RESEARCH at RIT

The Rochester Institute of Technology Research Report

Spring/Summer 2009

SPOTLIGHT ON

Bio-X

R·I·T

www.rit.edu/research

RESEARCH at RIT

The Rochester Institute of Technology
Spring/Summer 2009

Executive Editor
Donald Boyd,
Vice President for Research

Managing Editor
Mike Dwyer, Director,
Research Relations Office

Editor
Kara Teske,
Research Communications Specialist,
Research Relations Office

Design Director
Jeff Arbegast, Art Director,
University Publications

Head Writer
William Dube, Senior News Specialist,
University News Services

Contributors
Marcia Morphy

Office of Research Relations
74 Lomb Memorial Drive
Rochester, NY 14623
585-475-2167
E-mail: kmtpop@rit.edu

Rochester Institute of Technology publishes *Research at RIT*. RIT will admit and hire men and women; veterans; people with disabilities; individuals of any race, color, creed, religion, national or ethnic origin, sexual orientation, age, or marital status in compliance with all appropriate legislation.

Vol. 2, No. 2
10M-P0756-05/09-MER-JSA

Correction
In the previous issue an incorrect reference was made to the BS degree in environmental management and technology offered at RIT. This degree is offered through the College of Applied Science and Technology, not the College of Science.

Bio-X at RIT

Bio-X is a rapidly growing multidisciplinary research area at RIT, which builds on RIT's technical strengths to address challenges of the 21st century.

The first issue of *Research at RIT* featured key RIT research on Imaging; issue two focused on Sustainability. These are established RIT research areas that have a global reputation. This issue you will learn about an emerging area of RIT research that we are calling Bio-X.

Bio-X is comprised of research initiatives in life sciences, engineering, information systems, imaging, and other disciplines to make new discoveries and solve problems in biology, health care, and medicine. At first glance, RIT may appear to be a new player in the bio-related field, but the truth is RIT has been conducting research in this area for decades.

The International Center for Hearing and Speech Research at the National Technical Institute for the Deaf has been studying the causes, prevention, and treatment of age-related hearing loss (presbycusis) for over 30 years. NTID and RIT faculty are also using their vast experience in deafness education and research to investigate existing or new technologies that have significant potential for assisting disabled individuals to access information and environments that allows them to enjoy full access to education, the workplace, and society in general.

Supporting this initiative, earlier this year RIT announced a new strategic alliance with Rochester General Health System. This partnership will bring together RIT's technical strengths with the clinical and health delivery strengths of Rochester General.

In this issue we feature articles linked to Bio-X, including our biomedical engineers who are doing groundbreaking research that will shed light on processes at the most fundamental level inside the human body. This knowledge will then be used to support the development of new technologies that could help prevent and treat chronic health problems that face our nation.

Scientists in the Center for Imaging Science build on over two decades of experience in the imaging field to create new techniques for enhancing accuracy and methods that are safer for the patient.

Researchers in the Rochester Imaging Detector Laboratory are developing advanced detector technology that has wide applications from protecting the environment to providing better detection of activities inside the body.

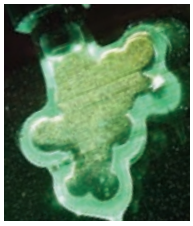
And, in this new world of online media, faculty, students, and staff are embracing and examining how the dynamics of doing business, communicating, learning, and even providing health care have changed with the Internet.

I invite you to enjoy this issue and explore Bio-X at RIT.

Best regards,

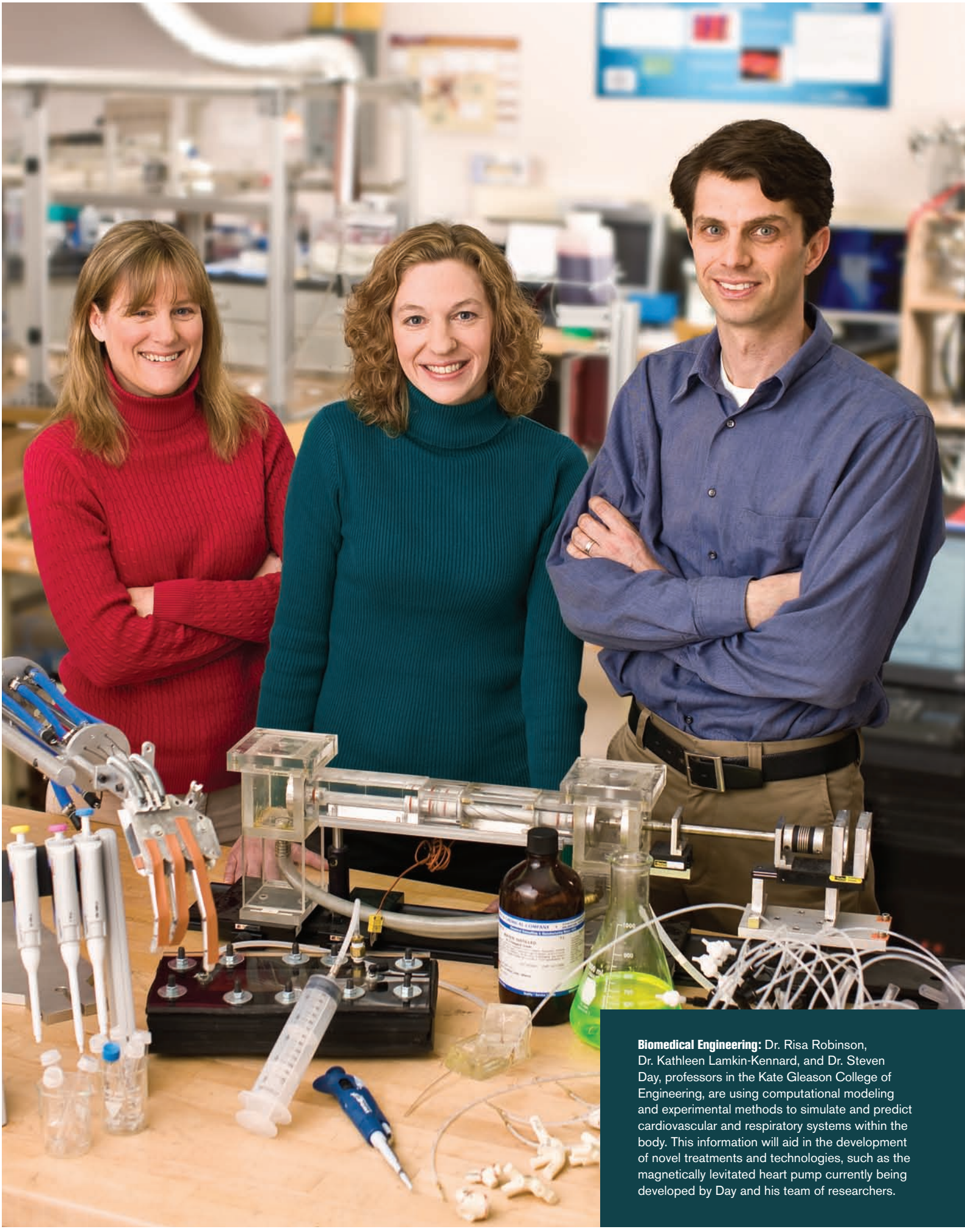
Donald Boyd, Ph.D.
Vice President for Research

Inside this Issue



On the Cover

A 3-dimensional model of an alveolar sac (the location where gas exchange occurs in a lung) mimics realistic breathing patterns. The model is imaged using a monochromatic camera and a laser to examine the complex flow patterns inside the alveolar sac. Scientists in the Kate Gleason College of Engineering use the model to examine the fluid flow and quantify the differences in where the particles deposit in a healthy lung, as compared to an emphysemic lung.



Biomedical Engineering: Dr. Risa Robinson, Dr. Kathleen Lamkin-Kennard, and Dr. Steven Day, professors in the Kate Gleason College of Engineering, are using computational modeling and experimental methods to simulate and predict cardiovascular and respiratory systems within the body. This information will aid in the development of novel treatments and technologies, such as the magnetically levitated heart pump currently being developed by Day and his team of researchers.

Simulate, Predict, Advance:
Cardiovascular & Respiratory Systems

by Kara Teske

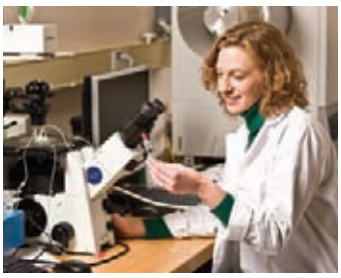
By pairing science with technology, engineers at RIT are helping to expand the fundamental understanding of some of the most basic biological processes, while working to develop the next generation of biomedical technologies.

Modeling for Prediction and Development

Researchers in the Kate Gleason College of Engineering are using computational modeling to recreate physiological systems that enable scientists to predict activities within the body. By understanding the fundamental fluid mechanics within the body, researchers will be able to develop targeted treatments and devices that help to address some of the most dire health conditions facing our nation.

Branched Microvessels Exposed

Understanding the interactions between fluid forces and cellular adhesion inside branched microvessels—the smallest intersections of blood vessels—could aid in the development of novel treatment strategies for cardiovascular diseases. Through a combination of experimentation and computer simulations, sponsored by the National Institutes of Health, Dr. Kathleen Lamkin-Kennard, assistant professor in the department of mechanical engineering, is working to predict fundamental fluid flow characteristics in branched microvessels.

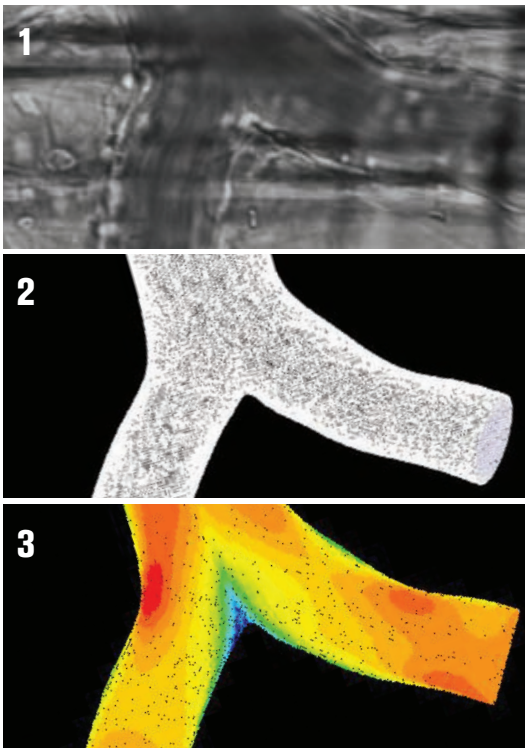


Characterizing Branched Microvessels: Dr. Kathleen Lamkin-Kennard views microspheres under the microscope as they roll through the microfabricated branched microvessels to study the distribution of rolling and adherent white blood cells.

Evidence suggests that many common disease states may have an inflammatory component that originates at a fundamental level, since it is in the venular microcirculation where white blood cells (leukocytes) interact with the vessel wall during the inflammatory response. However, little research has been conducted to understand the distribution of white blood cells in branched post-capillary venules and to evaluate the factors, such as fluid dynamics that contribute to the adhesive process.

Lamkin-Kennard and her team of undergraduate researchers are using a combination of computational fluid dynamics (CFD), in vitro experiments, and in vivo data analysis to characterize the distribution of adherent white blood cells in branched microvessels and how physical forces affect what white blood cells do.

"Traditionally, scientists look at a flat geometry, but if you

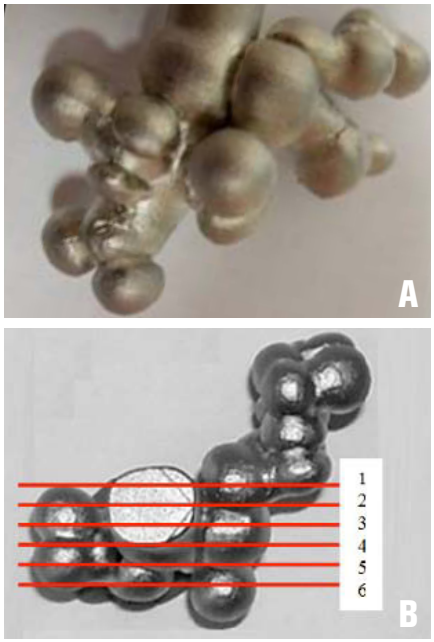


A Study of Branched Microvessels: This sequence illustrates the process being used to investigate the cellular adhesion inside branched microvessels. Understanding the fluid flow in branched microvessels will enhance understanding of the inflammatory response in many disease states.

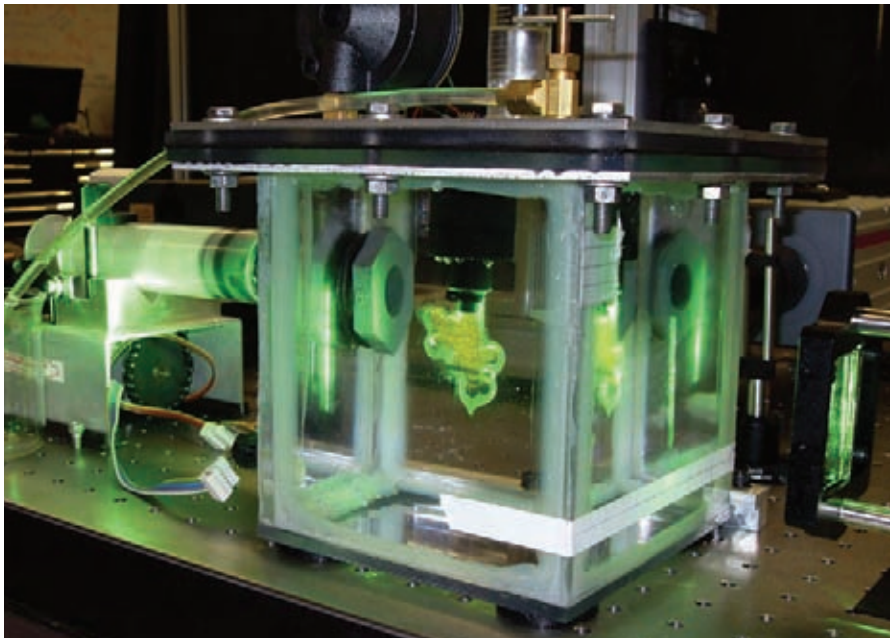
1. An in vivo image is first acquired of neutrophils in converging post-capillary venules from inside a mouse.

2. The image is then recreated as a 3-dimensional solid model using computer-aided design (CAD) software.

3 The model is then analyzed using computational fluid dynamics (CFD) to show the predicted flow velocities where the branched microvessels converge. The blue region, where the two vessels come together, is a region of low velocity, which correlates with a region of higher white blood cell adhesion.



Modeling Inside the Lung: (A) A large scale physical model of the alveolar sac is created using a replica human lung cast. (B) The model is illuminated at various cross-sections to examine the fluid flow inside the alveolar sac.



Particle Image Velocimetry: The alveolar sac model is housed in a glycerin-filled chamber and is connected to a computer-controlled syringe pump that draws a negative pressure on the fluid inside the chamber. The pressure is altered to expand and contract according to the applied motion of the pump, which mimics a realistic breathing curve.

look at the vessels within the body they are branched and twisted," says Lamkin-Kennard. "By recreating this environment in the lab, we can have a better understanding of the whole chemical-physical interaction."

John Jung, 4th year biomedical sciences student and Christopher Barrett, 4th year mechanical engineering student, have been working alongside Lamkin-Kennard to set up and perform the experiments. Using in vivo data from the University of Rochester, the team has microfabricated a 3-dimensional model of the branched microvessels. The microscale branches are coated with selectin—the same protein found inside blood vessels. Microspheres are then bioengineered to behave just like white blood cells. The microspheres are rolled through the microfabbed vessels, creating a controlled environment to study the distribution of rolling and adherent cells. The data collected provides vital information about how the simulated cells behave in the branches, such as where the cells adhere, how fast the cells roll at different locations, and how the flow affects the paths the cells follow.

The CFD analysis provides additional information about the fundamental fluid dynamics in the branches that cannot be obtained from the lab. By pairing these approaches together, the researchers can better characterize the behavior of white blood cells in the branched microvessels.

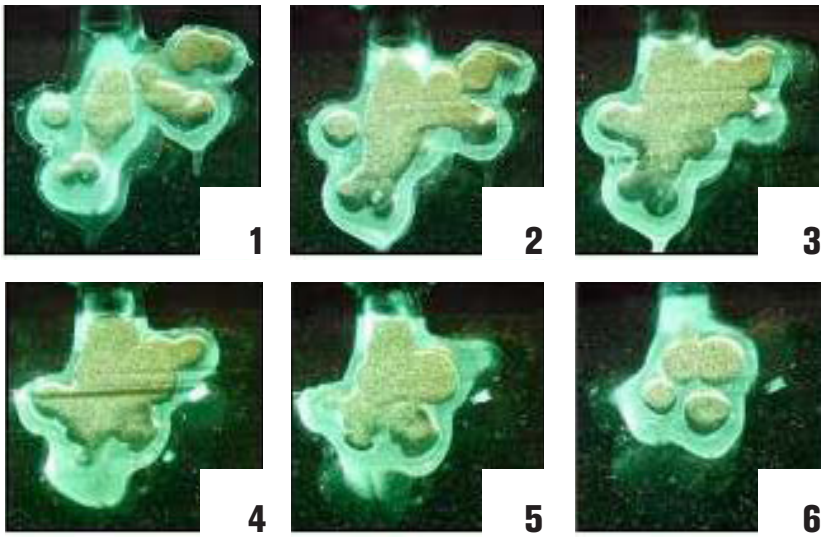
Their research has shown white blood cell counts are highest at the junction points between the converging branches. Importantly, this general observation holds true regardless of the specific geometrical configuration of each converging branch. Understanding how fluid forces contribute to this observation is the next piece of the puzzle.

"By understanding the whole chemical-physical interaction there is great promise for advancing the understanding of the inflammatory response in many disease states and could aid in the development of targeted drug or stem cell delivery methods, or development of microsensors or microrobotic devices," says Lamkin-Kennard. "Since metastatic cancer cells use the same mechanisms as white blood cells to roll along vessels walls, we will also have a better understanding of metastasis," adds Jung.

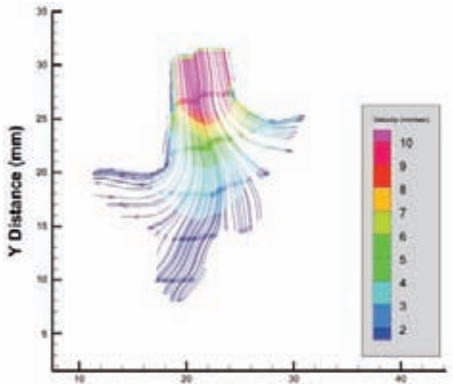
Particle Deposition Up Close

Nearly 35 million Americans have some form of chronic lung disease, which leads to approximately 400,000 deaths per year. Being able to predict how particles of aerosolized medications or airborne pathogens travel through the lung is crucial to understanding the physiological conditions that affect particle deposition and absorption into the bloodstream. Until now, little work has been done to examine how airflow and mass transport differ in diseased lungs compared to healthy lungs. Dr. Risa Robinson, associate professor of mechanical engineering, has completed the first-ever study that uses anatomically accurate healthy and diseased lungs to characterize and compare the fluid flow.

Using a replica human lung cast,



Imaging Particle Deposition: A camera equipped with a laser captures the motions of the particles inside the alveolar sac. Particle image velocimetry maps the velocity flow field in the model by illuminating tracer particles in the flow.



Streamlines of Particle Deposition: Inhalation streamlines show the velocity and particle deposition inside the alveolar sac. Particles shown in yellow have a greater velocity. Dr. Risa Robinson's research finds particle deposition happens more quickly in healthy lungs compared to diseased lungs.

computer models and large-scale physical models of the alveolar sac were created for both geometries—healthy and emphysemic. The 3-dimensional model is 75 times its natural size and mimics realistic breathing patterns, based on a breathing curve identified in a healthy female. Since emphysema patients breath differently than healthy patients, the experiment will help to collect data that can be incorporated into the model to account for the different tidal volumes and frequencies found in emphysema patients.

Using a monochromatic MotionPro X3 camera, the motion of the fluid inside the alveolar sacs is captured. Robinson and her research students are then able to use Particle Image Velocimetry (PIV) to examine the fluid flow in the model and quantify the differences in where the particles deposit in a healthy lung as compared to the emphysemic lung. "By using the model we can for the first time look at localized deposition within an individual cell," says Robinson. "This type of assessment has never been done before."

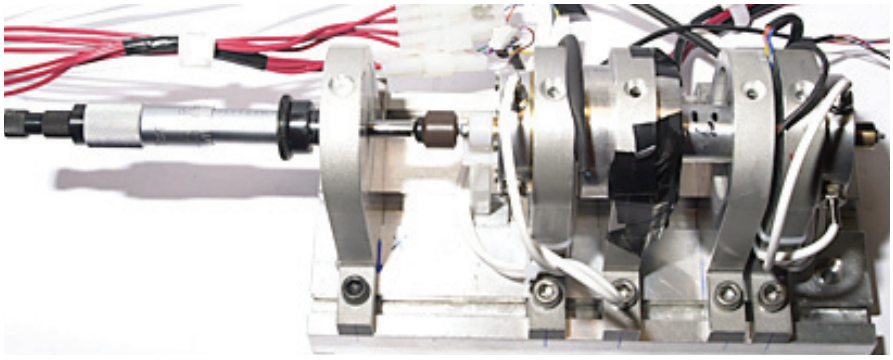
The experiment, funded by the American Cancer Society, has provided convincing evidence that recirculation does not occur in the alveolar sacs of the healthy or emphysemic lung, a theory historically used to explain the mixing of inhaled air with residual in the lung. Now, Robinson's students are working on new theories to explain the mixing. The work also shows that particle deposition will happen more quickly when lungs are healthy compared to emphysematous lungs. Understanding the variances in particle deposition in healthy patients compared to emphysemic patients can lead to better diagnosis and treatments.

Realistic Model of Alveolar Sac: Emily Berg, 6th year mechanical engineering graduate student, and Dr. Risa Robinson use an anatomically accurate 3-dimensional model of an alveolar sac to complete the first-ever study that compares fluid flow in healthy and diseased lungs. The study aids in the understanding of the physiological conditions that affect particle deposition and absorption into the blood stream.

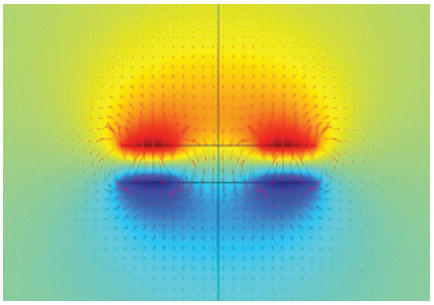
Heart Attraction

In 2007, 2,210 heart transplants were performed in the United States. However, thousands more adults would benefit from a heart transplant if more hearts were available. The lack of available donors has spurred development of artificial mechanical heart devices as an alternative to heart transplants. In collaboration with the Utah Artificial Heart Institute, Dr. Steven Day, assistant professor of mechanical engineering, is engineering a left ventricular assist device (LVAD) that aims to increase the mechanical life and decrease the damage caused to blood.

The device uses magnetic levitation instead of mechanical bearings found in



Magnetic Suspension System: The left ventricular assist device (LVAD) uses magnetic levitation, which reduces mechanical wear and damage to the blood. This prototype of the suspension system holds each component independently.



Characterizing Magnets: Magnetic finite element analysis is conducted to determine the magnetic fields and resulting magnetic forces of the individual components and interactions of neighboring magnets within the heart pump.

LVAD models available today. "The problem with most devices is that fluid mechanical stresses destroy red blood cells or contribute to clotting. By using magnetic levitation there is no mechanical wear on the parts and the fluid mechanics can be better controlled," says Day. An understanding and ability to predict and control the flow inside the pump is critical in the development of the device.

Pumping Blood: Dr. Steven Day and Steven Snyder, 2nd year mechanical engineering student, test the left ventricular assist device (LVAD) to assess the damage to red blood cells caused by flow within the pump.

The pump consists of two systems—magnetic and fluid—each developed in parallel. Compared to current LVAD devices, the magnetic system has fewer parts and no flexible materials, which increases the durability of the device. Pathways to the pump are clear with relatively large clearances between each moving part, which limits blood damage. "Current devices approved by the FDA have a limited lifespan due to blood clotting or mechanical design. Using magnetic levitation should solve this issue," adds Day.

The team is using magnetic finite element analysis to determine the magnetic fields and resulting magnetic forces for the individual components and interactions of neighboring magnets. Researchers are working to characterize these magnets to develop a more robust magnetic system. "Given the nature of magnets, in theory if the device can last for a month, it can last a very long time," says Day.

Although the pump rotates at a constant speed, flow through the device is pulsed due to the way that it's connected to the native heart. However, this leads to a complicated time-dependent flow within the device and requires that the magnetic system is fast and robust.

After two years of developing the fluid and magnetic systems in parallel, a complete functional prototype of the novel device has been created. Once some refinements are made to the magnetic system, Day plans to test the device in animals. "This technology presents great promise for the next generation of LVADs. By incorporating magnetic levitation into a simple flow path, the issues of mechanical damage and blood damage will be eliminated, increasing the efficiency of LVADs," says Day.

Development and testing of the pump is sponsored by the National Heart, Lung and Blood Institute, a division of the National Institutes of Health.

Partnership Announced with Rochester General Health System

Earlier this year, RIT announced plans to develop a strategic alliance with Rochester General Health System. RIT will become the health-care provider's official academic affiliate and RGHS will become the university's official affiliated medical center.

Through the alliance, RIT and RGHS will collaborate on education and research programs in these and other key areas—a collaboration that will include mutual access to each institution's expertise and facilities.

Areas of collaboration include engineering, microsystems, medical imaging, and medical device research. In addition, jointly authored grant proposals to state and federal agencies and private foundations for support of education, research, and public service programs are likely.

As technology continues to transform biomedical science, academic areas like computing and information sciences and digital imaging offer increasing relevance to future advancements in medicine.

On the Web

More information about this work and other related research is available online. http://www.rit.edu/kgcoe/mechanical

Genetics in Age-Related Hearing Loss

Dina Newman

Researchers believe there is a strong genetic component to age-related hearing loss that could help decode this complex disorder.

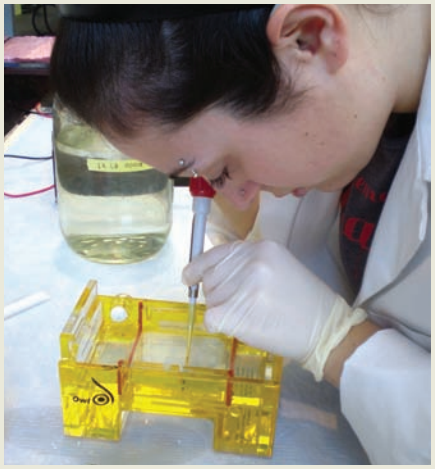
Age-related hearing loss, presbycusis, is a major public health problem, affecting one-third of the population over age 65. RIT researchers have been studying the disorder for nearly 20 years. More recently, Dr. Dina Newman, assistant professor in the College of Science, has been investigating the role genetics plays in age-related hearing loss.

Newman and her research team are hoping to find molecular mechanisms that can help explain why and how people experience hearing loss. "If we can determine which people are prone to the disorder, we will be able to target them for different types of preventative strategies," says Newman.

In a study sponsored by the National Institute on Aging, a division of National Institutes of Health, Newman has been studying the mitochondrial genome. Preliminary results show that certain people who have similar mitochondrial genomes are protected from age-related hearing loss. Newman is hopeful that these findings could lead to preventative treatments.

The connexin genes have also been under examination to determine if a change in one of these genes could cause accelerated hearing loss over a lifetime. While so far it appears there is no relation, Newman explains it is an important confirmation, as the connexin genes are known to be the main cause of congenital deafness.

Recently, Newman and her research team have partnered with the House Ear Institute in Los Angeles, California, to further examine the relationship of GRM7, a glutamate receptor, in age-related hearing loss.



Investigating Genetics: Amanda Souza, an undergraduate biology student in Dr. Dina Newman's laboratory loads DNA in an agarose gel. This method is used to determine which alleles are carried by the chromosomes of different people.

Bio-Electronic Rehabilitation Orthotics

Edward Brown

A new type of orthotic device is emerging from research underway at RIT. Dr. Edward Brown, assistant professor of electrical engineering and director of the Biomechatronic Learning Laboratory, is developing a platform that would allow orthotic devices to be controlled using physiological information, specifically electromyographic signals obtained from the surface of the skin (sEMG).

The platform is a robotic manipulator that has five degrees of freedom and resembles a human arm and is controlled using surface electromyographic signals. Currently, the team is studying pattern recognition and classification techniques to identify various features within the sEMG signal that can correlate with specific types of upper extremity motions. For example, if the platform receives a sEMG signal that recognizes the person is flexing his or her muscles, a control signal is sent to the robot to imitate the action.

Jay Radhakrishnan, a graduate electrical engineering student in the Biomechatronic Learning Laboratory, is using fuzzy logic to discriminate between different features in sEMG signals. Fuzzy logic is a soft computing technique that takes numerical data and translates it into linguistic terms that emulate how people think. Radhakrishnan hopes by applying fuzzy logic to sEMG signals he can create a more natural interaction between the user and the robot.

Testing Bio-Electronic Device: Adey Gebregioris, 5th year electrical engineering student, controls a robotic manipulator using sEMG signals obtained from her bicep muscles. Here, Gebregioris is curling her arm and the robot is imitating the action.

The ultimate goal is to create a rehabilitation exoskeleton system where the robotic device and the user can communicate seamlessly via physiological and biomechanical information. This type of orthotic device could aid people who suffer from muscular dystrophy or other conditions where the muscle is weakened or diseased, but the person's nervous system is still intact.

"We are very hopeful that this technology will lead to a new type of orthotic device," says Brown. "My greater vision is to expose students to STEM-related disciplines and perhaps inspire the next generation of rehabilitation roboticists and biomechatronic engineers."

The Biomechatronic Learning Laboratory was founded in 2007 by a grant from the National Science Foundation.

Staying Connected, Beyond the Classroom, Beyond Business: Social media technologies are transforming education, politics, business, and the way people interact with each other. RIT professors and social media researchers Dr. Elizabeth Lawley, far left, Dr. Neil Hair, far right, and Dr. Sue Barnes, foreground, have embraced the power of social media to engage their students and inspire innovation.

The Social Media Phenomenon

by Marcia Morphy

Online social networks are expanding relationships rapidly across the globe and providing interactive experiences never before possible.

A Social Media World

Twitter, Facebook, Flickr, YouTube, the iPhone, and programs like Adobe Connect are all tools of the trade. In the relatively new landscape of social media, users are seeking solutions that seamlessly cut across mobile, Web, and live interaction—while bringing back the human element to digital interaction.

Facebook is now a giant in the business, exceeding 175 million active members worldwide in February 2009—twice the population of Great Britain. RIT faculty and students have embraced the social media phenomenon in the classroom and through investigation and innovation at RIT's Lab for Social Computing.

Innovation and Education

"People create, join, and seek social networks that enable them to have meaningful and relevant experiences with each other,"

says Dr. Susan Barnes, professor of communication at RIT's College of Liberal Arts and associate director of the Lab for Social Computing (LSC). "At RIT, we're studying the online environment as well as using it."

Dr. Elizabeth Lawley, associate professor of information technology in the B. Thomas Golisano College of Computing and Information Sciences, founded the lab in 2004 and now serves as director. As the first university-based lab on social computing for undergraduate and graduate studies in this new area of technological research, the LSC vision is to leverage the power of social media through new innovations and provide information about social computing in business and industry contexts through publications, workshops, and Web-based resources.

The lab provides an interdisciplinary meeting place necessary for campus collaborations. "We'll be able to

Twittering: RIT faculty and students use Twitter to send and receive quick messages.

Terms and Tools of the Trade

Adobe Connect – Software that allows the user to communicate and collaborate instantly through interactive online personal meetings. **www.adobe.com/products/acrobatconnectpro**

Blog – A type of website usually maintained by an individual or organization related to a specific topic. Regular entries of commentary, description of events, and other materials are posted and readers can provide feedback for public viewing.

Digsby – Software developed by dotSyntax, a company founded by a team of RIT alumni, which integrates instant message, e-mail, and social network accounts into one interface. **www.digsby.com**

Facebook – Free-access networking website allows users to share photos, send e-mail, instant message, and connect with people who have similar interests. **www.facebook.com**

Flickr – Online photo and video management and sharing service. **www.flickr.com**

iPhone – Integrated cellular phone that includes a music and video player, digital camera, PDA, and an Internet communications suite. **www.apple.com/iphone**

LinkedIn – Business-oriented social networking site primarily used for professional networking. **www.linkedin.com**

MySpace – Social networking website allows users to create personal profiles, share media, blog, and connect with friends. **www.myspace.com**

Second Life – Free online 3-D virtual world where users can socialize, participate in group activities, create and trade virtual property and services, and travel the world. **www.secondlife.com**

Twitter – Social networking site with a microblogging service. Users are able to send and receive text messages via the twitter website. **www.twitter.com**

Wiki – Website designed to enable people to easily access, contribute, and modify content. Wikipedia is one of the best-known wikis. **www.wikipedia.org**

YouTube – Free video sharing website where users can upload, view, and share video clips. **www.youtube.com**

Facebook Friday: Rochester's local ABC news affiliate, 13WHAMNews, presents an interactive segment called Facebook Fridays. The segment, hosted by news anchor Doug Emblidge, and featuring Dr. Elizabeth Lawley, director of RIT's Lab for Social Computing, provides online and TV viewers with tips on how the site can be used to promote networking, marketing, and business operations.

combine human sciences like communication with technical sciences such as information technology, to conduct research and development related to a wide range of social activities," Lawley says.

Currently, Lawley and her students are partnering with Microsoft on the Personal Ubiquitous Library Project. PULP is a software application that will enable mobile phones to capture a picture of a bar code on specific items—a book, CD, DVD, or game—and upload the bar code image to their personal digital library. The software would recognize the photographed bar code and provide information about the product. Users would then upload their findings to their social networks to share similar interests, spark discussions, or simply promote the product.

"The benefit of using PULP software is less waste of personal time and money," Lawley says. "Take a quick picture of a bar code with a cell phone, download it and you won't waste your time reading a book with poor reviews or buying a game you can't play with your friends."

Another collaboration currently underway is with Gannett's *Rochester Democrat and Chronicle* to develop an Alternate Reality Game (ARG), called *Picture The Impossible*. ARG has been used for TV shows like ABC's Lost, but this is the first time someone has tried to do this with the newspaper as it transforms with the realities of online communication. RIT students will serve as writers, puzzle designers, artists, coders, and project managers to develop the game.

Picture The Impossible will not be a game where people sit in front of their computers; instead it sends people out into the community on a virtual treasure hunt to take pictures and find hidden clues in various parts of the city then log their results into *Democrat and Chronicle's* online network. "There's some mystery, problem-solving, and collaboration components to the game and the idea is to get people excited and involved in all that Rochester has to offer, while learning more about its history as a city of innovation," Lawley says.

Building upon research at the LSC,

Social Computing's Impact on Communication and Business: Dr. Sue Barnes, professor of communication, and Dr. Neil Hair, assistant professor of marketing, are investigating how the introduction of social media is changing the way people and businesses interact. One study examines the development of new media advertising and its impact on marketing, sales, and operations.

Online Social Networking to Enhance Education: New media technologies like Facebook are being used by faculty and students to enhance classroom lectures, promote outside discussions, and improve networking among scholars.

Barnes, along with faculty members Dr. Christopher Egert and Stephen Jacobs of the B. Thomas Golisano College of Computing and Information Sciences, and Dr. Nicholas DiFonzo of the College of Liberal Arts, is researching Theoretical and Applied Approaches to teaching social computing in STEM (science, technology, engineering, and mathematics) education through a grant from the National Science Foundation. Six graduate students are examining how STEM students establish social networks when they interact in online learning environments.

According to Barnes, the primary goals are to improve technology education by introducing the new discipline of social computing into the STEM curriculum, and to prepare undergraduates for positions in the social media sector of the technology industries.

"Measurable outcomes are to evaluate the level of student understanding of social media before and after they have taken the course, as well as the student's perceived awareness of the technology marketplace," Barnes explains.

Social, Learning, and Business Networks

Dr. Neil Hair, assistant professor of marketing in RIT's E. Philip Saunders College of Business, says the online interactive classroom can become a network and meeting space with businesses and professionals across the globe—as well as a virtual laboratory to create and test product concepts before they make their debut in the real world.

"It's all about the networks," says Hair. "We've got social networking in terms of Facebook and MySpace; we've got a virtual world like Second Life. And finally, we have partnerships we've formed using our professional contacts to help form that wider social network.

"It's not just about the students. It's also about the faculty; it's about real-world companies and organizations that want to get involved; it's about research to help us understand the strategies behind the use of social networks."

Navigating the virtual world is an overall mission for RIT's Online Learning department, which provides support for all RIT computer-collaborative communication. "We use a Web-based system called myCourses that adds an option for discussion groups, but we also have added tools like wikis and webinars through Adobe Connect for streaming support lectures and communication venues that stretch beyond the physical classroom," says Online Learning director Joeann Humbert. "We provide wraparound support for these technologies, and that includes our new RIT Island in Second Life."

A Lecture in Adobe Connect: Professor Hair utilizes Adobe Connect to give a remote lecture. The software package allows the user to view and hear the presenter, along with the presentation slides, and communicate via the online chat feature.

RIT Island in Second Life: Developed entirely by students, the virtual environment serves as a meeting and networking environment for the RIT community, as well as an education and research tool for software development and design (http://online.rit.edu/secondlife).

Virtual Learning: Professors Barnes and Hair created a course taught entirely in Second Life, which focused on developing online advertising campaigns and virtual marketing plans. The image above shows professor Hair lecturing in his virtual classroom.

"Business and education are the two highest users of Second Life right now," says Katie McDonald, instructional technologist at Online Learning. "Yes, the tools have great learning applications and obviously that's why we are using them, but just the fact that students are exposed to this simulated 3-D environment has a benefit without even talking about the content of the course.

"Within these worlds, users can communicate with high-fidelity, interact with other avatars, and immerse themselves into activities not possible in the real world. It's a huge asset to learn how to navigate and how to communicate in Second Life."

RIT Island in Second Life was selected by Linden Research Inc. (the software developer), as a showcase for new and existing residents to explore and discover what's most exciting in the Second Life world.

Humbert says the RIT Island was completely developed by students. It's a meeting place and a great social environment, but it's also an educational tool for RIT students who are interested in 3-D development and now have this opportunity to design and create on the island for their work portfolios."

According to Humbert, social media technology allows people to work together in ways never before possible by introducing a global perspective in the classroom. "It transcends any disabilities whether it's blindness, deafness, attention-deficit, social issues, or shyness. In an online world, the playing field becomes even."

Experience in the Virtual World

RIT's first online cross-listed undergraduate course in Second Life—Online Advertising—was co-developed by Hair and Barnes through the Provost's Learning and Innovation Grant. The virtual course taught students to develop online advertising campaigns for companies existing in the virtual world and those interested in building a presence there.

"Our students worked with real clients who owned businesses in Second Life and are making a living from it," Barnes says. "This is where innovation comes in because we went into Second Life and said let's look at this unique environment and bring in those people as guest lecturers to teach our students how to use it."

Three of the top ten richest avatars, according to *Business Week*, agreed to work with students in the class. "No one has ever given a guest lecture inside Second Life from a commercial perspective. Our students ended up working for real clients on consultancy projects and helped them make money," Hair says.

The classroom benefits are huge, says Hair. For example, IBM Europe and Xerox in the U.S. are very interested in this interrelationship because they understand its number one application—to hire graduates who understand Second Life and can help build branding strategies for their businesses in this new social medium.

"You've got the trinity: the academics, business practitioners, and bright young students—three parties that are playing very well," Hair says.

As a result of the course, Barnes is partnering with the Relationship Networking Industry Association, which builds communities of trust to manage the exponential growth of virtual networks. Barnes is helping to build RNIA's education component of social networking for the university.

"Education has always been about the experience, about creating that social experience that students find memorable, find pleasant, find exciting, find engaging," Hair says. "Online social media has allowed us to extend that experience beyond the classroom, beyond the confines of time and place so students can continue to connect with us and each other long after graduation. Social media has fundamentally transformed the educational experience in this country and the world over."

On the Web

More information about this work and other related research is available online.
http://labforsocialcomputing.net/
www.neilhair.com

Play the Social Media Game


Patricia Albanese


Matt Bernius


Michael Riordan

Social media networks have a proven ability to connect people around the world, forming powerful networking capabilities. RIT's Open Publishing Lab is leveraging social networking applications and digital printing technology to enhance networking opportunities among professionals, students, and faculty at face-to-face events.

The lab, founded in 2007 and sponsored by the School of Print Media's Gannett Professorship, the Sloan Printing Industry Center, and an HP innovation grant, combines faculty and students from multiple disciplines to create and implement a host of new media applications, including printable wikis, self-publishing guides, and a platform for instantly publishing Web and print newspapers.

One project underway is the Social Networking Game for use during networking events, such as conferences or campus events. Upon arrival, participants or players create a personal profile on a website, which includes interests relevant to the event. From the participant profiles, stickers are generated with bar codes and identifiers to denote player interests. The objective is to make as many connections as possible during the event by trading stickers with participants who share common interests. Following the event, the stickers are collected and scanned and the results are provided, via a secure webpage, to participants, allowing players to reconnect with people they met. Organizers of the event receive better information about the attendees, including who made the most connections and how many total connections were made.

The game was developed by RIT students Abdul Matsah, Guy Paddock, Michael Rubits, Gordon Toth, and Jacob Weigand, along with RIT professors Matthew Bernius, Michael Riordan, and Patricia Albanese. An open source version was recently released through their website (http://opl.rit.edu). The OPL hopes to implement the game at this summer's Rochester International Jazz Festival. The software and data collected from the game will also be used in additional social networking research being conducted through the lab.

Connection Wheel: Following a round of the Social Networking game, a Connection Wheel is generated to illustrate the interconnections formed by the players.

Blogging as a Marketing Tool


Deborah Colton

The Web log, or blog, is a relatively new technology that has spread quickly across the Internet; recent estimates identify over 120 million blogs are now on the Web. Blogs are created for a number of reasons, from sharing social interests to providing feedback on an idea, event, or product; but all blogs provide an instantaneous form of personal interaction. Dr. Deborah Colton, RIT assistant professor of marketing, is examining the impact of the blog on corporate marketing practices and its effectiveness as a marketing tool.

"While there are millions of blogs, only a fraction of companies are taking advantage of the opportunity they provide," notes Colton. "Blogs provide a unique opportunity for corporations to build their brands, develop personal relationships with their customers, and engage in subtle marketing activities. Despite the growth of blogs and their potential benefits, there is little information on how they are being used or what their overall effectiveness is."

Colton conducted a study of blog use by 51 Fortune 500 companies over a two-month period and analyzed the themes presented compared to the overall marketing and communications goals of the company. She also assessed how the blogs were used, such as for technical support or new product discussions, as well as the interactivity among companies and customers on the sites. For example, companies responded to only 4 percent of the comments posted on the blogs of those that were studied.

"This technology can be extremely beneficial in connecting customers to businesses and providing more direct feedback on product and marketing strategies," adds Colton. "However, this research indicates that corporations may not be fully embracing the benefits of blogging."

Colton presented her findings at the 2008 meeting of the E-Business Association, and a paper entitled "What are Corporations Blogging About? Identifying Strategies about Corporate Associations and Credibility" has been accepted for presentation at the 2009 American Marketing Association's Summer Marketing Educators' Conference. Colton plans to build on this research by surveying consumers about their attitudes toward corporate blogs.

Corporate Blogging: Dr. Deborah Colton's study of corporate blogs found companies responded to only 4 percent of the comments posted on the blogs of those that were studied. Colton notes only a fraction of companies take advantage of the opportunity blogs provide.

Developing Novel Detector Technology: Dr. Donald Figer, director of RIT's Rochester Imaging Detector Laboratory and professor of imaging science, is a national expert in detector technology. The laboratory develops and tests novel imaging detectors, like the Teledyne H4RG detector shown above, which will enable some of the most demanding observations.

Advancing Imaging Detectors

by Kara Teske

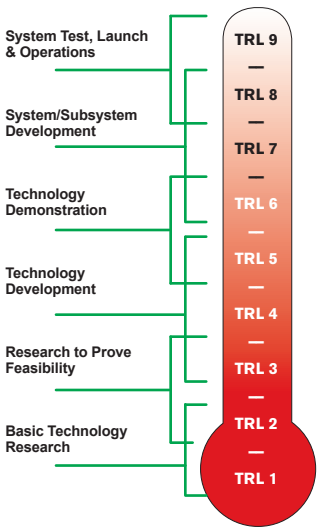
Advancements in imaging detectors promise to make more discoveries, solve more problems, cure more people, identify more threats, and manage resources more effectively.

Rochester Imaging Detector Laboratory

Imaging detectors are often the limiting factor for the most ambitious observations, across a broad range of applications. Some of the most demanding challenges require high-performance detectors.

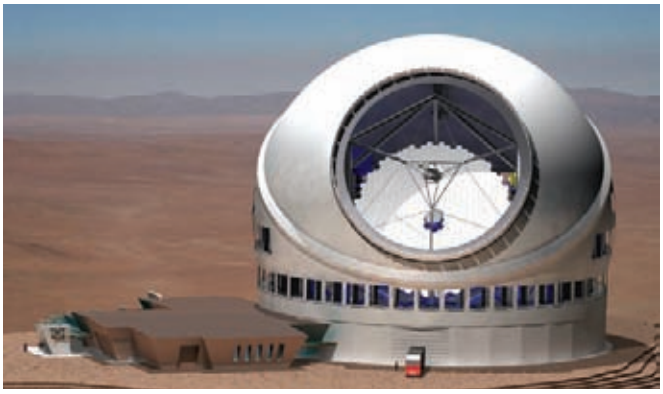
Founded in 2006, the Rochester Imaging Detector Laboratory (RIDL) is making significant contributions to design, develop, and implement advanced sensor technologies. Under the leadership of Dr. Donald Figer, lab director and professor of imaging science, the lab has established key partnerships with University of Rochester, Lincoln Laboratory at Massachusetts Institute of Technology (MIT), Sandia National Laboratory, the Jet Propulsion Laboratory at California Institute of Technology (CalTech), NASA, and other leading laboratories in an effort to advance imaging sensor technology.

RIDL aims to operate within all ranges of the Technology Readiness Level (TRL) scale, from initial conceptualization to successful deployment. TRL was developed by the Department of Defense and is used by agencies to assess the maturity of emerging technologies. At the low end—one to three—research is in its initial stages, where the idea for an invention begins. On the other end—six to seven—technology has been developed and is being tested in relevant environments. When an application is successfully deployed in its intended environment, the technology is said to reach a TRL of nine—full maturity.



Technology Readiness Level: The Technology Readiness Level scale was developed by the Department of Defense and assesses the maturity of emerging technology. RIDL aims to operate along all levels of the scale.

"At RIDL, our desire is not simply to implement existing hardware, and not simply to invent crazy ideas, and not simply to advance technologies; it is the whole range," says Figer.



Courtesy of TMT Observatory Corporation

Thirty Meter Telescope: TMT is expected to be among the first extremely large telescopes to be built over the next 20 years. The novel noiseless detector being developed at RIDL is expected to effectively quadruple the collecting power of the TMT for the faintest of objects in the Universe.

Novel Noiseless Detector

A quantum-limited imaging detector—that is the goal of the project sponsored by The Gordon and Betty Moore Foundation and in collaboration with Lincoln Laboratory. The novel detector will be able to detect individual photons, enabling the most sensitive observations from the world's largest telescopes, including the Thirty Meter Telescope (TMT).

TMT is expected to be the first of a new generation of extremely large telescopes, with a 30-meter diameter segmented

RIDL Facilities: RIDL is equipped with a class 10,000 clean room and class 1,000 flow bench to design and evaluate new detectors.

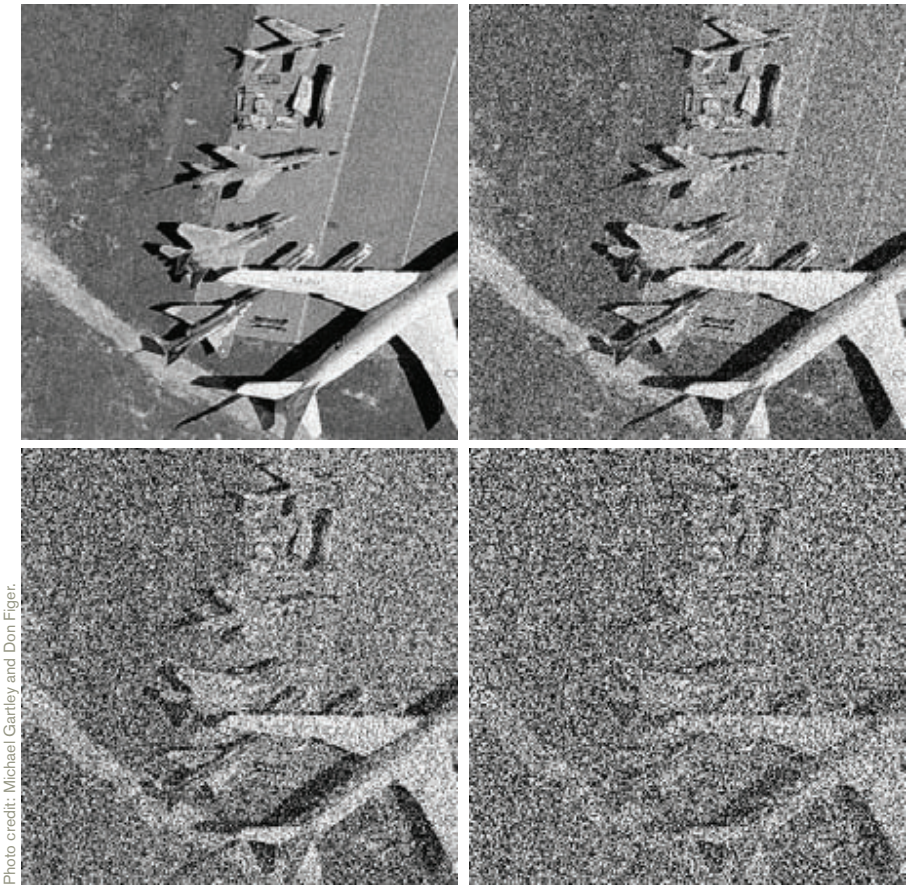
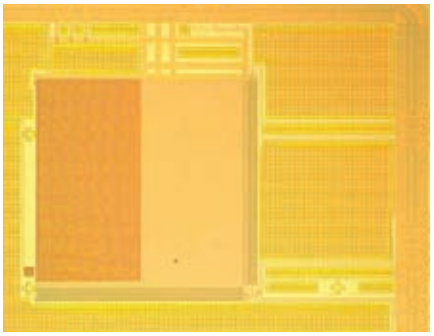
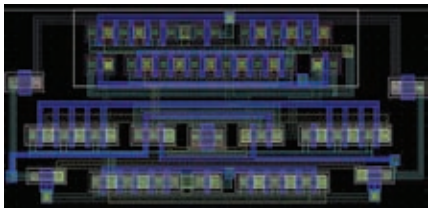


Photo credit: Michael Gartley and Don Figer.

Importance of Read Noise: The images above simulate varying levels of read noise in an image of airplanes at Robins Air Force Base. The image on the top left has zero read noise and the other images have read noise comparable to that found in common usage on space-based imaging platforms today. These images demonstrate the superior performance of a zero read noise detector.



Radiation Tolerant Detector: In partnership with NASA and the University of Rochester, RIDL is developing a detector that is expected to be resilient against the effects of high energy radiation. In planetary missions, radiation damage often limits the capabilities of deployed detectors.



Design for Radiation-Tolerant Detector: The device uses low power complementary metal-oxide semiconductor (CMOS) multiplexers arranged in high density.

mirror capable of observations from the near ultraviolet to the mid-infrared. With the novel noiseless detector, the collecting power from TMT will be quadrupled for low-light level applications. Quantum-limited imaging detectors will also be useful for ground-based and space-based astrophysics, Earth and planetary remote sensing, exo-planet identification, biomedical imaging, homeland safety, and even consumer imaging applications.

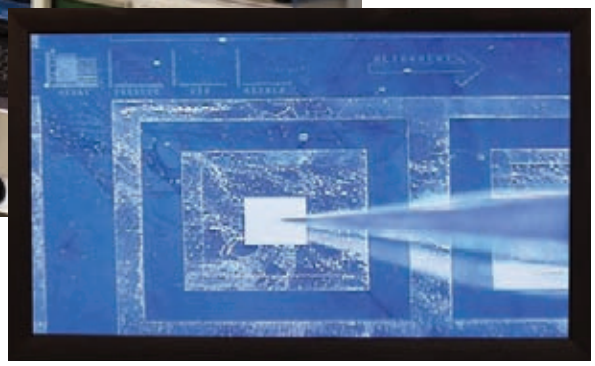
Regardless of the type, noise is often the limiting factor among most detectors. Usually caused by the device itself, noise can restrict the ability to view the image, especially in low-light conditions. "By using a digital photon counter to detect every single photon—or unit of light—our device will have zero read noise," says Figer. "A detector with zero read noise will dramatically reduce exposure times and increase the reach of the telescope."

The design is based on Geiger-Mode Avalanche Photodiode (GM-APD) circuitry. The device retains the best properties found in state-of-the-art devices, while demonstrating a 256x256 silicon focal plane array. By 2010, the detector is scheduled to be ready for testing in relevant environments. "This is a prime example of where we are inventing new technologies that are advancing the field," adds Figer.

Radiation-Tolerant Detector

For decades, we have been exploring life beyond Earth. The findings of these planetary missions often depend on the capability of deployed detectors. The challenge is long before the detectors reach their destination, the detectors must travel through harsh radiation

Probing a Test Structure: Matthew Simpson (right), 4th year biotechnology student, and Dr. Donald Figer (left) work in the clean room probing a test structure to determine properties of the detector, like dark current levels and breakdown voltage.



View of Test Structure: The test structure is an enlarged pixel and is probed to generate IV curves (electric current and voltage).

environments filled with solar particles, Galactic cosmic rays, and trapped magnetospheric plasma. And once they meet their final destination, even harsher radiation may await—near Europa and the Jovian moons, for example.

To maximize the "science return" of future planetary missions, the next generation of imaging detectors need to be immune to radiation. Through a project sponsored by NASA, and in partnership with the University of Rochester, RIDL is developing one such detector.

Current detectors for planetary missions

Journey of a Photon

Before high school students embark on their next life journey–college–Journey of a Photon gives students the opportunity to explore astronomy and detector science. The Journey of a Photon program is sponsored by NASA and led by Dr. Jacob Noel-Storr, associate research scientist at the Center for Imaging Science, and Dr. Donald Figer, director of the Rochester Imaging Detector Laboratory. The program immerses high school students in learning and communicating science by creating an interactive planetarium-like experience.

The program fosters relationships among students, science teachers, and the local scientific community. Students interact with researchers to understand the science issues involved with the Journey of a Photon, from its creation to its detection. At the conclusion of the program, final projects will be exhibited this fall at the Rochester Museum and Science Center to correspond with the International Year of Astronomy and the Coalition On the Public Understanding of Science (COPUS) Year of Science.

"The goal is to engage students so that they may enter a science discipline when they head off to college," adds Noel-Storr.

2009 Quantum-Limited Imaging Detector Symposium

On March 2-3, 2009, RIT hosted scientists and researchers from academia, government, and industry to advance the field of quantum-limited imaging detectors. The realization of quantum-limited imaging detectors would enable the ability of some of the most demanding measurements.

Experts from a broad range of fields shared critical application needs and new technology developments that could help to address those needs. Presenters included Andrew Berger of The Institute of Optics at the University of Rochester, Tim Tredwell of Carestream Health, Jim Beletic of Teledyne Imaging Sensors, Jeff Puschell of Raytheon Space and Airborne Systems, Dan Newman of ITT, and Brian Aull of Lincoln Laboratory.

Through collaborative breakout groups, participants identified key activities to enable the realization of quantum-limited detectors. "By bringing together such exceptional talent and experience, we were able to spark new ideas and create new opportunities that will bring our field just another step forward," add Dr. Donald Figer, event coordinator.

More information about the event is available online at http://www.rit.edu/research/itc/symposium/.

Advancing the Field: Jim Beletic, director of Astronomy and Civil Space at Teledyne Imaging Sensors, led a session on critical needs and applications for astrophysics at the Quantum-Limited Imaging Detector Symposium hosted at RIT.

use advance forms of the basic Charge-Coupled Device (CCD) or Complementary Metal–Oxide–Semiconductor (CMOS) multiplexers. By taking advantage of the performance approach in CCD and the low-noise capability of the CMOS architecture, RIDL is merging proven technology to improve the performance and provide excellent noise properties of CCDs.

The technology of the device instantly converts electromagnetic signals into digital information, pixel by pixel, eliminating the ability for radiation to affect the signal. "With the instant conversion, radiation doesn't have time to affect the signal. Once the data is digitized, it's nearly impossible to pick up noise," notes Figer.

To accurately assess the device's immunity to radiation, the device will be tested in three relevant environments, including the particle beam at UC Davis Crocker Nuclear Laboratory. When successfully deployed, the radiation-tolerant detector will enable greater information gathering capabilities in future planetary missions.

A Solution for Sandia

Much of RIDL's research and development focuses on detector technology, but the lab is also developing firmware and software applications to support these technologies.

Daniel Pontillo and John Frye, RIT computer engineering graduate students, are working with Sandia National Laboratories to develop hardware description language (HDL) software that is compatible with a specific infrared camera. The research students are investigating the feasibility of customizing a standard Field Programmable Gate Array (FPGA) chip to acquire data in a format compatible with the infrared camera in real-time.

"We have been able to implement a digital system within the FPGA that allows us to display the data on the computer," says Frye. "The next step will be to develop the software. While the challenge is rather rudimentary, it has allowed me to apply my knowledge of detectors and has given me exposure to a national laboratory. That experience is unmatched."

This research will help Sandia evaluate new sensor technology against critical mission areas.

Future of Detectors

In just three years, RIDL has established a national reputation for helping to advance detector technology. "The applications are wide—from making new discoveries outside our planet to having a better view of the innermost parts of the body. It is our hope the technology we create here may help to address some of the world's most pressing challenges," adds Figer.

On the Web

More information about this research and the Rochester Imaging Detector Laboratory is available online.
http://ridl.cis.rit.edu/

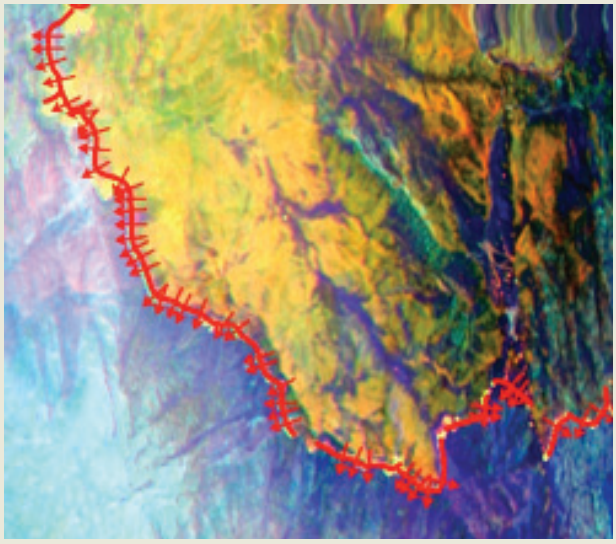
Managing Wildfires


Anthony Vodacek

RIT imaging scientist Dr. Anthony Vodacek is part of a multi-university partnership that is creating mathematical models and computer simulations to better manage and predict wildfires. Vodacek, an associate professor in the Center for Imaging Science, is utilizing imaging technology developed through RIT's Wildfire Airborne Sensor Program (WASP) in the development of new software that integrates assimilation algorithms and sensor data to produce real-time simulations of wildfire movement.

The process collects and analyzes data on fire development, local weather patterns, and wind speed to generate better predictive models on how and where a fire will spread. Additional software is then used to assimilate model data with geographic and thermal maps to help fire planners better plan emergency response and evacuations.

"A wildfire is essentially an atmospheric phenomenon that interacts with local weather patterns," notes Vodacek. "This project is creating more robust models that will assimilate what is happening on the ground and in the atmosphere with how the fire is moving."



Simulation to Predict Wildfire: A false color image of a wildfire is processed to automatically extract the position of the active fire line (red line) and the direction of propagation of the fire (red arrows) based on image processing tools.

The technology will also ultimately shed new light on how large fires affect existing weather phenomena, such as local wind patterns, allowing experts to better predict how wildfires move. The research, which is funded by the National Science Foundation and the U.S. Forest Service, also includes scientists from the University of Colorado at Denver, the University of Wyoming, and the National Center for Atmospheric Research.

---

gravitySimulator Tests Einstein's Theory


David Merritt

Recent advances in technology have enabled scientists to observe stars close to the supermassive black hole at the center of our galaxy, allowing us for the first time ever to truly test Einstein's theory of relativity.

An excessive amount of dust between the Earth and the center of the galaxy makes observing this region extremely difficult. High-precision simulations will add the extra information that scientists need to interpret features that would otherwise be ambiguous.

Using the gravitySimulator, Dr. David Merritt, professor of physics, has created a star-by-star representation of the galactic center region. "We are able to look at a black hole and a number of bordering stars and evolve the system forward in time, including all the effects of relativity, as we understand it. The simulations allow us for the first time to see how much the gravitational interactions between stars can affect the motion compared with relativistic effects," says Merritt.

By observing the way stars act on each other gravitationally, as well as within the black hole, scientists will be able to test Einstein's theory.

gravitySimulator is a novel supercomputer that incorporates special-purpose hardware to solve the gravitational N-body problem. Designed by Merritt and Dr. Rainer Spurzem, an astrophysicist at the University of Heidelberg, gravitySimulator is specifically used to study the dynamical evolution of galaxies and galactic nuclei.

This work is funded through the National Science Foundation. Merritt works in collaboration with scientists at Washington University in St. Louis, Weizmann Institute of Science, University of Amsterdam, and the University of Turku.

gravitySimulator: A novel supercomputer, housed at RIT, enables researchers to study the dynamic evolution of galaxies and galactic nuclei.

Advancing Multimodal Imaging: Dr. Maria Helguera, assistant professor of imaging science and director of the Biomedical and Materials Multimodal Imaging Lab at RIT, is conducting research designed to advance the use of positron emission tomography (PET), X-ray computed tomography (CT), and magnetic resonance imaging (MRI). Above, Helguera and one of her students discuss an image developed by the lab through registering and fusing separate MR and PET images. The work could eventually enhance several areas of medical imaging, including the detection of cancer.

Imaging to Enhance Diagnosis

by Staff Writer

RIT researchers are developing and evaluating imaging methods that enhance the accuracy and efficiency of medical diagnoses.

Biomedical Imaging at RIT

While the field of biomedical imaging has been around since the early 1900s, new advances in technology and computer science have greatly enhanced the diagnostic results of this discipline. RIT's Chester F. Carlson Center for Imaging Science's current research in the field includes efforts to enhance the development and application of multimodal image fusion and digital simulation. Additional research seeks to improve the capabilities of magnetic resonance imaging (MRI) systems.

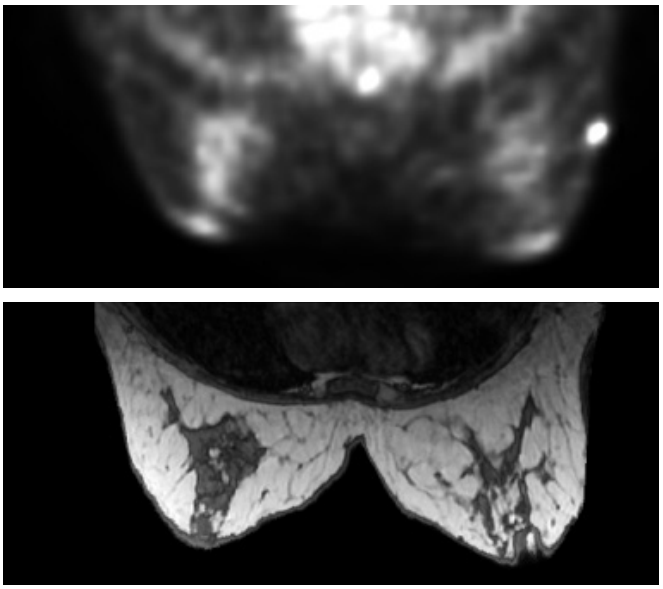
With significant computer facilities and software capabilities, combined with a depth of experience, RIT provides an ideal location for conducting biomedical imaging research. "One of the Carlson Center's key goals is to promote initiatives that have real-world impact," notes Dr. Stefi Baum, professor of imaging science and center director. "Nowhere is this truer than in our work in biomedical imaging, where our research results could literally help save lives."

Multimodal Breast Imaging

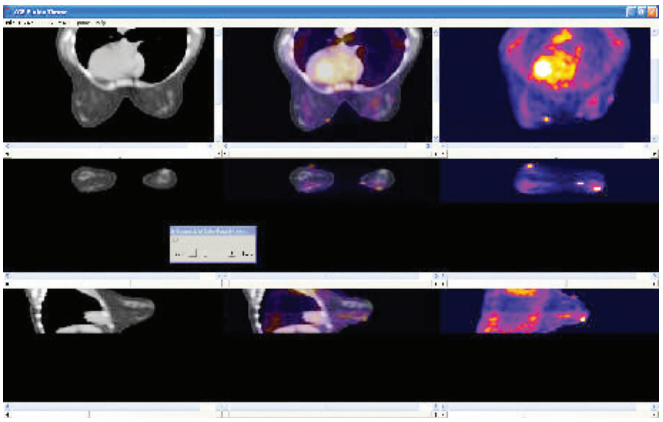
Currently, researchers in the Biomedical and Materials Multimodal Imaging Lab (BMMIL) are collaborating with Dr. Andrzej Krol of the State University of New York Upstate Medical University to advance positron emission tomography (PET), X-ray computed tomography (CT), and MRI capabilities. Dr. Maria Helguera, assistant professor of imaging science and director of BMMIL, is working to advance fusion techniques to enhance accuracy and efficiency for reading registered MR and PET breast images. While this research examines breast cancer, the technique could be applied to other ailments.

X-ray mammography is the primary tool for detecting and diagnosing breast cancer. Additional information can be provided by PET to show metabolic activity of the tissue, while MRI provides high-resolution structural information. Currently, these different imaging modalities are generated from separate equipment. To maximize the benefits both PET and MRI provide, the images need to be registered (brought into spatial alignment) and fused for evaluation by the radiologist.

The PET and MR images are registered using a finite element method technique that uses fiducial skin markers to provide common information visible in both modalities. However, even when viewing the registered images side by side, spatial relationships may be difficult to ascertain.

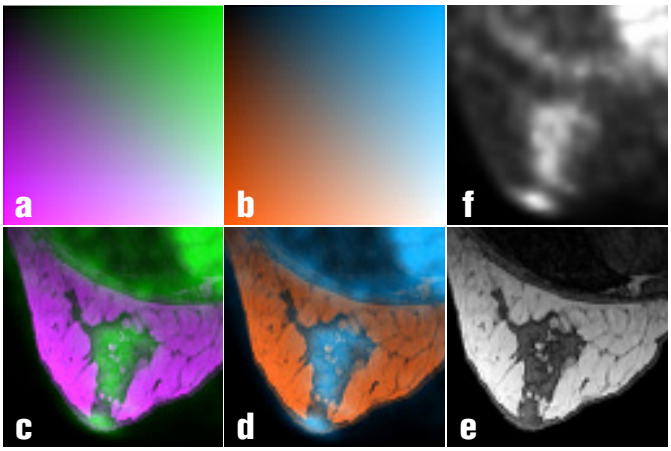


PET and MRI: Positron emission tomography (PET) is an imaging technique that visualizes metabolic activity in human tissue (top). Magnetic resonance images provide high-resolution structural images of the body (below). Scientists at the Carlson Center are researching techniques to fuse PET and MR images to maximize the benefits of each modality.



Benefits of Image Fusion: The three orthogonal images on the left represent MRI data, while the three on the right are PET images that include the application of a red color table. The center images are the result of fusing the MR and PET images using the weighted average fusion plug-in. The fused images allow analysts to view both the anatomical structure and metabolic activity of the body part being imaged.

Education and Research: Dr. Maria Helguera discusses the fusion for visualization technique developed by BMMIL, with Karl Baum, a post-doctoral fellow with the BMMIL, and Natalie Tacconi, 2nd year imaging science student.



Testing Fusion for Visualization Techniques: Dr. Maria Helguera, in partnership with SUNY Upstate Medical School, completed a study to test the validity of fusion for visualization techniques. Color table examples produced by the genetic algorithms are shown in images (a) and (b) above. Joint PET/MR images created using the new color tables are shown in (c) and (d). The MR and PET images that were fused are shown in (e) and (f). Initial results demonstrate the need and benefit of a joint display and emphasize the benefits of the genetic algorithm fused images over other fusion techniques currently available.

By fusing the PET and MR images into a single viewable image, it is expected that radiologists will be able to diagnose with greater specificity and accuracy.

A number of fusion techniques have been developed that allow the radiologist to see the anatomical structure and metabolic activity in a single image volume. Helguera, in partnership with SUNY Upstate Medical University, tested the validity of fusion for visualization techniques; including a genetic algorithm-based technique to generate 2-D color tables, developed by Helguera's research team.

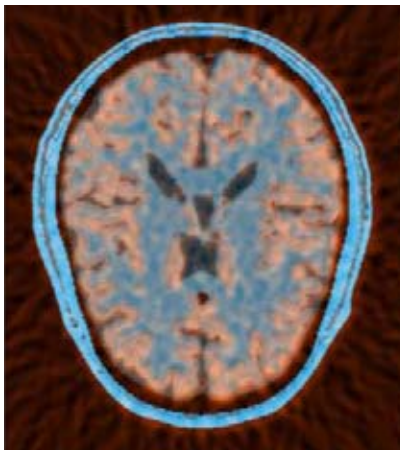
The initial study demonstrates the need and benefit of a joint display because of the inaccuracy when using a side-by-side display. In addition, the study indicates that the color tables generated by the genetic algorithm are good choices for fusing PET and MR images. The advantage of the proposed method over other color table generation techniques is its ability to consider a much larger set of possible color tables, ensuring that the best technique is found.

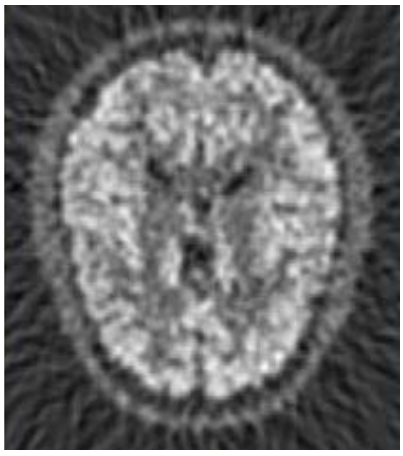
"Multimodal breast imaging holds promise for better diagnosis; however, it is important to thoroughly test the fusion techniques in the clinical setting," Helguera says. "We were pleased to see our technique showed favorable results, but we continue to work on additional assessment and modification."

Medical Image Simulation

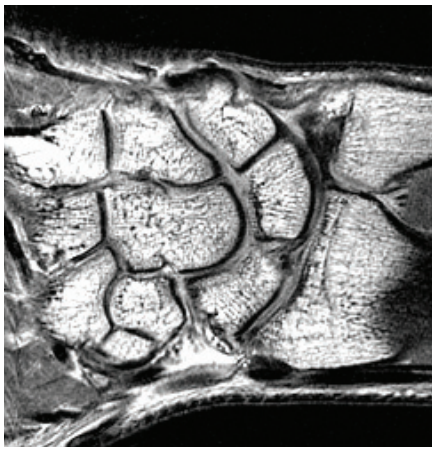
PET, CT, and MRI systems provide valuable diagnostic image data. However, the associated costs, resources, and clinical administration they require limit the ability to gather clinical data to conduct research and improve their diagnostic capabilities. By creating digital models of the human anatomy and modeling the medical physics, RIT researchers are able to study system design, acquisition protocols, and reconstruction techniques, and develop new image processing techniques with precise ground-truth.

Synthetic medical data sets can be used for training purposes or for quantitative evaluation in image processing and analysis algorithms. "Obtaining 'ground-truth' data in medical imaging is an almost impossible quest when pathology reports are not available," says Karl Baum, a post-doctoral fellow in imaging science and researcher with BMMIL. "One way to circumvent this limitation is by leveraging digital simulators that model the tissues being imaged, the imaging systems, and the image acquisition physics in order to create realistic synthetic images."





Synthetic Data Sets:
The image on the top is a synthetic multimodal PET/MR image of the brain showing a metabolically active lesion present in the PET image, created by fusing and registering the MR (middle) and PET (bottom) images and adding in color tables created by the research team. Synthetic data sets enable scientists to conduct research without the clinical adminstration and associated costs of obtaining actual PET/MR images.



MRI Coil for the Extremities: RIT Professor Joseph Hornak was part of a team that developed an asymmetric single-turn solenoid style MRI coil, as shown on the right. The device is especially suitable for MRI of the human wrist.

Image simulation is not a new idea; however, until recently, practicality and accuracy has been limited due to the complexity of the procedures and long computation times. Improvements in computational systems and advancements in processor architecture have enabled high-resolution realistic 3-D synthetic medical data sets to be generated in less than five hours.

Improving Magnetic Resonance Imaging

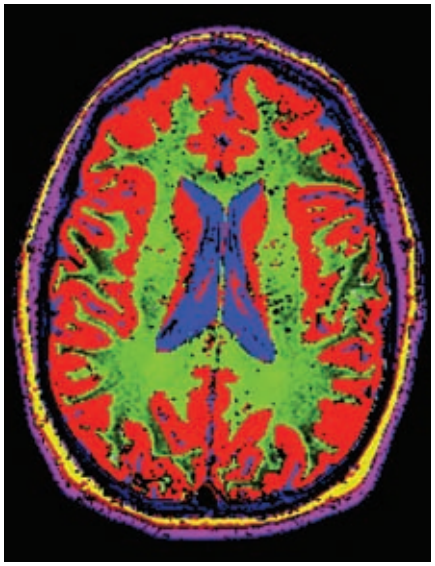
The creation of an MRI system with enhanced diagnostic power is also the goal of a Carlson Center research team lead by Dr. Joseph Hornak, director of the Magnetic Resonance Laboratory and RIT professor of imaging science and professor of chemistry. The Magnetic Resonance Laboratory at RIT is a research and development laboratory dedicated to solving real-world problems with magnetic resonance. The laboratory's efforts have focused on a variety of areas over the last two decades.

The lab develops novel resonators for MRI of extremities. A resonator is the antenna of an MRI system, sending out radio waves into the body and detecting the weak signal coming back. Hornak and his team patented a class of resonators called single-turn solenoids, which produce higher signal-to-noise ratio magnetic resonance images with less power. Discussions are underway with manufacturers to integrate this technology into the next generation of small, dedicated function MRI scanners. By incorporating their technology into unilateral MRI systems, the patient will no longer be surrounded by a magnet and a resonator.

In collaboration with MRI manufacturers, the laboratory develops specialty MRI phantoms, or anthropogenic objects within an MRI signal, to test the performance of an MRI system. Currently, Hornak's team is creating a resolution phantom for quantitative MRI of volume, which will enable the measurement of linearity and the point spread function at thousands of locations within its volume. This design is advantageous because the phantom does not need to be repositioned to collect measurements that cover the volume of interest or the three orthogonal imaging planes.

The laboratory is also recognized as a pioneer in the field of multispectral tissue classification and segmentation. Hornak's group developed an unsupervised MRI-based approach capable of segmenting the six healthy tissues in a magnetic resonance image of the brain. Such an approach has the potential to identify

Enhancing MRI: Dr. Joseph Hornak, director of the Magnetic Resonance Imaging Lab and professor of imaging science and chemistry at RIT, is working to develop MRI systems with improved diagnostic power. His efforts over the last two decades at RIT include the development of novel resonators for MRI of the extremities and investigating the impact of certain MRI contrast agents on the body.



Tissue Classification: Hornak's team developed an MRI-based approach for use in segmenting the six healthy tissues in a magnetic resonance image of the brain. The technique could ultimately improve diagnosis of brain related injury and illness.

pathology as these tissues also have unique signals identifiable by the algorithm. In collaboration with the Institute for Biostructure and Bioimaging, National Research Council, in Naples, Italy, the team is developing a digital brain phantom to assess brain tissue segmentation algorithms.

Currently, Hornak is leading an effort to better understand the impact of certain MRI contrast agents on the body. Contrast agents are paramagnetic substances introduced into the body during some magnetic resonance scans to enhance the contrast between tissues and pathology. Recently, some of these contrast agents have been associated with a fibrosing disorder called nephrogenic systemic fibrosis (NSF), a painful and sometimes life-threatening condition typified by hardened sections of skin and stiffening of joints.

Hornak's team has discovered that non-cyclic contrast agents preferentially interact with two copper ions, while not interacting with other transition metal ions. This discovery may contribute to the understanding of the mechanism of NSF as it shows that beneficial copper ions can be removed from a tissue through this interaction and that gadolinium may be released. The team also discovered that the interaction in essence creates a new contrast agent with an enhanced ability to alter magnetic resonance contrast. A potential spin-off from this discovery is a targeted contrast agent for copper. Such a contrast agent could be used to study disease pathways associated with a high concentration of copper.

Through his work in the field, Hornak realized the need for basic MRI training and capitalized on the opportunity of delivering educational material over the Internet. His hypertext book, *The Basics of MRI*, is helping scientists around the world gain quicker entry into the field of MRI. *The Basics of MRI* is currently being accessed by an astonishing 15,000 people per month and has been translated into three languages, most recently Italian.

A Shared Benefit

The combination of education and research in the area of biomedical imaging has assisted the Carlson Center in gaining national notice for their efforts. However, center director Stefi Baum notes that "publicity is not the driving force behind our research efforts. It's about the development of better methods to diagnose disease, the creation of better and more cost-effective medical equipment, and the training of future generations of biomedical scientists to assist in making our communities healthier—and this is the true reward."

On the Web

More information about this work and other related research is available online.
www.cis.rit.edu/research/biomedical
www.cis.rit.edu/people/faculty/hornak/mrl/

Capturing Life


Michael Peres


Christye Sisson

Photography is often used in the media to help tell a story, but in science, images are created to record scientific facts.

"A photograph can tell a truthful story," says Michael Peres, chairman of the biomedical photographic communications department and professor in the school of photographic arts and sciences. "By collaborating with researchers we help to illustrate their results, by bringing perspective without bias."

Biomedical photography is a true blend of art and science. The integrity of the image is determined by the ability of the photographer to have a fundamental understanding of the organism and the ability to preserve the subject in its natural environment. Once the picture is captured, image-processing techniques can be applied to further clarify the scientific statement. For example, color is often used to help reveal certain characteristics necessary to gain a better understanding.

Christye Sisson, associate professor in the school of photographic arts and sciences, focuses on ophthalmic photography, which is the only type of photography considered to be diagnostic. By photographing inside the eye, doctors can see systemic abnormalities on the retina.

To capture one type of ophthalmic photography—fluorescein angiography—the patient must first be injected with fluorescein. A camera equipped with special filters is used to highlight the dye as it traverses the retina. The highlighted regions help to identify vascular abnormalities such as swelling or abnormal blood vessels, which may be a sign of hypertension or diabetes.

The biomedical photographic communications program at RIT is the only program of its kind in the country. "Biomedical photography is really about capturing life in its purest form," says Peres. One image could be the determining evidence used in an investigation or confirm the presence of a chronic disease.

Fetal Cat Skull: This image was created using brightfield illumination on a compound light microscope and reveals the structures located in a fetal cat skull when prepared using a coronal or longitudinal section. The image was x2 at capture. Copyright Michael Peres.

Improving Diagnosis of Mental Disorders


Stefi Baum


Vince Calhoun

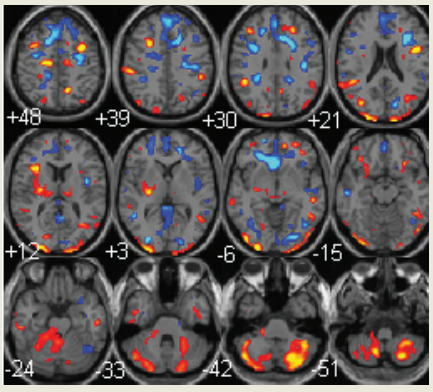

Andrew Michael

The National Institute of Mental Health estimates that an alarming 26 percent of Americans ages 18 and older suffer from a diagnosable mental disorder each year. Researchers are investigating image-based methods to improve diagnostic techniques, enhance knowledge, and treat a host of mental disorders from depression to schizophrenia.

Traditionally, most mental illnesses are diagnosed based on behavioral symptoms, which can vary by day, be subjective by doctor, and overlap between disorders. The development of new methods to diagnose schizophrenia is the goal of imaging research being undertaken by Andrew Michael, an RIT Ph.D. student in imaging science, serving as a graduate research assistant at the Mind Research Network (MRN) in Albuquerque, New Mexico.

This work is in collaboration with Dr. Stefi Baum, director of the Chester F. Carlson Center for Imaging Science, and Dr. Vince Calhoun, RIT affiliate professor and director of the image analysis lab at MRN. Michael is using a variety of novel brain imaging techniques such as structural magnetic resonance imaging (MRI), functional MRI, and diffusion tensor imaging to develop diagnostic markers that could be used to assess whether a patient suffers from schizophrenia, similar to how doctors now test for medical illnesses such as cancer.

For example, the team is developing data-driven methods to fuse structural and functional MRI of the brain. Fused images provide more precise and detailed information about brain behavior. The results of this effort support an existing theory called cognitive dysmetria and indicate that the cerebellum may be aberrantly connected to the rest of the brain in patients with schizophrenia. Outcomes of this research can possibly find consistent image-based markers to diagnose patients before they begin developing symptoms.



Imaging to Diagnose Mental Disorders: Correlations between structural and functional brain data are shown in shades of red and blue. Red indicates a higher correlation in healthy patients while blue indicates a higher correlation in schizophrenic patients. This image here shows a higher correlation in healthy subjects than in schizophrenics.

"Through this research, we hope to have a better understanding of the neural mechanisms of schizophrenia, while improving diagnosis of the disorder," Michael adds.

Research Awards and Honors

by William Dube

RIT values the research contributions of its faculty and staff across all colleges and centers. In this issue we highlight the winner of RIT's Four Presidents Award and members of the community who have recently received significant national awards, published notable books, and been issued patents.

Four Presidents Distinguished Public Service Award

The Four Presidents Distinguished Public Service Award was created by Alfred L. Davis, vice president emeritus, on the 65th year of his association with RIT to commemorate the dedication of the last four RIT presidents in their service to the Rochester community. The award is presented annually to a member of the RIT faculty or staff whose public service and commitment mirrors that of the four presidents who worked with Davis.

M. Ann Howard, professor of public policy, received the 2009 Four Presidents Award. Howard has spent 16 years at RIT, was the first chair of the public policy program, and is currently the director of the NENA-RIT partnership, a collaboration between RIT and Rochester's Northeast Neighborhood Alliance (NENA). The partnership, formed in 1999, provides opportunities for RIT students to work on community-based participatory research projects in collaboration with community partners. In addition, the partnership sponsors a Summer Learning Community comprised of RIT students and neighborhood youth who work together on neighborhood issues and assist in the development and management of The Vineyard, a resident-led urban farm and education center in Northeast Rochester. On top of her work at RIT, Howard has served as chairperson of the board of NeighborWorks Rochester, and as a member of Cornell Cooperative Extension's environmental advisory committee, the Kodak Park Citizens Advisory Council, the Downtown Community forum, and the board of Greater Rochester Urban Bounty.

National and International Recognition

Roy Berns, the Richard S. Hunter Professor of Color Science and director of the Munsell Color Science Laboratory in the College of Science, received the 2008 Newton Medal from the Color Group of Great Britain. Burns is an internationally recognized expert in digital archiving, spectral imaging, and color reproduction.

The Newton Medal is the Color Group's lifetime achievement award, and is given every two years to scholars who have made a significant contribution to the discipline of color science. The Color Group is an international scientific society focused on the science and technological application of color and color management.

Paula Grcevic, professor of arts and imaging at the National Technical Institute for the Deaf, was named a 2008 Model of Excellence in Education by *Exceptional Parent* magazine. Grcevic, who has twice earned RIT's Eisenhart Award for Outstanding Teaching, has earned national recognition for her efforts to enhance deaf arts education. She is also the co-founder of the Deaf Artists Web and has served as co-director of the Deaf Rochester Film Festival.

Ferat Sahin, associate professor of electrical engineering in the Kate Gleason College of Engineering, was nominated to serve on the Board of Governors of the Systems, Man and Cybernetics Society, an affiliate organization of the Institute for Electrical and Electronics Engineers. Sahin previously served four years as secretary of the society and also chaired the 2009 IEEE SMC International Conference on System of Systems Engineering. Sahin is a noted expert in robotic technology development and education.

James Winebrake, professor of science, technology and public policy, has been appointed to The National Research Council's committee on an assessment of fuel economy technologies for medium- and heavy-duty vehicles. The committee will produce a report to inform federal regulators about the options for a fuel economy standard for medium- and heavy-duty trucks.

R. Roger Remington, Massimo and Lella Vignelli Distinguished Professor of Design, was honored as a 2008 inductee of The Art Directors Club Hall of Fame. Previous inductees include Walt Disney and Andy Warhol. Since 1982, Remington has been engaged in the research, interpretation, and preservation of the history of graphic design. He was the lead developer in establishing the Graphic Design Archive and the Vignelli Center for Design at RIT.

Prominent Books Authored by RIT Faculty

Structural Steel Design: A Practice Oriented Approach, by **Abi Aghayere**, chair of the department of civil engineering technology, environmental management and safety, in the College of Applied Science and Technology, and Jason Vigil '98. This textbook is the second written by Aghayere, an expert in bridge construction and engineering, and Vigil, his former student and a professional structural engineer.

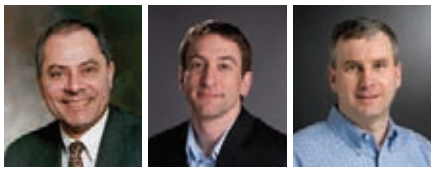
The Watercooler Effect, by **Nicholas DiFonzo**, professor of psychology in the College of Liberal Arts. This mass-market book, published by Avery, a subsidiary of Penguin Books, discusses the impact of rumors in society and builds on over a decade of research conducted by DiFonzo's team of faculty members and students.

Beat the Market Online: An Interactive Microeconomics Game, 2nd Edition, by **Steven Gold**, professor of economics in the E. Philip Saunders College of Business. *Beat the Market Online* is an interactive software program and simulation game that enables students to apply economic concepts while managing firms in a variety of "real-world" market environments. Gold is a national expert in business simulation and gaming.

Freedom's Prophet: Bishop Richard Allen, the AME Church and the Black Founding Fathers, by **Richard Newman**, professor of history in the College of Liberal Arts. This biography traces the life of former slave Richard Allen who founded the African Methodist Episcopal Church and was one of America's first black activists. Professor Newman is a noted African American historian who has published and presented widely on black life in colonial America.

Recently Issued Patents

A Method to Control Residual Stress in a Film Structure and a System Thereof, awarded to **Michael J. Parthum Sr.**, chair of the electrical/mechanical engineering technology program in the College of Applied Science and Technology.
Patent number: 7,470,462
Date of Award: 12/30/2008



A Method and System for Assessing Remanufacturability of an Apparatus, awarded to **Nabil Nasr**, director, and **Jeffrey Heintz** and **Scott Nichols**, senior staff engineers, at the Golisano Institute for Sustainability.
Patent Number: 7,467,073
Date of Award: 12/16/2008

Methods, Devices and Systems for Creating and Compressing Multi-Level Halftones, awarded to Samuel Inverso, **Peter Anderson**, **Jonathan Arney,** and Daniel Kunkle of the Print Research and Imaging Systems Modeling Laboratory.
Patent Number: 7,444,027
Date of Award: 10/28/2008

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.

Innovation and Entrepreneurship

by Kara Teske

RIT is transforming into an innovation university with significant advancement of commercialization and new businesses.

RIT encourages innovation and entrepreneurship among students, faculty, and staff and supports these rapidly growing areas through the Albert J. Simone Center for Innovation and Entrepreneurship and the Venture Creations Business Incubator. Commercialization and business development from these centers is one true measure of the innovation thriving at RIT. Presently, RIT's incubator is home to over 20 startup companies, including dotSyntax, FluxData, and The College Driver, a student company.

dotSyntax

For people who live by social media, your life just got a whole lot easier. Digsby, created by dotSyntax, is a social media application that manages your e-mail, instant messaging, and social networking accounts seamlessly in one application. The application is installed on your computer and from one interface you can chat with your buddies across all of your favorite instant messaging platforms; check, manage, and send e-mail from all your e-mail accounts, including Hotmail, Gmail, and Yahoo! Mail; and stay up to date on your Facebook, Twitter, MySpace, and LinkedIn accounts. Digsby synchronizes your accounts and gives you the ability to customize your online communication.

The idea emerged from an assignment to create a business plan in an entrepreneurship class Steve Shapiro took as an RIT graduate student. Shapiro, founder and president of dotSyntax, graduated from RIT with a degree in information technology in 2004 and is currently finishing his MBA. "I had faith in the idea and my ability to succeed," says Shapiro. "I took advantage of all RIT had to offer, from the entrepreneurship class, resources through the Center for Innovation and Entrepreneurship, office space at Venture Creations, and even hiring co-op students as employees."

dotSyntax: Operated by a team of RIT alumni, the company developed Disgby, a software program that integrates email, instant messaging and social networking applications into one interface. Since launching in March 2008, Digsby has grown to over one million members.

Digsby launched in March of 2008 and has found its way into the *Wall Street Journal*, *Laptop* magazine, and *PC Magazine*, which listed it in the "Best Free Software of 2009." Since launching, Digsby has grown to over one million users. The company is currently developing a version compatible for Mac and expecting a release later this year. For more information, go to www.digsby.com.

FluxData

FluxData, Inc., develops and manufactures color analytical instrumentation for a wide range of industrial applications. Its goal is to provide customized technology solutions where traditional monolithic analytical instrumentation does not meet the needs of the market. Pano Spiliotis, Tracie Spiliotis, and Lawrence Taplin, all graduates of RIT, co-founded the company in 2006.

FluxData's instruments are based on a core set of technologies that are modified to meet specific application requirements. Currently, the company offers two products: the FD-1665 3-CCD Multispectral Camera and the FD-1840 Spectroradiometer.

The FD-1665 3-CCD systems can be configured with three color and/or monochrome CCDs, the multispectral camera can capture three to nine spectral bands simultaneously and 30 frames per second. Each camera is built to customer specifications to modulate the 400-1000nm spectral response of each sensor. The flexible design is suitable for a variety of applications where multispectral data and high spatial resolution is required. Current applications include industrial imaging, medical imaging, and defense and homeland security. Customers include GE Medical Systems, NASA, JPL,

FluxData: A startup company founded at Venture Creations develops and manufactures customized cameras for a wide range of industrial applications. Pano Spiliotis, co-founder and chief executive officer, Lawrence Taplin, chief technical officer, Tracie Spiliotis, co-founder, and Tim Hattenberger, imaging systems engineer, are all RIT alumni.

Army, and Navy. Integrated prototypes for these customers are being tested for future production and deployment.

The company is growing with the recent hire of Tim Hattenberger, who will serve as an imaging systems engineer. Hattenberger is also a graduate of RIT.

More information about the company and its products is available at www.FluxData.com.

The College Driver

The College Driver: Corey Mack, 4th year mechanical engineering student, and business partner Zeid Nasser, 2nd year mechanical engineering technology student, launched the website The College Driver which provides car news and reviews from the perspective of the college-aged driver.

Remember the days when your dreams of a nice car were ruined by the reality of a college student's income? In some ways not much has changed. While your dream car may still await, today's college-aged car enthusiast has options that won't break the bank.

Corey Mack, 4th year mechanical engineering student, a car enthusiast himself, realized the opportunity to target college-aged car enthusiasts. "There are thousands of resources for car enthusiasts, like *Car and Driver* magazine and countless social networks, but no one has targeted the college-aged car enthusiast. We have a passion for cars, and while we would like to someday own a Porsche, we realize we never will be able to afford it now," explains Mack. This is the vision that created The College Driver.

The College Driver is a website (www.thecollegedriver.com) with three key components—news, reviews, and a social media feature called Dashboard. News stories are published daily and range from the newest car releases and recalls to weekly features such as car commercials of the week and the "Guess That Car" photo challenge.

Reviews are open-sourced so members can update reviews and provide feedback. The cars featured range from $14,000 to $25,000 and are reviewed with the college driver in mind. "Bigger and faster isn't always better. In fact, smaller, safer, and fuel efficient is best," says Mack. "For the most part, it's just us in the car, we know we are more likely to crash and we are college students, so we can't afford to be spending all our money on gas. We have different lifestyles than the average driver, for us it's about style and substance."

The company has partnered with the Insurance Institute for Highway Safety (IIHS) to provide realistic videos on accident impact. In the long term the company would like to be able to provide information on insurance breaks for certain cars. Future plans include other partnerships that will enhance the ability to provide more comprehensive reviews. The company also plans to sponsor two awards—best new car and best winter car—only fitting for navigating cold college towns.

The website launched in September 2008 and is ranked in the top 200,000 websites on QuantCast.com. Currently, the company is headquartered at Venture Creations and is operated by business partners Corey Mack and Zeid Nasser, 2nd year mechanical engineering technology student.

Richard DeMartino is the director of the Albert J. Simone Center for Innovation and Entrepreneurship and associate professor of management in the E. Philip Saunders College of Business. The Center for Innovation and Entrepreneurship provides RIT students with assistance and services to support student efforts to start companies or commercialize research. SimoneCenter.rit.edu

Jerry Mahone is the executive director of Venture Creations, a business incubator that houses students, faculty, and staff startup companies and provides development and fundraising expertise. www.rit.edu/research/vc/

R·I·T

Rochester Institute of Technology
125 Lomb Memorial Drive
Rochester, NY 14623-5608
www.rit.edu/research

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

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

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

Contact Information

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

Donald L. Boyd, Ph.D.
Vice President for Research
(585) 475-7844
donald.boyd@rit.edu

Michael E. Dwyer
Director, Research Relations Office
(585) 475-2698
mike.dwyer@rit.edu