LEHIGH UNIVERSITY | P.C. ROSSIN COLLEGE OF ENGINEERING AND APPLIED SCIENCE

In this issue:

Fall 2017 Newsletter

DEPARTMENT OF BIOENGINEERING | www.lehigh.edu/bioe/

Lehigh Bioengineering through the years

LAUNCHED UNDERGRADUATE PROGRAM
2002

GRANTED FIRST BACHELOR'S DEGREES
2006

LAUNCHED GRADUATE PROGRAM
2010

GRANTED FIRST MASTER'S DEGREES
2011

GRANTED FIRST DOCTORAL DEGREES
2014

CONVERSION TO DEPARTMENT OF BIOENGINEERING
2017

DEPARTMENT CHAIR'S MESSAGE

Welcome to the annual newsletter of the Lehigh University Department of Bioengineering! Those of you who have known us over the years will notice in this very statement the thrill of the major change and main item of news over this past year – we are now a new department in the Rossin College of Engineering at Lehigh.

On July 1, 2017, Lehigh announced the establishment of the new department[1]. It recognizes the growth and development of Bioengineering at Lehigh since it was initiated as an interdisciplinary program in 2002. It also recognizes the emergence of Bioengineering as the new "star" in the engineering firmament, as it were, with its own disciplinary basis and language, skills and methods. While we establish the department to lend a new level of recognition to the Bioengineering discipline, it remains the most collaborative and interdisciplinary faculty group on campus. Nearly all seventeen core members of the Bioengineering faculty have joint appointments, and we have an additional seventeen associated faculty members in other departments.

We have used the occasion to rededicate ourselves to research, scholarship, and our undergraduate and graduate education mission. I invite you to visit our new website www.lehigh.edu/bioe/, where we describe three major themes around which Lehigh Bioengineering research is organized: Biocomputations and Modeling, Diagnostics, Sensors, and Devices, and Materials and Therapies. This newsletter also features three stories highlighting ongoing faculty research, one in each area (Profs. Wonpil Im, Xuanhong Cheng, and Frank Zhang, respectively). To support our mission, Lehigh plans for continuing growth of Bioengineering. This year we have two active faculty searches, one in the area of Diagnostics, Sensors, and Devices, and the other in Biocomputations and Modeling. Additionally, Lehigh's President Simon recently announced a major new university growth initiative, its Path to Prominence, of which a critical component will be the establishment of a new College of Health[2]. The initiative involves significant growth in the undergraduate population, graduate students, and faculty; we expect Bioengineering to play a significant role in the development of the new college.

I invite you to read the rest of our news in detail in the following pages. In addition to faculty research spotlights, they include recent student and faculty accomplishments, and further description of our research themes and growth areas.

Anand Jagota
anj6@lehigh.edu
610-758-4396

[1]https://www1.lehigh.edu/news/lehigh-establishes-department-bioengineering
[2]https://www1.lehigh.edu/news/for-lehigh-a-path-to-prominence

A SILVER BUCKSHOT APPROACH

PATHOGEN DETECTION

Xuanhong Cheng focuses on challenges in point-of-care diagnostics.

Photo by Douglas Benedict
Academic Image | May 2016

A conversation with Xuanhong Cheng on her research is like talking to a multi-disciplinary artist. Cheng, an associate professor in the Departments of Bioengineering and Materials Science & Engineering at Lehigh whose work falls within the Diagnostics, Sensors and Devices research theme of the department, is developing new ways to detect pathogens in the field using portable devices. To do so, rather than looking for a silver bullet, she is taking what you might refer to as a silver buckshot approach. Using a creative combination of physical, chemical and optical methods, Cheng and her colleagues attack research obstacles from a variety of angles.

The demand for compact technology to analyze biological samples is urgent. For instance, determining viral load in HIV-positive patients is a routine monitoring task that is crucial to effective care, yet currently there is no point-of-care technology available. This often leads to delays in treatment or worse for patients in remote regions where HIV is most prevalent and even remote labs may be inaccessible.

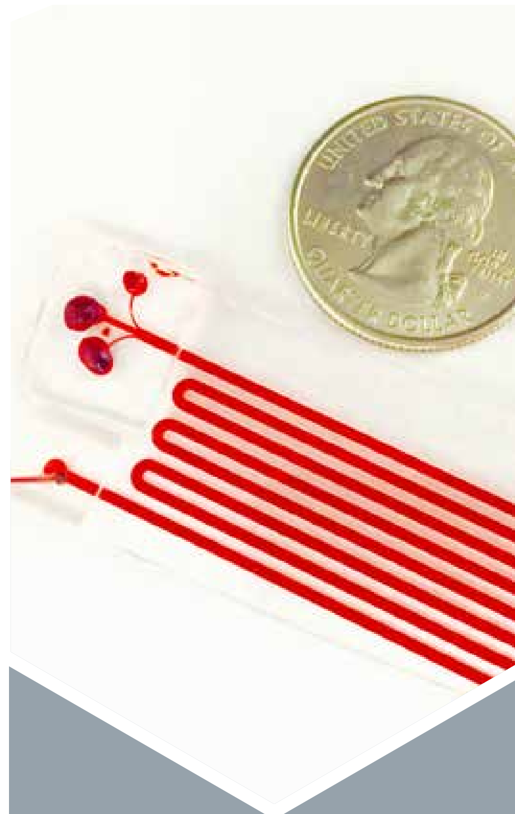
One of Cheng's current projects is a virus enrichment procedure that concentrates viruses found in trace amounts to enable point-of-need detection. Current practices of virus enrichment require either large centrifuges or high pressure filters, both of which require significant training to operate. Cheng is on the way to designing a portable, microfluidic device that can enrich the virus from small samples using a combination of a temperature field and a microstructured plate that disturbs the flow of the fluid across the plate. "The physical obstruction of the microstructures interrupts laminar flow and creates a vortex," Cheng said. "When you couple that with an external temperature gradient you can drive the virus to one side of the channel, increasing their concentration." She is experimenting first with nanoparticles prior to testing the system with HIV. The apparatus is currently tabletop in scale, and able to process a few microliters of sample per minute. "All of this can be miniaturized, and we have verified that it works well with the nanoparticle surrogates," Cheng said. "We are now making sure that the virus will remain viable and not aggregate, so the downstream tasks necessary to analyze a sample won't be affected."

A second approach to point-of-care virus identification Cheng is exploring employs electrical sensors combined with a chemical filtering technique. A sample flows through a specially fabricated membrane designed to ensnare the virus. When electrical current is run across the membrane, the virus alters the current flow in proportion to its concentration.

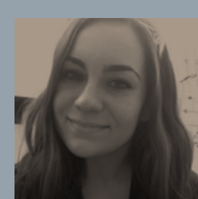
In a third project, Cheng is using optical techniques to quantify virus presence in a sample. Cheng runs a sample across a gold plate gridded with a micropattern. When the virus binds to the surface, it alters the electron vibration of the metal, and the concentration of the virus is correlated with a shift in the wavelength of the light. Since the light falls within the visible spectrum, the binding is evident to the naked eye, permitting immediate viral detection.

"WE ARE CREATING DIFFERENT COMPONENTS, AND ADDRESSING CHALLENGES IN POINT-OF-NEED DIAGNOSTICS—FROM SAMPLE PREPARATION TO TARGET DETECTION—IN PARALLEL, " CHENG SAID. "HOPEFULLY, THEY WILL ALL MEET DOWN THE ROAD."

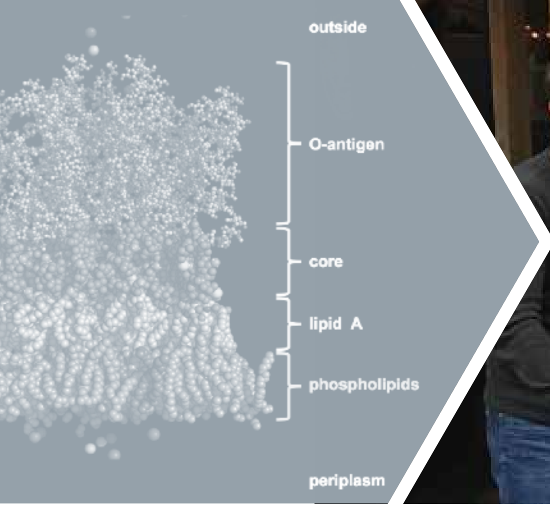
—Chris Quirk

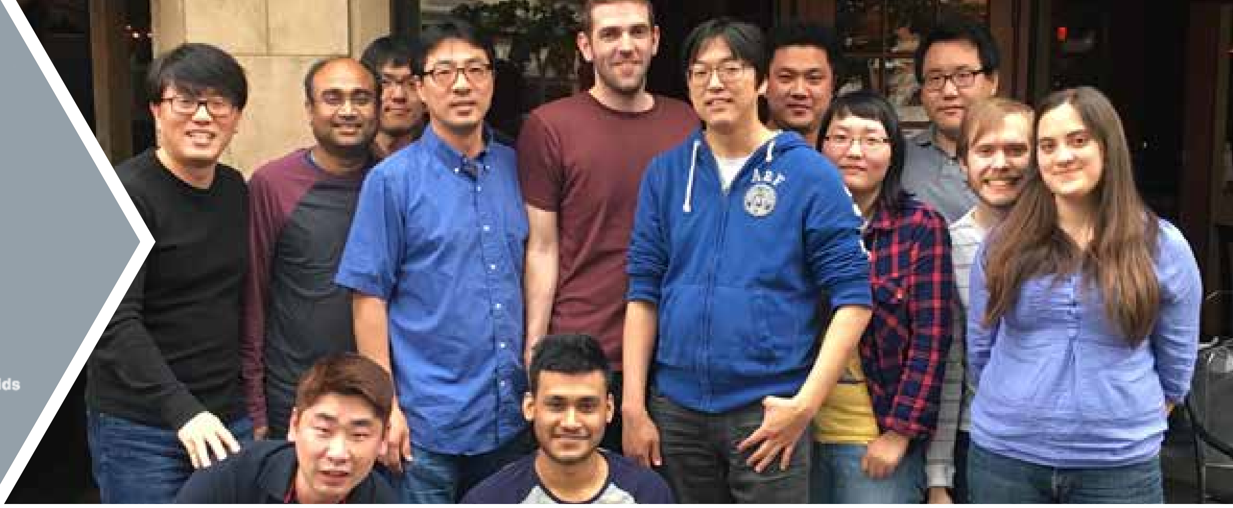


Welcome
NEW BIOENGINEERING FACULTY AND STAFF



Nicole Fortoul completed her PhD in Chemical Engineering with Anand Jagota in May, 2017, and will continue as a postdoctoral fellow in Jagota's research group.





THE RACE TO BATTLE SUPERBUGS

Wonpil Im's open-access models aid researchers around the world.

Last year, the Review on Antimicrobial Resistance, commissioned by then-UK prime minister David Cameron, began it's final report with a chilling statistic. The report forecast that by 2050 as many as 10 million lives a year could be lost to drug-resistant infections if methods were not developed to control the so-called "superbugs." Cameron himself, a pragmatist not prone to inflammatory rhetoric, said of the looming risk that, "If we fail to act, we are looking at an almost unthinkable scenario where antibiotics no longer work and we are cast back into the dark ages of medicine."

Wonpil Im, the Presidential Endowed Chair in Health - Science and Engineering at Lehigh and a professor in the Departments of Bioengineering and Biological Sciences, needs no convincing. Im has been working on the creation of models, using computational biophysics, of the complex outer layers of Gram-negative bacteria. Unlike Gram-positive bacteria, Gram-negatives—which are the progenitors of some nasty afflictions—have a double layer of protection (inner and outer membranes), making them more difficult to penetrate with antibiotics. "The key is that while we have antibiotics that can get through these outer membranes, in many cases we do not have a definitive understanding of how the antibiotics are achieving this," said Im. "What we are doing here is basic science, trying to better comprehend the dynamics and laws of how these cells function." Once the mechanisms of the molecular penetration of the membranes are better understood, researchers should be able to find antibiotics that can more effectively destroy these disease-causing agents.

In June, Im won a prestigious Friedrich Wilhelm Bessel Research Award from the Humboldt Foundation in Germany. In addition to a cash prize, Im will continue his work on modeling bacteria membranes and researching the mechanisms of molecular transport through those membranes in collaboration with scientists at Jacobs University in Bremen, Germany.

In a related project, Im and his colleagues have created a web-based graphical user interface called CHARMM-GUI (http://www.charmm-gui.org). The website is an open access tool, and is used by researchers to model molecular systems. It is expected to be especially helpful in the development of new classes of antibiotics, as CHARMM-GUI makes it possible to create simulations of complex bacterial components rapidly. "There have not been any new classes of antibiotics in 30 years," Im noted. "The bacteria have now evolved faster than our means to fight them." The CHARMM-GUI website has seen more than 25,000 visits a month on average this year, and the website tool has been cited in numerous papers. Im and his team have also received substantial funding from the National Science Foundation to maintain and improve CHARMM-GUI.

Im has just released the CHARMM-GUI Membrane Builder on the website, using lipopolysaccharides from various Gram-negative bacteria to build these complex outer membranes. Researchers around the globe may now use the membrane models.

"NOT EVERYONE HAS THE CAPACITY TO BUILD THESE KINDS OF MODELS," SAID IM. "THE HOPE IS THAT BY RELEASING THE MODELS PUBLICLY, IT WILL HELP OTHER RESEARCHERS IN THE RACE TO FIND DRUGS TO FIGHT THESE SUPERBUGS."

—Chris Quirk

SENSE OF PURPOSE

Frank Zhang's research into mechanosensing goes to the heart of cardiovascular function.

Photo by Douglas Benedict
Academic Image | May 2016

It's a process fundamental to survival: If you injure yourself, a clot forms to stanch any bleeding. Likewise, if a blood vessel heals or was never damaged, blood becomes or remains relatively thin. Yet the basic biomechanics of this process have been poorly understood. Too much clotting can form a blockage and lead to problems like stroke. Too much thinning can lead to uncontrolled bleeding. What determines when blood clots and when it thins?

Such questions have guided much of Xiaohui (Frank) Zhang's research. An assistant professor in the Departments of Bioengineering and Mechanical Engineering, Zhang is fascinated by a multifactorial protein called the von Willebrand Factor (vWF). "The centerpiece of my research is mechanosensing—how cells and molecules sense and respond to mechanical stimuli," Zhang says. "The von Willebrand Factor is a flow sensor. But it's also functionally a clotting factor."

Understanding how biological elements can have multiple properties and functions can lead to insights that blend materials and therapies. Zhang's work with mechanosensing both in the clotting process and on the inner surface of blood vessels provides a foundation for potential therapies such as bioactive polymers and new targets for controlling cardiovascular disease.

In the case of blood clotting, when a blood vessel sustains damage, cell fragments called platelets glom onto the injury site to plug and seal the wound—a process that's been observed at the molecular level. But scientists didn't completely understand how platelets interact with blood flow and vWF to activate and adhere to a wound—processes that are tiny, transient and difficult to measure.

As part of their research, Zhang and colleagues have developed or refined technologies and applications such as single-molecule force spectroscopy and optical tweezers that allow researchers to observe and manipulate how vWF behaves when influenced by minuscule forces or flow at the micro or nanoscale. Flow is especially important in arteries. "Platelets need help from vWF because arterial flow is so fast that a platelet alone doesn't have the chemical bond strength to grab onto a wound and stop bleeding," Zhang says.

His research has revealed previously unknown biomechanical interactions between platelets and vWF. The interactions explain how vWF anchors to a wound and grabs platelets from blood, using the force of blood flow to unravel a chain-like structure between platelet and vWF that facilitates platelet aggregation.

On the flip side, Zhang has shown how vWF deactivates when it's no longer needed. As a built-in safety feature, a domain on the protein interacts with an enzyme that cuts the molecule in two and deactivates it. "This is a natural mechanism to prevent too much platelet aggregation," Zhang says. Understanding this mechanism may lead to drugs that treat a group of genetic coagulation disorders called von Willebrand diseases.

Zhang is also investigating mechanisms that underlie mechanosensing and mechanotransduction in the endothelium, the layer of cells lining the walls of blood vessels. The project focuses on how a carbohydrate-rich layer called endothelial surface glycocalyx (ESG) senses blood flow and transduces the mechanical signal into production of nitric oxide—a potent vasodilator.

"IT'S A VERY IMPORTANT MECHANISM," ZHANG SAYS. "IF IT DOESN'T WORK PROPERLY YOU HAVE THE BEGINNING OF CARDIOVASCULAR DISEASE." BETTER UNDERSTANDING THE PROCESS COULD PROVIDE INSIGHTS ON PREVENTING OR TREATING THE TOP CAUSE OF DEATH IN THE UNITED STATES.

—Richard Laliberte

THE INTERFACE OF
TISSUE AND TECHNOLOGY

Becoming one of Lehigh's first Bioengineering doctoral graduates changed Antony Thomas' career path and advanced the field of biomimetics.

Antony Thomas started down a medical-school track during high school in India. "But I always loved engineering and came to feel I was not meant for med school," he says. "Bioengineering seemed a perfect marriage."

Still, when he came to Lehigh University as one of the first graduate-level students in Bioengineering, he didn't fully understand the discipline's breadth. "I thought of it more as electronics and instruments in hospitals," he says. "Seeing all the options on the tissue-culture side was very inspiring and eye-opening. The experience I gained at Lehigh changed my whole outlook and career."

His experience also contributed to important new applications of microfluidics—a rapidly growing, multidisciplinary field involving the precise observation, control and manipulation of fluids at the micro or nanoscale.

Working in the lab of Yaling Liu, associate professor in Lehigh's Departments of Bioengineering and Mechanical Engineering, Thomas explored ways to create synthetic platforms that replicate biological functions so they can be studied in controlled lab settings outside the body. "In vivo research is complex, difficult to control and expensive," Thomas says. "Yet traditional cell culture is limited in its biological relevance because when you isolate a cell outside of its native environment, it changes and loses functionality. So we were interested in creating in vitro biomimetic platforms."

Microfluidic systems allowed Thomas, Liu and colleagues to create micron-size channels using organic polymers. These could be molded into different shapes and sizes to mimic bodily systems such as blood vessels. "The whole microfluidic system is more in vivo-like," Thomas says.

One line of research in which Thomas participated entailed populating microfluidic channels with enthothelial cells, which line the inner surface of blood vessels and interact with a variety of forces and molecules. The presence of an intercellular adhesion molecule called ICAM-1 indicates inflammation and disease. Studying the dynamics of ICAM-1 on endothelial cells in disease-like conditions allowed the team to gain real-time insights into the inflammation process and how it's affected by elements such as fluid flow and nanoparticles coated with ICAM-1 antibodies. The research furthers understanding of chronic inflammation, which plays a key role in a variety of major diseases, including cardiovascular disease.

Thomas and colleagues also have applied lab-on-a-chip biomimetic techniques to other areas of research. One line of study has tested the effectiveness of drugs that bind with specific proteins on endothelial cells, helping to facilitate highly targeted therapies. In another project, Thomas worked with Liu to develop an inexpensive and simple biomimetic device that can detect circulating tumor cells in blood. Capturing tumor cells on a microfluidic pad coated with anti-epithelial cell adhesion molecules provides an early warning of cancer. "It's like a pregnancy test," Thomas says. "It doesn't tell you details on progress but will give you a yes-or-no answer."

After receiving his Ph.D. in Bioengineering at Lehigh in 2015, Thomas went on to apply what he learned in his role as senior scientist at Ionis Pharmaceuticals in Carlsbad, California, where he uses biomimetic models to screen candidate molecules for drug therapies.

"THE TRAINING AND BACKGROUND KNOWLEDGE I GAINED AT LEHIGH WERE VERY IMPORTANT PREPARATION FOR THE WORK I'M DOING ON CELL SYSTEMS NOW," THOMAS SAYS.

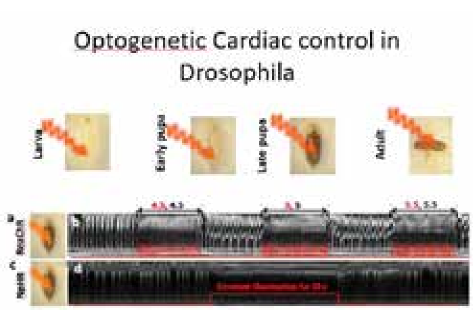
—Richard Laliberte

TURN ON YOUR HEARTLIGHT

Jing Men uses optogenetic strategies to control cardiac pacing.

As aging populations experience greater incidences of arrhythmia, more people than ever receive pacemakers each year. The American Heart Association estimates that about 600,000 people worldwide get them annually, and in 2017, global expenses for these electronic devices reached $15 billion.

Though they have been saving lives since the 1960s, pacemakers introduce lifelong consequences for patients. They must first undergo surgery, with all its accompanying potential risks and complications. For the rest of their lives, they must maintain the device's batteries and wires and face possible issues related to the strong magnetic fields of the device.

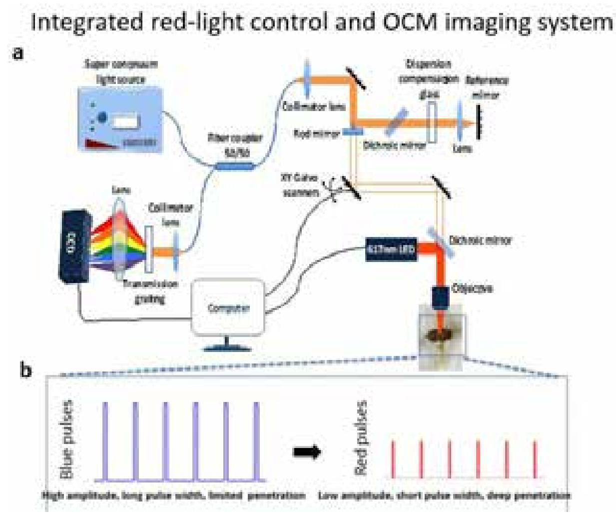


Optogenetic cardiac control could be the elegant next-generation answer to the bulky complexity of current technology. Jing Men, a PhD student in Bioengineering, has been exploring a method to control the hearts of fruit flies, *Drosophila melanogaster*, using red light pulses instead of electricity. Men found that the hearts of transgenic flies could be regulated using a novel noninvasive system that integrates red-light bursts with a precise imaging technique. Men can speed up, stop and restart a fly's heart on demand, at all life stages, including larva, pupa, and adult. She is able to manipulate *Drosophila* heart function using the excitatory opsin, ReaChR, and the inhibitory opsin, NpHR, light-sensitive proteins that form part of the retinylidene protein family.

Optogenetic cardiac control has been around since 2010, allowing unprecedented fine-tuning of targeted cells. "Compared with traditional methods, there are many advantages," Men says. "We can target the specific cardiac tissue non-invasively with low excitation power. Deeper penetration into cardiac tissue was achieved with red light, allowing for optical control of intact fly heart. We can excite activity in cells or inhibit cell function, and therefore regulate the heart. Though this method is still in the research phase, it's promising."

Compared to other animal models, the fruit fly possesses many research advantages, including a short life cycle of approximately 10 days, making experiments efficient and cost-effective. About 85 percent of the fruit fly's disease-related genes are analogs to human genes, and its genetic pathways and heart functions are similar to those of vertebrates. The fly heart is easy to observe with the Optical Coherence Microscopy (OCM) platform, a high resolution and high speed imaging system Lehigh develops for a number of research applications, including integrated biomedical devices for diagnostics and sensing.

OCM can provide images at the rapid rate of 128 frames per second with high axial and transverse optical sectioning capabilities. Living *Drosophila* hearts can be monitored noninvasively, using a



supercontinuum light source. "When we shine red light at a controlled frequency and amplitude, we find that we can cause the heart to contract with each pulse. The heartbeat follows the frequency of the excitation light pulse," Men says.

Men looked at heart cross sections and processed each image to visualize the beating frequency. She found that the heart beats with each pulse when red light is applied and normalizes when the light is removed. This type of optogenetic pacing in flies could eventually help human patients, Men hopes. "Eventually, we want to do experiments not just in flies, but also in other animal models, and at all ages, because as animals grow, their hearts change.

IT'S HELPFUL TO KNOW HOW WE COULD CONTROL HEART FUNCTION AT DIFFERENT DEVELOPMENTAL STAGES AND HOPEFULLY, DOWN THE ROAD DEVELOP NOVEL PACING STRATEGIES TO TREAT HUMAN HEART DISEASES," MEN SAYS.

—Manasee Wagh

GRANT SUCCESS

YALING LIU (**Bioengineering**/MEM) recently received funding for two projects. A five year grant from the National Institutes of Health funds a project on "Multiscale predictive modeling of blood cell damage with experimental verification" through 2021. A second project, "PFI: AIR technology translation: Evaluation of drug carrier delivery in a biomimetic microfluidic devices" runs through 2018 with support from the National Science Foundation

CHAO ZHOU (**Bioengineering**/ECE) received a grant from the National Science Foundation titled "Prototype development for wide-field optical coherence tomography angiography", which runs through 2018.

BRIAN BERGER (**Bioengineering**/CHBE), Damien Thevenin (Chemistry), and Kerney Glover (Chemistry) comprise an multi-disciplinary research group, recently awarded an MRI grant from the National Science Foundation for the upgrade of a 500 MHz nuclear magnetic resonance (NMR) spectrometer for biomolecular research at Lehigh. **BERGER** is also the PI on a second collaborative grant with coPI's Mark Snyder (CHBE), Steven McIntosh (CHBE) and Christopher Kiely (CHBE and MatSci & Eng), titled "Scalable Biomineralization of Functional Oxide Nanoparticles and Nanostructures for Environmental and Energy Applications," funded through 2021.

SVETLANA TATIC-LUCIC (**Bioengineering**/ECE), **LORI HERZ** (**Bioengineering**) and **SUSAN PERRY** (**Bioengineering**) were awarded a 2017 VentureWell Faculty Grant for "Building Innovation and Entrepreneurship into the First-Year Bioengineering Seminars."

2017 PUBLICATION SPOTLIGHT

Lehigh Bioengineering faculty members and Bioengineering students co-authored more than 40 publications that were accepted for publication in the last year. Some of the notable ones are listed below. (Names in **BOLD** are current Lehigh BioE faculty or current/former Lehigh BioE students)

Bondu, V., C. Wu, **W. CAO**, P. Simons, J. Gillette, J. Zhu, L. Erb, **X.F. ZHANG** and T. Buranda (2017). Low Affinity Binding in cis to P2Y2R Mediates Force-Dependent Integrin Activation During Hantavirus Infection. *Mol Biol Cell* in press PMID: 28835374, DOI: 10.1091/mbc.E17-01-0082)

BUCETA, J. (2017). Finite Cell-size Effects on Protein Variability in Turing Patterned Tissues. *J. Royal Soc Interface* **14** 20170316, DOI: 10.1098/rsif.2017.0316.

BUCETA J. and K. Johnson (2017). Modeling the Ebola Zoonotic Dynamics: Interplay Between Enviroclimatic Factors and Bat Ecology. *PLoS ONE* **12**(6): e0179559.

Dragovich, M., **K. GENEMARAS**, H. Dailey, **S. JEDLICKA** and **X. F. ZHANG** (2017). Dual Regulation of L-Selectin-Mediated Leukocyte Adhesion by Endothelial Surface Glycocalyx. *Cell Mol. Bioe*. **10**(1), 102-113. DOI: 10.1007/s12195-016-046306

Huang, Y., S. Wang, S. Kessel, I. Rubinoff, **Y. LIU**, P. Li, J. Qiu, L.-Y. Chan and **C. ZHOU** (2017). Optical Coherence Tomography Detects Necrotic Regions and Volumetrically Quantifies Multicellular Tumor Spheroids. *Cancer Research*, 10.1158/0008-5472.CAN-17-0821.

Ignatova, T., **S. CHANDRASEKAR**, M. Pirhbai, **S. JEDLICKA** and S. Rothkin (2017). Micro-Raman Spectroscopy as an Enabling Tool for Long-term Intracellular Studies of Nanomaterials at Nanomolar Concentration Levels. *J Mat Chem B*., **5**: 6536-6545.

Jo, S., X. Cheng, J. Lee, S. Kim, S-J. Park, D.S. Patel, A.H. Beaven, K.I. Lee, H. Rui, S. Park, H.S. Lee, B. Roux, A.D. MacKerell Jr, J.B. Klauda, Y. Qi, and **W. IM** (2017). CHARMM-GUI 10 Years for Biomolecular Modeling and Simulation. *J. Comput. Chem*. **38**:1114-1124.

Liu, J., Y. Saponjian, **M. MAHONEY**, K. Staley and **Y. BERDICHEVSKY** (2017). Epileptogenesis in Organotypic Hippocampal Cultures has Limited Dependence on Culture Medium Composition. *PLoS ONE* **12**(2): e0172677 DOI 10.1371/journal.pone.0172677.

Liu, T., N. Nadermann, Z. He, S. Strogatz, C.–Y. Hui and **A. JAGOTA** (2017). Spontaneous Droplet Motion on a Periodically Compliant Substrate. *Langmuir* **33**(20): 4942-4947.

Parmer, P. J.-P. St-Pierre, **L. CHOW**, C. Spicer, V. Stoichevska, Y. Peng, J. Werkmeister and J. Ramshaw (2017). Enhanced Articular Cartilage by Human Mesenchymal Stem Cells in Enzymatically Mediated Transient RGDS-Functionalized Collagen-Mimetic Hydrogels. *Acta Biomat.* **51**(15), 75-88.

D.S. Patel, Y. Qi, and **W. IM** (2017). Modeling and Simulation of Bacterial Outer Membranes and Interactions with Membrane Proteins. *Curr. Opin. Struct. Biol.* **43**:131-140.

Shankar, A., M. Zheng and **A. JAGOTA** (2017). Energetic Basis of Single Wall Carbon Nanotube Enantiomer Recognition by Single Stranded DNA. *J Phys Chem C.* **121**(32):17479-17487.

SHI, W., S. Wang, A. Maarouf, R. He, Y. Doruk, **Y. LIU** (2017). Magnetic Particles Assisted Capture and Release of Rare Tumor Cells using Wavy-herringbone Structured Microfluidic Devices, *Lab on a Chip*, in press, DOI: 10.1039/C7LC00333A

Surawanthanawises, K., **V. WIEDORN** and **X. CHENG** (2017). Micropatterned Macroporous Structures in Microfluidic Devices for Viral Separation from Whole Blood. *Analyst* DOI: 10.1039/C7AN00576H.

THOMAS, A., S. Wang, S. Sohrabi, **C. ORR**, R. He, **W. SHI** and **Y. LIU** (2017). Characterization of Vascular Permeability Using a Biomimetic Microfluidic Blood Vessel Model. *Biomicrofluidics* **11**(2), 024102. DOI: 10.1063/1.4977584.

Wan, S., H.C. Lee, X. Huang, T. Xu, T. Xu, X. Zeng, Z. Zhang, Y. Sheikine, J.L. Connolly, J.G. Fujimoto and **C. ZHOU** (2017). Integrated LBP Texture Features for Classification of Breast Tissue Imaged by Optical Coherence Microscopy. *Med Image Anal* **38**:104–116, 2017.

Yang, Z., L. Lu, C. Kiely, **B. BERGER** and S. McIntosh (2017). Single Enzyme Direct Biomineralization of CdSe and CdSe-CdS Core-Shell Quantum Dots. *ACS Applied Materials & Interfaces*, **9** (15), 13430-13439. DOI: 10.1021/acsami.7b00133.

ZHOU, C., Z. Cao, **J. FRASER**, A. Oztekin and **X. CHENG** (2017). Optimization of nanoparticle focusing by coupling thermophoresis and engineered vortex in a microfluidic channel. J. of Applied Phys **121**(2):024902. DOI: 10.1063/1.4973272.

FACULTY




NOTABLES AND MEDIA MENTIONS

WONPIL IM, the Presidential Endowed Chair in Health – Science and Engineering, received the prestigious Friedrich Wilhelm Bessel Research Award from the Alexander von Humboldt Foundation, which promotes collaboration between scientists from Germany and abroad. Award winners are honored for their outstanding and influential research efforts. Im, was also named a KIAS Scholar in Biophysics, by the Korea Institute for Advanced Study. Im joined the Faculty in the Departments of Bioengineering and Biological Science in August 2016.

ANAND JAGOTA was the recipient of the 2017 Eleanor and Joseph F. Libsch Research Award, recognizing faculty who are conducting distinguished research. Dr. Jagota, Chair, Bioengineering and Professor in the Departments of Bioengineering and Chemical and Biomolecular Engineering, is known internationally for his expertise in the area of adhesion, particularly biomolecules (for example DNA) and carbon nanotubes. His contributions are exceptional for their fundamental depth, interdisciplinary synthesis of concepts, and their ability to make an impact on real-life applications. Jagota was also named the 2017 Total Chair at ESPCI Paris, an internationally renowned research center in Paris, France.

SVETLANA TATIC-LUCIC, Professor of Bioengineering and Electrical and Computer Engineering has been named as the Associate Dean for Faculty Development in the P.C. Rossin College of Engineering.

CHAO ZHOU, Assistant Professor of Bioengineering and Electrical and Computer Engineering, was awarded the National Innovation Award at the 2017 TechConnect World Innovation Conference and National Innovation Summit.

GRADUATE





NEWS

Congratulations to our 2017 Bioengineering graduate degree recipients: **WENPENG CAO, MS '17** (Zhang lab), **BIXI KANG, MS '17** (Buceta Lab), **PENGHE WU, MS '17** (Zhou lab) and **ZIJIAN ZHANG, MS '17**.

NATHANAEL SALLADA and **SAJEDEH YAZDANPARAST TAFTI** were named Rossin Doctoral Fellows for the 2017-18 academic year. Sallada, a third-year student, and Yazdanparast Tafti a fourth year student in the Bioengineering doctoral program will take part in the special preparation for careers in academia and research provided by a gift from the late Peter C. Rossin '48.

Bioengineering graduate students, **CHRISTOPHER UHL**, **OLIVIA POSADAS** and **SWETHA CHANDRASEKAR** joined other Lehigh students to help promote STEM disciplines at the Pennsylvania Junior Academy of Science, Region 3, regional science fair competition for area junior and high school students. The students served as judges for the annual competition held at the Easton High School.

YANYAN CHEN (Buceta lab) recently attended the 11th Annual q-bio Conference, where she presented her work entitled "Stochastic Modeling of Bacterial Cell Size Control and Homeostasis."

ALUMNI UPDATE

YU SONG, PHD '16 (Berdichevsky Lab) now is a postdoctoral fellow in the Biofabrication Center of Tsinghua University in Beijing, China.

MEGAN CASEY BS' 11, MS '14 (Jedlicka Lab) is a Process Development Engineer II at Regeneron Pharmaceuticals. At Regeneron, she has the company of Lehigh alums, **AMY HOSKINSON BS'10**, **CAROLYN SCOTT, BS'10**, **BRIDGET NOLAN, BS'15**, **COLIN ORR, BS'15, MS'16**.

COLLEEN CURLEY, BS'11 (Biol), **MS'13** (Jedlicka lab) is currently a doctoral student in the Department of Biomedical Engineering at the University of Virginia, where she was the recipient of the 2016 Presidential Fellowship for Collaborative Neuroscience.

UNDERGRADUATE
STUDENT SUCCESS

Our undergraduate Bioengineering majors are scholars, athletes, musicians, leaders and much more. Their impact is felt on campus, in our local community and abroad, and we are very proud of their contributions!

The **UNDERGRADUATE BIOMEDICAL ENGINEERING SOCIETY** at Lehigh sponsored a Bioengineering Careers Alumni Panel event, featuring several Lehigh alumni who are currently employed in engineering positions at Catalent, ABEC and SJ Associates. BioE undergraduates had an opportunity to network with bioengineering professionals and to learn about the working environment in companies providing component, equipment and/or integrated solutions to the biopharmaceutical and biomedical device manufacturing industries. The student BMES chapter hopes to make this an annual career networking event on campus.

NICHOLAS HIRDT (BIOE), **CASSIE CHRISTMAN** (BIOE, Zhang lab), **SHANNON HAYES** (BIOE, Berger lab) and **RACHEL FAN** (IBE/BIOE, Chow lab) traveled to Minneapolis in October 2016 for the Biomedical Engineering Society Meeting. All presented their independent research work in the undergraduate research poster session, and all students in attendance took advantage of the opportunity to network with graduate program and corporate representatives.

EVAN ECKERSLEY (IBE/BIOE) was awarded the prestigious 2017 Bill Hardy Memorial Award. The award is presented to a senior who best reflects the qualities that typified Bill Hardy including personality, scholastic achievement and leadership qualities.

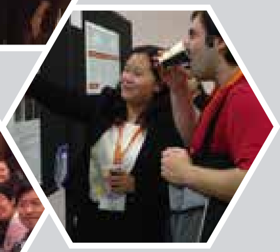
For the second year in a row, a Lehigh Bioengineering major was the 1st place winner at the 2016 David and Lorraine Freed Undergraduate Research Symposium. **SHANNON HAYES** (BIOE, '17) was awarded a $2000 travel award for her research titled "Inhibition of an RTX Toxin Using Small Receptor-Based Peptides" under the supervision of Prof. Angela Brown. Bioengineering students **EVAN ECKERSLEY**, **LIAM DOW** and **MEGAN KOZAR** also participated in the symposium.

YASMINA SIRGI was honored at the 2017 Student Life Leadership Awards Ceremony in May. Yasmina received a "Student Senate Leadership" award.

DIVYA PATEL and **KELLY SEIMS** have joined a prestigious group of women undergraduates of the P.C. Rossin College of Engineering by being named Clare Boothe Luce Scholars. Both are conducting advanced-level research in the lab of **PROF. LESLEY CHOW**.

Nine Bioengineering students were selected as 2017 Iacocca International Interns and participated in a variety of applied global learning experiences during the 2017 summer. Selected from a competitive field, **MARYAM KHAN**, **AMANDA STRATTON** spent ten weeks in Dublin, Ireland on individual, customized internships; **ANNE BEHRE**, **MICHAEL MCGOWAN** (IBE/BIOE) and **ANGELIKA WYZLIC** participated in biomedical research at the National University of Ireland in Galway; **KEVIN LY** worked as a Research and Data Analysis intern at UTP in Malaysia; **PREOM SARKAR** and **RACHEL FAN** interned at the Nagoya Institute of Technology in Japan; and **SYDNEY YANG** worked at 3M in Singapore.

MICHAEL WU, a 3rd year IBE/BIOE major spent the 2017 summer on a service trip to Antigua and Barbuda. He followed up with a volunteer experience at an elephant sanctuary in Thailand. In September, Michael represented Lehigh Bioengineering at the 2017 MedHacks event, a biotech and healthcare hackathon at Johns Hopkins University.







BIOENGINEERING RESEARCH
AT LEHIGH UNIVERSITY

Names in **BOLD** are Lehigh BioE core faculty.

BIOCOMPUTATIONS AND MODELING

Biomolecular Modeling
Bioinformatics
Bioengineering Systems & Controls
Biophysics
Modeling of Biological Systems
Computational Bioengineering
Data Analytics
Biomedical Image Analysis

Y. BERDICHEVSKY, **J. BUCETA**, B. Chen, **J. HSU**, X. Huang, **W. IM**, **A. JAGOTA**, M. Kotare, **Y. LIU**, D. Lopresti, J. Mittal, **D. OU-YANG**, D. Vavylonis, A. Voloshin

DIAGNOSTICS, SENSORS AND DEVICES

Biomedical Imaging
Biophotonics
BioMEMS
Biosensors
Microfluidics
Bioelectronics
Medical Devices

Y. BERDICHEVSKY, D. Brown, **J. BUCETA**, **X. CHENG**, H. Dailey, X. Huang, J. Hwang, **Y. LIU**, D. Lopresti, **L. LOWE-KRENTZ**, **D. OU-YANG**, **S. TATIC-LUCIC**, D. Vavylonis, D. Vezenov, **C. ZHOU**

MATERIALS AND THERAPIES

Biomaterials
Molecular Bioengineering
Biopharmaceutical Engineering
Cell & Tissue Engineering
Neuroengineering
Biofluid & Solid Mechanics
Biomolecular & Cellular Mechanics
Environmental Bioengineering

Y. BERDICHEVSKY, **B. BERGER**, A. Brown, D. Brown, **J. BUCETA**, **X. CHENG**, **L. CHOW**, H. Dailey, M. Falk, J. Hsu, **W. IM**, **A. JAGOTA**, **S. JEDLICKA**, H. Jain, **Y. LIU**, **D. OU-YANG**, K. Shultz, **S. TATIC-LUCIC**, D. Thevenin, D. Vezenov, A. Voloshin, **F. ZHANG**

Additional Bioengineering related research can be found in Industrial Systems Engineering **(https://ise.lehigh.edu)** *and Healthcare Systems Engineering* **(http://hse.lehigh.edu)**.

Department at a glance:

17
CORE FACULTY MEMBERS

17
ASSOCIATED FACULTY MEMBERS

7
POST-DOCTORAL SCIENTISTS

1
TECHNICAL &
1 ADMINISTRATIVE STAFF

15
PHD LEVEL GRADUATE STUDENTS

6
MS LEVEL GRADUATE STUDENTS

190
UNDERGRADUATE MAJORS IN 3 UNDERGRADUATE TRACKS

(Biopharmaceutical Engineering, Bioelectronics & Biophotonics, and Biomechanics & Biomaterials)

www.lehigh.edu/bioe/

LEHIGH UNIVERSITY | P.C. ROSSIN COLLEGE OF ENGINEERING AND APPLIED SCIENCE