Joint Department of

BIOMEDICAL ENGINEERING

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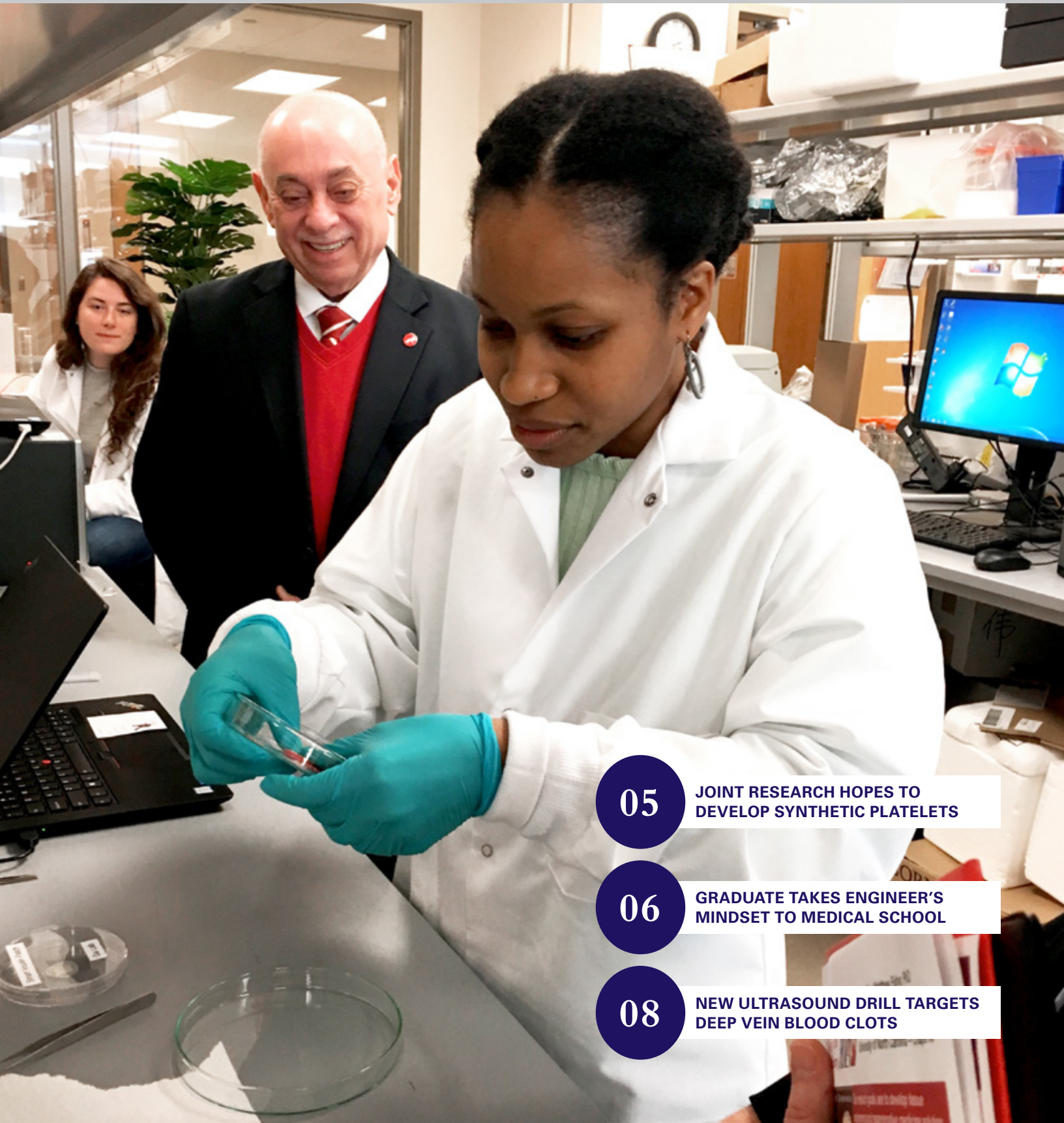

IN THIS ISSUE

LETTER FROM THE CHAIR

Nancy Allbritton

DEAR BME ALUMNI AND FRIENDS:

On the spectrum of biomedical research activities, Biomedical Engineering (BME) is a translational field. The ultimate goal of most BME projects is to provide a device, or material, or instrumented technique that will benefit human health. The UNC/NC State Joint Department of Biomedical Engineering possesses a vibrant culture of researchers who endeavor to transfer BME technology from the bench into the hands of those treating patients. This translational/entrepreneurial spirit is found throughout our membership; faculty, staff, post-docs, and students of every level. As quantified in the following summary, their collective creative efforts are spinning out exciting BME technology almost every month.

Joint BME core faculty members are inventors on more than 130 pending or issued patents. More than 10 percent of our current graduate students are involved in launching a startup venture. Joint BME averages one or two undergraduate design teams spinning out or licensing their design project technology every year. Our core faculty is associated with the launch of more than 30 companies (learn more about one example, Zenomics, on page 9). Success stories representative of the Joint Department's translational/entrepreneurial portfolio follow.

- As has been covered by *CBS Morning News* and countless other outlets, then-BME undergraduate Jeffrey Powell founded "The Helping Hand Project" student organization. Its mission is to use innovative technologies (in particular open-source 3D printing) to make and provide useful prosthetic devices at no cost to children in need. **heellife.unc.edu/organization/helpinghandproject**
- Cortical Metrics, a company spun out by BME faculty members Bob Dennis and Mark Tommerdahl, makes Brain Gauge, a device that measures changes in the brain's information processing to rapidly provide low-cost, objective assessments of brain health. Brain Gauge so robustly differentiated concussed from non-concussed individuals it received support from the inaugural NFL/GE Head Health Challenge. **corticalmetrics.com**
- This year, a former Senior Design team (Denise Witman, Laura Rucker, Ashley Hayes, Alex Eller and Lizz Davenport) saw their class project become a medical device product. Local company 410 Medical introduced LifeFlow, a rapid infuser used in the resuscitation of critically ill patients. Early use in local hospitals and doctor's offices is so successful that LifeFlow's market is expanding nationwide. **410medical.com**
- SonoVol, a spin-out company co-founded by BME faculty member Paul Dayton and run by former BME graduate student Ryan Gessner, was awarded a $1.8 million SBIR grant from the National Institutes of Health to develop novel 3D imaging products in the preclinical oncology, cardiology and tissue engineering space. SonoVol, which has raised more than $8 million in total research funding, is located at the First Flight Venture Center in RTP and has nine full-time employees. **sonovol.com/company**

As discerned from the statistics and examples above, the extent of our department's translational activity creates a critical mass of inspiration, talent, and investment that is demonstrably generating jobs and better health for North Carolinians, the US population as a whole and, ultimately, the world.

Sincerely,

Nancy Allbritton MD, PhD

Nancy Allbritton, M.D., Ph.D.
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BME Ph.D. candidate Andrea Brandt works with a patient in the Neuromuscular Rehabilitation Engineering Lab.

When **high-tech bionics** merges with the human side of science in order to meet individual needs

WHEN LOWER LIMB AMPUTEES are fitted with a powered prosthesis, a technician sets the device's performance parameters in a clinical setting where the person is walking on a flat, level surface. But those clinical conditions don't correspond to all the walking conditions and movements that an amputee will experience in life.

Ph.D. biomedical student Andrea Brandt is studying how above-knee amputees adapt to using a powered prosthesis for activities like carrying a load. She wants to change the prosthetic knee mechanics to relieve amputees from compensating or working so hard when they do carry loads. She hopes that what she learns will allow amputees better mobility and control of movement.

What most amputees want is a prosthesis that is adaptable, allowing them to return to activities they really enjoyed before having a leg amputated, Brandt said. Her goal is to develop prostheses that adapt to the amputee users, rather than amputees having to adapt to their prosthesis — the ultimate bionic leg that can automatically adjust for specific activities and conditions.

Brandt didn't set out to be a biomedical scholar. After earning an undergraduate degree in math, she took a year off from education to think about what was next for her. She was looking for a field that combined, "a human side and a math side." Biomedical engineering seemed "one of the most fulfilling ways" to do that, she said.

She chose the department's Neuromuscular Rehabilitation Engineering Lab. The lab is widely recognized for its gait lab equipment — sort of a high-tech treadmill — that records whole-body movement and evaluates novel control and

rehabilitation techniques for prostheses, orthotics, computers and other assistive devices. According to the program's website, "Our research goal is to improve the quality of life of persons with disabilities."

Brandt especially enjoyed the opportunity to study at both UNC and NC State. Early in her student career, she actually spent more time at UNC.

"It's nice to get access to the human, medical side," she said. "UNC has a great school of medicine, and NC State has a great engineering program." Brandt's human motor control class through the Human Movement Science Department at UNC was one of her favorite classes, and she found it very informative for her work.

"Our research goal is to improve the quality of life of persons with disabilities"

- Biomedical student Andrea Brandt

Amputees face challenges when walking under different conditions that are not supported by a pre-programmed activity mode, or variations within an activity mode, such as using the "level ground walking" mode or carrying a load like a backpack, small child or groceries. Research has found that even carrying 10 lbs. of groceries can be difficult for amputees, forcing them to shift their weight more to their intact leg. Such shifting can lead to joint and back problems like osteoarthritis, scoliosis and sometimes injuries from falls.

"When people get a prosthesis, they go to the clinic and the clinician will adjust the prosthesis settings for them, and that's what they'll use in their daily life," Brandt said. "They aren't testing a number of conditions, like people don't pick up a bag of groceries and see how they walk, or carry their child on their hip. So the first question for us to understand was, does this make a difference, and in what way?"

Last summer, Brandt and her team enlisted help from volunteer amputees who tested an experimental powered knee by walking on the lab's force-measuring treadmill. Participants were fitted with a weight against their backs that simulated the task of carrying a backpack.

"The amputees give us valuable feedback – how they felt, changes they would like to make with the prosthesis," Brandt said.

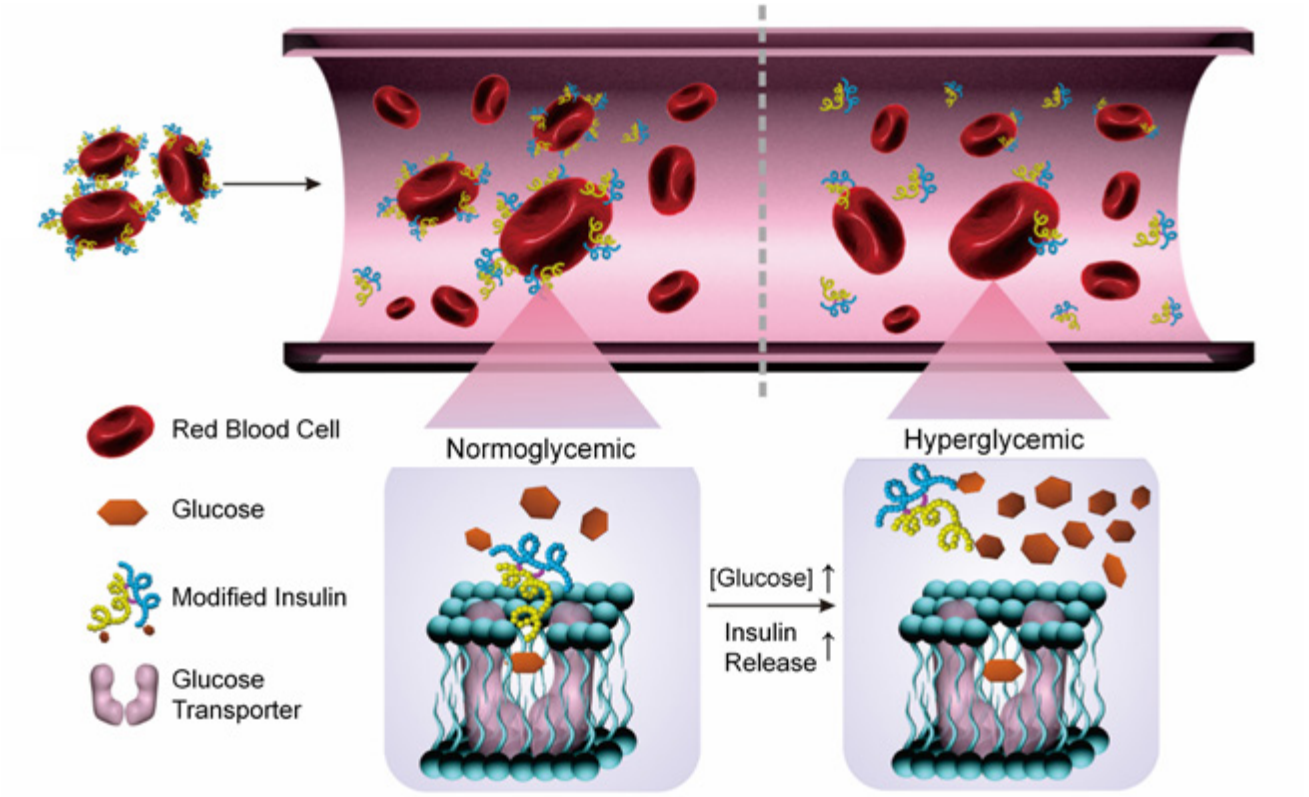
In March, Brandt and postdoctoral scholar Dr. Stephanie Huang joined their professor, Dr. Helen Huang, at the Museum of Natural Sciences' Science Café, regular discussions by local scientists that are open to the public. They showed the audience different types of prosthetic knees and feet and explained how each can adapt to different activities.

Working with the amputees in the research study is meaningful, Brandt said. "It sounds cheesy, but we're really helping people," she said. "Not every lab can actually develop something and test it on the people it's going to be helping."

Brandt was inspired by one participant in the study last summer. He later became an intern in the neuromuscular lab, and he hopes to become an engineering student at NC State. "Not only has he helped us gain valuable insight into how amputees use prostheses, but I hope we've helped him gain lab experience and research experience," she said.

The lab research with amputees also helped Brandt recognize individual issues, making the goal of adaptable prostheses more important.

Graduation is still a couple of years away for Brandt. But she continues her research, helping bring life a little closer to routine for amputees. •



Researchers use modified insulin and red blood cells to **regulate blood sugar**

RESEARCHERS FROM BME and the School of Medicine at the University of North Carolina at Chapel Hill have developed a new technique that uses modified insulin and red blood cells to create a glucose-responsive "smart" insulin delivery system. In an animal model study, the new technique effectively reduced blood sugar levels for 48 hours in a strain of mice that had Type 1 diabetes.

The researchers modified insulin by chemically binding it to a glucose derivative called glucosamine. The glucosamine could then bind to glucose transporters on the surface of a red blood cell, effectively attaching the insulin to the blood cell. The end result is a red blood cell studded with insulin molecules.

The idea is that these insulin-loaded blood cells could then be injected into a diabetic patient. In this study, the work was done in Type 1 diabetic mice.

Once in the bloodstream, the blood cells carrying insulin interact with their environment. If glucose levels are high, glucose molecules effectively displace the glucosamine in the blood cells' glucose transporters. And when the glucosamine is set free from the blood cell, so is the insulin.

The insulin can then bind to insulin receptors in the liver, muscles and fatty tissues, triggering a process that reduces glucose levels in the blood.

"In short, this is a fully biocompatible smart system that responds, when needed, to normalize glucose levels in the blood," says Dr. Zhen Gu, co-corresponding author of a paper on the work and an associate professor in BME.

In the study, researchers compared mice receiving the modified insulin and blood cell system to three other groups: a group that received saline solution, a group that got only modified insulin, and a group that got a mixture of unmodified insulin and red blood cells.

The researchers found that the Type I diabetic mice that received the modified insulin and blood cell system were able to significantly reduce blood glucose levels for more than two days. The best performance among the other groups saw an initial dip in blood sugar levels, but returned to high glucose levels within 12 hours. •

BME-NC State team pioneering the development of **synthetic platelets**

By Ashton Robertson

From left, Laura Sommerville, Maureane Hoffman, Dougald "Mac" Monroe III, Ashley Brown and Seema Nandi. *Photo by Ashton Robertson.*

DUKE CLINICAL and Translational Science Institute (CTSI) has awarded $50,000 to an inter-institutional team of researchers investigating the possibilities of synthetic platelets for wound-healing processes.

Ashley Brown, Ph.D., and her team in BME are developing new strategies for treating bleeding disorders as well as chronic nonhealing wounds through the use of nanoparticles that mimic the shape and other features of natural platelets in wound healing and coagulation. Most importantly, they've created particles that, like platelets, are able to augment the clotting process and retract clots, making them smaller and more stable.

In related work, Maureane Hoffman, MD, Ph.D., and her colleagues in the Duke Department of Pathology are studying the effects of hemophilia on wound healing. Even after bleeding stops, patients who have hemophilia are known to exhibit impaired wound healing. Their clots are not as strong, and they degrade quickly. The team's hypothesis is that reduced thrombin generation results in poor platelet activation and impaired fibrin structure, causing the patients' impaired healing.

In 2016, the two groups realized the potential of working together, and in early 2017, the CTSI Duke/NC State funding gave them the opportunity to make their collaboration official. Together, their goal is to apply platelet-mimetic particles to patients with hemophilia, enhancing functions of platelets that may lead to improved healing.

The potential implications of this project far outreach those affected by hemophilia. The group is also looking at impaired healing in the presence of oral anticoagulants; similar to hemophilia, oral anticoagulants negatively affect fibrin structure and may contribute to impaired wound healing.

Maureane Hoffman's clinical specialty is blood banking. In the blood banking field, platelets are collected from normal donors, and the platelet concentrates have a very short shelf life. If a platelet alternative could be pulled off the shelf and given to patients, that would be a great advance in the blood banking field.

Although researchers have been interested in developing synthetic platelets for at least twenty years, their strategies for doing so have changed profoundly over the years. According to Brown, the biomaterial and nanotechnology realm has recently experienced a boom of interest and research in using nano- and micro-particles to create completely synthetic platelets. Synthetic platelet development before that consisted of natural platelets that had been freeze-dried. The cells are no longer alive, but they still are able to exhibit some of the function of fresh, natural platelets in clotting.

In the last several years, however, researchers have begun to focus on adding a binding element to nanoparticles that allows researchers to mimic certain aspects of platelet behavior. Distinctively, the Duke-NC State team wants to mimic the mechanics of platelets, too. Unlike many other approaches, these particles are malleable, and allow the particles to mimic the shape and texture of natural platelets. •

From engineering comes a **doctor in the making**

FIRST-YEAR UNC MEDICAL STUDENT and Albert Schweitzer Fellow Vinayak Subramanian works with UNC REX cardiologist Dr. George Adams to improve the care of patients with peripheral artery disease, a condition that is not well understood.

Subramanian is quick to tell you all the things he doesn't know. He did, after all, just complete his first year as a UNC medical student. But spend a few minutes talking with him and it's clear that his humble nature belies an incredible list of accomplishments – multiple publications, patient engagement programs, a photo sharing app that can help patients and providers – and the promise of countless more.

He has the mind of an engineer, possessing the ability to not only diagnose problems but to conceptualize and then build the systems to solve them. A graduate of the Joint BME program, Subramanian could have put that mind to work developing innovative products and devices. Instead, he's choosing to practice medicine.

"With engineering, the intellectual component was there and it was stimulating and interesting, but I just didn't want to be that far away from the people who would benefit. It's all about the people," Subramanian said.

Since his time as an undergraduate at NC State, Subramanian has worked closely with Adams, who specializes in working with patients suffering from peripheral artery disease – a condition marked by the narrowing of the arteries that extend to the legs, as well as arms, stomach, and head. Many patients have been told amputation of a limb is likely. Adams works to find other solutions.

Vinayak Subramanian

Truly collaborative

The complexity of treating these patients has limited their options. There is just not a wealth of conventional guides on treating their advanced vascular disease.

Adams is a leader in the field, and working closely with him has allowed Subramanian to learn on the leading edge of the discipline. Adams also serves as a model for the career he'd like to build.

"I always thought that innovation, clinical care, and education were different silos, and you picked one of those three to focus on. Dr. Adams has shown me the ways they all connect," Subramanian said.

And while Adams is definitely a mentor, he says the work with Subramanian is a true collaborative partnership.

"Vinayak has done exemplary work. He's really proactive and has the great ability to creatively design projects that help answer questions and solve problems important to patients," Adams said.

Two complementary projects fit that description.

Subramanian won an Albert Schweitzer Fellowship to support his efforts to help patients develop individualized exercise and smoking cessation plans.

It's common for physicians to advise 30 minutes of walking. But that can prove incredibly challenging for patients with peripheral artery disease.

Subramanian works with patients to log their activity, telling patients: if they can't get through 30 minutes, that's all right, do what you can, log it, and then work with the care team to come up with an individualized plan to meet that patient's needs.

Subramanian is also collaborating with a company in Raleigh on a project to deploy a photo sharing app – CarePics – that will allow providers to share photos to evaluate patients. The goal is to exchange information quickly, hopefully cutting down on appointments for patients who are often sent back and forth to multiple providers during the period of diagnosis and care. •

DEPARTMENT LAUNCHES CLOSED-LOOP ENGINEERING FOR **ADVANCED REHABILITATION**

THE BME DEPARTMENT is excited to announce the transformation of the former Rehabilitation Engineering Center into the Closed-Loop Engineering for Advanced Rehabilitation (CLEAR) core.

Administratively housed in the Joint BME Department, the core's vision is CLEAR:

BME envisions a center of excellence that investigates human-machine interactions; develops advanced wearable, rehabilitation technologies; and enables seamless integration and co-adaptation of rehabilitation machines and humans to assist and augment physical abilities, performance, and experiences in individuals with disabilities.

The department will fulfill this vision with:

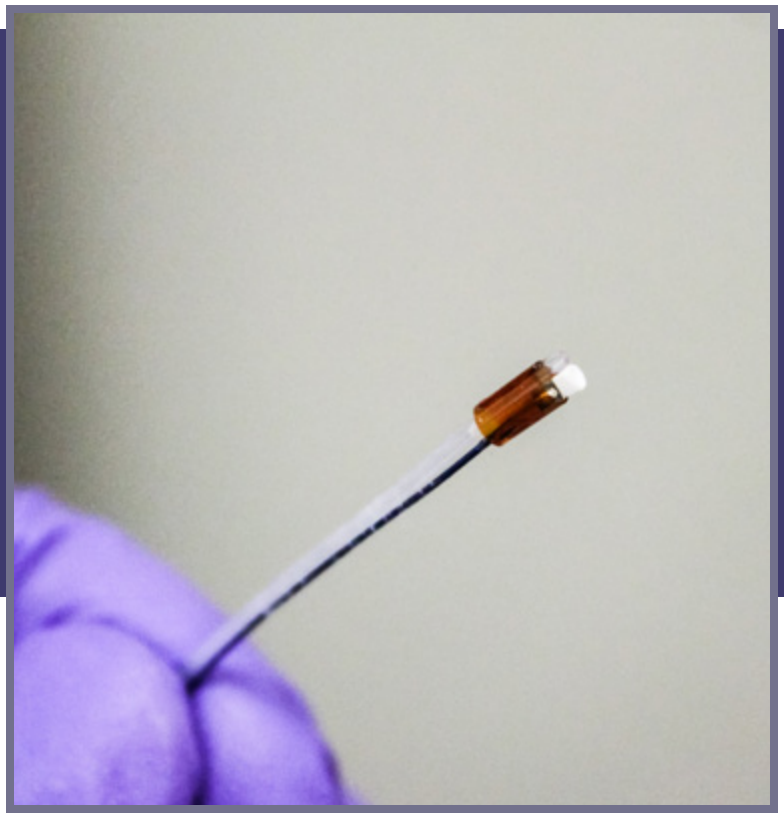
- well-coordinated, interdisciplinary research
- training for the next generation of rehabilitation engineers
- effective knowledge translation and technology transfer

To fulfill its mission, CLEAR will focus on three overlapping foci: 1) Mechanics, 2) Control and Learning, and 3) Perception and Cognition. The interaction of these foci will allow for unprecedented advances in human-machine symbiosis to improve the lives of individuals with disabilities.

CLEAR represents a unique opportunity to make significant advances in the field of engineering for advancing rehabilitation. Of note, its applications close the loop between human and machine with novel sensing agents, control algorithms and actuation. Applications are made to both the human and machine, recognizing the need to create a seamless integration such that the machine responds appropriately to the human, while the human moves with the machine in a state of true embodiment.

The leadership of CLEAR recognizes that the required growth of these relevant research priorities is critical to meet the stated vision. Effective growth will be accomplished by integrating outstanding research programs across CLEAR investigators, training the next generation of innovative thinkers, and transitioning novel advances to the communities that need them.

You can find out more about the new CLEAR core at **www.clear-ncsu-unc.com**. •



NEW ULTRASOUND 'DRILL' *TARGETS DEEP VEIN BLOOD CLOTS*

RESEARCHERS IN BME and other colleagues at North Carolina State University and the University of North Carolina at Chapel Hill have developed a new surgical tool that uses low-frequency intravascular ultrasound to break down blood clots that cause deep vein thrombosis. The tool is the first ultrasound "drill" that can be aimed straight ahead, allowing doctors to better target clots. Though to date the technology has been tested only in synthetic blood vessels, these preliminary results hold promise for significantly reducing treatment time.

Existing intravascular ultrasound tools for clearing clots emit ultrasound waves laterally. This makes it harder to target clots exclusively, meaning that the ultrasound can also damage surrounding blood vessels. However, ultrasound breaks the clots into very small pieces, so doctors don't need to use large doses of blood thinner to dissolve the clot remnants.

Another technique uses a diamond-tipped drill to effectively chew through clots. This is more targeted, posing less risk to blood vessels. However, this technique breaks the clot into relatively large pieces, requiring higher doses of blood-thinning drugs – which can pose risks of their own.

"Our new ultrasound tool is forward-facing, like a drill, but still breaks down clots into very fine particles," says Xiaoning Jiang, a professor of mechanical and aerospace engineering at NC State and corresponding author of a paper describing the work. "Our approach improves accuracy without relying on high doses of blood thinners, which we hope will reduce risks across the board."

The tool also incorporates an injection tube that allows users to inject microbubbles at the site of the clot, making the ultrasound waves more effective at breaking down the clot.

The researchers tested a prototype of the device in a synthetic blood vessel using cow's blood.

"These results establish feasibility, and we are now working on acquiring follow-on support to move into animal model trials," says co-author Dr. Paul Dayton, professor in BME.

The researchers have filed a patent on the technology and are interested in working with industry partners to help develop the device.

The paper, "Intravascular forward-looking ultrasound transducers for microbubble-mediated sonothrombolysis," is published in the Nature Publishing Group journal *Scientific Reports*. Paper co-authors include Wei-Yi Chang of NC State; Brooks Lindsey and Paul Dayton of BME; and Xuming Dai and Joseph Stavas of UNC. •

FACULTY NEWS

Smart insulin patch featured in *U.S. News & World Report*

Dr. Zhen Gu

A "smart" insulin patch developed by Dr. Zhen Gu, associate professor in the department, has made the headlines again - this time, in *U.S. News & World Report*.

According to the article, clinical experts in the diabetes space are hopeful that this user-friendly drug delivery system will reduce side effects of current insulin therapy techniques, including hypoglycemia. The patch is also expected to reduce dosing errors, as it senses and automatically releases the correct amount of insulin needed.

You can read more at **bit.ly/2yNZZIq**.

Diekman receives grant to study mechanisms of aging

BME faculty member Dr. Brian Diekman has received a $100,000 grant from the American Foundation for Aging Research (AFAR)/Arthritis National Research Foundation (ANRF) to study the mechanisms of aging in relation to osteoarthritis.

Although the greatest risk factor for osteoarthritis is aging, little is known about how age-related changes ultimately cause the destruction of cartilage. "I want to answer this fundamental question by getting insight into the common mechanisms of aging across different tissue systems," Diekman said. "The search for disease-modifying drugs for osteoarthritis has been very challenging, and many patients have to withstand high levels of pain until the time is right for a total joint replacement."

Dr. Brian Diekman

The AFAR, a non-profit organization dedicated to advancing biomedical research on aging, and the ANRF, the only charity solely focused on funding arthritis research to cure arthritis, support this project and are hopeful that it will lead to better treatment and preventative measures for osteoarthritis patients.

BME spinout company raises $5.8 million for 'smart' insulin devices

A Research Triangle Park startup founded by Dr. Zhen Gu, associate professor in the department, has received a $5.8 million commitment to continue translation efforts of "smart" insulin devices.

The technology invented in Gu's lab could soon mean painless diabetes testing and insulin injections for the nearly 400 million people with diabetes worldwide.

The $5.8 million Zenomics, Inc. raised was from MicroPort Scientific Corporation, a biomedical device company that promotes the translation of Gu's patented smart insulin technology.

The microneedles – hundreds of which fit onto the coin-sized patch or other smart device platform – feature

microscopic storage units for insulin and glucose-sensing components, Gu explained. When blood sugar levels get too high, the microneedles automatically release insulin, combining the testing with the insulin injection in a pain-free and perfectly timed manner that requires little to no effort by the person wearing the device.

"If this translates successfully, this technology will enhance the health of patients with diabetes and improve their lives," Gu said. "The technology is painless and it also lessens human error, so that you receive a more accurate blood-sugar controlling."

With this round of investment funding, Zenomics, Inc., which Gu cofounded in September 2015, will continue furthering this technology, while also recruiting employees to staff its labs. Additional testing will be on large animal models. If the technology were to be effective and efficacious in large animals, clinical trials in humans could follow.

Anti-obesity therapy is new target for microneedle patch

The microneedle patch developed by Dr. Zhen Gu, associate professor in the department, and his research team now has a new application: delivering fat-fighting therapies.

Gu, his team and study co-leader Li Qiang of Columbia University have created a patch-based method by which energy-storing white fat is transformed into energy-burning brown fat, therefore raising the body's overall metabolism. Although the anti-obesity patch has not been tested on humans yet, it has delivered promising results during the animal testing phase: overweight mice with the therapy-laden patch applied saw a 20 percent reduction in fat at the treated site. The patch, therefore, could have fantastic implications for fighting obesity and other metabolic-related disorders.

The study, titled "Locally-Induced Adipose Tissue Browning by Microneedle Patch for Obesity Treatment," is available to read at *ACS Nano* at **pubs.acs.org/doi/abs/10.1021/acsnano.7b04348**.

Franz receives NIH award to study age-related mobility and balance

Dr. Jason Franz, assistant professor in BME, and his Applied Biomechanics Laboratory have been awarded a National Institutes of Health (NIH) grant to study walking balance control and risk of falls in the elderly.

The project will continue to support their ongoing collaboration with Drs. Erik Wikstrom (Department of Exercise and Sport Science at UNC-Chapel Hill) and Prue Plummer (Department of Physical Therapy at UNC-Chapel Hill) as they continue toward new and more effective ways to detect and mitigate falls risk.

Dr. Jason Franz

Read more about the study at **abl.bme.unc.edu/?p=790**.

Jason Franz receives National MS Society Research Grant

BME faculty member Dr. Jason Franz, in collaboration with UNC Healthcare and researchers at the University of Illinois at Urbana-Champaign, has been awarded a research grant from the National Multiple Sclerosis (MS) Society.

The project will leverage the BME Applied Biomechanics Lab's virtual reality infrastructure to quantify standing and walking balance control and response to balance perturbations in people with MS vs. age-matched controls. The project's long-term translational goal is to develop novel and more effective markers of balance and mobility impairment for the detection of disease onset and progression.

Faculty members named scientific teaching fellows of the National Academies

Drs. Xiaogang Hu, Jason Franz, and Devin Hubbard attended the Summer Institutes on Scientific Teaching, a program that trains educators to create inclusive, student-centered classrooms that engage students to learn - as scientists do - through active problem solving and discussion.

The Summer Institutes model the scientific teaching principles they teach. College and university faculty members, instructional staff and future faculty members are invited to develop teaching skills at multi-day workshops to transform the undergraduate STEM classroom. Summer Institutes draw on the expertise of both presenters and participants. Current research, active learning, assessment,

Drs. Devin Hubbard, Jason Franz, and Xiaogang Hu

and inclusive teaching are woven into the program, creating a forum to share ideas and develop innovative instructional materials to be implemented upon returning home.

Franz and Hu are assistant professors in BME. Hubbard is a lecturer in the department.

Ligler shares licensing, commercialization advice at Tech Transfer event

Dr. Frances Ligler, Lampe Distinguished Professor in the department, recently shared her intellectual property expertise with innovators and investors alike at an NC State Office of Technology Commercialization and New Ventures event.

Having more than 30 patents to her name, Ligler can easily be considered an expert – and her audience appreciated the tips and wisdom that she was able to share.

Learn more and watch a recording of the event at: **bit.ly/2zNytsS**.

NC State News features guest post by Fran Ligler

Dr. Fran Ligler, Lampe Distinguished Professor in the department, wrote a guest post for NC State News Services as part of its ongoing Research Matters series, in which NC State researchers address the value of science, technology, engineering and mathematics.

Her article, "Can Tiny Plumbing Fix Broken Hearts?," explores two biomedical projects that begin with a new technology but end with the body helping to heal itself. Using innovative biomedical products (often developed right here in the BME department), researchers have been able to use the individual's own cells to help both the heart and the knee repair itself after damage.

The key to success, Ligler argues, is an interdisciplinary team that includes scientists, engineers, medical professionals and financial supporters.

Read Ligler's post at **news.ncsu.edu/2017/06/tiny-plumbing-broken-hearts-2017**.

National Academy of Engineering re-elects Ligler to Governing Council

Dr. Frances Ligler, Lampe Distinguished Professor in the department, has been re-elected to serve as a Councillor for the National Academy of Engineering (NAE) Governing Council.

The new appointment will run for three years, during which time Ligler will continue to help steer the Academy, and the nation, into the future. The mission of the NAE is to advance the well-being of the nation by promoting a vibrant engineering profession and by marshalling the expertise and insights of eminent engineers to provide independent advice to the federal government on matters involving engineering and technology.

Dr. Frances Ligler honored at 2017 National Inventors Hall of Fame induction

Dr. Frances Ligler

Dr. Frances Ligler, Lampe Distinguished Professor in the department, attended the 2017 National Inventors Hall of Fame Induction Ceremony in Washington, D.C. in May, where she was honored as one of this year's inductees.

The National Inventors Hall of Fame recognized Ligler for her innovative application of emerging technologies in a variety of fields to make optical biosensors smaller, more versatile and more sophisticated. Thanks to her work conducted at the U.S. Naval Research Laboratory (NRL), biosensors have moved out of the lab and into use for food safety, disease diagnosis, pollution control and homeland security.

The induction included an Illumination Ceremony, where her name was added to a backlit wall of inventors who joined the Hall of Fame before her; a red carpet event; the ceremony, where she received her medal of achievement; and an Innovation Celebration. During the Ceremony, Ligler was introduced with a moving video about her background and scientific passion (view it at **youtu.be/-LXDx5OOfTE**).

Polacheck co-authors groundbreaking publication in *Nature*

Dr. Bill Polacheck

New BME faculty member Dr. Bill Polacheck and a team of Harvard scientists have discovered a new cell signaling pathway that is a promising target for drugs to treat a variety of conditions, including cancer and cardiovascular diseases.

The study, published this month in *Nature*, outlines how the well-known Notch protein is responsible for keeping blood vessels from becoming leaky. When blood flow is disrupted, as in surgical procedures or even strokes, blood vessels can begin to leak, which can cause a myriad of negative inflammatory responses. The researchers utilized a blood-vessel-on-a-chip model that allowed them to easily simulate and control the flow of blood through a vessel and evaluate the cells' responses. As a result, the team realized that adjusting the Notch protein affected the rate at which blood is able to leak through the outside of the vessel, which in turn meant that the protein regulates blood vessel leakage through a heretofore unknown secondary signaling pathway.

"In retrospect, we rolled the dice with this project, because by choosing to investigate Notch we were entering one of the most crowded research areas in biology. But our engineering-based approach let us study it in a new way, without the influence or bias of past work, which I think is what made us open-minded enough to observe and characterize this new, unexpected pathway," Polacheck said.

This discovery of a secondary Notch signaling pathway could have far-reaching effects on healthcare, one of which is the creation of safer, more effective cancer and cardiovascular therapeutics.

See more about the project and the team's investigators at **bit.ly/2AcpOTB**.

Cole awarded Junior Faculty Research Grant by American Society of Biomechanics

Dr. Jacque Cole, assistant professor in the department, is the 2017 recipient of the Junior Faculty Research Grant from the American Society of Biomechanics (ASB).

This grant is intended to be used to help generate pilot data and support early-career investigators. Cole's proposed project, "Changes in the Osteovascular Niche Following Ischemic Stroke in Mice," would expand our understanding of the functional, structural and cellular changes in osteovasculature that occur following stroke. ASB received nine applications, each of which were reviewed based on the significance of the problem, the scientific approach and the impact of the project on the candidate's research program.

Dr. Jacque Cole

Fisher, team published in *Journal of Orthopaedic Research*

Dr. Matthew Fisher

Dr. Matthew Fisher and a collaborative team including NC State and University of North Carolina at Chapel Hill scholars have been published in the *Journal of Orthopaedic Research*.

The article, "Orientation changes in the cruciate ligaments of the knee during skeletal growth: A porcine model," is available at **onlinelibrary.wiley.com/doi/10.1002/jor.23594/abstract**.

It outlines how pig knee joints can be used as a facsimile for human knee joints at all maturity levels in biomedical studies – a finding that could lead to a vast amount of knee, joint and gait-related research.

Stephanie Teeter wins University Award for Excellence

Stephanie Teeter, lab manager and 10-year veteran of the BME Department, received an NC State University Award for Excellence.

At a ceremony in June presided over by NC

From left, Dr. John Gilligan, Stephanie Teeter and Chancellor Randy Woodson.

State Chancellor Randy Woodson, Teeter was given the Award for Excellence in Public Service. Her selfless service record is impeccable: she has logged hundreds of hours on community projects, many of which are related to STEM education for children. The award made Teeter eligible to win a Governor's Award for Excellence, the highest honor that can be awarded to a state employee. She is also BME's first university-level Excellence Award winner.

Helen Huang selected as review board member for 2017 Delsys Prize

Dr. Helen Huang

Each year, the De Luca Foundation awards the Delsys Prize to a researcher who has illustrated an innovative use of electromyography. This year, the Foundation has asked Dr. Helen Huang to become part of the Delsys Review Board, the committee that ultimately chooses the prize recipient.

Huang's expertise in neural-machine interfaces for prostheses and human movement control makes her the perfect complement to the existing four review members. Established in 2003 by Professor Carlo De Luca, the Delsys Prize recognizes advancements in the understanding, techniques, or applications of the electromyographic signal.

Magness receives NIH grant to study gut cancers

Gut cancers are some of the least understood in the oncology world, something Dr. Scott Magness hopes to change in the near future.

Dr. Scott Magness

Magness, an associate professor in the department, and a dedicated research team have received funding from the National Institutes of Health (NIH) to develop novel approaches to studying and understanding these types of cancers. The ultimate goal of the project is to understand what causes gut tumors so the research team can develop models for testing new methods of diagnosis and treatment.

Learn more about the study at **unc.live/2yM608p**.

Allbritton receives Edward Kidder Graham Award

From left, Dr. Nancy Allbritton, Governor Roy Cooper and Dr. Leslie Parise

Dr. Nancy Allbritton, Kenan Distinguished Professor and Chair of Biomedical Engineering and Chemistry, was honored with the 2017 Edward Kidder Graham Award.

The Edward Kidder Graham Award was established in 2010 to recognize outstanding service by a member of the faculty of the University of North Carolina at Chapel Hill.

Upon nomination by any member of the general faculty, the recipient is recommended by the Committee on Honorary Degrees and Special Awards. The committee's recommendation is approved by the Faculty Council.

The award recalls President Graham's ambition "to make the campus co-extensive with the boundaries of the State," in the context of the University's modern mission to extend knowledge-based service world-wide.

Allbritton received the award on October 12, 2017 during University Day celebrations, which commemorate the laying of the cornerstone of Old East and the official founding of the university. •

STUDENT NEWS

Undergraduate team wins Engineering Education Award

Belltower Medical, from left, Thomas Wright, Hope Piercy, Andrew DiMeo, Brandon Regnerus, Joel Newton and Rizwan Dard.

Belltower Medical, an undergraduate team formed in Dr. Andrew DiMeo's BME Senior Design course, received a $7,500 Engineering Education award from the National Council of Examiners for Engineering and Surveying (NCEES) for their urinary catheter solution.

The award recognizes both outstanding solutions for engineering problems and college engineering programs for engaging their students in collaborative projects with licensed professional engineers. The brains behind the innovative catheter product are Rizwan Dard, Brandon Regnerus, Hope Piercy, Joel Newton and Thomas Wright.

The students developed an improved Foley urinary catheter. The team wanted to address issues with traditional urinary catheters that expose patients to higher rates of catheter-associated urinary tract infections.

The team was mentored by DiMeo, who regularly coaches his students to biomedical success.

BME student groups win first, third place in ASAIO Design Competition

BME's student-led groups continue to dominate in national and international medical device design competitions. In June, the ASAIO (formerly American Society for Artificial Internal Organs) held its annual conference and student design competition, inviting seven student groups to present their medical innovations for a chance to win funding. Out of the seven, two BME groups emerged as winners: BetterFlux Technologies, led by Jonathan Freund, won first place; and Belltower Medical, led by Rizwan Dard and Thomas Wright, came in third.

BetterFlux Technologies has designed a way to clear blockages in ventriculoperitoneal (VP) shunts using ferromagnetic fluid. The device is an attachment to current technology and does not require a physician to operate it; patients can clear and prevent blockages from the comfort of their own home. The team, comprised of Jon Freund, Emily Fawcett, Michael Lebhar, Michael Rogers, Laura Feinleib, Ansel Dow, Jerrel (Trey) Cobb and Kara Segerstrom, has shadowed and been mentored by physicians at Duke Hospital as well as industry giants such as Medtronic. The team has now tied for first in the i4 competition, won the ASAIO design competition, and were runners-up in the Innovate Carolina competition. BetterFlux has filed for a provisional patent for this patient-centered technology.

Belltower Medical has developed a safer urinary catheter that reduces infection rates in hospital patients. Currently, 40 percent of all hospital infections are a

direct result of urinary catheters, which ultimately costs hospitals between $5,000 and $20,000 per patient. The team's two-fold solution reduces some of the main causes of infection by limiting bacterial exposure both during and after insertion, and reduces the amount of residual volume in the bladder. By collaborating closely with clinicians, medical device design companies and urinary catheter manufacturers, they have been able to design clinically effective and marketable solutions. Belltower Medical's team members are Rizwan Dard, Brandon Regnerus, Hope Piercy, Joel Newton and Thomas Wright.

BME students receive NC State Undergraduate Research Grants

Vibhavari Vempala

Thomas "Jed" Doman

Two BME undergraduate students received NC State Undergraduate Research Grants for the 2017-2018 school year.

Vibhavari Vempala, a senior in Dr. Helen Huang's CLEAR lab, received the grant to continue her work on above-knee amputee trip recovery. Tripping is the number one cause of falls and amputees have higher incidence rates for fall-related injuries compared to other at-risk populations. Vempala will use her previously validated, well-controlled trip platform to conduct a study in which she will investigate above-knee amputees' response time (the time between a simulated trip and the onset of their muscle activity). Understanding how amputees recover from trips is important in order to develop more reliable trip-recovery strategies for prosthetics and rehabilitation.

Thomas "Jed" Doman, a senior in Dr. Helen Huang's CLEAR lab, received a grant to continue his work with upper-limb amputee training. Advanced prostheses can be controlled by upper-limb amputees' residual muscle activity with training, but current training via virtual reality is limited to 2D environments. Doman will test whether or not amputees can manipulate a virtual prosthesis in a novel, 3D virtual environment that offers better accuracy and precision than the traditional 2D virtual environment. A 3D virtual training environment is more realistic and comparable to the physical world, and it may allow upper-limb amputees greater control of their prosthesis.

Torres takes first place in EMBS Student Competition

Gabriela Torres

BME graduate student Gabriela Torres won first place in the Student Paper Competition during July's IEEE Engineering in Medicine and Biology Symposium (EMBS) held in JeJu, Korea.

The conference theme, "Smarter Technology for a Healthier World," was designed to allow for diverse topics of cutting-edge research in biomedical engineering, healthcare technology R&D, translational clinical research, technology transfer and entrepreneurship and biomedical engineering education. Torres competed against 14 other high-achieving students to take home the top prize for her paper, "Acceleration (VoA) for Noninvasive Characterization of Human Carotid Plaques in Vivo." •

ALUMNI & FRIENDS NEWS

Chris Giardina

BME graduate student awarded US patent

Chris Giardina, a fifth year BME graduate student and current UNC-Chapel Hill MD/Ph.D. candidate, has been awarded a US patent for a surgical tool relating to cataract surgery (US 9,700,458).

"I'm really proud to be a part of this BME department," Giardina said about his achievement. "I consider both Dr. Nancy Allbritton's and Dr. Fran Ligler's successes with innovation as major motivating factors which helped me get through the long and often difficult patent defense process. That they have produced so many patents adds to the profound respect I have for their careers and successes with both academia and innovation."

Industry Advisory Board member elected to National Academy of Engineering

BME Industry Advisory Board member Dr. George T. Ligler has been elected to the National Academy of Engineering (NAE).

An expert in complex, interdisciplinary systems engineering, he was inducted into the NAE section devoted to Special Fields and Interdisciplinary Engineering on October 8th "for leadership and engineering innovation in specifying and implementing complex computer-based systems for aviation and the US Census."

Dr. George T. Ligler

Ligler is a private consultant in Fuquay Varina, NC. He has extensive experience in information management and software and computer system engineering, having been a software/systems engineer and research manager at Texas Instruments (1976-1980), an engineering executive at Burroughs Corporation (1980-1982), a division president at the Aydin Corporation (1982-1984), a vice president at Computer Sciences Corporation (1984-1988), and proprietor at GTL Associates, a private consultancy that he founded in 1988 that has provided computer systems engineering consulting to more than 40 clients on three continents.

He has worked extensively at the national and international levels in the development and implementation of standards for aircraft communications, navigation and surveillance equipment. He has also provided pro bono services through four National Academies of Sciences, Engineering, and Medicine Panels and Committees as well as to Georgia Tech, aviation standards bodies and the U.S. Secretary of Commerce.

A Rhodes Scholar, he received his B.S. in mathematics from Furman University in 1971 and his M.S. and Ph.D. from Oxford University in 1973 and 1975, respectively.

Ligler enjoys helping faculty members and students with issues related to intellectual property and consulting contracts. •

DEPARTMENT NEWS

BME welcomes new development director

Laura Schranz

The department is pleased to announce that Laura Schranz has joined the UNC/NC State Joint Department of Biomedical Engineering this fall as the director of development.

Schranz most recently served as director of development for the New York Institute of Technology (NYIT), a private college with campuses on Long Island and in Manhattan.

Schranz came to NYIT from The Philanthropic Resource Group, Inc., where she served as the director of grants/government relations. Her many accomplishments at the Philanthropic Resource Group included being the account executive for a $19 million capital campaign.

Schranz received a master's degree in communication arts, public relations and advertising from the New York Institute of Technology and a bachelor's degree in social sciences from the State University of New York (SUNY) at Stony Brook. •

Please share your personal and professional milestones with us!

To submit an item for the newsletter, send your information to **jpodaly@unc.edu**. Be sure to include your name and class year.

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UNC/NC State Private Giving Opportunities

The UNC/NC State Joint Department of Biomedical Engineering seeks private investment to capitalize on the collegial and fertile inter-institutional environment between UNC-Chapel Hill and NC State to become the best BME department worldwide. Private gifts will enable the Department to make strategic investments to bring in and keep the best people, launch bold new research and academic programs, and seed a culture of innovation through state-of-the-art labs on both campuses. With this investment, UNC/NC State BME will expand three core Department-wide initiatives.

INITIATIVE 1: Be the world-renowned leader in research

We have created an unprecedented collaborative environment that promotes seamless exchange among engineers, clinicians and scientists.

PROMOTE COLLABORATION AND RESEARCH

To attract world-class scientists and engineers to North Carolina and expand our high-impact research and training programs, the Department seeks to add six endowed professorships (three at NC State and three at UNC). The Department will also showcase its research and faculty, the universities and the state by sponsoring an international scientific meeting (held in North Carolina), as well as a distinguished lecture series.

INITIATIVE 2: Recruit and educate exceptional students

BME is committed to educate a new generation of biomedical engineers expressly equipped to meet the complex yet vital societal challenges impacting the health of our nation.

INVEST IN EDUCATION AND ENTREPRENEURSHIP

To increase educational competitiveness, BME seeks funds to provide graduate and undergraduate fellowships and scholarships to students. Funds supporting our international exchange program will support our students to gain global experiences so that they are "market ready" upon graduation.

INITIATIVE 3: Translate technology into economic growth

Our goal, which permeates every function of BME, is to create and translate practical solutions to health care needs. Students are taught not only the skills of the life sciences and engineering, but are also provided with hands-on experience in interdisciplinary teamwork. Faculty members collaborate with companies and also start new ones.

Seed technology transfer

To enhance technology translation and speed the transition of new technologies to the marketplace, BME seeks funding to increase the department's capacity to move new product designs out of the laboratories and to encourage greater entrepreneurship among faculty and students. In addition, a new BME Innovation Fund will be endowed to fund new faculty members and student research projects, departmental initiatives including international conferences, student and faculty professional development and ongoing department-wide strategic planning.

For more information about these and other opportunities to invest in UNC/NC State BME's mission to unite engineering and medicine to improve lives, please contact Laura Schranz at **lschranz@unc.edu** or **919.962.6212**.