Physicist Herbert Levine joins Rice bioengineering program

Move brings top labs, including an NSF Center for Theoretical Biological Physics

By B.J. Almond

Herbert Levine, currently at the University of California, San Diego, will join Rice University as the Hasselmann Professor of Bioengineering in July 2012.

Levine is one of a group of three leading researchers recruited to Rice, thanks in part to a grant from the Cancer Prevention and Research Institute of Texas (CPRIT). Levine and physicist José Onuchic and chemist Peter Wolynes, all members of the National Academy of Sciences, have begun transitioning their research laboratories to Rice's BioScience Research Collaborative (BRC).

Levine and Onuchic are co-directors of the Center for Theoretical Biological Physics funded by the National Science Foundation (NSF) Physics Frontiers Centers program and will bring the core of that center to the BRC in stages over the next two years. In addition to continuing their basic research, they will collaborate with cancer specialists in the Texas Medical Center to apply new concepts from physics to cancer research and treatment.

The recruitment of Levine and Onuchic, the Harry C & Olga K Wiess Professor and professor of chemistry, from

Herbert Levine will join the Rice University Department of Bioengineering as the Hasselmann Professor of Bioengineering in July 2012 thanks to a $4 million CPRIT grant.

Continued on p. 3

Rice, UW win $2M grant for synthetic biology research

By Jade Boyd

Programming bacteria for 'patterned growth' could help advance stem cell research

Sometimes it's good to start with a clean slate.

That's the idea behind a new four-year, $2 million research program at Rice University and the University of Washington that aims to push the boundaries of synthetic biology by modifying run-of-the-mill bacteria with sophisticated genetic circuits. Researchers say their plan to create bacteria that form geometrical patterns could help scientists better understand the behavior of stem cells.

"In complex creatures like humans and animals, cells co-operate to form extraordinary patterns and structures from the earliest stages of embryonic development," said Rice bioengineer Jeff Tabor, the principal investigator for the new project. "We want to understand the genetic programming that makes this possible, but these cells are so complex -- and there is so much going on biochemically -- that it's hard to focus on just the piece we want."
Tabor said *Escherichia coli* (*E. coli*) provides the researchers with a "blank slate" because colonies of the bacteria don't normally exhibit patterned growth. "By inserting specific genetic circuits into *E. coli* -- for example, genes that cause them to grow in star patterns -- we can focus on just one piece of a much larger genetic picture."

Jeff Tabor and Oleg Igoshin (left-right) are part of a $2 million research program with the University of Washington.

Rice bioengineer Oleg Igoshin, who specializes in computational bioengineering, said, "The question is really about how much we can control. Can we create a genetic program that forces the overall system into a given geometric pattern?"

Continued on p. 3

The Department of Bioengineering, located at the junction of Rice University and the Texas Medical Center (TMC), is part of a growing world-class community of interdisciplinary researchers and physicians who work together to address a broad spectrum of problems in science and medicine.

This unique environment provides bioengineering students with hands-on research, education and design experiences in laboratories located at Rice's BioScience Research Collaborative (BRC), the Oshman Engineering Design Kitchen, and in clinical settings in the TMC, which is the largest medical center in the world.

In July 2012, we will welcome renowned physicist Herbert Levine as the Hasselmann Professor of Bioengineering thanks to a $4 million grant from the Cancer Prevention and Research Institute of Texas (CPRIT). Dr. Levine's research at Rice will specialize in nonequilibrium processes with applications for a wide variety of biological systems.

Dr. Levine and his collaborator José Onuchic, Rice's new Harry C. and Olga K. Wiess Chair of Physics, are co-directors of the Center for Theoretical Biological Physics funded by the National Science Foundation (NSF) Physics Frontiers Centers program. They will bring the core of that center to the BRC in stages over the next two years.

The department has nine talented young investigators who are gaining funding for exceptionally creative projects, engineering robust platform technologies, and advancing the field of bioengineering through teaching, research and peer-reviewed published results. Details of some of these projects are contained in the pages of this newsletter.

For outstanding contributions to teaching and research, many of our faculty members have been recently honored by the university and the professional societies they serve. Dr. Antonios Mikos was chosen for the College of Fellows Award by the Controlled Release Society; Dr. Tomasz Tkaczyk won the Paul F. Forman Engineering Excellence Award by the Optical Society (OSA); Dr. Ann Saterbak was selected for the George R. Brown Prize for Excellence in Teaching – Rice's top teaching award; and Dr. Kurt Kasper earned the Hershel M. Rich Invention Award, the Graduate Student Association Faculty Teaching/Mentoring Award, and the Young Investigator Award by the Tissue Engineering and Regenerative Medicine International Society (TERMIS).

Our doctoral program was recognized by the 2010 National Research Council (NRC) for the quality of its peer-reviewed publications and for the number of citations per publication. This fall, published research from my lab as well as from Drs. Tkaczyk and Igoshin's published papers was honored as 'most cited' and 'best papers of the year.'

Rice University and the Department of Bioengineering are proud to host two events this semester. The 9th Annual Computational & Theoretical Biology Symposium will be December 9-10 at the BRC. Advances in molecular and high-throughput biology are producing an explosion of information and transforming our understanding of biology, medicine, and bioengineering. Such progress is producing a growing need to quantitatively understand and manipulate this data and translate it into practical applications. This year's symposium will focus on the *Multiscale theory of networked biological systems: from molecular complexes to cellular networks and multicellular self-organization*.

From December 11-14, Dr. Antonios Mikos and I will co-chair the TERMIS North America Annual Conference and Exposition at Houston's Hilton Americas. The theme of this prestigious event, which will welcome more than 900 experts, will focus on *Emerging technologies in scaffolds in tissue engineering: bridging matrix biology and biomaterials science.*

This year's TERMIS North America chapter meeting promises to be larger than ever, showcasing the latest tissue engineering/regenerative medicine approaches to restoring the function of damaged and diseased tissues and organs. ●

Inside this issue...

Rice BIOE NEWS is a biannual publication of the Department of Bioengineering. Some content is courtesy of B.J. Almond, Jade Boyd, and Michael Williams of the university's Office of Public Affairs and Dwight Daniels of the George R. Brown School of Engineering. Send comments, story ideas, and alumni news to bioeng@rice.edu.

Renowned physicist Herbert Levine joins Rice bioengineering program (Cont.)

UCSD was made possible by a $10 million CPRIT grant awarded to Rice. Levine's portion of the grant is $4 million.

CPRIT was approved by state taxpayers in a 2007 ballot initiative to provide $3 billion to support cancer research in Texas. The program includes grants designed to attract outstanding senior research faculty to academic institutions. Levine and Onuchic have been nominated as Established Investigators / CPRIT Scholars in Cancer Research.

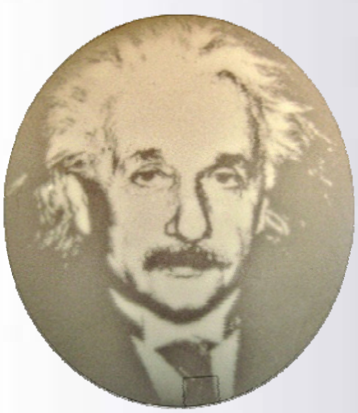
Levine's research at Rice will specialize in nonequilibrium processes with applications for a wide variety of biological systems. Projects will include combining theoretical approaches and advanced experiments to understand directed cell motion in eukaryotic cells and to elucidate both signal transduction and cellular mechanics aspects of this critical process. Additional areas of research in biological physics will include calcium-based cell signaling (most recently at the neuronal synapse), the statistical mechanics of Darwinian evolution, and pattern formation in microorganism colonies. Levine has a Ph.D. and an M.A. in physics from Princeton and a B.S. in physics from Massachusetts Institute of Technology.

Levine's and Onuchic's research is complementary, and they plan to expand their focus to tackle complex issues in cancer progression and treatment. According to the two researchers, cancer is a complex set of diseases marked by changes at different scales. At the smallest scale, changes occur in molecules and genes, at higher scales they are seen in cells, and higher still in the tissues and organs that are made up of those cells. Levine and Onuchic led the biological physics community in devising an integrated picture of many model biological systems, and they hope to use a similar approach in developing an integrated view of the many changes caused in the body by cancer.

"The cancer research community has recognized that collaborating with physical scientists is a way to achieve such a goal, which makes the BRC an ideal location for Levine and Onuchic's Center for Theoretical Biological Physics," said Rice Provost George McLendon. "The NSF supports university-based Physics Frontiers Centers so that the collective efforts of a larger group of individuals can make transformational advances in the most promising research areas." ●

Rice, UW win $2M grant for synthetic biology research (Cont.)

Igoshin and Tabor said the feedback between experiment and computational modeling is crucial to the success of the project.



In previous research, synthetic biologist Jeff Tabor and colleagues created colonies of light-sensitive bacteria that exhibited complex patterns when exposed to images, like this portrait of Albert Einstein. In coming research, Tabor and colleagues at Rice and UW plan to insert genes that will allow the bacteria to grow into complex shapes on their own.

Image by Matt Good and Jeff Tabor

"Accomplishing simple patterns may be possible with intuition, but we will need computational models that are grounded in underlying theory to achieve the kind of complexity that we're aiming for," said Igoshin, assistant professor of bioengineering.

Tabor's co-principal investigators on the four-year program, which was recently awarded a competitive grant from the National Science Foundation, are Igoshin and University of Washington researchers Eric Klavins, Ben Kerr and Georg Seelig. The five come from disciplines as diverse as electrical engineering and evolutionary biology. Tabor said such diversity can be beneficial in synthetic biology, a new field of study that centers upon engineering biological functions not found in nature.

"Synthetic biology has come a long way in the past decade," said Tabor, assistant professor in bioengineering. "There have been significant advances in engineering cells that can sense and react to one another or to external stimuli like light. The next big challenge is to build upon those techniques to program cells that can cooperate with one another in complex, coordinated tasks."

Igoshin and Tabor are each faculty investigators at Rice's BioScience Research Collaborative (BRC), and BRC Scientific Director Cindy Farach-Carson said the grant award highlights Rice's growing prominence in synthetic biology. ●

Rice wins $1.2 million for heart-valve tissue research

NIH funds four-year study of new materials for growing replacement heart valves

By Jade Boyd

Rice University bioengineers Jane Grande-Allen and Jennifer West are bringing a promising new strategy for growing replacement heart valves closer to reality, thanks to a four-year, $1.2 million grant from the National Institutes of Health. The team hopes to use gel-like materials to generate three-dimensional scaffolds that can simultaneously mimic the complex structural and physical properties of heart-valve tissues and guide the behavior of tissue-forming cells.

Grande-Allen, the lead investigator on the grant, said researchers once believed that replacement heart valves would be one of the easiest and first tissues that could be grown in the laboratory. At just a millimeter thick, the rugged flaps of tissue in heart valves seemed simple enough when researchers first started trying to engineer them in the mid-1990s.

"It's ironic because they turned out to be one of the most difficult and complex tissues of all," said Grande-Allen, associate professor of bioengineering at Rice.

Rice University tissue engineer Jane Grande-Allen is lead investigator on a $1.2 million NIH grant to grow replacement heart-valves . P*hoto by Jeff Fitlow*

Grande-Allen said it's been difficult for engineers to find synthetic materials that truly mimic the complex structure and mechanical properties of heart-valve "leaflets," the tough yet flexible flaps of tissue that form a tight seal to prevent blood from flowing backward each time the heart pumps. Having materials that can both mimic the leaflets' microscopic structure and act as a pattern for tissue-forming stem cells has been a missing link in growing replacement heart valves.

Each aortic or pulmonary heart valve contains a trio of leaflets. Prior to each heartbeat, the leaflets open, like the petals of a blooming flower, allowing blood to flow into one of the heart's chambers. Then the leaflets fold back, interlocking with one another to form a tight seal that prevents blood from flowing backward. In cases of heart-valve disease, the valves don't seal properly, and the heart must pump much harder to deliver sufficient amounts of blood.

More than 90,000 Americans are hospitalized each year for heart-valve disease, and with too few human valves available for transplant, the most common surgical options are mechanical valves, which are noisy and require patients to stay on anticlotting medications for life, and artificial valves made of biological material, usually from pigs, which wear out after about 15 years.

Ideally, tissue engineers would like to grow living valves that use a patient's own cells to eliminate the risk of tissue rejection. But engineers have struggled to find nontoxic, biodegradable materials that can act as a scaffold to guide the cells' behavior. The ideal scaffold will have the same mechanical properties of a valve so that it can be surgically implanted and function as a valve, even as cells grow new tissue to replace it.

Grande-Allen said the fact that valve leaflets have three distinct layers has presented serious complications to creating scaffolds. Leaflets have a soft, malleable layer sandwiched between denser outer layers. The soft layer adds flexibility and sits between outer layers that have subtly different properties. The upshot is that to truly mimic the valves, engineers must design a multilayered scaffold.

"That hasn't been done before, but we have a real shot at success with some of the new methods that have been developed here at Rice in recent months that will allow us to cross-link, layer and reinforce hydrogel scaffolds to have spatially varying mechanical behavior," Grande-Allen said.

Grande-Allen and co-principal investigator Jennifer West, department chair and the Isabel C. Cameron Professor of Bioengineering at Rice, will work with several graduate students and postdoctoral fellows to create a multilayered, patterned scaffold with new techniques initially developed by West's team and then further refined in collaboration with Grande-Allen's laboratory. The key technique is one that allows researchers to selectively reinforce soft, nontoxic polymer scaffolds so that they'll mimic the various leaflet layers and won't peel apart.

"We're taking a very pragmatic approach," Grande-Allen said. "We have the tools to make a lot of headway in designing appropriate patterns, but we want to make certain the class of materials that we're planning to work with will ultimately be translatable to create functional valves." ●

Bioengineering team chosen for National Academies Keck Futures Initiative

New research at Rice University explores ways to model blood vessel growth

By Shawn Hutchins

Amina Qutub, Michael Diehl, and Tomasz Tkaczyk are one of 13 groups chosen for a 2011 National Academies Keck Futures Initiative (NAKFI) grant to analyze and model blood vessel growth from subcellular to capillary network levels.

The seed grant enables interdisciplinary research at the intersection of science, engineering and medicine, and enhances education opportunities among laboratories.

The project involves building multiscale computer models of blood vessel growth from experimental wet-lab data using Tkaczyk's hyperspectral imaging techniques and a new class of erasable molecular imaging probes, developed by Diehl, that monitor gene expression patterns in the vascular endothelial cells responsible for capillary development. Qutub, the lead investigator on the project, will integrate the complex biophysical data to test theories of capillary development, or angiogenesis.

"Angiogenesis underlies wound healing, and the progression of cancer, neurodegeneration and cardiovascular disease," said Qutub, an assistant professor of bioengineering. "But, more rigorous studies in vascular systems biology are needed to show how the molecular and cellular processes work to keep tissues healthy. The models derived from this research will greatly improve our understanding of how reduced levels of oxygen and nutrients are linked to adaptive changes in cellular structure and function; and consequently, how these changes drive capillary formation."

Vascular endothelial cells, which line the interior of blood vessels, respond to low levels of oxygen, or hypoxia, through a series of molecular processes. The outcome produces a particular protein – hypoxia-inducible factor-1 (HIF-1) – that becomes the basis for how future cells differentiate, adapt, and mediate blood vessel sprouting behaviors.

To effectively assess the complex endothelial cell-to-cell interactions and measure hypoxic responses, the team will use new image-based technologies developed by Diehl and Tkaczyk.

Diehl, an assistant professor in bioengineering and of chemistry, will adapt a new erasable molecular-imaging probe to determine the expression profiles of several tens of key proteins that contribute to the HIF-1 molecular pathway within individual cells. The DNA labeling procedure is well-established and based on a proof-of-concept paper in the November 16, 2010 journal *Bioconjugate Chemistry*.

The imaging process involves sequentially attaching multiple fluorescent probes that serve as colored beacons within the cell's DNA to label HIF-1, and monitoring its molecular pathways that guide angiogenesis.

"A unique feature of the probes is that the fluorescent signals can be washed from a biological specimen through simple washing procedures and without disrupting regular cell operations," Diehl added. "This is crucial given the vast number of molecular cell pathway components that participate in angiogenesis, and the implicit relations between pathway status, cell migratory status and tissue morphology."

The imaging process, when combined with Tkaczyk's hyperspectral imaging instrument, will instantly reveal a biological specimens' composition in an array of color that can simultaneously detect up to 10 different color dyes (10 mRNA) targets.

In a single snapshot and without the use of scanning techniques, the hyperspectral instrument captures a specimen and separates it into zones using an image mapper, which is a series of long, thin, multi-angled mirror facets.

A high-resolution digital camera acquires this array of information and correlates each active pixel with the encoded spatial and spectral information. This volume of information is assembled like a jigsaw puzzle by a laptop computer to instantaneously produce a 3-D data cube that can be used at multiple imaging levels.

"The non-scanning, snapshot nature of the system will allow us to image a specimen repeatedly and for extended periods of time," said Tkaczyk, an assistant professor in bioengineering and in electrical and computer engineering.

The high-resolution spatial molecular signaling data will be coupled to observed cell behavior through probabilistic and graphical models. Qutub says results of the multiscale modeling can be used to simulate regeneration of capillaries as a function of hypoxia for applications in tissue engineering, protein- and gene-based drug development, and synthetic biology.

"The integrated imaging-modeling approach will provide unprecedented insight into how molecular changes drive cellular decision making. In doing so, it makes what can seem like unfathomable complexity, approachable," said Qutub. •

Controlled Release Society presents Mikos with 2011 College of Fellows Award

Tissue engineer honored for material and drug delivery research

By Shawn Hutchins

Antonios G. Mikos has been selected for the Controlled Release Society's (CRS) 2011 College of Fellows Award for his landmark contributions in material and drug delivery research that has brought about significant advances to the field of tissue engineering.

The award, which is the most prestigious level of membership of CRS, credits decades of Mikos' efforts in the research, development, and testing of many biomaterials for injectable delivery or implantation to aid in the repair or replacement of damaged tissue due to disease or trauma.

Mikos is the Louis Calder Professor of Bioengineering, Chemical and Biomolecular Engineering, director of the John W. Cox Laboratory for Biomedical Engineering, and director of the Center for Excellence in Tissue Engineering. His research focuses on the development of polymeric, biodegradable implants that serve as 3-D architectures for seeding cells and the controlled delivery of different drugs that influence cell behavior, stimulate growth and differentiation, and prevent infection. The work has resulted in the development of novel orthopaedic, dental, cardiovascular, neurologic, and ophthalmologic biomaterials that mimic native tissue development and structure as closely as possible.

For the past three years, the Mikos lab has been involved in highly collaborative projects with the Armed Forces Institute of Regenerative Medicine (AFIRM) to develop novel tissue engineering strategies to treat wounded military personnel and to accelerate the translation of regenerative medicine technologies from the laboratory to the clinic.

As a result of his investigations, Mikos is one of the top-published U.S. scientists in tissue engineering and regenerative medicine with more than 420 publications tied to his name. He has been cited over 20,000 times, has an h-index of 78, and is the editor of 14 books and author of the award-winning textbook Biomaterials: The Intersection of Biology and Materials Science published by Pearson Prentice Hall.

Mikos is a founding editor and editor-in-chief of the journals Tissue Engineering Part A, Tissue Engineering Part B: Reviews, and Tissue Engineering Part C: Methods. He is also a member of the editorial boards of the journals Advanced Drug Delivery Reviews, Cell Transplantation, Journal of Biomaterials Science Polymer Edition, Journal of Biomedical Materials Research (Part A and B), and Journal of Controlled Release.

Mikos has mentored 50 doctoral graduate students and 33 postdoctoral fellows. He is the founder and organizer of the continuing education course Advances in Tissue Engineering, which has been offered annually at Rice University since 1993. He is currently president of the North American Tissue Engineering and Regenerative Medicine International Society (TERMIS). ●

Computational model of distant gene regulation noted

Rice bioengineers receive IET Premium Award in Systems Biology

By Shawn Hutchins

Rice University bioengineering researcher Oleg Igoshin and graduate student Jatin Narula have developed a new computational model to explain how cells control protein production with distant enhancers.

The research, which was published in the journal *IET Systems Biology* in November 2010 in a paper titled *Thermodynamic models of combinatorial gene regulation by distant enhancers*, was recently selected for an IET Premium Award in Systems Biology. The award is given by the journal's editorial board members and editors-in-chief who nominate the 'best paper of the year' for each journal published by Institute of Engineering and Technology (IET).

DNA double helix is made up of two intricately woven strands of base-pairs of nucleotides (adenine, guanine, cytosine, and thymine). The sequence of nucleotides encodes genetic information and determines cellular gene expression profile -- which amounts of proteins are being produced for each cell.

"What we wanted to find out was how gene expression can be regulated by proteins that bind to very distal genetic sequences that are between 10,000 to 50,000 base pairs upstream or downstream from the gene they control," said Igoshin an assistant professor of bioengineering.

Pictured left to right are Oleg Igoshin and graduate student Jatin Narula. *Photo by Jeff Fitlow*

The widely accepted textbook model for gene regulation from distant enhancers says that as DNA loops and twists it brings enhancer-bound proteins from very far away in contact with the gene they regulate.

Continued on p. 7

Tomasz Tkaczyk wins Paul F. Forman Engineering Excellence Award

OSA award recognizes technical achievements in optical engineering

By Shawn Hutchins

Tomasz Tkaczyk has been selected for the 2011 Paul F. Forman Engineering Excellence Award by the Optical Society (OSA) for his robust cost-effective optical-imaging platform technologies that instantaneously provide multi-dimensional biological data. The systems have broad use in basic research and in point-of-care diagnostics in various clinical settings worldwide.

OSA will present the award to Tkaczyk during a ceremony at Frontiers in Optics (FiO), the organization's annual meeting, in San Jose, CA on October 17, 2011. His inventions will also be featured in *Optics & Photonics News*, the society's monthly magazine.

Tkaczyk, an assistant professor in bioengineering and in electrical and computer engineering, combines technologies in optics, opto-mechanics, electronics and software, and biochemical materials to build devices that produce quality images and quantitative data at various lengths of scale.

Since 2007, Tkaczyk has worked as lead investigator over the development of a dual-functioning endoscope capable of imaging wide areas of tissue at low magnification to pinpoint suspicious cancer lesions. Then with the help of contrast agents, the medical instrument's miniature high-resolution component, which is smaller than a penny, exposes abnormal cellular and subcellular features.

More recently, he coupled the endoscope with the Image Mapping Spectrometry (IMS) technology developed in his lab. As the endoscope provides multiple filed-of-view imagery, IMS extends beyond white-light visual examinations to show morphologic and molecular signatures of cancer in real time.

The IMS, which is a specialized compact digital camera that incorporates mirror and prism-lens arrays, reveals a biological specimens' chemical and physical composition in a single snapshot and without the use of scanning. Cellular dynamics and architectures are revealed in a spectrum of color that spans 10 to 100 visual channels. This volume of information is then assembled by a laptop computer to instantaneously produce a 3-D data cube.

Tests have proven the IMS' potential as a fundamental research tool for microscopy; however, the biophotonics-based technology has use in a variety of industries, such as security, oil exploration, quality control and research. Details about the new system and its applications appeared in *Optics Express* (June 2009, July 2010 and August 2011) and *Journal of Biomedical Optics* in May 2011.

The IMS was featured in OSA's "Hot topics" and "Papers of the Year" in 2010, and the company Tkaczyk co-founded to commercialize the technology, Rebellion Photonics, was featured in *Fortune* and selected as winner of the Goradia Innovation Prize by the Houston Technology Center and more than $150,000 in cash prizes at top international business plan competitions.

Tkaczyk is author of 30 peer-reviewed publications and the textbook, Field Guide to Microscopy. Other awards he received recently include: a John S. Dunn Research Foundation award to build a high-resolution endoscope that images the intricate workings of the inner ear *in vivo* (2009), and a Becton-Dickinson Professional Achievement Award by the Association for the Advancement of Medical Instrumentation (2010). •

Computational model of distant gene regulation noted (Cont.)

However, Igoshin and Narula's model shows that in eukaryotic cells distal enhancers can control gene expression without any contact with the gene.

A typical mammalian nucleus is less than 10 microns in diameter and contains billion base-pair-long DNA polymers that if stretched end-to-end, would extend to over a meter in length, explained Narula. "To ensure that DNA fits into the nucleus, it is compacted with specialized proteins to form chromatin. To allow the expression of encoded genes, this tightly packaged form of DNA must first be locally unwound. We found that by increasing the probability of local unpacking of chromatin DNA, distant enhancer-bound proteins can drastically change the rate of gene expression."

Using a thermodynamic description of the process, Igoshin and Narula showed that the looping model and their non-contact model were equally capable of accounting for the combinatorial effect of multiple proteins acting at a distant enhancer. However the two mechanisms have very different predictions about the effect of enhancers on the uncontrolled fluctuations in gene expression.

"This raises the possibility that cells might use different enhancer mechanisms to specifically control the patterns of variability in gene expression," Narula added.

The research was supported by Rice University and a National Science Foundation's Division of Molecular and Cellular Biosciences (MCB) award. •

Ann Saterbak wins Rice's top teaching award

By Shawn Hutchins

Ann Saterbak was selected for the 2011 George R. Brown Prize for Excellence in Teaching by Rice University. The top teaching award is decided by Rice alumni vote.

Saterbak, a Rice alumna herself who graduated *summa cum laude* in 1990 with a B.A. in chemical engineering and biochemistry, said she is "both honored and encouraged by the award because it affirms, from the alumni perspective, the strengths and emphasis of the undergraduate program in bioengineering."

In 1999, Saterbak rejoined Rice as a lecturer and director of laboratory instruction as the bioengineering program's first undergraduate class began their course of study. Since then, every one of the more than 270 students who have graduated with a B.S. degree in bioengineering has taken at least one class with Saterbak.

Saterbak is passionate about teaching students to integrate their knowledge in science and engineering to make appropriate assumptions, calculate solutions to problems and then verify the answer. The engineering problem-solving techniques were acquired when she worked as an associate research engineer in the Environmental Technology group at the Shell Development Company.

Working in industry did not alter her desire to return to academia, though. Even during her undergraduate years at Rice, Saterbak had plans to return to the college level in a teaching-intensive position, "which is pretty rare," she said. "And, I was very fortunate to find the position at Rice."

Saterbak, now a professor in the practice of bioengineering education and associate chair for undergraduate affairs, said she admires teachers who are on the leading edge of incorporating active learning into their classrooms and labs. Most afternoons when she is not teaching or advising students, she is managing logistics for

Continued on p. 9

Kurt Kasper selected for teaching, research awards

By Shawn Hutchins

It has been a banner year for Kurt Kasper, faculty fellow in bioengineering. He was selected for three notable awards in teaching and research.

The Hershel M. Rich Invention Award, which recognizes the development of an original invention, and the Graduate Student Association's (GSA) Faculty Teaching/Mentoring Award for outstanding service to graduate student education were both given to Kasper this spring by Rice University.

Then early this fall, he was chosen for the Young Investigator Award by the Tissue Engineering and Regenerative Medicine International Society (TERMIS) North American chapter.

The TERMIS award will be presented to Kasper at the North American chapter's Annual Conference and Exposition that will be held at the Hilton Americas in Houston and co-hosted by Rice's Antonios Mikos and Jennifer West, December 11-14, 2011.

Kasper was selected for the TERMIS Young Investigator Award for his outstanding achievements within the tissue engineering and regenerative medicine field. His research at the BioScience Research Collaborative focuses on the development and evaluation of novel materials and approaches for the regeneration of orthopedic tissues, including bone and cartilage. He is a principal investigator on a $1.7 million grant from the National Institutes of Health to develop an injectable mix of polymers and adult stem cells that promote growth of new cartilage in injured knees and other joints. He is the author of more than three dozen peer-reviewed publications and has contributed significantly to the preparation of an undergraduate-level textbook on biomaterials.

"This award is a direct reflection of Dr. Kasper's talents in taking fundamental research forward by developing technologies and methods that have great potential for future clinical use," said Mikos, the Louis Calder Professor of Bioengineering, Chemical and Biomolecular Engineering; director of the Center for Excellence in Tissue Engineering and director the J.W. Cox Laboratory for Biomedical Engineering. "I am delighted to be a part of the TERMIS conference and to support him in celebrating his hard work and accomplishments."

Kasper earned his Ph.D. in bioengineering from Rice in 2006 and conducted postdoctoral research at Rice before becoming a faculty member of the department in 2008. He has a bachelor's degree in biomedical engineering from Case Western Reserve University. ●

Ann Saterbak wins Rice’s top teaching award (Cont.)

student experiments. Saterbak also grades posters and exams herself to provide comments on technical issues as well as students’ methods of communication, and writes hundreds of letters of recommendation each year.

"Dr. Saterbak is an extraordinarily gifted and caring educator whose teaching transitions thinking from mostly closed-ended to very open-ended problems. The methods challenge students, but she has always been very nurturing as she gets them to reach their full potential,” said Jennifer West, the Isabel C. Cameron Professor of Bioengineering and chair of the department.

In addition to teaching laboratory courses in tissue culture, tissue engineering and bioprocessing, Saterbak (pictured left) teaches BIOE 252 Bioengineering Fundamentals.

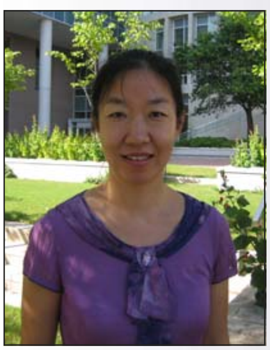
Saterbak’s approach to creating innovative teaching standards and materials has positioned her as a leader in undergraduate bioengineering education. In building the program’s undergraduate laboratories in experimentation and instruction from the ground up, she collaborated extensively with department faculty. The work contributed greatly to her winning the 2007 Robert G. Quinn Award by the American Society for Engineering Education (ASEE), her election to the ASEE board of directors in 2009, and the success of the undergraduate program, which is ranked 6th in the nation by *U.S. News & World Report's* 2011 rankings.

In addition to teaching laboratory courses in tissue culture, tissue engineering and bioprocessing, Saterbak teaches BIOE 252 – Bioengineering Fundamentals. She originally co-taught the course with Rice colleagues Ka-Yiu San and Larry McIntire, who are also co-authors of the book Bioengineering Fundamentals. Published by Prentice Hall in January 2007, the textbook has made substantial and timely contributions to undergraduate education, and has been adopted by more than 20 universities in the U.S. •

Rice University research scientist earns DoD Concept Award

Researcher pursues heat-induced gene therapy to fight breast cancer

By Shawn Hutchins



The U.S. Department of Defense Breast Cancer Research Program (BCRP) has awarded a Concept Award to Rice University research scientist Fang Wei for her innovative approaches to combine targeted gene therapy with gold nanoparticles to detect and fight breast cancer.

Wei, who conducts research in Assistant Professor Junghae Suh’s Laboratory for Nanotherapeutics Research at Rice’s BioScience Research Collaborative, was one of six percent of proposals accepted for funding out of 592 candidates.

Wei’s one-year project will involve attaching nano-sized nonpathogenic viruses to gold nanoshells that were first developed in the mid-1990s by Naomi Halas and adapted for use against a variety of cancers in collaboration with Jennifer West.

“The adeno-associated viruses developed in our lab serve as both a cancer cell targeting agent and a gene delivery vehicle,” said Wei, who earned her doctorate in chemistry from Rice University in 2009. “Once the virus-gold nanoshell assemblies enter the cancer cell, the bond is broken and the viral component travels and gains access to the cell’s nucleus and delivers its cancer-killing genes.”

To increase the efficacy of cancer gene therapy, Wei will then illuminate gold nanoshells with near-infrared light. The nanoparticles absorb the energy and create heat, which will selectively up-regulate the cancer-killing genes in tumors only while leaving healthy tissue unaffected.

“The combined forces of heat, or hyperthermia, and viral gene therapy are a promising approach,” Wei added. “The energy from the light excites certain encoded gene expression processes that when combined with the nanoparticle’s physicochemical properties deliver a double blow to the cancer cells at both cellular and subcellular levels.”

The development of highly defined virus-based therapeutics for gene delivery has the potential to be quickly translated from bench research into clinical reality and can be designed to carry drugs into a wide range of cells, as well as contrast agents for MRI and other diagnostic tests.

Established by BCRP in 1999, Concept Awards provide much needed support for explorative research, particularly those efforts involving multidisciplinary and/or multi-institutional collaborations and alliances. •

Bioengineering's Marcella Estrella reaches career milestone

Manager celebrates 45 years of history and life in the lab

By Shawn Hutchins

Marcella Estrella surpassed a career milestone this year. She has worked for the Department of Bioengineering for 45 years.

Estrella started working for the university's Laboratory for Biomedical Engineering on Valentine's Day 1966 to help Mike Serrato, a research technician, with lost-wax casting for the Baylor College of Medicine (BCM) and Rice University project to build the first artificial heart.

The laboratory, which was established by Rice emeritus professors William Akers and J. David Hellums, was an interdisciplinary group that collaborated with Dr. Michael E. DeBakey and his Department of Cardiovascular Surgery at BCM on basic research projects funded by the National Institutes of Health that involved the circulatory system, capability and blood flow, and minimizing thrombosis problems that plague prosthetic devices.

"I was recruited from the UT Dental Branch where I previously worked as a clinical science technician with Mike," said Estrella. "I had some lab experience, but mostly I learned to help investigators working on the job through direct one-on-one mentorship. It has been really exciting."

In addition to watching the department's programs in research and education take root, Estrella said she has witnessed significant changes in technology. "For example, for Professor Hellums' blood flow studies, I labored over IBM punch cards; and then by the early 1970s, I helped Professor McIntire's group analyze experimental data using the first handheld Texas Instruments' electronic calculators."

Today, Estrella's sleek desktop computer holds her own research into companies for the procurement of custom-tailored supplies geared for Professor Jennifer West's Laboratory for Biofunctional Materials/Cardiovascular Tissue Engineering.

"Through the years Marcella has stuck with us and worked with a lot of different people. Her diverse knowledge gained by decades of hands-on lab management experience has been an invaluable service to the department and hundreds of students. Many have said she is the glue that holds the lab together," said Jennifer West, Isabel C. Cameron Professor of Bioengineering and chair of the department.

In addition to working as laboratory manager for Professor West, Estrella maintains supplies and equipment for the department's rapidly growing undergraduate program.

"Marcella is amazingly good at troubleshooting problems with equipment. She will quickly figure out what's broken and what to do about it. I've never known anyone to be as handy at fixing things as she is," said Ann Saterbak, professor in the practice of bioengineering education and associate chair for undergraduate affairs.

Estrella, a native Houstonian and member of a large family of Mexican-Filipino descent, said she never imagined working in the same place for so long. "But the years have been great, and I've done so many things. My plan is to keep on working as long as I can." ●

Student mentors hone leadership, communication in design class

By Dwight Daniels

A new course at Rice University has engineering upperclassmen refining their leadership skills by mentoring freshmen through engineering design projects.

"Students are hungering for creative design opportunities while realizing that they also need to develop their leadership skills," said Mark Embree, founding director of the Rice Center for Engineering Leadership (RCEL) and the John and Ann Doerr Professor and professor of computational and applied mathematics. "This course gives the students a chance to do that while working as leaders on teams to solve problems people care about."

The mentors, or Apprentice Leaders, are juniors and seniors in various engineering majors. Each mentor works with teams of four or five freshmen enrolled in an introductory engineering design class, ENGI 120. The mentors take ENGI 315 and 316 over two consecutive semesters.

"Freshman design teams work with the mentors as they build things, test them out and watch them fail, and then successfully redesign them," said Bioengineering Professor Ann Saterbak who is also an instructor for ENGI 120. "Both the freshmen and the mentors have the opportunity to improve their communication and teamwork skills."

Four faculty members of the school of engineering serve as advisers to the freshman teams and full-time RCEL specialist Dr. Tracy Volz coaches students in the development of effective communications skills.

The class is one of the first formally added to the engineering curriculum under RCEL, which held its inaugural celebration in November. Venture capitalist John Doerr '73 and his wife, Ann '75, provided $15 million to fund the initiative, which has as a goal of fostering leadership skills in fledgling engineers. ●

Rice bioengineering students, alum named NSF Fellows

By Shawn Hutchins

National Science Foundation (NSF) Graduate Research Fellowships were awarded to three Rice University bioengineering students and one alumna from the bioengineering program.

Awarded to top graduate students, NSF fellowships are substantial and provide three years of support over a five-year period. This year's winners are: alumna Catharine Shea Thompson (Rice B.S. '11), and Laila Roudsari, Jordan Trachtenberg, and Fergus Wong, who are all first-year Ph.D. graduate students at Rice.

Laila Roudsari is a new graduate student in Professor West's group and in the Rice University/UT MD Anderson Cancer Center Med Into Grad training program funded by the Howard Hughes Medical Institute. She will use the NSF fellowship to explore tissue engineering approaches and apply her expertise in engineering and natural sciences to develop innovative cancer therapies. She has a B.S. in bioengineering from Clemson University.

Jordan Trachtenberg, also a student in the Med Into Grad training program, hopes to integrate translational cancer diagnostics and therapeutics research with tissue engineering applications. Trachtenberg has a B.S. in materials engineering and a secondary major in French from Iowa State University.

Fergus Forbes Wong's interests are focused at the cellular and molecular lengths of scale, particularly in the study of cellular processes and mechanics that are linked to disease and the purposeful design and delivery of drug treatments. He has a B.S. in bioengineering from the University of California, Berkeley.

Catharine Shea Thompson, a first-year Ph.D. student in the jointly run bioengineering program at the University of California at Berkeley/San Francisco, will use the coveted fellowship to pursue research in the development of microfluidics technologies that provide point-of-care diagnostics and improved vaccinations. •

Rice's low-cost 'infantAIR' device wins big in international contest

By Jade Boyd

The low-cost "infantAIR" device -- a global health technology invented by students to help newborns struggling with respiratory distress -- was one of 19 projects selected for seed-grant funding July 29 at the Saving Lives at Birth global health contest in Washington, D.C.

The contest, which was sponsored by the U.S. Agency for International Development (USAID), Norwegian government, Bill and Melinda Gates Foundation, Grand Challenges Canada and the World Bank— drew more than 600 entries.

"InfantAIR" was invented by Rice students to help newborns struggling with respiratory distress.
Photo by Jeff Fitlow

In Rice's project, a team of physicians and engineers from the U.S. and Malawi are refining the bubble continuous positive airway pressure device, or bCPAP, and implementing it throughout the African nation of Malawi. The device is designed to help infants breathe when they are struggling with acute respiratory infections.

"We believe that the bCPAP device has the potential to greatly reduce neonatal mortality related to respiratory distress in low-resource settings. We are so pleased to have been nominated for funding to implement this life-saving technology in Malawi," said Rebecca Richards-Kortum, director of Rice 360° and the Stanley C. Moore Professor of Bioengineering.

The bCPAP was invented and improved by undergraduates in Rice 360°'s Beyond Traditional Borders program: Michael Pandya, Jocelyn Brown, Joseph Chang, Haruka Maruyama, and Katie Schnelle. The students worked at the Oshman Engineering Design Kitchen under the guidance of Rice bioengineering faculty and pediatricians from Baylor College of Medicine, Texas Children's Hospital, and the University of Malawi's Queen Elizabeth Central Hospital (QECH).

"The bCPAP is a proven therapy to treat neonates in respiratory distress, but it is often too expensive for hospitals in the developing world," said Brown a former bioengineering student, who began developing the device in 2009. "The device has been shown to deliver the same therapeutic pressure as the bCPAP setup at Texas Children's Hospital, while costing almost 35 times less."

In the Saving Lives at Birth competition, Rice proposed a one-year program to refine and test the device and to develop a plan to scale up distribution in rural hospitals throughout Malawi. Rice bioengineers will collaborate with pediatricians at QECH and Texas Children's as well as with industrial design engineers from 3rd Stone Design.

Other awards to recognize the device in 2010 include: an $11,750 prize in Rice's Business Plan Competition for first prize in the Best Social Venture category, an Advanced E-team grant from the NCIIA Neonatal Technologies Forum, and Best Engineering Design in Service to Society at the Brown School of Engineering Design Showcase. •

Breaking it down: detecting how cells make decisions

Student's research into what drives cell-fate decisions earns HHMI fellowship

By Shawn Hutchins

Jatin Narula combines systems and synthetic biology methods to identify and understand how gene regulatory networks guide change within a cell or a group of cells.

Through the research, which is supported by a newly awarded International Student Research Fellowship by the Howard Hughes Medical Institute, Narula hopes to discover how cells detect changes in their environment and how they, in turn, use this information to make decisions for either adaptation or phenotypic change.

"For example when *Bacillus subtilis*, a common soil bacterium, sense nutritional deprivation, some cells stop their growth and initiate a multistage differentiation process of sporulation. The stress response produces a tough non-growing structure in which bacteria can pack its DNA," explained Narula, a Ph.D. student in Assistant Professor Oleg Igoshin's group and one of 48 talented graduate students from 22 countries to receive the HHMI fellowship.

"Then if conditions become favorable, the organism has the genetic information it needs to grow and propagate."

Narula says the grant will address questions into what gene regulatory networks control this 'bet-hedging' strategy. He then expects to break it down even further to find out how the decision to sporulate came about.

Narula said a combination of experimental and mathematical modeling approaches will be used to explain cell sporulation processes. "Fortunately gene regulatory networks are highly modular and can be dissected into subunits that play specific roles in processing environmental signals. So we can study the subunits separately to understand their contribution to the decision making process."

Due to the probabilistic nature of biochemical reactions, the dynamics of bacterial gene regulatory networks contain irregular fluctuations or 'intrinsic noise'. These fluctuations can interfere with or obscure environmental signals and significantly affect the ability of regulatory networks to make reliable decisions.

In a related project, Narula has designed a synthetic genetic circuit that can be used to tune the level of noise in gene expression in the bacteria *Escherichia coli*. The application of this 'Tunable Noise Generator' should prove to be very useful in investigating how the strength of gene expression fluctuations affects cell growth and bacterial resistance to antibiotics. ●

Lucas Hartsough awarded NASA Space Technology Research Fellowship

By Shawn Hutchins

Lucas Hartsough was selected to the inaugural class of NASA Space Technology Research Fellows (NSTRF).

He was one of 81 students chosen to receive the graduate student fellowship from NASA's Office of the Chief Technologist.

NSTRF fellowships are designed to support graduate student education and the development of highly skilled engineers and technologists who will address the needs identified in NASA's Space Technology Grand Challenges for space exploration, scientific discovery and national technology competitiveness.

Hartsough, a first-year Ph.D. student, will use the annually-renewable, four-year grant to study and conduct research in synthetic biology to engineer more reliable, sustainable, and cost-effective technologies for the colonization of space.

"Designing organisms to produce a particular product or perform reliable functions that astronauts may one day depend on is very exciting," said Hartsough.

Bacteria by nature are self-sufficient, self-replicating, adaptive, and resilient organisms that can extract energy and nutrients from their surroundings. Hartsough's research will combine biological and computational approaches to understand how bacteria can be engineered to use these strengths to address human problems.

"Synthetic biology can be defined as the engineering of 'biological machines using interchangeable synthetic genetic parts' that can be manipulated to hopefully produce highly versatile and mission-critical resources," said Hartsough. His proposal suggests photosynthetic cyanobacteria, for example, could conceivably be optimized to produce oxygen and other nutrients in extraterrestrial environments like Mars.

In addition to conducting research at Rice's BioScience Research Collaborative (BRC), Hartsough will intern at a NASA research center each summer after being matched with mentors and a professional advisor within NASA. ●

Rice Bioengineering Department announces 2011 alumni awards

By Shawn Hutchins

The Rice University Department of Bioengineering is pleased to announce its alumni awards for excellence in research, teaching, service, or significant contributions to the bioengineering industry, academia, or society. The 2011 winners include: Robert C. Thomson, Distinguished Alumnus; Michael Detamore, Outstanding Bioengineering Graduate Alumnus; and Stephanie Seidlits, Outstanding Bioengineering Undergraduate Alumna.

Robert C. Thomson (Rice Ph.D. '97) is a product specialist leader in the Medical Products Division at W.L. Gore & Associates, Inc. – a leading manufacturer of thousands of advanced technology products for the electronics, fabrics, industrial and medical markets. Thomson played a key role in the development of a clot-resistant vascular bypass graft and has contributed to many facets of Gore's medical business. He currently oversees the development and maintenance of Gore's Thoracic Aortic Endovascular NPD portfolio. In this role, he actively works with Gore's functional teams in engineering, manufacturing, planning, clinical and regulatory divisions to assure the timely approval of life-saving implantable medical products worldwide. His role also includes coordinating collaborative clinical efforts with a network of physicians and societies to understand and overcome limitations of current endovascular therapies via the development of novel approaches to patient treatment.

Thomson is author of nearly a dozen peer-reviewed publications and six book chapters, and owner of two U.S. patents. He was elected to the American Institute for Medical and Biological Engineering College of Fellows in 2009, and has been an active member of Rice's Department of Bioengineering External Advisory Board since 2007. Thomson has been with Gore since receiving his doctorate in bioengineering from Rice under Professor Antonios Mikos' supervision in 1997. He has a B.S. in chemical engineering from Edinburgh University, Edinburgh, Scotland.

Michael Detamore (Rice Ph.D. '04), an associate professor of chemical and petroleum engineering at the University of Kansas (KU), Lawrence, researches biomaterials, biomechanics, stem cells and tissue engineering. His highly published investigations in tissue engineering focus on bone and cartilage regeneration, including the temporomandibular joint (TMJ), intervertebral disc (IVD), knee, cranium, and trachea. Central research themes include umbilical cord stem-cells and gradients in tissue engineering. His group published the first study of umbilical cord mesenchymal-stromal cells in a 3-D musculoskeletal tissue engineering application in 2007, and published a comprehensive review of this topic in the January 2011 issue of Regenerative Medicine.

Since joining KU in 2004, Detamore has received numerous awards and $4.3 million in teaching and research grants from government agencies and foundations. This funding includes a 2009 NSF CAREER Award; a 2011 Coulter Foundation Award for Translational Research in osteochondral defects and injuries; a 2011 Fulbright Scholar Award to conduct research and teach at the National University of Ireland (NUI) Galway, Ireland; and a Sharp Teaching Professorship and Raymond Oenbring Teaching Award, both earned in 2011 from KU. Students in Detamore's lab have earned NSF fellowships, Hertz Fellowships, Goldwater Scholarships, NIH trainee appointments, and university awards.

Detamore has a Ph.D. in bioengineering from Rice with Professor Kyriacos Athanasiou as his adviser, and a B.S. in chemical engineering from the University of Colorado.

Stephanie Seidlits (Rice B.S. '04) recently joined the group of Lonnie Shea, professor of chemical and biological engineering, at Northwestern University in Evanston, IL. Working as a postdoctoral fellow under an IBNAM-Baxter Early Career Award, Seidlits is investigating biomaterial-based strategies to enhance nervous system regeneration.

Seidlits completed her doctorate in biomedical engineering at the University of Texas, Austin in 2010 under the co-supervision of Christine Schmidt, the B.F. Goodrich Endowed Professor in Materials Engineering and professor of biomedical engineering, and Jason Shear, professor of chemistry and biochemistry. While at UT, Seidlits' studies were supported by a UT College of Engineering Scholarship, an NSF Integrated Graduate Education and Research Trainee Fellowship in cellular and molecular imaging for diagnostics and therapeutics, a THRUST Fellowship – UT's highest academic scholarship, and a Scholar Award from the Philanthropic Educational Education Organization (P.E.O.).

As an undergraduate at Rice, Seidlits gained independent research experience working in Professor Mikos' group. •

Class of 2011 doctoral degree recipients

The Rice University Department of Bioengineering is proud to recognize the 18 doctorate degree recipients for the 2010-2011 academic year:

Lissett Ramirez Bickford, Ph.D. Dec '10
Adviser: Rebekah Drezek, Ph.D.
Near-Infrared Silica-Based Gold Nanoshells as Potential Rapid Diagnostic Imaging Agents for Breast Cancer Tumor

Michael Paul Cuchiara, Ph.D. May '11
Adviser: Jennifer West, Ph.D.
Microfabricated Poly(ethylene glycol)-Based Hydrogels for Microvascular Tissue Engineering Applications

Emily S. Day, Ph.D. May '11
Adviser: Jennifer West, Ph.D.
Molecularly-Targeted Gold-Based Nanoparticles for Cancer Imaging and Near-Infrared Photothermal Therapy

Athanasios Dousis, Ph.D. Dec '10
Adviser: Jianpeng Ma, Ph.D.
Ab Initio Methods for Protein Structure Prediction

Dzifa Yawa Duose, Ph.D. May '11
Adviser: Michael Diehl, Ph.D.
Multiplexed and Reiterative Detection of Protein Markers in Cells Using Dynamic DNA Complexes

Christopher Durst, Ph.D. May '11
Adviser: K. Jane Grande-Allen, Ph.D.
Novel Dynamic Bioreactor and PEGDA Hydrogel Scaffolds for Investigation and Engineering of Aortic Valve Tissues

Nikhil Gheewala, Ph.D. May '11
Adviser: K. Jane Grande-Allen, Ph.D.
Mitral Valve Organ Culture Provides a Novel Experimental Paradigm

Dan J. Huey, Ph.D. Dec '10
Adviser: Kyriacos Athanasiou, Ph.D.
Development of a Self-assembled Meniscal Replacement

Dale Kenneth Jamison, Ph.D. '11
Adviser: Michael Diehl, Ph.D.
The Biophysics of Intracellular Transport Driven by Defined Systems of Motor Proteins

Karem Nathan Kalpakci, Ph.D. '10
Adviser: K. Jane Grande-Allen, Ph.D.
Interspecies Characterization and Tissue Engineering of the Temporomandibular Joint Disc

Robert Timothy Kester, Ph.D. '10
Adviser: Tomasz Tkaczyk, Ph.D.
A Real-time Snapshot Hyperspectral Endoscope and Miniature Endomicroscopy Objectives for a Two Field-of-View (Bi-FOV) Endoscope

Eleftheria Leda Kloudas, Ph.D. '10
Adviser: Antonios Mikos, Ph.D.
Development of a Thermoresponsive and Chemically Crosslinkable Hydrogel System for Craniofacial Bone Tissue Engineering

Nastassja Aileen Lewinski, Ph.D. '11
Adviser: Rebekah Drezek, Ph.D.
Biodistribution of CdSe/ZnS Quantum Dots in Aquatic Organisms

Jiehong Liao, Ph.D. '11
Adviser: Antonios Mikos, Ph.D.
Modulation of Chondrogenic and Osteogenic Differentiation of Mescenchymal Stem Cells Through Signals in the Extracellular Microenvironment

Kelsey Boitnott Mathieu, Ph.D. '11
Adviser: Dianna Cody, Ph.D. UTMDACC
Novel Methods of Reducing Breast Dose During Computed Tomography Scans

Kellie Irene McConnell, Ph.D. May '11
Adviser: Junghae Suh, Ph.D.
Surface-immobilized Adeno-Associated Virus Nanoparticles for Applications in Controlled Gene Delivery and Biosensing

Keyao Pan, Ph.D. '11
Adviser: Michael Deem, Ph.D.
Computational and Theoretical Analysis of Influenza Virus Evolution and Immune System Dynamics

Kelsey Jane Rosbach, Ph.D. May '11
Adviser: Rebecca Richards-Kortum, Ph.D.
Development and Evaluation of Approaches for Quantitative Optical Molecular Imaging of Neoplasia

The masters in bioengineering

Rice's M.B.E. program moves forward as graduate numbers increase

By Shawn Hutchins

Each year for the past two years, the number of graduate students in the Rice University Masters in Bioengineering (M.B. E.) program has more than doubled. An increasing amount of these students are also gaining independent research experience in BIOE 506.

The M.B.E. is a widely recognized, nonthesis degree that provides students with greater depth in their engineering training to advance their career objectives.

The typical course of study for an M.B.E. is one year and part-time study options are available for individuals who want to continue working.

Students complete 30 semester hours of upper-level courses (300 or higher), including at least 15 bioengineering credit hours at graduate level or above.

This includes:

– Six engineering credit hours,
– Graduate-level or above MATH, STAT or CAAM (3 credit hours), and
– Six general elective credit hours.

At least 24 of the 30 hours must be taken at Rice.

The Jones Graduate School of Business and the Department of Bioengineering also offer a Master of Business Administration/Master of Bioengineering (M.B.A./M.B.E.) degree program.

Designed to meet the growing demand for managers with technical expertise, the program trains students to apply management strategies that meet the needs of high-technology companies.

The department is proud to recognize the seven M.B.E. degree recipients for the 2010-2011 academic year:

Rebeca Romero Aburto, M.B.E. May '11

Iris Chu, M.B.E. May '11

Alina Daszkowski, M.B.E. May '11

Olin Ray Hebert, M.B.E. Dec '10

Marcos Gabriel Hung, M.B.E. May '11

Sunil Arvind Kamath, M.B.E. May '11

Corey Michael Rountree, M.B.E. May '11

Rice alumnus wins Biophysical Society Student Research Achievement Award

By Shawn Hutchins

Rice University bioengineering alumnus W. Austin Elam (Rice B.S. '05) was among 20 students selected to receive the Biophysical Society's 2011 Student Research Achievement Award.

Society judges chose Elam's work from more than 300 entrants at a competitive poster session at the Biophysical Society's Annual Meeting last spring in Baltimore, Maryland. He was recognized for research in the category of *Intrinsically Disordered Proteins*.

Elam, a graduate student in the T.C. Jenkins Department of Biophysics at Johns Hopkins University, studies the dynamic nature of proteins using both experimental and computational approaches.

His research in the lab of Vincent Hilser, a professor in the Department of Biology and Department of Biophysics, seeks to understand conformational propensities in the unfolded states of proteins and how proteins may exploit conformational biases in folding and function.

Elam's work also has implications for understanding how intrinsically disordered proteins, which lack a stable structure under physiological conditions, perform functions.

While at Rice, Elam was a member of the senior engineering design group *Team Cobra* that developed an exercise device to counter bone and muscle loss experienced by astronauts during space travel. In 2005, the team of five students, which also included Roland Robb, Thomas Rooney, Chris Gibbson, and Zeyad Metwalli, entered and won several local and national engineering design competitions.

As an undergrad, Elam was encouraged to pursue graduate studies in biophysics while working in Associate Professor Rob Raphael's Membrane Bioengineering Group.

The Biophysical Society, founded in 1956, is a professional, scientific society established to encourage development and dissemination of knowledge in biophysics. The society promotes growth in this expanding field through its annual meeting, monthly journal, committees, and outreach activities. •

Department of Bioengineering
MS-142, 6100 Main Street,
Houston, TX 77005-1892

Phone: 713.348.5869
Fax: 713.348.5877
bioeng@rice.edu