Drug Delivery Made Easy: Wireless Control of Implantable Devices Could Make Cancer Treatment Tolerable

By Claudia Borke

Wouldn’t it be nice to make chemotherapy a painless, noninvasive, and short procedure? Systemic drug therapy takes a toll on the human body, physically and emotionally, and can make recovery a long and painful road. With approximately 40 percent of men and women diagnosed with cancer at some point during their lifetimes (National Cancer Institute 2010-12), researchers are actively engaged in efforts to improve treatment outcomes as well as patients’ quality of life. Parag Chitnis, assistant professor in the Department of Bioengineering, is developing new techniques that employ ultrasound for controlling implantable drug-delivery devices, which could facilitate localized chemotherapy and revolutionize cancer treatment.

In his laboratory, located at the Krasnow Institute for Advanced Study, Chitnis leads a team consisting of one postdoctoral fellow, two PhD students, and one MS student to pursue research in three different fields—photoacoustic imaging, therapeutic applications of ultrasound, and development of new sensors.

To develop his novel paradigm for drug delivery, Chitnis collaborated with Professor Samuel Sia at Columbia University, who is a world-renowned expert on biocompatible materials and microfabrication. Under their leadership, the team won a research grant from the National Science Foundation to study the interactions between ultrasound and implantable devices and elucidate the underlying physics.

Chitnis demonstrated that certain heat-sensitive hydrogels, when wirelessly heated from 37°C to 45°C using ultrasound, rapidly change their dimensions in a reversible manner. When incorporated into implantable devices, these hydrogels can be employed to create mechanically moving components such as valves and pumps. Unlike current implantable technologies, Chitnis’s approach does not require electronics and batteries for actuation and control, which makes these devices more biocompatible and safer for clinical use.

Chitnis’s research now focuses on methods to fine-tune control over these devices to achieve a desired rate and amount of compound release, so it can be used for different drugs for a variety of clinical needs. An example would involve insertion of these devices at the disease site during surgical or biopsy procedures and release of the chemotherapy drug to either preoperatively reduce the tumor size or postoperatively treat residual cancer.

This approach would be especially beneficial for treating cancer in the brain where localized drug delivery is hindered by the barrier between brain tissue and blood vessels. Apart from uses in the field of cancer treatment, it is Chitnis’s vision to potentially use this ultrasound technique for treatment of neurodegenerative diseases such as the Parkinson’s disease and bacterial infections.

In addition to being an active scientist, Chitnis is a dedicated educator. He teaches a core undergraduate course on...
Dear Friends, Faculty, and Alumni of Mason Bioengineering:

I am delighted to report that Dr. Michael Buschmann will be assuming the role of chair and full professor of bioengineering in August. Dr. Buschmann comes to Mason with more than 20 years of experience at École Polytechnique in Montreal. His selection as the next chair of the Bioengineering Department resulted from a highly competitive and rigorous recruitment process. Dr. Buschmann is a world-class researcher who has made fundamental and translational contributions to the fields of biomechanics, biomaterials, and nanomedicine. With his considerable experience in research, teaching, and entrepreneurship, Dr. Buschmann will no doubt lead Mason Bioengineering to even higher levels of excellence.

In addition to Dr. Buschmann’s hire, Dr. Shani Ross was hired in spring 2017 as an assistant professor. In summer 2017, Dr. Michelle Harris-Love transferred to the department from Mason’s College of Health and Human Services. Dr. Caroline Hoemann joined the department in August as a full professor.

The BS and PhD programs in Bioengineering continue to grow at a healthy pace. We currently have around 224 undergraduate students and 22 PhD students. We are in the process of obtaining approval from the State Council of Higher Education for Virginia (SCHEV) to launch a new MS in Bioengineering Program, if all goes well, in fall 2018. About 30 percent of the students belong to the Mason Honors College. Many students received outstanding awards last year, and one of our students, Zachary Baker, received the prestigious Goldwater Scholarship. Over winter break our fall BENG 499 Bioengineering World Health class travelled to Guatemala to work in remote hospitals. Students were so impressed that some of them changed their future career goals after their return. Our undergraduate senior design projects were especially strong this year. One of the projects, involving the design and fabrication of a prosthetic arm for a young aspiring violinist, received worldwide attention in the press.

Our faculty members are highly active in conducting cutting-edge research and developing curricula to advance our educational mission. Dr. Wilsaan Joiner and Dr. Qi Wei have been engaged in a fascinating collaborative research project with Mason’s School of Dance. Dr. Siddhartha Sikdar and Dr. James Thompson from the Department of Psychology received a large NSF equipment grant (total amount $2.65 million, including $1 million in matching funds from Volgenau School of Engineering and the College of Humanities and Social Sciences) to purchase a state-of-the-art functional MRI scanner. The new fMRI will be housed in the new Peterson Hall building in mid-2018. Dr. Laurence Bray, our associate chair, developed and taught a new course in collaboration with Inova Health System, Applied Neurotechnologies, which was featured on the George Mason website.

A good indicator of the amount of activity in the department is that we were unable to fit in several newsworthy articles in this issue. As partial recompense, the department
Bioengineering Measurements as well as a graduate-level course on Medical Imaging. Chitnis is an out-of-the-box thinker and incorporates different teaching methods in his open classroom approach to make his lectures a fun experience. He fosters critical thinking through continuous questions and infuses the otherwise traditional lecture with his own cutting-edge research, videos, and other pertinent examples. Most importantly, he encourages students to engage in research at an early stage to acquire hands-on skills and crystalize the technical knowledge acquired in the classroom.

In his short tenure of three years, Chitnis has actively involved two high school students and ten undergraduate students in his research. In addition, he has mentored five senior-design (capstone project) teams of four students each. Two of these projects have produced provisional patents.

Chitnis has also been active in the growth of the Bioengineering PhD Program, which was launched in 2015. He served on the PhD committee responsible for recruitment and evaluation of prospective PhD students, and was the architect of a proposal that won a $442,000 grant from the Mason Provost’s Office for enhancing the Bioengineering PhD Program.

Chitnis also serves on the Research Council for the School of Engineering, and was recently selected as the provost administrative faculty fellow (only one selected in the entire university), a position in which he will help create policies aimed at improving the quality of PhD programs and student benefits across all colleges and programs at Mason.

In recognition of his accomplishments as a junior academic at Mason, Chitnis was selected as one of the 2017 state finalists for the Outstanding Faculty Award (Rising Star Category), State Council of Higher Education for Virginia.

2017 Degree Celebration Student Speaker: Francisca Wood Ortiz

By Martha Bushong

Francisca Wood Ortiz came to the United States from Chile when she was 10 years old. Like many students at Mason, she chose to study here in the heart of Northern Virginia because she understood that the university’s proximity to Washington, D.C., would provide a wealth of opportunities for jobs, internships, and research.

Her work as a researcher at the Micro-Scale lab in the Krasnow Institute for Advanced Study fueled her passion for research and led her to advanced studies after graduation. Wood will be working at the National Institutes of Health as a postbaccalaureate researcher before she heads off to the University of North Carolina, Chapel Hill, to earn her PhD in bioengineering.

Wood’s desire to help other students led her to create a mentoring program that pairs bioengineering seniors and juniors with freshmen and sophomores to guide underclassmen through the challenges in bioengineering. She hit on this idea because, as a freshman, she felt somewhat bewildered about how to get involved and says she would have benefitted from having a student mentor.

In her degree celebration remarks, she remembered the challenges of her undergraduate courses, and celebrated the victory of graduation. She encouraged the audience to move boldly into the future and to be proud of their Mason engineering education.
New Faculty

Welcome to New Chair,
Michael Buschmann, PhD

Michael Buschmann joins the Bioengineering Department as chair and full professor. He earned his PhD in 1992 in medical engineering and medical physics from the Massachusetts Institute of Technology in the Harvard-MIT Division of Health Sciences and Technology, and conducted his postdoctoral studies at the ME Mueller Institute of Biomechanics, University of Bern, Switzerland. He became a faculty member at École Polytechnique in 1994, becoming a full professor in 2001. His research achievements are impressive, with more than 150 peer-reviewed articles, more than 330 conference proceedings, 5 book chapters, more than 75 invited presentations, 19 patent applications (7 granted), more than 12,000 citations, and an h-index of 56. He has graduated 20 PhD students, 17 MSc students, and supervised 14 postdoctoral fellows. During his academic career at École Polytechnique, he obtained more than $50 million in external research funding as principal investigator.

Buschmann’s research work has been recognized with 19 prizes/awards and his abilities as an educator have earned him 6 teaching awards at Ecole Polytechnique. Buschmann has received numerous awards for his research, including the prestigious Canada Research Chair Tier 1 in 2001, the Melville Medal of the American Society of Mechanical Engineering (ASME) in 1997, and Article of the Year for ASME’s Journal of Biomedical Engineering in 1996. He has been the driving force behind four biotech startup companies as founder or principal inventor: Biosyntech Inc., sold to Smith & Nephew; Biomomentum Inc.; ANRis Pharma; and Ortho Regenerative Technologies Inc.

Faculty Highlight:
Giorgio Ascoli, PhD—How Does the Brain Work?

By Colleen Kearney Rich

Where do character traits like creativity and humor originate? By studying nerve tissue and building a computational model, neuroscientist Giorgio Ascoli and his team of researchers are trying to answer this fundamental question.

For decades, the construction of a computational model of the brain has been a kind of holy grail in neuroscience and computing. Through his research, Ascoli wants to gain a better understanding of how mind and body connect and interact. The findings have potential biomedical implications in the study and treatment of debilitating diseases such as epilepsy, Alzheimer’s, and Parkinson’s, as well as the mental decline that comes with aging.

“We are looking at the mechanism underlying brain function,” Ascoli says. “How the nerves and their plasticity allow connectivity on a cellular level.

By understanding the structure and the activity of the resulting network, we can attempt to infer answers to basic questions about how the brain works.

“When we recall an episode of our childhood, our thoughts, feelings, emotions, and imagination all correspond to or emerge from electrical waves in our brains,” he says. “How this is brought to be, from a bunch of tree-shaped nerve cells, is the beautiful mystery we are after.”

Giorgio Ascoli discusses dendrites, which are branches of neurons, with PhD student Todd Gillette.
Faculty Highlight: Avrama Blackwell, PhD—
Are There Other Ways to Treat Parkinson’s Disease?

By Colleen Kearney Rich

As the principal investigator at the Computational and Experimental Neuroplasticity Lab, Avrama Blackwell, is focusing her research on the biophysical and biochemical mechanisms of long-term memory storage.

About 50,000 people are diagnosed with Parkinson’s disease each year, and at present there is no cure. For those affected by Parkinson’s, the dopamine-producing neurons in the brain are destroyed. Current treatments involve replacing dopamine, a chemical in the brain that helps relay signals between the neuron and other cells, but this technique only provides relief for a while. Mason neuroscientist Avrama Blackwell believes the answer to Parkinson’s may lie farther down the neural pathway.

“When dopamine binds with its receptors, many other molecules get activated,” says Blackwell, who is the principal investigator of the institute’s Computational and Experimental Neuroplasticity Laboratory. “A whole cascade of biochemical reactions takes place.”

This “cascade,” or signaling pathway, is what she is focusing on in her research, which uses computer modeling and experiments. “I want to find out which of those molecules are critical and how things change when you block those molecules.”

An expert in neuroplasticity, an area of science that focuses on learning or the brain’s ability to make connections, Blackwell believes that when those molecules are identified they could be targets for drug design, and medicine could bypass the dopamine altogether.

Michelle Harris-Love, PhD, earned a master of science degree in physical therapy at the Mayo School of Health Sciences in 1997 and a PhD in rehabilitation science at the University of Maryland in 2004. She completed postdoctoral training in the Human Cortical Physiology Section at the National Institutes of Health in Bethesda, Maryland, in 2008. Her research is focused on motor recovery following stroke, neural control of reaching movements, and non-invasive brain stimulation.

Caroline Hoemann, PhD, joins Bioengineering as a full professor. She received her BA in biochemistry in 1983 from the University of California at San Diego. She earned an MSc in applied biology and a PhD in toxicology from MIT in 1988 and 1992, respectively. She did postdoctoral work at INSERM in France and the Friedrich-Miescher Institute in Switzerland. She was director of research at a Montreal-based biomedical device company before joining Ecole Polytechnique of Montreal in 2002, becoming a full professor in 2013. Her research interests lie in cartilage and bone tissue engineering, and biomaterial-induced blood and innate immune responses.

Shani Ross, PhD, received her bachelor of science in electrical engineering from Howard University in Washington, D.C. in 2004 and her master’s and PhD in biomedical engineering with a bioelectrical concentration from the University of Michigan in Ann Arbor, in 2006 and 2013, respectively. Her current research involves studying bladder neurophysiology and working on a closed-loop neuroprosthesis for bladder control. In general, Ross’ research interests are in the areas of neural engineering and neuromodulation. In particular, she is interested in closed-loop neuroprosthesis, peripheral nerve stimulation for restoration of function, and deep brain stimulation.
Class Gives Students Clinical Experience at Hospital

By Martha Bushong

To help students gain firsthand experience in a clinical setting and prepare them for the future, Laurence Bray, associate chair of the Department of Bioengineering, developed a unique technical elective. The class, Applied Neurotechnologies, combines classroom learning with state-of-the-science clinical experience at Inova Fairfax Hospital’s campus.

“The class was a combination of the best of everything,” says bioengineering major Abdul Gouda. “There was clinical practice, classroom experience, teamwork, and some friendly competition.”

The specialized curriculum divides the semester into four segments, and each segment takes on a specific bioengineering skill or challenge. The segments include on-preparation and follow-up at Mason, and hands-on lab experiences at Inova’s Advanced Surgical Technology and Education Center (ASTEC), one of the most technologically advanced surgery simulation facilities in the region.

After teaching these students for several years, Bray says she had a good idea of what kind of course would excite them. “When registration opened, the class filled up in one half a day,” she says. “The response was overwhelming.”

Bray designed the class with the cooperation of the Department of Surgery at Inova and two hospital neurosurgeons, Mahesh Shenai and James Leiphart, who taught the clinical portion of the course at ASTEC.

“We learned the importance of teamwork and how to work together, despite different styles,” says Gouda. “The groups changed four times, so we were not with the same team throughout the semester, which was different. Usually we choose our own teams—in the real world that doesn’t always happen.”

Bioengineering major Anuradha Nagulapati worked as Bray’s summer intern, helping with course preparation, and spent countless hours in the hospital. She said it was the first time she worked in a hospital setting with the health care team and interacted closely with physicians.

“Working in the hospital setting let us see all the different career fields for bioengineering graduates,” says Nagulapati.

Engineering students in the Mason-Inova Applied Neurotechnologies class work with faculty and clinicians in both an academic and simulated clinical environment on the Inova Fairfax Medical Campus.
Trip to Help Hospital Triggers Desire to Return

By Damian Cristodero

When Mahsa Layazali and her co-workers received the skin grafting device to repair, it needed a thorough washing—it had just been used during a dermatological procedure. The blood and remnants of skin didn’t bother Layazali, but she did wonder how the surgeon, now without a key piece of equipment, completed the procedure.

“He was skilled,” she says. “He found another way.”

Layazali and three classmates spent three weeks maintaining and repairing medical equipment in Mazatenango, Guatemala, and the experience was transformative for the bioengineering major, who graduated this past December.

“I’d really like to live there,” she says. “I just feel, in general, that country needs help, and they are open to people who try to help them.”

“I’m not surprised,” says Claudia Borke, Layazali’s academic advisor. “She was so touched. She had some experiences that really changed the way she’s going to walk down her life path.”

It was her sister’s recommendation that helped push Layazali to Mason after two years at Northern Virginia Community College. “It was a good choice for me,” says Layazali, who is considering medical equipment repair as a career. “It worked perfectly.”

And enrollment in Mason ultimately led to the trip to Guatemala, arranged through the Engineering World Health organization and the Bioengineering Department. The hospital had equipment donated from the United States, but had few manuals explaining their use. With a semester’s worth of training through her Bioengineering World Health class, Layazali became part of a service and repair shop, fixing things such as patient monitors and surgical suction devices. Basic manuals in Spanish, created by her bilingual classmates, were left behind.

Layazali says she plans to return to the hospital as a volunteer.

“Education is the most powerful weapon which you can use to change the world.” —Nelson Mandela
Mason Engineering Students Build Arm for Aspiring Violinist

By Damian Cristodero

Isabella Nicola tentatively pulled the bow across the strings of her violin. The sound was as strong as her smile, and applause filled the room at Mason’s Long and Kimmy Nguyen Engineering Building.

It was the first time Isabella, born without a left hand and with only partial bone from her left elbow to her wrist, had played using the prosthetic prototype created by a senior design team of five Mason bioengineering majors who witnessed the impromptu concert.

The prosthetic is hot pink, one of Isabella’s favorite colors, and fashioned in three sections with the bow attached at the end. The 12-ounce device, made of acrylonitrile butadiene styrene, was produced using a 3-D printer and is connected by straps to allow freedom of movement.

It took Isabella a few tries to get the hang of placing the bow on the strings, but once comfortable, she played simple scales, then wowed with a version of Beethoven’s “Ode To Joy.”
“I’m just very happy to see it,” says design team member Racha Salha. “I would never believe we would get such a result.”

“Extremely overwhelming,” says Isabella’s mother, Andrea Cabrera. “I want to cry because of how lucky I am that they took over this project.”

Isabella, a fifth grader at Island Creek Elementary School in Alexandria, Virginia, has been learning to play the violin for a year. But she rests the instrument on her right shoulder (instead of the usual left) so her right hand can finger the strings, which, thanks to a local music shop, were restrung for left-handed bowing.

She had been using a simple prosthetic constructed from PVC pipe by Mason alumnus Matthew Baldwin, the string director at Island Creek.

“It wasn’t great,” says Baldwin, who has a degree in music education from Mason. “I didn’t have the knowledge to take it to the next level, but I knew I could reach out to George Mason University.”

The design team met Isabella the day before Thanksgiving in 2016. Creating the prosthetic became their senior capstone project, but it also became a duty.

“Seeing her smile, our feeling was we really want to help her,” says team member Yasser Alhindi. “Immediately, we said, “This is our Thanksgiving miracle.”

In addition to Alhindi and Salha, the design team consists of Mona Elkholy, Abdelrahman Gouda, and Ella Novoselsky. The team instructor is Laurence Bray, associate chair of the Bioengineering Department. Faculty mentors are Mason bioengineering professors Wilsaan Joiner and Vasiliki Ikonomidou.

“It’s really exciting,” says Novoselsky. “This really shows me how applying your knowledge will affect people directly.”

“Tell me and I forget. Teach me and I remember. Involve me and I learn.”

—Benjamin Franklin
Faculty Highlights and Awards

Wilsaan Joiner, PhD, won a 2015-16 Emerging Researcher/Scholar/Creator Award. www2.gmu.edu/news/312376

Laurence Bray, PhD, won the OSCAR Mentoring Excellence Award and graduated from Mason’s Leadership Legacy program.

Parag Chitnis, PhD, was selected as one of the 2017 state finalists for the Outstanding Faculty Award (Rising Star Category), State Council of Higher Education for Virginia.

Student Highlights and Awards

Sameen Yusuf is a recipient of the OSCAR Student Excellence Award 2017.

“I began my bioengineering degree at Mason with one goal: to integrate my passion for international development, policy, and technology. Although my coursework facilitated building a foundation in engineering concepts, research has been the key to my growth as a design thinker. Learning to be a meticulous and curious researcher provides me with confidence to pursue an MD/PhD and a career in research. Receiving the OSCAR Student Excellence Award speaks to that, and I am so grateful for the advisors, professors, and mentors that have supported me in reaching my long-term goals.”

Erin Schulte is a recipient of Bioengineering’s Outstanding Academic Achievement Award and the Provost Scholar Athlete Award, February 2017. This was Schulte’s third time receiving this award. This year she is one of only eight student-athletes to have received the award for all three years they were eligible. volgenau.gmu.edu/news/424861

Zachary Baker received a Goldwater Scholarship. Awarded since 1989, the one- or two-year scholarship provides up to $7,500 per year for tuition, fees, books, and room and board. There were 240 recipients this year out of 1,286 applications from colleges and universities nationwide. www2.gmu.edu/news/394396

Forrest Bussler received a Katona Scholarship for Bioengineering Excellence (2016) and GMU Foundation Scholarship for $5,000.

Shaun Meyer is a recipient of Bioengineering’s Outstanding Academic Achievement Award and a Dean’s List Scholarship (fall 2015, spring and fall 2016) for $1,000.

Christian Koudelka and Elizabeth Tarbox are recipients of Bioengineering’s Chairman’s Award.

Internships and Fellowships

Brian Schnoor was awarded a highly competitive Research Internships in Science and Engineering (RISE) undergraduate internship. He is spending summer 2017 in Germany conducting research on biofilms. volgenau.gmu.edu/news/424396

More information on RISE can be found at www.daad.org/en/find-funding/undergraduate-opportunities/research-internships-in-science-and-engineering-rise.

Neil Jacob was named a Virginia Micro Electronics Consortium summer scholar for an internship at the College of William & Mary. vmec-scholars.org/prof.htm

Bobby Graham received a five-year PhD fellowship to study at University of Michigan, Ann Arbor.

Nashaat Rasheed is a recipient of the 2016 and 2017 George Mason University Summer Research Fellowship, Office of the Provost, for $7,000, and the Oak Ridge Institute for Science and Education Fellowship from the FDA for summer 2017 conducting research in the field of photoacoustic imaging.

Alex Kaiser was accepted to participate in the Computational Sensory-Motor Neuroscience 2017 summer school.

Felicitas Detmer is a recipient of a Mason Presidential Scholarship (2016-present).

Ravi Doddasomayajula received a summer internship at the FDA through the FDA Research Fellowship Program (summer 2017).
The Dancing Brain

By Colleen Kearney Rich

How dancers move and learn may make them the perfect collaborators for George Mason University researchers. This new line of research brings together the Departments of Bioengineering and Psychology with the School of Dance in a whole new way.

As a bioengineer, Wilsaan Joiner’s research interests include sensorimotor learning and control. One of his ongoing projects focuses on the neural processes underlying motor adaptation and memory consolidation. In the simplest terms, he studies how one learns a physical skill and retains that knowledge.

“When we study motor control, we study the human ability to learn and refine movement. In my scientific field, we talk about generalization, which basically is I teach you how to move in A and then make it slightly different, let’s call that B. How much of what you learned for A transfers to B?” says Joiner.

“And how we study this is ridiculously constrained,” he adds. “These experiments are typically very short lived, usually an hour over the course of one day. Learning motor skills over a period of months—that’s something people don’t study.”

That’s why Joiner found the Mason dancers so fascinating. Not only do they learn a dance over a fixed period of time, and repeat that performance over and over, they can also adjust their movements—as a group—to fit the performance space, such as moving from a rehearsal studio to an arts center stage.

Joiner asked how long it takes the dancers to make that transition, expecting an answer involving days or weeks. The response: a few minutes.

“How do you learn that step? How do you maintain the memory of it? It is a very sophisticated process,” says Mason dance professor Elizabeth “Buffy” Price. “We all have the skill, but [dancers] hone it.”

One of the first things the team of researchers did was apply for a National Science Foundation grant and convert a dance studio in the de Laski Performing Arts Building into a space where they could collect data using 3-D motion capture techniques.

Mason bioengineer Qi Wei, director of Mason’s Biomechanics Laboratory, is part of the team developing the computer models to replicate the dancers’ movement in the new lab.

“Straight away the [research] group clicked,” says Mason psychology professor James Thompson. “The grant proposal was just a first pass at trying to put a series of experiments down on paper. We are continually talking about side projects. I have about 10 years’ worth.”

They also included the development of an undergraduate class as part of the proposal. Tentatively called “Engineering Dance,” the class will bring together students from dance, engineering, psychology, and other fields and explore theories about learning and emotion, and how they relate to movement.
Bioengineering Senior Design Project 2017 Highlights

VioArm: A Customized Prosthetic Arm
Students: E. Novoselsky, R. Salha, A. Gouda, M. Elkholy, Y. Alhindi
Advisors: Wilsaan Joiner and Vasiliki Ikonomidou
Partner: Elizabeth Adams, Mason School of Music
Website: vioarm.onmason.com

A Touch Screen Application for Stroke Rehabilitation
Advisors: Michelle Harris-Love and Wilsaan Joiner
Partner: National Rehabilitation Center
Website: seniordesignstrokerehab.onmason.com

Mapeurysm
Advisor: Juan Cebral and Carolina Salvador-Morales
Website: dholling.onmason.com

Application of Hydrogel Nanoparticles for a Latent Tuberculosis Rapid Diagnostic Test
Students: M. Howard, S. Yusuf, R. Madhu, S. Sharif
Advisors: Lance Liotta and Alessandra Luchini
Article: www2.gmu.edu/news/394681

Remote Video Estimation of Blood Pressure Employing dPTT
Students: K. Scott, L. Hirt, C. Rios, V. Tran, S. Meyer
Advisor: Vasiliki Ikonomidou
Website: lhirt8.wixsite.com/bp4me

Wearable Technology for Autism Spectrum Disorders in Children
Advisors: Ken Hintz
Partner: Vorbeck
Website: senior-design-2016-2017-vorbeck.mozello.com

Interferometer System to Detect Shunt Failure
Students: B. Khong, N. Jacob, I. Gulati, A. Idris
Advisors: Siddhartha Sikdar and Parag Chitnis

A Triplanar Spinal Alignment Measuring Device for Adolescent Idiopathic Scoliosis
Students: H. T. Lim, O. Franjie, L. Glew, S. Kommaraju
Advisor: Qi Wei
Partner: National Scoliosis Center
Website: customscoliosis.com

Wearable Acoustic Sensor for Continuous Monitoring of Arteriovenous Graft Patency
Students: K. Ghaffari, C. Koudelka, C. Mullins
Advisors: Siddhartha Sikdar and Parag Chitnis

Spinal Cannulation Automated Navigation (SCAN) Robotic System
Students: D. Le, A. Daniel, A. Mia, L. Tran, D. Obodo, Q. Javid
Advisor: Feitian Zhang
Partner: Mahesh Shenai, Inova
Website: argroup9.onmason.com

Wearable Acoustic Sensor for Continuous Monitoring of Arteriovenous Graft Patency
Students: K. Ghaffari, C. Koudelka, C. Mullins
Advisors: Siddhartha Sikdar and Parag Chitnis
Cancer treatments often involve applying drugs or therapies from outside the body, but bioengineering professor Nitin Agrawal is working on a method to treat tumors internally.

Agrawal received a $300,000 grant from the National Science Foundation to develop an anti-cancer therapy in which researchers will induce the body to grow more T-cells. Cytotoxic T-cells are white blood cells that are involved in recognizing and responding to foreign or abnormal cells.

“We are trying to make an army of these white blood cells without taking them out of the body,” Agrawal says.

To do this, the researchers use liposomes, or small packets of lipids—molecules that don’t readily mix with water—that can hold a desired treatment. They plan to fill those packets with the materials necessary for cell growth.

The researchers also include on the liposomes a molecule, protein, or antibody that seeks out the T-cells the scientists want to expand.

Once the packets go into the bloodstream, they selectively and specifically bind only to the T-cells the researchers want to multiply. Once attached, the liposomes slowly release the encapsulated drug inside them.

Agrawal has been working on this project for a year, but the concept of using the body’s own immune system to kill cancer cells has been around since the 1990s.

The liposomes offer two key benefits—they prevent unnecessary contact between the drugs and unaffected cells, and they allow the drugs, which would otherwise have a very short half-life, to remain stable within the body.

Currently, this type of therapy only works effectively on melanoma—a sometimes deadly form of skin cancer—but Agrawal hopes it will one day be a treatment option for solid tumors.

Agrawal says his grant money is being used to fund the student researchers working with him and the materials they are using.

He says the current project will include in vitro studies using cultured cells and, depending on the results of those studies, animal trials and human tests would follow.
intends to produce a fall 2018 newsletter that will highlight these items, and contain a message from the new chair, Dr. Buschmann. After two years as acting chair, I have come away with a deep admiration and appreciation for the Bioengineering Department. It has truly been a pleasure working with such an active and enthusiastic group of faculty and staff. I look forward to seeing the department’s continued growth and success in the coming years.

Sincerely,

Brian L. Mark, PhD
Acting Chair,
Department of Bioengineering
Professor, Department of Electrical and Computer Engineering
Volgenau School of Engineering

Bioengineering Students

Join the BMES:
• Mentor/ Mentee program
• Networking
• Outreach
• Fun and Friendship

Contact: Connor Stapp (cstapp@gmu.edu), President
## Active funded projects as of July 28, 2017

Currently the Department of Bioengineering accounts for more than $20 million in active grant awards

<table>
<thead>
<tr>
<th>PI</th>
<th>Abbreviated Project Title</th>
<th>Funding Agency</th>
<th>Total $ Amount</th>
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<tr>
<td>Nitin Agrawal</td>
<td>Real-time hypoxia studies</td>
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<td>Nitin Agrawal</td>
<td>Biomanufacturing: Liposome mediated targeted expansion and stimulation</td>
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<td>Giorgio Ascoli</td>
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<td>Reliable high-throughput consensus for neuronal morphologies</td>
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<td>Generation and description of neuronal morphology and connectivity</td>
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<td>Giorgio Ascoli</td>
<td>Cytoskeletal mechanisms of dendrite arbor shape development</td>
<td>GSU/NIH/CRCNS</td>
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<td>Automated parameter tuning of large-scale spiking neural networks</td>
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<td>Giorgio Ascoli</td>
<td>Contribution to Center for Neural Informatics</td>
<td>GMU Foundation</td>
<td>$22,275</td>
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<tr>
<td>Giorgio Ascoli</td>
<td>Development of a biologically plausible computational model of the hippocampal formation</td>
<td>Northrop-Grumman</td>
<td>$50,000</td>
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<td>Giorgio Ascoli</td>
<td>Barcode sequencing of axonal projections to classify long-range cortical neurons</td>
<td>Burroughs Wellcome</td>
<td>$5,000</td>
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<tr>
<td>Kenneth Ball</td>
<td>Eminent scholar recruitment</td>
<td>CIT</td>
<td>$500,000</td>
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<td>Avrama Blackwell</td>
<td>Dopamine modulation of calcium influx</td>
<td>NIH/CRCNS</td>
<td>$641,087</td>
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<td>Avrama Blackwell</td>
<td>Spatial and temporal aspects of molecular signaling</td>
<td>NSF</td>
<td>$477,155</td>
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<td>Avrama Blackwell</td>
<td>CRCNS: Spatio-temporal dynamics of dopamine activated 2nd messenger pathway</td>
<td>NIH/CRCNS</td>
<td>$1,407,594</td>
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<td>Avrama Blackwell</td>
<td>The role of the dorsal striatum during large-scale adaptation</td>
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<td>Juan Cebral</td>
<td>Improved evaluation of PCOM aneurysms: Angio-architecture, hemodynamics, and shape</td>
<td>NIH – R21</td>
<td>$406,503</td>
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<td>Cebral/Robertson</td>
<td>Improving cerebral aneurysm risk assessment through understanding wall vulnerability and failure modes</td>
<td>NIH – R01(U. Pitt)</td>
<td>$1,093,655</td>
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<td>Cebral/Kadirvel</td>
<td>Computational and biological approach to flow diversion</td>
<td>NIH – R01 (Mayo)</td>
<td>$731,756</td>
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<td>Juan Cebral</td>
<td>Treatment of aneurysms</td>
<td>Philips</td>
<td>$80,000</td>
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<td>Parag Chitnis</td>
<td>Ultrasound-mediated control of implantable micro-devices made of biocompatible polymers</td>
<td>NSF (Columbia)</td>
<td>$172,290</td>
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<td>Michelle Harris-Love</td>
<td>Mechanisms of arm recovery in stroke patients</td>
<td>NIH/R-21</td>
<td>$411,552</td>
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<td>Vasiliki Ikonomidou</td>
<td>Student-directed engineering</td>
<td>NSF</td>
<td>$149,952</td>
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<td>Vasiliki Ikonomidou</td>
<td>Senior design projects</td>
<td>U.S. ARMY</td>
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<td>Wilsaan Joiner</td>
<td>Role of the saccadic eye-movement corollary discharge in stable visual perception</td>
<td>NIH</td>
<td>$714,828</td>
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<td>Wilsaan Joiner</td>
<td>Probing the neural integration of sensorimotor signals for limb motor coordination and perception</td>
<td>NSF CAREER</td>
<td>$503,225</td>
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<td>Wilsaan Joiner</td>
<td>Mechanisms of saccadic disorders</td>
<td>NIH R01</td>
<td>$1,878,044</td>
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<td>Carolina Salvador-Morales</td>
<td>A multiplexing photoacoustic theranostic system for treatment of breast cancer</td>
<td>CIT</td>
<td>$200,000</td>
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<td>Salvador-Morales/Cebral</td>
<td>Engineering a novel theranostic device for breast cancer</td>
<td>NIH – R15</td>
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<td>James Thompson and Siddhartha Sikdar</td>
<td>Acquisition of a 3T MRI for integrative brain-body imaging</td>
<td>NSF/MRI</td>
<td>$1,647,968</td>
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<td>Siddhartha Sikdar</td>
<td>Dexterous control of upper extremity prosthetics</td>
<td>NSF</td>
<td>$995,055</td>
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<td>Siddhartha Sikdar</td>
<td>Carotid stenosis</td>
<td>VA</td>
<td>$79,860</td>
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<td>Sikdar/Joiner/Chitnis</td>
<td>Closed-loop hybrid exoskeleton utilizing wearable ultrasound sensors for measuring fatigue</td>
<td>NSF</td>
<td>$399,931</td>
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<td>Sikdar/Joiner/Chitnis/Harris-Love</td>
<td>Intuitive control of upper extremity prostheses using ultrasonic sensing of muscle activity</td>
<td>U.S. ARMY</td>
<td>$999,095</td>
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<td>Qi Wei</td>
<td>The neural control of internal joint state variables</td>
<td>NIH (Northwestern)</td>
<td>$56,172</td>
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</tbody>
</table>
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Email 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 website to follow our progress at bioengineering.gmu.edu.

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