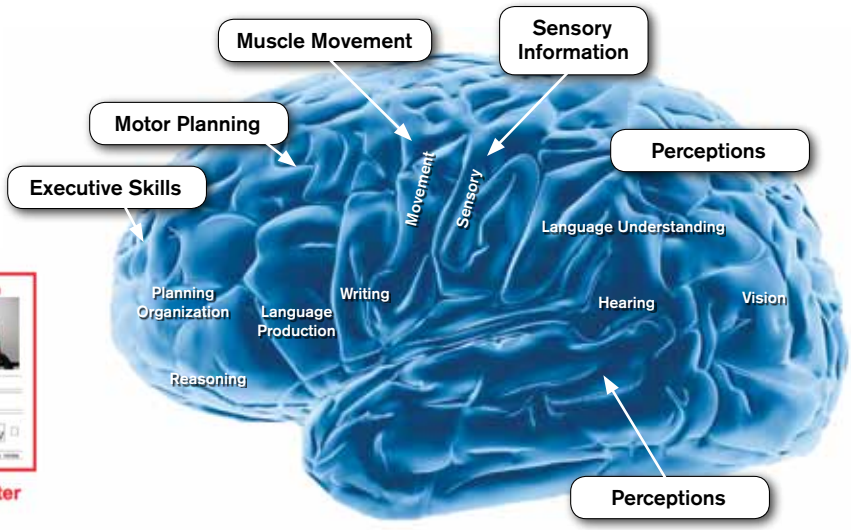
Hauser says it has been generally understood that deaf people learn to pick up visual cues of what is happening peripherally quicker than hearing individuals, because they have fewer senses to rely on.

"Attention is a key psychological indicator of how information is transmitted from the senses to the brain," he adds. "By showing how this works differently in deaf people, we can assist in developing techniques that foster visual learning."

Hauser has further examined differences in visual processing by comparing reading comprehension between hearing and deaf people. His team tested children



Assessing Sign Language Proficiency: Hauser's team created one of the first standardized tests to measure proficiency in ASL. The test utilizes standard linguistic techniques used in spoken language assessments to rate fluency among ASL users.



Executive function is that portion of the brain that controls central cognitive functions, including behavior and memory. Hauser seeks to examine how executive function works differently in deaf brains.

ages 8 to 16 from four different countries (with five languages) on letter recognition, word recognition, and how the reader processed semantics and sentence processing. Participants included deaf children of deaf parents, deaf children with hearing parents, hearing children, and hearing children with dyslexia.

The preliminary findings appear to suggest that early sign language acquisition and deaf parents' indigenous knowledge on how to raise deaf children prepare students to become successful readers regardless of the language, written orthography type, or region. Deaf children raised by deaf parents are able to achieve the same basic reading skills as hearing individuals early in life, suggesting that deafness per se does not cause reading challenges but what does have an effect is being raised in impro-vised visual language environments that do not foster visual learning.

Hauser's neuroimaging research also suggests that skilled deaf readers use different parts of their brains for processing reading.

"Traditional methods for teaching reading and assessing comprehension are based on how hearing people learn and do not generally take into account the visual needs of deaf learners," Hauser says. "Our research shows that deaf students do not necessarily learn to read more slowly than hearing students—just differently."

Understanding Executive Function

"Attention control, emotional control, impulse control, memory, organizing your thoughts, planning your thoughts—these are all components of executive function that continue to develop in the brain until early adulthood," Hauser says. "And language appears to be a necessary component of executive function development. But for the majority of deaf people growing up in hearing families, language development is delayed."

Hauser argues that inefficient executive function development can have a negative impact on learning and academic achievement. His team is conducting a series of experiments, using both deaf and hearing participants, to investigate the impact of language learning on executive development.

"The problem we encountered when beginning this research was that there are no standardized tests available to measure individuals' sign language fluency," he continues.

Mentoring the Next Generation: Erin Spurgeon (center) worked with Peter Hauser as a research associate before pursuing her Ph.D. in language and communicative disorders at the University of California at San Diego and San Diego State University.

Deaf Cognition: Hauser is the co-editor of two books on the development of cognitive learning in deaf indivuals, both published by Oxford University Press.

Given this, the team developed a highly sensitive test of competency in American Sign Language that can easily be administered in a short period of time. Hauser developed a Web-based administration protocol so the test can be administered remotely, with participant responses sent to his laboratory for analysis.

The test is currently being used in a number of psychological, linguistic, and cognitive neuroscience research studies at universities all over the country.

"The creation of this test has finally enabled researchers to test research questions related to the effect of sign language skills on learning and cognition," Hauser adds.

The test has already been adapted to measure German and British sign languages and Hauser hopes to further expand its use in the future.

Promoting the Deaf Learner

On top of his basic research efforts, Hauser has sought to enhance understanding of deaf learners and promote educational and outreach opportunities in the deaf community. This includes efforts to disseminate information on deaf cognition to the broader scientific and education community as well as supporting the next generation of researchers.

Hauser has presented his research at numerous international conferences, served as a presenter/mentor for the Youth Leadership Conference of the National Association of the Deaf, and served as a delegate to the Test Equity Summit, which sought to ensure that educational testing better accounted for deaf learners. He also co-edited, with NTID Professor Marc Marschark, the 2008 book *Deaf Cognition: Foundations and Outcomes*, and the 2011 book *How Deaf Children Learn: What Parents and Teachers Need to Know*, both published by Oxford University Press.

Hauser has also worked with numerous students at RIT, NTID, and his partner institutions to promote their research efforts and enhance enthusiasm for the topic as a whole.

Erin Spurgeon, who enjoyed Hauser's enthusiasm for his subject matter when he taught a psychology class she was enrolled in while an RIT/NTID master's student, ended up working as his research associate in the Deaf Studies Laboratory. She worked on several cognition projects and traveled with Hauser to the University of Haifa in Israel in 2009 and to Turkey in 2010 for his international research team meetings. Spurgeon is currently pursuing her Ph.D. in language and communicative disorders in a joint program at the University of California at San Diego and San Diego State University.

"The opportunity to work with Professor Hauser as a research associate was one of the most valuable experiences I had in preparation for this doctoral program," she says. "Students who are interested in deaf research are fortunate to work with a knowledgeable and respected member of the scientific community."

With continued research based at RIT/NTID, Hauser believes a legacy is being built here for deaf cognition, education, and outreach in deaf studies and sign language research.

"My hope is to bring more people into research, have junior faculty involved more, mentor them, create a deaf-friendly lab environment where people can come in and learn how to conduct research," Hauser adds.

On the Web

For more information about Peter Hauser and the Deaf Studies Laboratory visit http://dsl.rit.edu.

Capstone Projects Making a Difference


Beth DeBartolo

Faculty-student teams are working with local community agencies to provide novel assistive devices for individuals with physical challenges.

The initiative, funded by the National Science Foundation, involves fourth- and fifth-year undergraduate student design teams in the industrial, electrical, mechanical, and computer engineering programs working with partners in the Rochester area, including The Arc of Monroe County and Nazareth College's School of Health and Human Services.

Supervised by a group of engineering faculty, including Elizabeth DeBartolo, associate professor of mechanical engineering, the design teams work hands-on with individuals with physical challenges in order to design devices intended to facilitate independent transportation, prevent injury, and promote rehabilitation. The projects require students to apply their engineering and innovation skills throughout the process of creating the device, from the analysis of the needs of the consumer to the construction of the prototype.

According to DeBartolo, the senior projects afford the students an experience that they cannot get from a technical class.

"The opportunity to see the impact of their engineering decisions shows the students the value of their work beyond a financial bottom line," she says.

The hands-free presentation remote allows signers to manipulate a PowerPoint presentation without using their hands. Users were given a wireless USB receiver to allow the remote to interface with a computer and spare batteries.

Among the variety of projects undertaken, the team worked with Gary Behm, director of the Center on Access Technology at NTID, to design a hands-free wireless presentation remote. It allows presenters using America Sign Language to have wireless control of a PowerPoint slideshow without the need to carry a remote in their hands. The device attaches with a wristband, allowing the presenter to have both hands free to sign.

"The real value of these projects is that students get to experience the entire design process and end up with a device that is going to make a difference in someone's life," adds DeBartolo, whose collaborators include Matthew Marshall, associate professor of industrial and systems engineering, Daniel Phillips, associate professor and director of the biomedical engineering program, and George Slack, lecturer in electrical engineering.

Improving Assessment of Autism


Vincent Pandolfi

A multi-university research team, which includes RIT Professor Vincent Pandolfi, is working to establish evidence-based assessment protocols for use with individuals with autism spectrum disorders (ASD). The effort could ultimately enhance the procedures used by medical doctors, school psychologists, and clinical psychologists to assess symptoms and properly diagnose patients.

The research includes one of the first series of comprehensive statistical analyses of current ASD and mental health assessment measures. The research will inform professionals about the measures' utility for diagnostic decision-making, treatment planning, and monitoring response to treatment over time.

"Autism is a neurodevelopmental disorder characterized by impairments in social interaction, communication, and behavior with onset in early childhood," says Pandolfi, associate professor of school psychology at RIT. "However, specific symptoms can vary widely between individuals and autism can present differently within the same person over time, making diagnosis challenging."

Research also indicates that individuals with ASD frequently present with an accompanying emotional and/or behavioral disorder that requires specific treatment. Unfortunately, it is often hard to accurately identify disorders like depression and anxiety in autistic patients, because many of these individuals have difficulty accurately reporting their symptoms and they may have atypical presentations of mental health problems compared with the general population.

Pandolfi notes that identifying reliable and valid measures for these patients will help clinicians more properly diagnose individuals so treatment can begin as soon as possible.

The research group has also conducted surveys of school-based professionals to assess their levels of training and confidence related to working with students with ASD. The results will inform the field about training needs of school psychologists and other school professionals and will help identify future directions for research.

"The earlier we can detect ASD and co-occurring emotional and behavioral disorders, the earlier we can provide specific treatment and hopefully improve the quality of life of affected individuals and their families," adds Pandolfi.

Enhancing Understanding of Autism: School psychology professor Vince Pandolfi is working to improve testing and assessment of autism and the corresponding mental disorders that often accompany the disease.

The research team also includes Dr. Caroline Magyar, associate professor of pediatrics at the University of Rochester Medical Center, and Charles Dill, professor of psychology at Hofstra University.

Earth Observation: For over 30 years, RIT imaging scientist John Schott has been a key figure in the design and deployment of the Landsat series of satellites. The NASA- and USGS-led effort represents the largest widely-used, annually updated, source of global remote sensing data and provides a wealth of information on historical changes in the environment around the world. One of Schott's many contributions to the Landsat program includes collection of ground truth temperature readings to improve satellite calibration.

Imaging the Earth

by Susan Gawlowicz

NASA's Earth-observing satellites in the Landsat program have demonstrated the capabilities of remote sensing on a global scale and provided previously unavailable data on global climate change. Imaging scientist John Schott's 30-year involvement with the program calibrating and simulating the technology won RIT its first major research grant in 1981 and laid the cornerstone for the university's imaging science program.

Landsat and RIT

Imagery data from the Landsat series of satellites represents the largest widely used, annually updated source of global data at the human scale, where roads and individual agriculture fields can be seen. It also provides a wealth of historical information on environmental, land, and temperature changes that are greatly enhancing research in agriculture, climate change, and atmospheric science. RIT has a long history of supporting the Landsat program with many students, faculty, and alumni contributing to the satellites' design and operation.

The originator of RIT's relationship with Landsat is John Schott, the Frederick and Anna B. Wiedman Professor in Imaging Science. Schott won a proposal from NASA in 1981 to assist in the development of Landsat 4, the fourth satellite in the series. It was RIT's first major research grant from NASA and marked the beginning of Schott's 30-year history with the land-satellite program. The remote sensing initiative would also become the cornerstone of RIT's Chester F. Carlson Center for Imaging Science.

Today, Schott continues to play an integral role in the Landsat program, which includes service on the U.S. Geological Survey's (USGS) Landsat Science Team, providing expert advice and technical support that has greatly advanced the use and impact of the data collected.

An Environmental Record of the Earth: The Landsat satellite orbits the Earth's poles, passing over the same spot every 16 days to build up a cloud-free composite image over a year. Illustration provided by the Digital Imaging and Remote Sensing Lab.

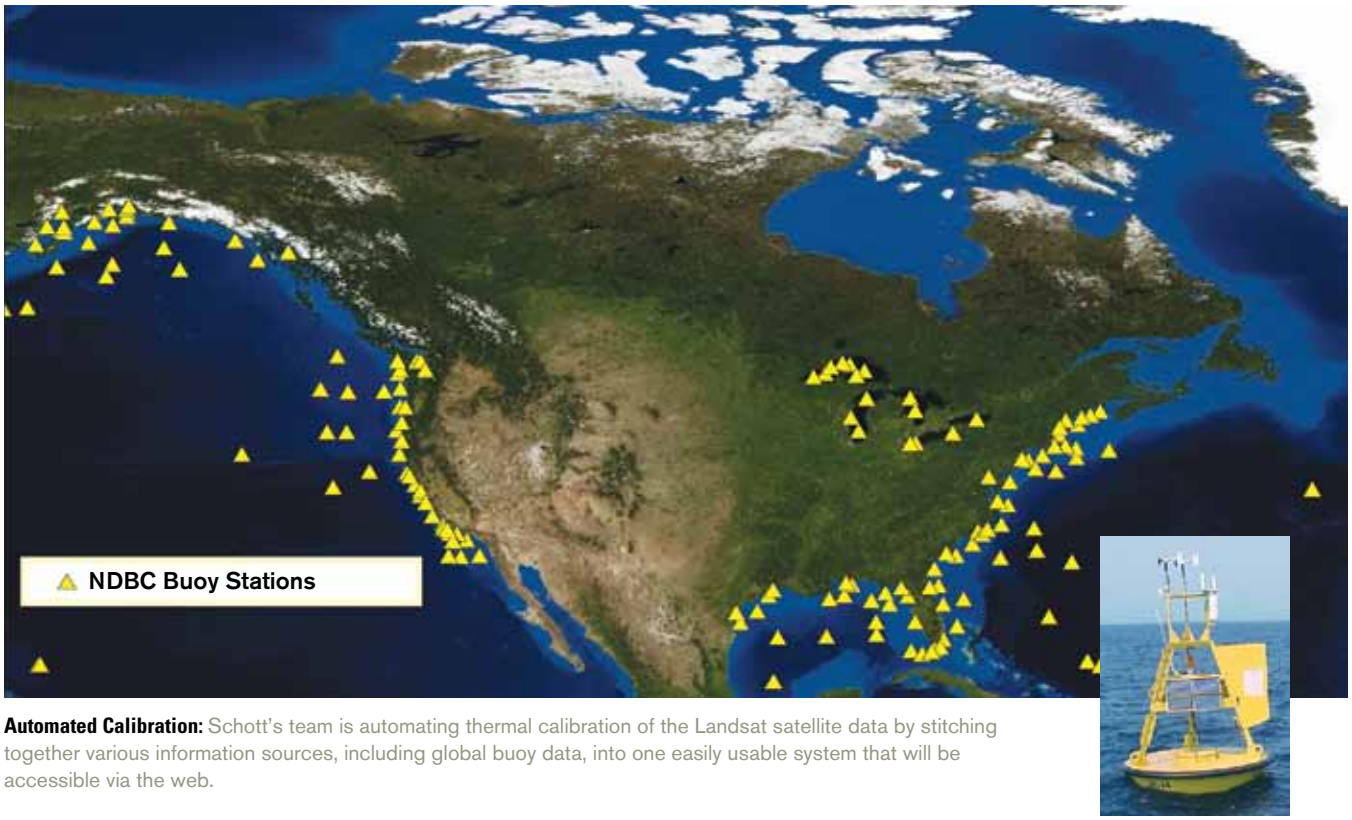
Utilizing Historical Data

One of Schott's longest running efforts with the program has involved the use of calibration techniques to better utilize temperature data collected by the program over its history.

In 1999, NASA and the USGS asked Schott to cast his calibration net backward 15 years to capture data starting with Landsat 4 and Landsat 5, which were launched in 1982 and 1984, respectively. Schott and graduate student Frank Padula investigated how to calibrate the satellites by looking at instrumented buoys in the Great Lakes and the Atlantic Ocean that belong to the National Oceanic and Atmospheric Administration (NOAA). While the Landsat satellites read temperature on the water's surface, the buoys take measurements about a meter under water.

Padula's master's thesis focused on developing a method for using the NOAA buoys to predict surface temperature. His next step was to propagate it through the atmosphere to approximate the apparent temperature seen by the satellite.

"We figured out that we could very precisely use the NOAA buoys to calibrate this 15-year gap where nobody knew what was going on and in the process we found out that the instruments weren't perfectly calibrated and that there had been a fairly sizable change right in the middle of the period," says Schott. "We fixed all the calibration for all those intervening 15 years.



Automated Calibration: Schott's team is automating thermal calibration of the Landsat satellite data by stitching together various information sources, including global buoy data, into one easily usable system that will be accessible via the web.

"From 1982 to the present, we now have all the instruments well calibrated so that when someone uses them, they get accurate, repeatable results," Schott says. "This has become particularly important because the USGS has made all the Landsat data free, enabling long-term trend studies undisturbed by calibration issues."

Enhancing Usability

NASA recently awarded Schott a contract to automate the buoy analysis technique used for calibration. His team is stitching together information generated and posted on the Internet, including buoy data, meteorological data, data from balloons launched from the airport to characterize the upper atmosphere, and satellite images.

"We're going to try to put ourselves out of business by writing software that will take in all this data, automatically link all of our programs that are now hand done, and post the results on the Internet so that people running the satellite at USGS and NASA just have to look at the website," Schott says.

RIT is also partnering with the Jet Propulsion Laboratory (JPL) to develop the enabling technology that will allow the USGS to create land-surface temperature products based on the calibrated Landsat data. The Geologic Survey will use the methodologies to convert the images to land-surface temperature maps that will "glue" temperatures to every pixel making up an image.

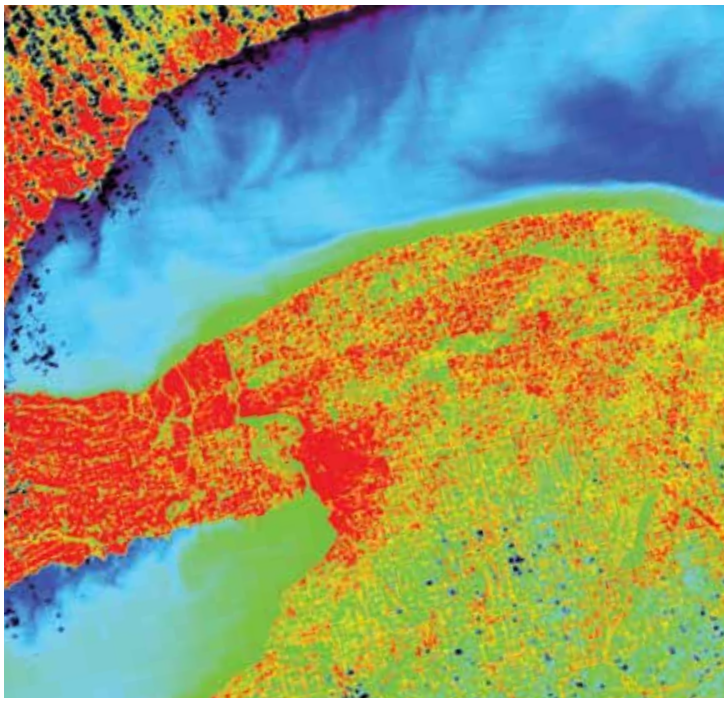
To build the tools for the USGS to mass-produce the data, teams at RIT and JPL are correcting for the atmosphere and surface reflectivity that distorts radiometric signals.

"Landsat has been staring at the globe for nearly 40 years, since 1972. We need to learn how to analyze it and understand what's been going on," Schott says. "You don't want to wait 40 years to learn what processes are impacting the globe. All of a sudden you can do the science today that we'd have to wait years to do. That's the excitement about Landsat at the moment."

Landsat 8

For the last five years Schott has been assisting in development of the Landsat Data Continuity Mission, the nascent Landsat 8. The satellite—tentatively scheduled to launch in December 2012—is being built under NASA guidance for the USGS.

Landsat 8 represents a new technology and advances the thermal mapping capabilities introduced with Landsat 4.



Thermal Mapping: Working with the Jet Propulsion Lab, Schott is assisting the USGS in creating land-surface temperature maps that will allow scientists to assess how different aspects of the Earth have changed over time.

Creating the Next-Generation Imaging Satellite: The team is working with the Goddard Space Flight Center to design key instrumentation for Landsat 8, which is scheduled to launch in 2012. This includes testing of the Thermal Infrared Sensor, pictured above, which utilizes novel detector technology that has never been tested in space. Photo provided by Matthew Montero, Goddard Space Flight Center.

Landsat 8 is "a very different sensor," Schott says.

The satellite will view Earth with two separate cameras. The Operational Land Imager (OLI) will detect visible light and the Thermal Infrared Sensor (TIRS) will cover the infrared part of the spectrum. Ball Aerospace in Colorado is building OLI and the NASA Goddard Space Flight Center is building TIRS.

Landsat 7 has 16 detectors to generate all the information in each region of the spectrum. All 16 had to be cross-calibrated so they responded in the same manner. In contrast, OLI has a staggering 12,000 blue detectors that must be manufactured and calibrated so they respond in unison. On the thermal side, TIRS represents new detector technology that has never been tested in space, Schott says.

The high spatial resolution and the significantly improved radiometric resolution will enable detailed mapping of fresh and coastal waters, a particular interest of Schott's and one that, in the future, could help small municipalities monitor the quality of their fresh water supply.

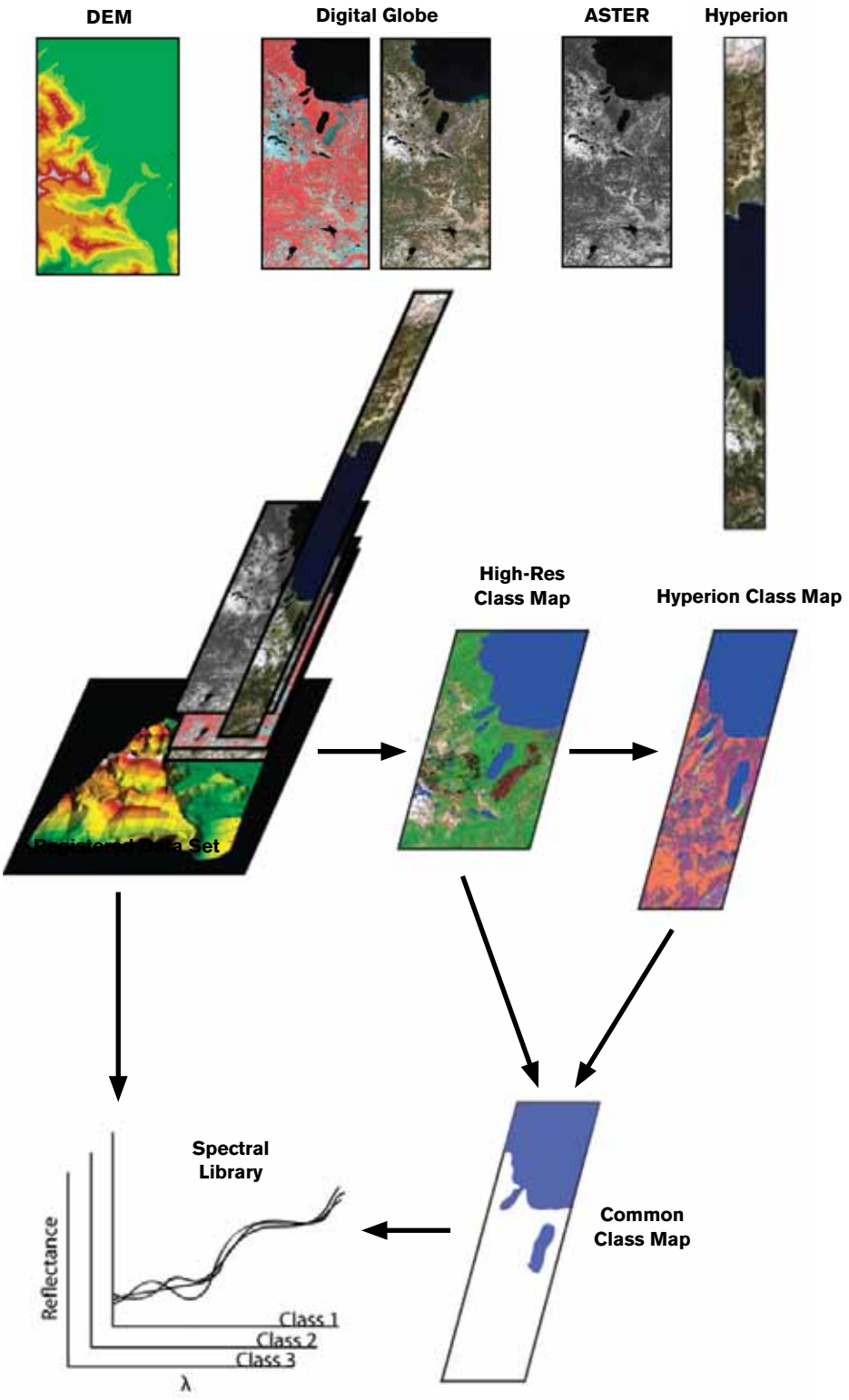
"John is probably one of the few people in the country with over 30 years of Landsat experience. He knows their capabilities and their weaknesses," says Matthew Montanaro, a calibration scientist with Sigma Space Corp., a contractor to NASA Goddard for design of Landsat 8's TIRS instrument.

"Being a member of the science team has allowed John to influence the design of Landsat 8," adds Montanaro, who was a student of Schott's while earning his doctorate in imaging science at RIT. "John will also continue his involvement in characterizing the Landsat 8 instruments after launch as he has been doing for Landsat 5 and 7. This allows him to be involved with making sure that the entire past and future Landsat archive will be as accurate as possible."

Simulating Satellite Operation

Montanaro relies on Schott's team to simulate potential problems in the development of Landsat 8 through the use of Digital Imaging and Remote Sensing Image Generation (DIRSIG), a synthetic image-generation tool developed by Schott and Carl Salvaggio, associate professor of imaging science at RIT. The tool simulates in a computer what an aerial or satellite remote sensing system would see by modeling the thermal and radiometric behavior of the Earth and atmosphere.

The team utilized DIRSIG to build



Simulating What a Satellite Sees Using DIRSIG: The figure depicts the many different components used to create a simulated portion of the earth, specifically South Lake Tahoe. The three dimensional shape was derived from a Digital Elevation Model. High spatial resolution imagery from Digital Globe was used to determine land cover types and spectral information was added from the Hyperion and ASTER imaging systems.

a simulated OLI instrument that was flown on a Landsat orbit around the world. They also used the tool to create simulated images of specific settings, such as Lake Tahoe, which has a lot of terrain variation, making satellite imaging of the lake more complex.

The data collected is allowing designers to test instruments or different designs before spending millions of dollars building the cameras for the satellite and well before the moment of "first light," a turn of phrase in the remote sensing world that signifies when the shutter first opens and captures a picture.

"Being able to preview the images Landsat will produce allows us to spot any potential problems and also allows us to test processing algorithms well before launch," says Montanaro.

"Roughly three years before first light, we're showing them the pictures they will be collecting," Schott adds.

The Story Going Forward

Schott hopes his current and future research efforts will further enhance the Landsat program and its use in Earth observation research. He also plans to continue his equally important three-decade-long effort to utilize the program as a teaching tool for RIT's students and an opportunity to engage his colleagues in research.

"I am extremely proud that so many of the students who have worked on this project have gone on to careers in imaging science and remote sensing," Schott says. "In addition, many RIT faculty and staff have worked with me on different components of Landsat and it is gratifying to know that this has assisted them in developing their own research portfolios.

"Being able to include so many people on this journey has been as important as the research itself."

On the Web

To learn more about Professor Schott's research visit http://dirs.cis.rit.edu/.

Predicting Space Weather

Roger Dube

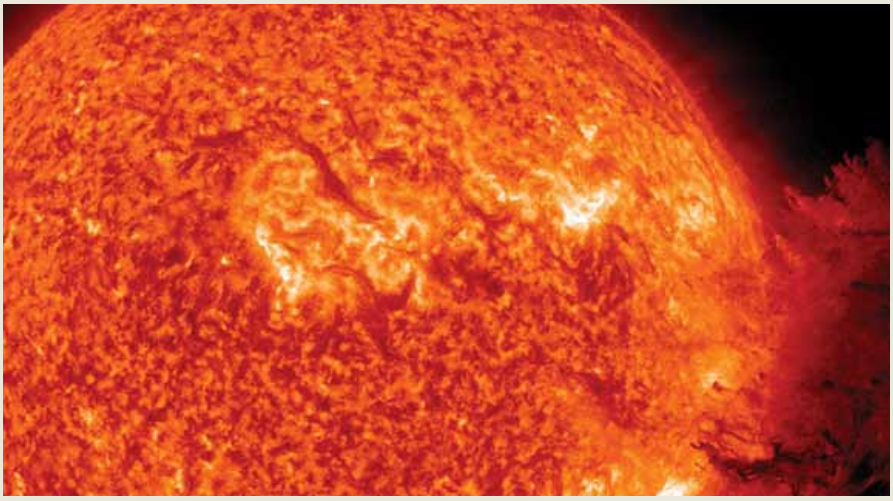
Roger Dube, professor in the Chester F. Carlson Center for Imaging Science at Rochester Institute of Technology, is developing an early warning system for space weather storms on Earth. His NASA-funded research initially focused on the protection of future Mars colonists.

"My original space weather project was oriented toward the colonization of Mars," Dube says. "Because I've had to step back and look at the data on Earth, we've come to realize that there is a big problem even here in terms of our potential sensitivity to severe space weather storms. I think the level of awareness has increased because we're seeing more data that says this is not that rare an event."

During a space storm, the equivalent of hurricane-force gusts flow through interplanetary space carrying X-rays and particles emitted from solar flares and coronal mass ejections—high-energy explosions on the surface of the sun.

Dube and his team of seven students have developed a neural network that digests the massive amount of data taken from different types of variables, such as electricity and magnetism, to better predict when a storm will occur. They are also analyzing features on the sun for use in predicting storms and linking activity on the sun (such as sunspots) with other types of impacts on Earth (such as the Aurora Borealis and radio storms).

"What's happening is that we're able to recognize these precursors in this data that are within half a day of the event. That's good, but we'd really like to have it several days in advance so that we could do something about it," Dube says. "For example, with enough warning we can turn our satellites away from the sun so they don't get hurt by the particles that hit them as the storm passes."



The sun is the source of radiation and particles that can disrupt satellite communication and radio waves. Predicting space weather can allow for the prevention of damage to the sensitive satellite infrastructure that orbits Earth.

Knowledge Management Tool Aids UN Disaster Management

Brian Tomaszewski

Using space-based technologies and a colorful interactive Flash-based matrix developed at RIT, United Nations agencies involved in providing support to countries in the area of disaster risk management can specifically identify space-based technology solutions to support the disaster management cycle.

Brian Tomaszewski, an assistant professor in RIT's department of information sciences and technologies, and several students have teamed with the United Nations Platform for Space-based Information for Disaster Management and Emergency Response (UN-SPIDER), a programme being implemented by the United Nations Office for Outer Space Affairs (UNOOSA), to create a Web-based tool that provides information, communication, and process reporting to disaster managers. This tool, called the Space Application Matrix, takes existing information available—mostly case studies, guides, and product information—and makes it easier to access and retrieve.

"The Space Application Matrix has an intuitive, visual interface as opposed to the keyword searches that were used before," says Tomaszewski. "The information is now much easier to access."

The tool allows users to select from a variety of hazards, ranging from fires to oil spills to epidemics, providing to disaster managers information on how they can utilize space-based technologies in the various phases of the disaster management cycle (mitigation, preparedness, response, and recovery). These technologies include satellite communication—useful when there is no cell phone coverage in an area—satellite navigation and Earth observation/remote sensing technologies.

Tomaszewski began working on the tool in the summer of 2009 with the help of RIT students. He spent three months in Bonn, Germany, immersed in the knowledge portal and other geographic information science and technology projects for the United Nations. It was completed in January 2011, after he recruited information science and technology students Joseph Spens and Beytullah Sarcia to put the finishing touches on the project.

Results of his research with the UN-SPIDER Programme ensure that all relevant information is available and accessible to all those interested in understanding how space-based technologies could contribute to their everyday needs.

The Space Application Matrix, a tool the United Nations uses to aid disaster management, was developed by Brian Tomaszewski, an assistant professor of information sciences and technologies, and two RIT students.

Impact as an Undergraduate

by William Dube

VIDEO LINK

Research conducted by RIT students Barbara Spieker, Cory Ilo, Danielle Burnash, and Delilah Bowman exemplifies the increasingly diverse, relevant, and cutting-edge work being undertaken on campus. It also showcases the growing impact undergraduates are having on RIT's research portfolio.

Research that Matters

These four students, with widely divergent interests and backgrounds, are tackling significant problems that will have a major societal effect well beyond RIT. Their research includes analyzing gene expression in echinoderms, creating novel 3D gesture control technologies, studying the incidence of abuse in the deaf community, and advancing building security and control systems.

Their efforts illustrate how the university's research operations continue to expand and the significant opportunity the student body has to participate in the effort.

"RIT students have challenged their professors to devise research projects that go above and beyond the university's toughest courses," notes Darren Narayan, professor of mathematical sciences and director of undergraduate research for RIT's

A Community of Scholars and Educators: Students, staff, and faculty at RIT come together to promote cutting-edge research and help create our next generation of scientists and engineers. Through a multitude of projects in numerous disciplines these teams are creating technologies and making discoveries that will improve society.

College of Science. "The result has been the creation of an exciting and dynamic environment that is moving RIT toward being the first university synonymous with undergraduate research."

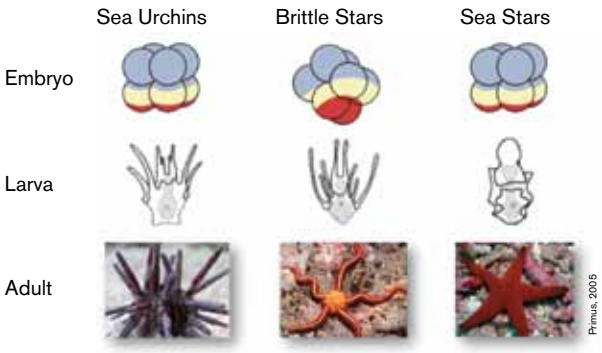

Barbara Spieker

Discovering How Species Evolve

Like the relationship between humans and apes, the Esmark serpent star and the spiny brittle star are genetically very similar animals. Both are brittle stars, similar to a starfish, are members of the echinoderm phylum, and evolved from the same common ancestor. However, we still know very little about how the species diverged from each other approximately 450 million years ago and the impact different genes had on that divergence.

Barbara Spiecker was part of a team of scientists, led by Hyla Sweet, an associate professor of biological sciences, that is attempting to solve this puzzle through the use of comparative gene expression and function.

"By comparing how similar genes function differently in the two species we can learn more about how development of serpent stars and spiny brittle stars evolved to lead to the animals we now have today," says Spiecker, a 2011 biology graduate who spent four years working in Sweet's lab.



Genes and Evolution: An RIT team is seeking to uncover how genetically similar species such as sea urchins, brittle stars, and sea stars evolved into the animals we now see today. By analyzing gene expressions the team hopes to shed new light on the impact central developmental genes have on species evolution.

Developing New Scientists: Barbara Spieker, right, a 2011 biology graduate, spent four years working in Professor Hyla Sweet's lab. The experience helped prepare her for the real-world research environment while allowing her to advance understanding in evolutionary biology.

Manipulating 3D Images: Computer engineering student Cory Ilo demonstrates the software platform NuWii, a 3D user interface that detects movements by the user and allows for virtual manipulation of 3D images. Ilo was part of a team that developed an iPad application of the program, which could ultimately enable virtual surgery or enhance 3D filmmaking.

Sweet received a National Science Foundation grant to fund undergraduate research fellowships and is committed to including her students in all aspects of the project, including presenting their research at conferences and writing manuscripts.

"Barbara and the other students on our team are taking part in all of the experiments and analysis involved. We really try to balance the dual goals of basic research and high-quality educational experiences," she adds.

Spiecker used Rapid Amplification of cDNA Ends (RACE), a technique used to isolate the RNA strands that code the proteins that control central developmental events in each species. Through an analysis of the similarities and differences in expression and function of these RNAs, the team hopes to discover the reasons underlying the differences seen in species development.

Sweet hopes the research will ultimately enhance general knowledge of echinoderm development and how changes in embryonic gene expression can be used to better understand evolution.

Cory Ilo

Improving 3D Visualization

The creation and use of 3D images is hampered in part by the traditional keyboard and mouse interface, which was designed for two-dimensional environments. Through the development of new software platforms, an RIT team, which includes Cory Ilo, a second-year computer engineering major, is seeking to create immersive, 3D interfaces that model the futuristic worlds depicted in films such as *Minority Report*.

"When working in 3D, users want to view and interact with the simulations in a simple and natural way that allows for easy manipulation and analysis," notes Hans-Peter Bischof, professor of computer science and director of RIT's Research Experience for Undergraduates (REU) center in Computer Science. "Through our REU center, our student teams have developed and deployed a software package that captures the user's motions and uses them to control the camera positions utilized by a 3D visualization system."

The program, called NuWii, is a 3D user interface that utilizes Nintendo Wii remotes as infrared tracking cameras to detect movements by the user and allow for virtual manipulation of 3D images. Ilo was part of a team, which also included management information systems major Brandon Colli and computer science student D'artist Vaughn, that developed a mobile version of the program that could be used on an iPad.

"The project not only involves significant programming work but also mathematical modeling of various human gestures, research into how people perceive computer-generated scenes, and analysis of how individuals interact with those scenes and the computers that display them," Ilo says.

NuWii is already being used by astrophysics researchers to view and manipulate three-dimensional visualizations of black hole collisions. The team is also investigating the creation of an iPad version of the application, which will utilize the device's motion and orientation

Presenting Critical Information on Child Abuse: Danielle Burnash, center, unveiled results from her undergraduate thesis, a study of child abuse and maltreatment among the deaf and hard of hearing, at the annual meeting of the Association of Behavioral and Cognitive Therapies. The Associated Press ran a story on the findings and the team was contacted by the National Institute on Deafness and Other Communication Disorders about utilizing the results in future studies.

sensors to control a virtual camera within a 3D scene. Ilo argues the technology could some day assist doctors in conducting remote surgeries or be used by film directors to create 3D movies.

The REU is funded through the National Science Foundation and is one of three such centers on campus. The other two are located in the Chester F. Carlson Center for Imaging Science and the School of Mathematical Sciences.


Danielle Burnash

Analyzing Childhood Maltreatment

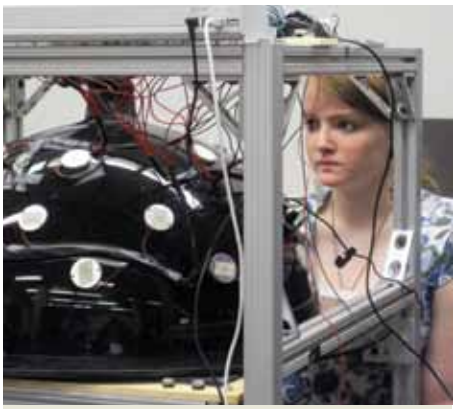
Child abuse and maltreatment are an ongoing social and public policy issue, particularly in the deaf and hard-of-hearing community where communication barriers can often reduce options for assessment and intervention.

Danielle Burnash, in collaboration with Gail Rothman-Marshall, associate professor of liberal studies at NTID, and Lindsay Schenkel, assistant professor of psychology in the College of Liberal Arts and the lead investigator on the project, conducted one of the first studies to compare childhood maltreatment and abuse between deaf and hearing children.

The results indicate that the incidence of maltreatment, including neglect and physical and sexual abuse, is more than 25% higher among deaf and hard-of-hearing children than among hearing kids. The research also shows a direct correlation between childhood maltreatment and higher rates of negative cognition, depression, and post-traumatic stress disorder in adulthood.

"By providing clear data on the high rate of childhood maltreatment in the deaf community we hope to shine a light on the issue and provide mental health professionals with the necessary data to better treat both children and adults suffering from mental and behavioral disorders," notes Burnash, a 2011 graduate in psychology who conducted the research as part of her undergraduate thesis.

The findings were unveiled at the annual meeting of the Association of Behavioral and Cognitive Therapies,




Stefano Prezioso

Engaging Freshmen in Imaging Science

The Chester F. Carlson Center for Imaging Science created the Freshman Imaging Project to provide students with a hands-on, student-driven introduction to imaging science, research, and technology creation.

"I think there is so much value in a student-driven, project-driven class where you are forced to go learn for yourself," says Stefano Prezioso, now a second-year double major in imaging science and biomedical photography who took the course in 2010.

Prezioso and his classmates, including second-year imaging science major Scarlett Montanaro (shown above), were charged with designing and building an enhanced imaging device, based on the concept of polynomial texture maps (PTMs). To date, PTMs have been used primarily by professionals working in the preservation of historical documents, manuscripts, and small artifacts. PTMs use visible light to illuminate a subject from different directions and angles and allow for examination of subtle surface textures and features, such as dents and cracks in an artifact.

The phase one device was completed and unveiled at RIT's Innovation and Creativity Festival in May 2011. At the request of an RIT alumna working at the Boston Public Library, four of the team members traveled to Boston and utilized the PTM system they had designed and built to produce high-quality images of artifacts held by the library.

The students involved are now continuing the project, even though the class is over. They are working on a proof of concept for a novel multispectral device that will extend the instrument's imaging capability to the infrared wavelength. It will be the first PTM device to utilize multispectral imaging.

where Burnash was the only undergraduate to present. A story on the study appeared in the Associated Press and the team has been contacted by the National Institute on Deafness and other Communications Disorders about utilizing the results in future studies. Schenkel is also developing a broader project, in collaboration with Marc Marshark, director of the Center for Education Research Partnerships at NTID, to create a more precise method for measuring maltreatment among both hearing and deaf populations.

The work was funded in part through the McNair Scholars program, a U.S. Department of Education initiative designed to promote advanced scholarship by first-generation and minority college students. Burnash is currently working toward a master's degree in school and community counseling at the University of Rochester.

Delilah Bowman

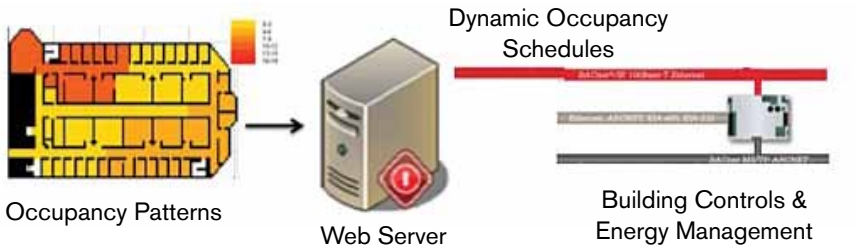
Making Buildings "Smarter"

What if there were a way to monitor occupancy in specific rooms of a building and adjust the heat or air conditioning automatically? Or what if the Department of Motor Vehicles could alert you when there was no line?

Delilah Bowman, a second-year packaging science major, says that the building sensor technology to accomplish these types of tasks already exists.

"The camera and sensor systems that are part of most modern buildings to monitor security and fire safety could also be used to analyze movements within a building or conduct pattern recognition on individuals," she adds. "This data could be used for all manner of operations such as noting when a person has entered or left a room and adjusting the heating controls accordingly to reduce overall energy use."

Bowman worked with Robert Garrick, associate professor of mechanical engineering technology, to investigate the modification of building security and building control system packages for use in occupancy monitoring. The project is a partnership between RIT, Lenel—a business of UTC Fire & Security, which is a unit of United Technologies Corp.—and Automated Logic, part of Carrier Corp. It sought to integrate off-the-shelf security and building control systems to monitor occupancy via video analytics and send notifications to the building control system if certain criteria were met.



Creating Smarter Building Systems: RIT engineers are working with United Technologies Corporation to modify building security and control system packages for use in occupancy monitoring. The technology could ultimately help reduce building energy use or warn a person when the DMV line is too long.

"It included programming and hardware design as well as discussions with UTC designers about system specifications and potential redesign options," says Bowman, who participated in the project through the National Science Foundation's Louis Stokes Alliance for Minority Participation in research. "The ultimate goal was to provide data on how such a system could be set up as well as the quality of the results produced."

Based on the initial work, Garrick is seeking to apply the modified system for use on campus. This could include the analysis of traffic flow in the Student Financial Services area of the University Services Center to improve human comfort and work flow.

An Impact Now and in the Future

All four students sought to join research teams to move beyond the classroom and work on real problems. While the projects have often been challenging, knowing they are contributing to discovery that will have a positive impact provides significant incentive.

"Working in the REU center provided a crash course in how actual software development is conducted, knowledge I never could have gained in a classroom or in most internship opportunities," says Ilo.

From a broader perspective, these experiences also illustrate how research opportunities can enhance both the educational and scholarship mission of the university.

"My own research goals have been significantly enhanced through the support of student teams, leading to results that will advance what we know about developmental biology," adds Sweet. "And as a teacher, it has been amazing to see individuals transformed from students to working scientists who will ultimately make their own discoveries."

Undergraduate Research is a Team Sport: Numerous faculty and staff are involved in supporting undergraduate research through serving as mentors, assisting with administrative oversight, and providing laboratory management. This infrastructure provides strong learning environments and allows students to conduct research with significant real-world implications and prepares them for future graduate study and employment opportunities.

Creating "Greener" Courses

Spencer Kim

Advances in sustainable technology and the demand for environmentally friendly products have become increasingly important components of engineering and engineering technology education. Through a grant from the National Science Foundation, RIT is seeking to create new curricula in green plastics that will both enhance the educated experience and further pedagogical development in sustainable manufacturing.

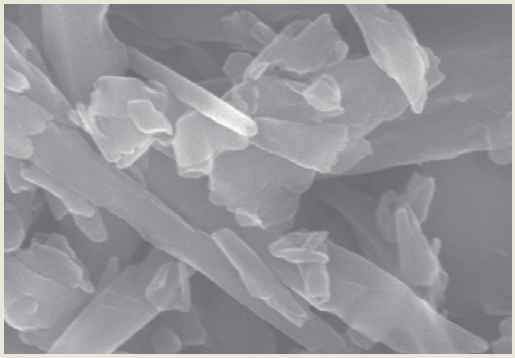
"There is an increasing need to transform the existing university curriculum in materials and manufacturing engineering to keep pace with new green technology advances that are being implemented in numerous industrial sectors," says Spencer Kim, associate professor of manufacturing and mechanical engineering technology at RIT.

Through the project, Kim and his team are developing new practice-based educational models that incorporate the growing body of research in green materials, polymer blends, and hybrids. The goal is to provide our next generation of engineers and designers with a comprehensive understanding of the refined manufacturing processes associated with sustainable production.

"Students will be better prepared for work in this emerging field as more companies transition from using petroleum-based plastics to more green materials, such as biodegradable polymers and eco-friendly hybrid materials," Kim adds.

The group is modifying a number of existing courses, including materials technology and plastics processing, and creating new course work in green plastics and sustainable polymers. The learning modules developed will also be integrated into the department's undergraduate research and senior design activities.

"Our educational models need to match with the changes happening in all industries," Kim says. "It is our hope that this effort will serve as a model for green engineering education and ultimately help promote the sustainability revolution."



Green plastics are a growing component of modern manufacturing operations. Through courses at RIT, future engineers and designers study a host of novel materials including thermoplastic cornstarch/clay hybrids.

Enhancing the Development of Computing Professionals

Trudy Howles

Tom Reichlmayr

The U.S. Bureau of Labor Statistics predicts that jobs in computing and mathematical sciences will increase by over 20% by the year 2018, with jobs in some specific disciplines, such as software engineering, increasing by as much as 30%. Unfortunately, at the same time there has been a national decrease in students graduating with computing degrees.

In order to satisfy the increasing demand for employable computing professionals, and to combat declining undergraduate enrollment in computing disciplines, the Computing Undergraduates Scholarship Program (CUSP) was established at Rochester Institute of Technology in 2006.

Led by Trudy Howles, associate professor of computer science, and Tom Reichlmayr, associate professor of software engineering, the program provided scholarship opportunities to financially eligible students, especially those from underrepresented groups, who demonstrated academic talent. Funded through the National Science Foundation, CUSP provided two-year scholarships to students enrolling in computing programs offered through RIT's B. Thomas Golisano College of Computing and Information Sciences (GCCIS).

"All students cited the scholarship as having an impact on their ability to continue in school," notes Reichlmayr. "In addition to financial assistance, the students also identified the importance of practicing good time management skills and maintaining grades in order to participate in the program."

Seventy-two students received scholarship assistance through CUSP and the first cohort of scholars graduated from RIT in 2010. Howles is seeking funding to offer broader programming that will incorporate additional scholarship support and outreach efforts to middle and high school students.

"CUSP has helped make RIT more financially accessible to talented students and helped enable GCCIS to continue to produce some of the most well-prepared computing professionals in the industry," adds Andrew Sears, dean of GCCIS.

Lindsay Ellis, left, a third-year software engineering major, is one of 75 students to receive scholarship assistance through GCCIS' Computing Undergraduate Scholarship Program. In 2011, Ellis and her research partner, Alex Canter, were selected to present their undergraduate research project at a Congressional reception in Washington, D.C.

Research Awards and Honors

by William Dube

RIT values the contributions of its faculty, staff, and students across all colleges and centers. Below, we highlight members of the RIT community who have received significant internal, national, or 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 academic scholarship. In 2011, Professor Roy Berns was selected to receive the Trustees Scholarship Award.

Roy Berns is the Richard S. Hunter Professor of Color Science, Appearance and Technology at the Munsell Color Science Laboratory at RIT. Berns' research focuses on applied colorimetry and the color modeling of materials and imaging systems. He has worked with numerous arts organizations and preservation societies to promote the restoration of a host of artworks and artifacts. This includes service as a Visiting Senior Fellow in Conservation Science at the National Gallery of Art and as a member of the Technical Advisory Group of the Star-Spangled Banner Preservation Project. Berns is a fellow of the Society of Imaging Science and Technology and the recipient of the 2008 Newton Medal presented by the Color Group of Great Britain.

Fulbright Scholars

The Fulbright program was established in 1946 by the U.S. Department of State. It is the largest U.S. international exchange program offering advanced research and teaching opportunities for students and scholars in more than 150 countries worldwide.

Elizabeth Hane, assistant professor of environmental science, was a 2011 Fulbright Fellow in Dubrovnik, Croatia. She taught courses and conducted research in biodiversity and environmental science.

Robert Ulin, professor of anthropology, was named a 2011 Fulbright Senior Specialist in anthropology. He traveled to Poland to both conduct research and deliver a series of lectures on globalization and the anthropology of work.

National and International Recognition

Stefi Baum, director of the Center for Imaging Science, has been selected as a 2011-12 fellow of the Radcliffe Institute for Advanced Study at Harvard University. Through the fellowship, Baum will conduct research on galaxy formation and evolution using multi-wavelength spectral and polarimetric imaging. The Radcliffe Institute is a scholarly community where fellows pursue advanced work across a wide range of academic disciplines, professions, and creative arts.

Sharon Beckford-Foster, visiting assistant professor of English, has been awarded an African-American Studies Fellowship from the Black Metropolis Research Consortium. Through the award, Beckford-Foster will conduct a study of noted author and African-American activist Richard Wright. The consortium, housed at the University of Chicago, is dedicated to promoting scholarship in African-American and African culture, history, and politics.

Juan Carlos Caballero-Perez, an associate professor of jewelry and metals in the School for American Crafts, received a 2011 NICHE award for his gold jewelry piece "Mother's Brooch." The annual competition, sponsored by *NICHE Magazine*, recognizes outstanding craft design and production by professional artists and students. Caballero-Perez is a noted metal sculptor whose work has been exhibited at numerous museums including the Fuller Craft Museum.

Andrea Hickey, a fourth-year graphic design major, received a 2011 ADDY award for excellence in print advertising. Hickey was recog-

nized for "Crime Scene Fashion," which depicts models as crime victims wearing a new clothing line. The ADDYs, presented by the American Advertising Federation, are the world's largest advertising competition.

Ron Hira, associate professor of public policy, was invited to testify before the United States House of Representatives as part of a public hearing on the H1-B visa program. Hira discussed his research on immigration policy and potential government reforms to the program, which provides temporary work visas to skilled foreign workers. The House Judiciary Committee's Subcommittee on Immigration Policy and Enforcement sponsored the hearing.

Kathleen Lamkin-Kennard, an assistant professor of mechanical engineering, and **Lea Michel**, an assistant professor of chemistry, have been selected for the National Institutes of Health's Early Career Reviewer Program. The effort places emerging scientists on NIH review panels to help researchers develop an understanding of the review process and assist the agency in selecting research for funding. Lamkin-Kennard and Michel will both serve on biomedical research review panels.

Chris Langer, a photojournalism major in the School of Photographic Arts and Sciences, has been selected as the White House News Photographers Association's 2011 Student Photographer of the Year. The award, part of the association's annual "Eyes of History" competition, recognizes photographic excellence and visual artistry in student photojournalism. Langer is the first person from RIT to win the honor. The association was founded in 1921 and focuses on promoting excellence and professional development in public interest photography.

Frank Padula, a master's degree student in imaging science, received the American Society for Photogrammetry and Remote Sensing's John I. Davidson President's Award for best research in remote sensing. Padula was honored for his work on thermal infrared calibration as part of NASA's Lansat 5 satellite program.

Todd Pagano, associate professor of science and mathematics at the National Technical Institute for the Deaf, served as a technical adviser to the National Academy of Sciences' Committee on Prudent Practices in the Laboratory. In that post he assisted in the creation of the 2011 report, *Handling and Management of Chemical Hazards*, which provides updated guidelines for scientists and laboratory managers on the use of hazardous materials.

Harvey Palmer, dean of the Kate Gleason College of Engineering, received the 2011 R. Wells Moulton Award from the University of Washington. The honor recognizes university alumni for their contributions to the engineering industry, faculty service in academia, or public service. Palmer received his Ph.D. in chemical engineering from the University of Washington in 1971.

Carol Richardson, professor emerita in electrical, computer, and telecommunications engineering technology, received the 2011 Frederick J. Berger Award from the American Society for Engineering Education. Richardson was cited for her engineering research and curriculum development efforts and her service to the society on both the regional and national level.

Michael Richmond, professor of physics, received a 2011 Invitation Fellowship from the Japan Society for the Promotion of Science. Through the award, Richmond traveled to Japan to conduct astronomical observations of supernova at the Institute for Astronomy in Tokyo. The Japan Society is an independent national agency tasked with promoting advances in the sciences and humanities.

Andreas Savakis, professor and former chair of the department of computer engineering, has been appointed a 2011-2012 Fellow of the American Council on Education. Savakis was one of only 50 individuals accepted to the program nationally, which provides leadership development and training for senior administrators in higher education.

About This Section

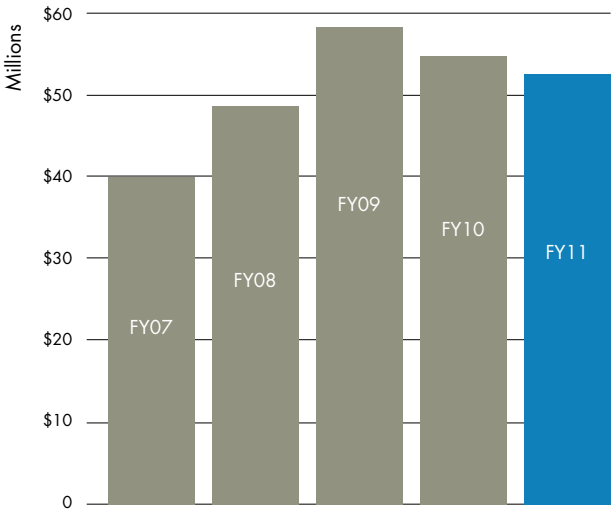
This listing is a sample of awards and honors that have been received by RIT faculty and staff over the past year. For more information, please visit www.rit.edu/news.

By the Numbers

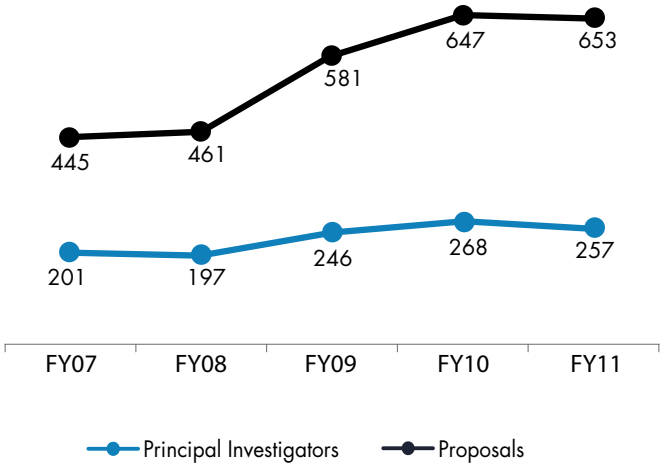
by David Bond

In 2011, RIT's research efforts continued to earn prominent recognition, which included the awarding of a $13.1 million grant from the National Institute of Standards and Technology, the largest single federal research grant in the university's history.

Value of Awards Received



Proposals Submitted and Principal Investigators



During fiscal year 2011, RIT continued to enhance its research programming in key focus areas, including imaging science, sustainability, and biotechnology, while also increasing national and international recognition for its efforts. Highlights include receiving a $13.1 million grant from the National Institute of Standards and Technology for construction of the Golisano Institute for Sustainability facility.

Overall, RIT received $52.5 million in new research awards for the fiscal year ending June 30, 2011, including grants and contracts purposed for research, instruction, outreach, and construction; direct federal support for research at the National Technical Institute for the Deaf; and gifts in support of research.

RIT is committed to enhancing faculty participation in research to both expand opportunities for funding and to properly address the challenging economic and budgetary environment. In FY 2011, 257 principal investigators submitted a record total of 653 new proposals.

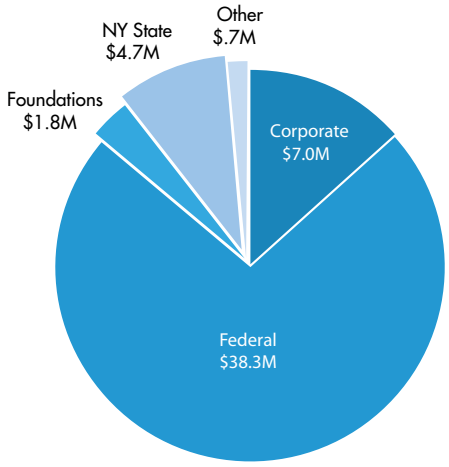
New Research Awards

RIT's total for new research awards was down slightly from the last fiscal year, due in large part to the continued unfavorable economic climate. However, the university is increasingly being invited to participate in high-level peer-reviewed funding programs and competitive grant initiatives, due to the growing reputation of our faculty:

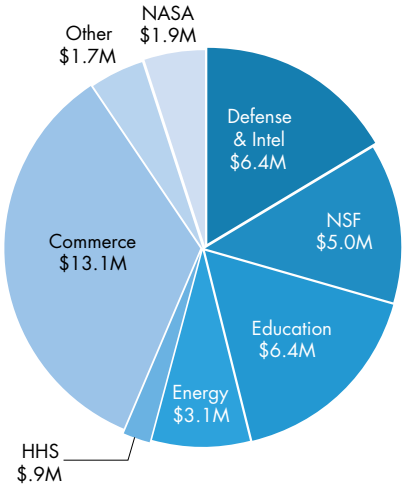
Nabil Nasr received a $13.1 million grant from the National Institute of Standards and Technology supporting construction of a new research building for the Golisano Institute for Sustainability. It was the largest construction grant awarded by NIST in 2011 and the largest competitive federal award in RIT's history.

Mechanical engineering Professor Satish Kandlikar received a $1.4 million grant from the U.S. Department of

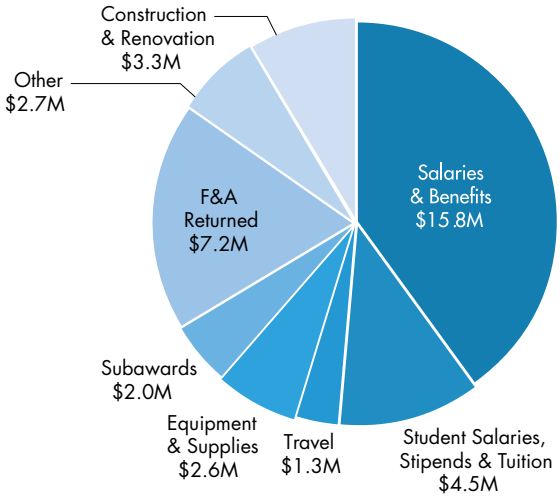
FY11 Awards by Funding Source Type



FY11 Awards from Federal Sponsors



FY11 Research Expenditures by Category



Energy to continue research in improved fuel cell performance, in partnership with General Motors.

Industrial engineering Professor Denis Cormier received a $446,000 grant from the U.S. Department of Energy in support of nano-design research being conducted through the multi-university Energy Frontiers Research Center in nano-structures design for energy systems led by the University of South Carolina.

NTID's Northeast Technical Assistance Center for deaf education, directed by associate dean Dianne Brooks, received $2 million in continued funding from the U.S. Department of Education.

Manuela Campanelli, director of the Center for Computational Relativity and Gravitation, was awarded $646,000 by the National Science Foundation to advance pioneering methods for observing black hole properties.

RIT received $38.3 million in new funding from 115 federal sponsors last year, $4.7 million from various New York state agencies, and $7 million in research sponsorship from corporate partners.

In addition to the construction award from NIST, RIT received increased funding support from federal defense and intelligence agencies (from $5.3 million in FY 10 to $6.4 million in FY 11) and the U.S. Department of Education (from $4.8 million in FY 10 to $6.4 million in FY 11).

Research Expenditures

Sponsored research supports salaries and benefits for participating RIT faculty and staff, salaries and tuition for students, equipment and supplies, research-related travel, and the facilities and administrative costs associated with research.

The returned facilities and administrative costs are distributed to central administration, colleges and divisions, research centers, principal investigators through faculty startup packages, bridge funding, required cost share matching and seed funding.

Each year, RIT reports research expenditures on research and development to the National Science Foundation. These are limited to certain functions and may not include expenditures on sponsored activities including education, outreach, and other services. The NSF survey results show that RIT has steadily increased research and development work over the last four years. RIT has also gained in "market share" of research funding and has moved up in NSF's rankings against other universities to 57th in research expenditures among private universities and 105th among all universities without a medical center.

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Rochester Institute of Technology is internationally recognized for academic leadership in computing, engineering, imaging technology, sustainability, and fine and applied arts, in addition to unparalleled support services for deaf and hard-of-hearing students.

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 2011 edition of *The Best 373 Colleges* as well as its *Guide to 286 Green Colleges. The Fiske Guide to Colleges 2011* lists RIT among more than 300 of the country's most interesting colleges and universities.

Contact Information

To learn more about research opportunities on campus, contact us directly or through the RIT research website at **www.rit.edu/research**.

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