Collaboration

Sensors are adjusted on a cap worn by OU student Julia Tang. The imaging device measures brain function through EEG and oximetry.

for Hope

THE NEW OU SCHOOL OF BIOMEDICAL ENGINEERING BRINGS TOGETHER DISPARATE DISCIPLINES TO TEACH THE NEXT GENERATION HOW TO FIGHT DISEASE WITH ADVANCES IN TECHNOLOGY.

By April Wilkerson
Photos by Hugh Scott

What if brain imaging could help physicians diagnose Alzheimer's before a person begins having symptoms? What if regenerative tissue could help a person with a jaw disorder be free of debilitating pain? What if tiny nanotubes made the difference between killing cancer cells and harming nearby healthy cells?

What if?

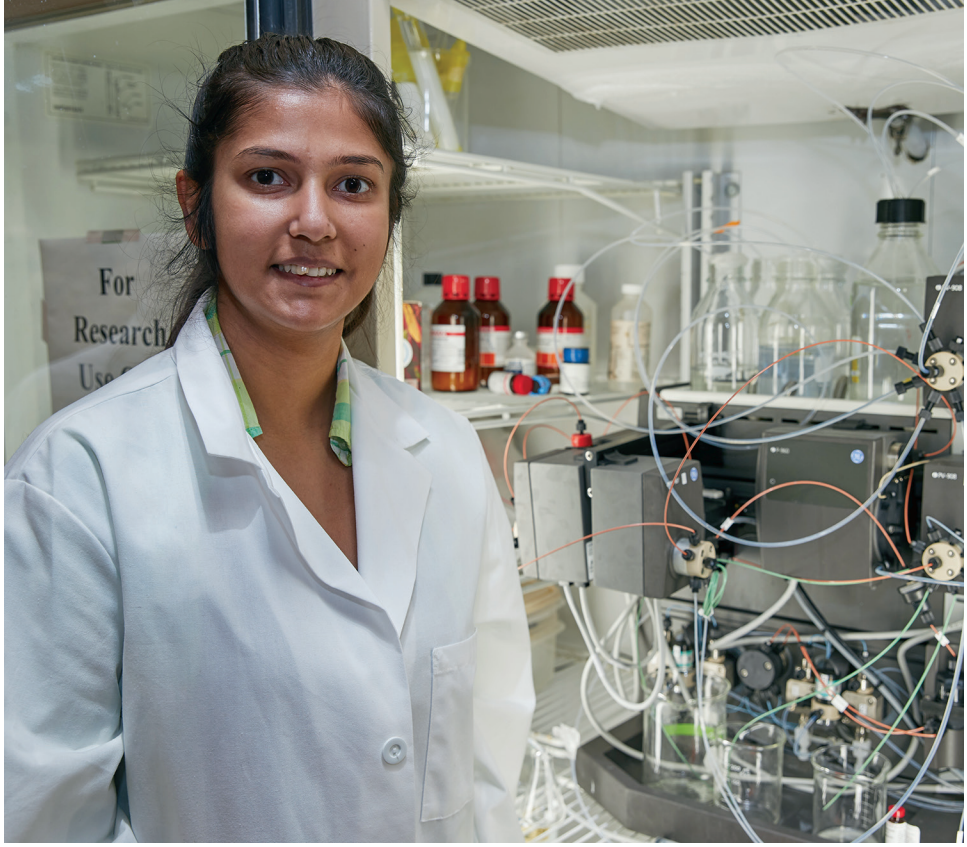
The people asking – and answering – those questions may be an unlikely pairing: clinicians, scientists and engineers. Professionals from seemingly disparate disciplines are collaborating in the name of a shared goal: to leverage engineering technology for better treatment of disease.

Through the new Peggy and Charles Stephenson School of Biomedical Engineering, the University of Oklahoma now offers a formal network to not only spark such partnerships, but also to educate future generations in that mindset. Launched in fall 2016, the school welcomes undergraduates who will earn degrees in biomedical engineering. Additional faculty are coming on board, including a new director, Michael Detamore, Ph.D., who is building a program certain to play a role in the future of health care and job creation.

"We have fantastic faculty members, all of whom are interested in inventing technology that can ultimately help physicians to diagnose or treat patients," Detamore says. "We also have a strong group of students who share a passion for health care and for making the world a better place."

Different languages, one goal

By their nature, people from engineering and medicine speak different professional languages and often approach a problem from separate vantage points. But those differences are at the heart of biomedical engineering. A physician may be thinking of a device that could improve her abil-



What looks like a maze of plastic tubes and wires is actually a chromatography machine that allows OU biomedical engineering doctoral student Needa Virani to separate proteins while researching cancer therapeutics and diagnostics.

ity to perform a surgery, and an engineer could provide details on potential materials and design. An engineer might be considering a better way to monitor a patient's disease progression, and a physician could give insight about how it might be possible in the clinic.

"We want to create the environment where both clinicians and engineers can initiate projects, and where they have the conduit to reach out to each other," Detamore says. "I like to call it 'serendipity by design' – creating opportunities for professionals to visit with each other and talk about possible collaborations."

One biomedical engineering faculty member who has made significant advances with her technology is Han Yuan. The first faculty member hired directly into the Stephenson School of Biomedical Engineering, Yuan brings a passion for utilizing medical technology and for teaching students to think in terms of "what if."

Yuan's research niche is in brain imaging, specifically the creation of a smaller, portable imaging device that could be used in outpatient settings to provide quality and quick images of the brain. Yuan has created a cap fitted with sensors that measure brain function in two ways – via electroencephalogram (EEG) and via high-density oximetry, similar to the finger oximetry test patients might experience in the hospital. She is testing the accuracy of the device as compared to functional MRI testing. The MRI, while accurate in its imaging, takes longer to provide results and is neither affordable for most nor broadly accessible to clinicians. Yuan envisions her device available in clinics to provide objective metrics. For example, physicians would still conduct behavior-based tests while considering a diagnosis of Alzheimer's disease, but that could be supplemented with a scan that confirmed the affected parts of the brain. She also is developing a computational algorithm that provides the ability to project the sensor measurement to activity inside the brain.

"This device is potentially transformative because it could provide an independent imaging metric for physicians, and it could be accessible for many different clinical environments and medical conditions where brain imaging is needed," Yuan says.

Yuan has worked with a variety of physicians and scientists who contribute the clinical and scientific insight she needs to refine her imaging techniques. She spent a year as a research fellow at the OU Health Sciences Center, working with a cardiothoracic surgeon who sought a device to better measure the blood flow of his patients during surgery. When the heart is on bypass, blood pressure is kept low to minimize bleeding, but that also contributes to less oxygen to the brain.

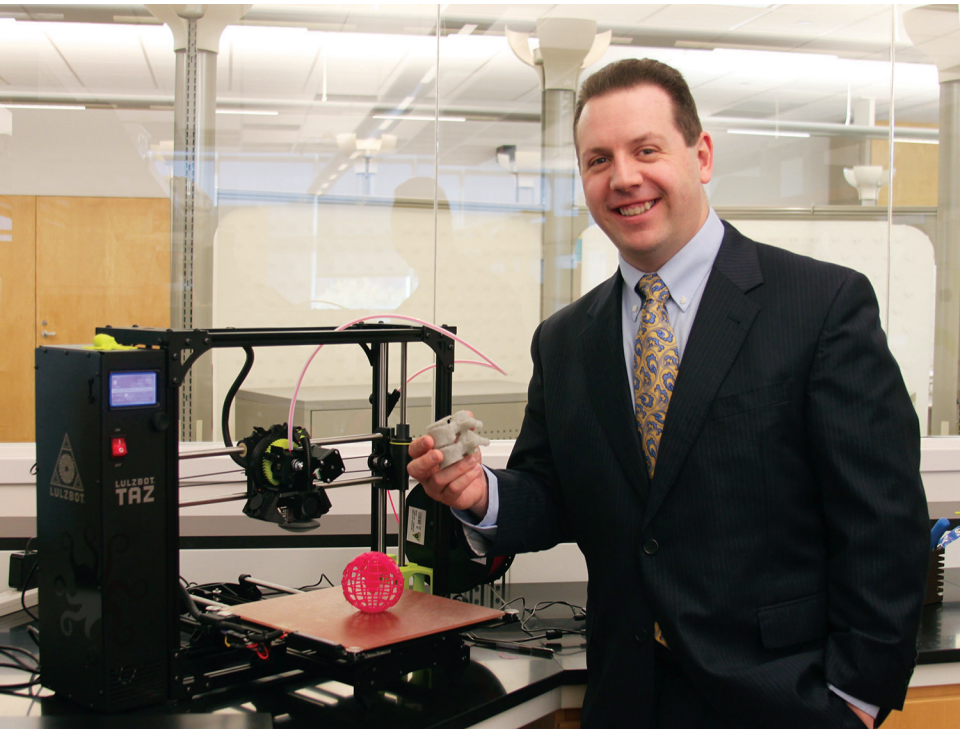
Since then, she has been working with geriatrics researchers at the OU Health Sciences Center and with a neurologist at the Laureate Institute for Brain Research in Tulsa, as well as several others who work in the fields of nursing and psychology.

Matchmaking

Since Detamore arrived, he's been seeking collaborations with professionals at the OU Health Sciences Center, as well as the Oklahoma Medical Research Foundation. He is doing the same on OU's Norman campus, interacting with people in biology, chemistry, biochemistry, physics and other disciplines. He is reaching out to people who can help with commercialization of technology, business planning and entrepreneurial activities. He is organizing a symposium for 2017 where many such professionals could meet and brainstorm.

Detamore also is making partnerships with Oklahoma's biosciences industry, including the creation of a Biosciences Industry Affiliates program.

"We want to engage regional industry with our faculty and students and be a pathway for students to obtain internships and permanent positions in the biosciences industry," he says.



As the inaugural director of OU's Stephenson School of Biomedical Engineering, Michael Detamore is leading the exploration of boundaries between invention and medical breakthrough – like his own work to develop artificial vertebrae that might be produced on 3-D printers.

"Oklahoma's biosciences industry represents a golden opportunity for our state to diversify its economy, and we believe our pipeline of talent can help with this."

The Stephenson School of Biomedical Engineering is developing a program called IBEST, the Institute of Biomedical Engineering Science and Technology, under the direction of faculty member Lei Ding. One of IBEST's goals is to award seed grants for clinicians and researchers who have an idea they would like to pursue. Such grants are crucial to gather data before applying for larger grants.

Tomorrow's Biomedical Engineers

The thread that runs through all such activities is the mission to educate future generations of biomedical engineers. The Gallogly College of Engineering previously offered a concentration in biomedical engineering for master's and doctoral students. Now they are joined by undergraduate students who will be steeped in the topic for four years. In addition to a curriculum that builds each year on the fundamentals of biomedical engineering, undergraduates will have the opportunity to work on projects under the supervision of a faculty member.

The freshman and sophomore classes are already full of bright students. Among the 56 enrolled, 25 percent are National Merit Scholars, 50 percent are honors students, and 60 percent are female. "That's a remarkable population of students to serve as our inaugural two classes," Detamore says.

Yuan, who teaches a course in biomedical engineering fundamentals, says she requires her students to identify biomedical problems, then work individually and in teams to devise potential solutions.

"I always challenge my students, but they end up surprising me," she says. "They come up with biomedical problems to address that I hadn't even realized; many of them carry interest from their early personal experiences. They are very motivated to make a difference in diverse areas."

Needa Virani, who is a doctoral student in biomedical engineering, researches cancer therapeutics and diagnostics using targeted nanotechnology. The principal investigator of her research project, Roger Harrison, is a faculty member in the Gallogly College of Engineering as well as the Stephenson School of Biomedical Engineering. Harrison and fellow faculty member Daniel Resasco, have made significant headway with development of a cancer therapy that targets specific cancer cells using single-walled carbon nanotubes that bind directly to the tumor, then are heated with near-infrared light.

Virani was drawn to that area as an undergraduate and to a field that she increasingly sees as having the ability to help patients with disease.

"Biomedical engineering is a critical field that helps to unite engineers with clinicians, which is a gap that has long been void of a mediator," she says.

Students and faculty in the school will soon have a new facility for their pursuits. Gallogly Hall, named for major OU supporters Janet and Jim Gallogly of Houston, will be constructed in the Engineering Quadrangle on the OU Norman campus and is planned for completion in 2019. The four-story building will house classroom and administration space, research labs for both undergraduate and graduate students, and a "maker space" with machinery often used in the field.

Yuan, who also supervises the work of master's and doctoral students in her research lab, says she expects her students will be among those who harness the field of biomedical engineering for great good.

"I am excited to help build this department and to teach our students, who are very intelligent," Yuan says. "I think biomedical engineering will be a driving force in new technology in the years to come, and I think it will help to improve the lives of people in Oklahoma and beyond."

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