According to a recent report by the Institute of Medicine, the economic impact of the burden of pain in terms of lost productivity in 2010 was approximately $300 billion. Millions of Americans suffer from chronic pain, which can often be localized in soft tissues such as the ligaments, muscles, and fascia.

Patients with back or neck pain complain of trigger points or muscle knots, which are hard, painful nodules. These irritable nodules are often associated with referred pain, but not always. The reason why some hard nodules are spontaneously painful and others are not is unknown.

Most people avoid problems that are the “pain-in-the-neck” variety. But Siddhartha Sikdar, Mason assistant professor of bioengineering and electrical and computer engineering, has sought them out. Working with College of Health and Human Services Professor and clinician Dr. Lynn Gerber, he has developed a method to quantitatively characterize these trigger points.

“By using ultrasound techniques, we have developed a noninvasive and easily accessible method to objectively describe trigger points” says Sikdar.

As shown on the figure on the left, a variation of ultrasound called elastography measures the stiffness of soft tissues by assessing regional tissue compression in response to an applied vibration. The more compression, the less stiff the tissue. Another potentially important factor for the trigger point is regional blood flow, which can also be readily determined through Doppler ultrasound.

It is also not known why and how these trigger points form and what role they play in the pain syndrome. A major impediment to research on this topic has been the fact that these trigger points are diagnosed based on a subjective physical exam. Also, the only information that physicians have about pain severity involves the self-assessment from the patients themselves, which is notoriously nonquantitative. “Doctor, my neck pain on a scale of 1 to 10 is an 11!”

Siddhartha Sikdar, Assistant Professor of Bioengineering and Electrical and Computer Engineering.
Dear Friends, Faculty, and Alumni of Mason Bioengineering—

I am very pleased to share with you news from our growing Bioengineering Department. Our goal with this newsletter is to keep you updated on the progress our department, students, and faculty are making in creating a world-class program. This past July was the first anniversary of the establishment of the Bioengineering department, but already we are making our mark both within and outside of Mason. An important feature for the Mason Bioengineering program is the proximity to well-recognized organizations in the Washington, D.C., metropolitan area where we have current and promising collaborative ties (e.g., National Institutes of Health Clinical Center, Walter Reed National Military Medical Center, U.S. Naval Research Laboratory, and Children's National Medical Center). Here are a few highlights:

We have expanded the faculty significantly. This newsletter lists new Bioengineering faculty hires for Fall 2012 bringing new areas of expertise: Nitin Agrawal (microfluidics/biosensors), Caitlin Burke (imaging), Wilsaan Joiner (sensorimotor integration), and Qi Wei (musculoskeletal computational modeling). Like the Washington, D.C., metropolitan area, our faculty diversity is excellent. We have roughly equal numbers of men and women with a broad range of ethnicity and races.

Faculty members affiliated with Bioengineering are considered rising stars at Mason for their shared passion for research and success in establishing funded efforts. Faculty members hired under the Mason Bioengineering initiative have funding as principal investigators from the National Institutes of Health, the National Science Foundation, and the Defense Advanced Research Projects Agency.

Excellence in the classroom: Our faculty average teaching ratings exceed both Mason and the Volgenau School of Engineering teaching ratings.

Enrollment into the undergraduate program is on the rise to approximately 120 students by fall 2012. The vast majority of students entering the program have aspirations for either graduate or medical school, and they are very serious about achieving academically. Plans are underway for establishing a Bioengineering PhD program in either 2013 or 2014.

Last year, we saw the first corporate sponsorship for a Bioengineering senior design project—our thanks to Trapollo, LLC (Sterling, VA) which specializes in telehealth and remote monitoring technology.

Scholarships in Bioengineering—the department is hard at work to establish its first named scholarship in honor of Professor Peter Katona. The scholarship once endowed will support an outstanding undergraduate student in Bioengineering.

Over this next year, the Bioengineering Department is excited about the transition in leadership at Mason. We are welcoming a new university leader, President Ángel Cabrera, who has an engineering background, and a new dean for the Volgenau School of Engineering, Kenneth Ball. I am looking forward to working with them in the pursuit of world-class recognition for research and education. I am also looking forward to the continued expansion of the department and the breadth of the research and the next group of exceptional students joining Bioengineering.

Sincerely,

Joseph J Pancrazio, PhD
Professor and Chair, Bioengineering Department
Department Welcomes Four New Faculty

Nitin Agrawal, PhD
Assistant Professor, Bioengineering Department
PhD Chemical Engineering, Texas A & M University (2006)
BS Chemical Engineering, National Institute of Technology Durgapur (1999)

Nitin Agrawal completed postdoctoral training in bioengineering from Harvard Medical School (HMS, 2009). Agrawal joins Mason after working at the Pacific Northwest National Laboratory in Richland, Washington, as a research associate, where he used his experiences in microscale technologies to decipher the fundamental aspects of cellular heterogeneity at the single cell level.

Caitlin Burke, PhD
Assistant Professor, Bioengineering Department
PhD Biomedical Engineering, University of Virginia (2011)
BS Biomedical Engineering, University of Virginia (2006)

Caitlin Burke joins the department after completing a post-doctoral fellowship at the National Institutes of Health in the department of Interventional Radiology. Burke’s research interest is focused ultrasound mediated targeted drug delivery and the potential for focused ultrasound applications to reduce the system-wide effects of current drug therapies. Her most recent research involves investigating how ultrasound and heat sensitive drug carriers can be used in combination to deliver drugs to liver tumors.

Wilsaan Joiner, PhD
Assistant Professor, Bioengineering Department
PhD Biomedical Engineering, Johns Hopkins University (2007)
BS Biomedical Engineering, St. Louis University (2001)

Wilsaan Joiner joins Mason after a post-doctoral fellowship working in the laboratory of Robert Wurtz in the National Eye Institute in Bethesda, Maryland. Joiner’s research uses both human psychophysics and electrophysiology experimentation to define the neural signals used by the eye and arm movement systems that enable predictive control. In fall 2012, he will teach a new Bioengineering course, BENG 313 Physiology for Engineers, which provides a broad introduction to the subject of human physiology, focusing on learning the subject from an engineering viewpoint.

Qi Wei, PhD
Assistant Professor, Bioengineering Department
PhD Computer Science, Rutgers University (2010)
MSc Computer Science, University of British Columbia (2004)
BE Computer Engineering, Beijing Institute of Technology

Qi Wei joins the Bioengineering Department after completing a postdoctoral fellowship in the Department of Physiology in the Feinberg School of Medicine at Northwestern University. Her research is focused on biomechanical modeling and simulation, eye movement, and biomedical imaging.

Biophysics of Pain, continued from page 1

While the research will address fundamental questions about the biophysical nature of trigger points, it also has translational/clinical implications. Specifically, the work will help develop objective and quantitative diagnostic metrics for assessing various therapeutic strategies.

The effort is supported by a four-year, $1.974 million R01 grant from the National Institutes of Health (NIH) led by Sikdar. Colleagues who are contributing to the research effort include Gerber; Nadine Kabbani, assistant professor of molecular neuroscience in Mason’s Krasnow Institute for Advanced Study; Saleet Jafri of Mason’s School of Systems Biology, whose area of expertise is bioinformatics and computational biology; William Rosenberger, chair of the Department of Statistics; and Jay Shah, a physiatrist and staff clinician at NIH.
Kenneth S. Ball Named New Dean of Volgenau School

By Catherine Probst Ferraro

Kenneth S. Ball, L. S. Randolph Professor and head of the Department of Mechanical Engineering at Virginia Tech, has been appointed dean of the Volgenau School of Engineering. Ball succeeds Lloyd Griffiths, who has served as dean since 1997.

"Kenneth Ball brings an exciting background in mechanical engineering and management that will benefit not only the Volgenau School, but the university as a whole," says Mason Provost Peter Stearns. "I am very excited for the new ideas and opportunities Dr. Ball will bring with him to the school."

Prior to joining the faculty at Virginia Tech, Ball served as the Temple Foundation Endowed Faculty Fellow in Engineering No. 5 at the University of Texas at Austin. In 1992, he received the National Science Foundation's Young Investigator Award. Ball is also a Fellow of the American Society of Mechanical Engineers and a registered Professional Engineer.

"After reviewing the credentials of many qualified candidates, the search committee felt that Dr. Ball’s academic background and leadership experience, as well as his passion for helping students discover knowledge in the engineering field make him the ideal person to lead the Volgenau School of Engineering in its future successes," says School of Management Dean Jorge Haddock, who chaired the search committee. "This was further validated by the campus community in the interview process."

During his career, Ball has published more than 100 technical articles and reports and has given more than 80 technical presentations at conferences and workshops. In addition, Ball has more than $20 million in externally sponsored funding for current and completed projects and program development in mechanical and nuclear engineering. He also has two U.S. patents filed or in application.

"I am very excited and honored to become the next dean of the Volgenau School of Engineering," says Ball. "I look forward to working with the faculty, staff, and administration in the school and share their enthusiasm for preparing our students to become leaders in the engineering field."

Ball received his PhD from Drexel University and served as a post-doctoral research associate in the Center for Fluid Mechanics, Turbulence, and Computation at Brown University. He holds a master of science in mechanical engineering from Drexel University and a bachelor of science in mechanical engineering from Leigh University.
Recent Faculty Grants

Nathalia Peixoto and Vasiliki Ikonomidou teamed on National Science Foundation (NSF)-awarded project ($125,000) titled “GARDE:EQuls: Enhancing Quality of Life of Students through Senior Designs.”

Joseph J. Pancrazio and Nathalia Peixoto were awarded $3.2 million from DARPA for their project, “Biocompatibility of Advanced Materials for Brain Interfaces (BAMBI).”

Nathalia Peixoto was awarded a $310,000 NSF-funded project titled “Pattern-Steering in Nonlinear Dynamical Networks.”

Amarda Shehu received a NSF CAREER award ($550,000) for “Probabilistic Methods for Addressing Complexity and Constraints in Protein Systems.” In addition, Shehu was previously awarded $450,000 for her NSF project “AF: Small: A Unified Computational Framework to Enhance the Ab-initio Sampling of Native-like Protein Conformations.”

Siddhartha Sikdar awarded $194,000 from the Department of Veteran Affairs for his project, “Asymptomatic Carotid Stenosis: Cognitive Function and Plaque Correlates (ACCOF).” In addition, Sikdar was previously awarded $1.97 million R01 grant from the National Institutes of Health titled “Pathogenesis and Pathophysiological Mechanisms of Myofascial Trigger Points” and a NSF CAREER award ($400,000) for “An Integrated Systems Approach to Understanding Complex Muscle Disorders.”
Mason Brings Nanotechnology to the Classroom

In the past century, we have witnessed enormous innovative strides. Everything has become smaller and faster, and its pace is continuously accelerating with lightning speed. What the computer revolution was in the 1980s, we are experiencing now with nanotechnology, which has revolutionized modern science, medicine, and the technological world. It brings the realm of the impossible to the possible.

So, what exactly is nanotechnology?

We sat down with Carolina Salvador Morales, PhD, an assistant professor of bioengineering, to discuss her class, BENG 441 Nanotechnology in Health. Morales states that nanotechnology is the application of nanoscience. Understanding the fundamentals of nanoscience, we can envisage myriad applications in many fields including medicine and electronics. Morales goes on to indicate that “to treat diseases like cancer, diabetes, and neurodegenerative diseases,” nanoscience will be helpful to target the disease better by creating biodegradable “envelopes” to deliver the medication directly to the diseased cells of the body.

Morales came to Mason from the Massachusetts Institute of Technology (MIT) in August 2011. Her numerous years of work with Professor Robert S. Langer on drug delivery at MIT and the Harvard Medical School made her the ideal candidate to teach the Nanotechnology in Health course last spring semester. The student response to this new course was excellent. When asked, “What is your favorite topic to teach in the class,” Morales responded: “The physico-chemical principles, and the second part of my class which focused entirely on nanomedicine.” Nanomedicine has been of particular interest to Morales, both in and outside of her class.

Due to her interest in nanomedicine, she emphasizes the importance of nanotechnology by giving examples on how this field has the potential to improve the treatment for devastating diseases such as cancer. Since nanotechnology is a highly multidisciplinary field, very often we can see innovative engineering approaches used in this area for the solution of a specific problem. This is the feature of nanotechnology that excites her the most since along with conducting basic science, there is the possibility and the need for innovation to find simpler, faster, and effective solutions in medicine.

The use of engineering approaches is an aspect that she focuses on teaching in her class. Her goal is to make students see the power that nanotechnology has in our everyday life and encourage students to continue in research.

Morales will be teaching Translation and Entrepreneurship in Bioengineering this fall.

The popular Nanotechnology in Health will be offered next in spring 2013.
Our Mission and Educational Objectives

The mission of the Bioengineering Department at Mason is to create new knowledge and technology at the interface between engineering and bioscience to improve human health through research and education. To accomplish this mission, the primary goals of the department are:

- To provide a challenging and rewarding multidisciplinary education to our students;
- To establish and conduct nationally-recognized research programs in bioengineering;
- To serve the university as a nexus for opportunities at the interface of engineering and biomedicine; and
- To foster links with nearby public- and private-sector laboratories and organizations to collaborate on research and development projects, promote biomedical technology transfer, and establish training/internships for students.

To achieve the educational aspect of our mission, our curriculum emphasizes the development of problem solving, critical thinking, communication skills, and teamwork. We have the following educational objectives for students who graduate from our program:

- Alumni electing to work after graduation (for example, in industry or government) will contribute to the development or application of new biomedical products or processes that are of benefit to society.
- Alumni electing to continue their formal education will have completed their studies, or will have made demonstrable progress toward an advanced degree in their chosen profession.
- Alumni will communicate and perform effectively as members or leaders of multi-disciplinary teams.
- Alumni will continue to enhance their skills and knowledge in a quest for further professional development.

“Our imagination is the only limit to what we can hope to have in the future”

—Charles F. Kettering, American Engineer 1876–1958
Senior Design Team Builds Automatic “Arm” to Assist Fellow Student
By Colleen Kearney Rich

Mason bioengineer Nathalia Peixoto lost a bet this semester, and she couldn’t be happier. Earlier this year, she bet one of the senior engineering design teams she was advising that the automatic self-feeding device they were building would never be able to feed someone rice. Over the course of the semester, the automatic “arm” in its various iterations has served up Legos, Cheerios, and other small items. Peixoto lost the bet in April when the device did indeed finally serve up some rice.

“It was a good bet to lose,” says Peixoto, an assistant professor of electrical and computer engineering in the Volgenau School of Engineering. The rice was part of an Iranian chicken dish prepared by one of the team members, electrical engineering major Farideh Madani, for Neima Izadi, the Mason student for whom the arm was built.

“He is from my country, so I knew what kind of food he would like,” Madani says with a smile. The food was prepared, and Izadi, a criminology, law and society major, was able to enjoy it using the new device. In addition to Madani, the design team includes Jane Kambugu, Sidra Khan, and Kamran Mohammadi, and is led by Salma Mahmoud. All are electrical engineering majors, and all were smiling when they came to the Students as Scholars end-of-the-year event to celebrate the successful completion of their project.

But the journey to this point was not easy and involved a lot of hard work, late nights, and some last-minute creative problem solving.

IN THE BEGINNING
When the group came together in the fall, they were interested in developing something that would help someone. Bioengineering, Peixoto’s specialty, was one of the concentrations on which the engineering students could focus. It was Madani who suggested a device that could help her friend.

“He is in a wheelchair and can move his arms, but it takes a long time for him to complete the motions to eat a meal,” says Mahmoud. “We thought this device could help him enjoy a meal in the same amount of time it would take one of us.”

The time-saving and social benefits of such a device for a busy college student were clear to the group, so they decided to proceed.

How the senior engineering design projects work is the group spends one semester doing research and planning and then uses the second semester to build whatever it is they have committed to creating. The projects often involve a considerable amount of work, and it isn’t unusual for a group to be unable to complete the project or take the project as far as planned, according to Peixoto.

“It was really good that they had five people in this group,” says Peixoto, who also directs the Neural Engineering Lab on campus.

The engineering students spent last fall researching what kind of devices were already on the market and finding out more about the mechanics of wheelchairs. Over time, they came up with goals for their device: it had to be portable and discreet, it had to save time and minimize spills, it had to weigh less than five pounds, and
it had to run on battery power using a rechargeable six-volt battery.

They designed it—on paper—and came up with a budget. Mohammadi even built a version of the arm for their presentation using a Lego Mindstorms kit. Their presentation was well received, and by the end of the fall semester, they were ready to move to phase two.

**CONSTRUCTION BEGINS**

With construction of the device, the real work began, and everyone on the team is quick to point out that they are not mechanical engineers.

“In the beginning, we had been working pretty linearly,” says Mahmoud of the process. “One week we would work on one motor, then move on to the next. Soon it became obvious that we would never finish.”

So they divided up the tasks, trying to make sure everyone was working on something they were interested in. The project easily broke into five parts: the robotic arm, the mount that connects the device to the wheelchair, the printed circuit board (PCB), the sensor, and programming.

For many of these tasks, the students had to almost start from scratch to learn what they had to do. “Everything was a learning experience for us,” says Madani.

In terms of the fabrication of the mount and the PCB, these tasks included learning software in which they would design the piece before it went to manufacturing. Khan oversaw the design of the mount; Madani worked on the PCB. “Three months,” Madani says as she holds one of the small green circuit boards in the palm of her hand. That’s how long it took to get the piece designed so it could go to the manufacturer. When the boards finally arrived, there was still soldering to do.

**ROCKY ROAD**

Were there hiccups in the process? You bet. For one, there was miscommunication between the team and the company that was selling them a tiny camera that was to be the “eyes” of the device and help the spoon find food. Just three weeks from their deadline, they had to come up with a better plan.

“I knew nothing about sensors except that we needed one,” says Kambugu who oversaw that portion of the project. “So I did a ton of research to figure out what kind of sensor would work best for us. Then it needed to be calibrated for this use.”

How much help was their mentor Peixoto? “A lot,” says Mahmoud with emphasis. “In the beginning, we got stuck on something I now realize is very basic, but we had spent a week trying to work out a solution.” A simple suggestion from Peixoto got them past that first hurdle, and she has been guiding them throughout the process. “I know they pulled many all-nighters,” says Peixoto. “I got several e-mails from them that were written at odd hours of the night saying ‘we need this....’”

Because of the nature of the group’s project, Peixoto was also able to provide some financial assistance. Peixoto and Vasiliki Ikonomidou, an associate professor also in the Department of Electrical and Computer Engineering, are coprincipal investigators on a National Science Foundation (NSF) grant specifically designed to support senior design groups that are developing projects to help other students. Their current plan is to fund one group per semester with the $100,000 grant that runs until 2016.

**THE FINAL STRETCH**

It was always the intention of the team that the completed device go to Izadi. It was built for him. What they didn’t anticipate was that it might have a life beyond the prototype. Peixoto says that she and the group have been in communication with a local assistive technology company that designs custom wheelchairs. The
The Volgenau School of Engineering is pleased to announce the establishment of the Katona Scholarship for Excellence in Bioengineering. Our goal is to raise $100,000 to support an endowment for an undergraduate student scholarship in the Department of Bioengineering at Mason.

Peter Katona, PhD, has been a pioneer in the field of bioengineering. He served as president of the Biomedical Engineering Society in 1984-85, and he is now a fellow of the American Association for the Advancement of Science, American Institute for Medical and Biological Engineering (AIMBE), and the cardiovascular section of the American Physiological Society. He served on numerous advisory committees of academic, government, and private organizations.

In 1991, Katona joined the Whitaker Foundation as vice president for biomedical engineering. His responsibility was to design and administer grant programs that would enhance and establish educational programs in biomedical engineering at U.S. universities. In July 2000, he was appointed president and CEO, a position he held until the foundation’s closing in June 2006. After his appointment in September 2006 as Professor of Electrical and Computer Engineering at George Mason University, he started to lay the groundwork for what was later to become Mason’s new Department of Bioengineering and has been the cornerstone of its development and growth ever since.

The faculty, staff, and students here are very humbled to have Katona on staff, and feel there is no better tribute to his work than to create this scholarship for students to continue his legacy.

If you would like to donate, please contact Jennifer Lamb
George Mason University
4400 University Drive, MS 4A3
Fairfax, VA 22030
E-mail: jlamb@gmu.edu
ANNOUNCEMENT

Department Supports Summer Undergraduate Research Experience

A goal of this program is to motivate Summer Undergraduate Research Experience (SURE) students to consider research careers and pursue graduate degrees in Bioengineering.

After last year’s success with our SURE Internship program, we were able to support undergraduate students again this summer. Selected students work under the supervision of Bioengineering professors who serve as mentors with the objective to cultivate an interest in research and development in the emergent field of bioengineering. Research projects, which will form the cornerstone of the experience, may involve computation, clinical measurements, or wet laboratory work. This year we have three outstanding Bioengineering students who currently work with the following faculty:

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<tr>
<th>Faculty/Mentor</th>
<th>SURE student</th>
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<td>Dr. Carolina Salvador Morales</td>
<td>Justin Zamory</td>
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<td>Dr. Huzefa Rangwala</td>
<td>Emily Eastlake</td>
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<td>Dr. Siddartha Sikdar</td>
<td>Von Botteicher</td>
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These three students have the opportunity to work with their mentors and graduate students on a range of related topics including bioinformatics, bioimaging, neuroengineering, and rehabilitation engineering. Last year the effort of one SURE student, Noran Hussein, led to her poster presentation at the Biomedical Engineering Society.
Keep in Touch!

Stay connected to us... We want to hear from you!

E-mail the department with any questions you may have about the program, and any projects featured in the newsletter at bioeng@gmu.edu

Website information can also help answer questions about the department, and provide up-to-date information about any upcoming events that the department is undertaking. Please visit our site to follow our progress at bioengineering.gmu.edu

Use the QR Code on your smartphone to see more about the department!

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