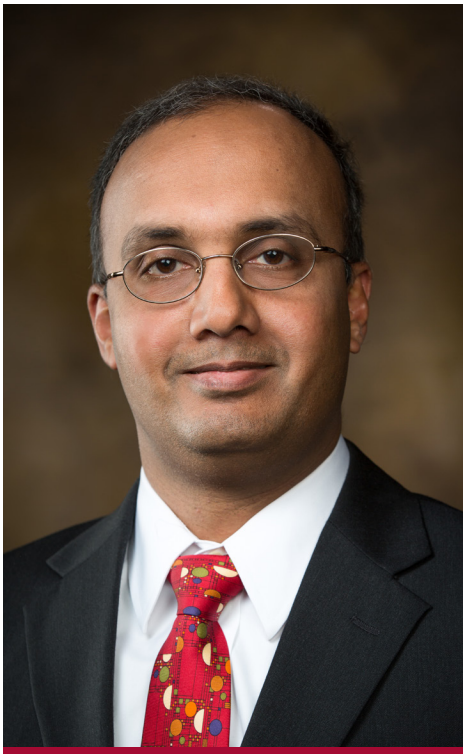
University of

ARKANSAS

2018 Department Newsletter

Biomedical Engineering

From the Department Head



Dr. Raj Rao

Dear Biomedical Engineering Alumni and Friends:

Greetings from Fayetteville! I am very pleased to share the developments in the department over the past year. Decision Day in March was a huge success with 79 first-year students signing up to earn their undergraduate degree in biomedical engineering! In the past year, our faculty members have received numerous grants and showcased at research conferences. We created a new partnership with University of Arkansas Medical Sciences, and are celebrating the launch of companies by our faculty and students. Our graduating seniors were recognized with numerous honors, and junior Olga Brazhkina was named a Goldwater Scholar. I also encourage you to read more about our ongoing research activities.

Ahead, I hope you'll read the stories and join me in recognizing the accomplishments of all our students and faculty. I'm looking forward to seeing what else we accomplish this year! The Department is also thankful for the scholarship support we have received so far and appreciate your continued support as we grow further. Please do not hesitate to call (479-575-8610), email (rajrao@uark.edu) or visit us. We would love to hear from you.

Best regards,
Raj Rao
Professor and Department Head

Biomedical Engineering Faculty and Students at the 2018 Picnic with the Professors, organized by EWH-UArk Chapter.

New Partnership with University of Arkansas Medical Sciences

Offering students real-world experience through clinical rotations

The Department of Biomedical Engineering partnered this semester with UAMS Northwest to develop a program focused on offering undergraduate students an opportunity to identify and implement real-world medical needs.

The program had 16 students in the inaugural course, coordinated by Hanna Jensen, research assistant professor. Students studying biomedical engineering who take the new course — BMEG 3801: Clinical Observations and Needs Finding — will participate in a clinical rotation in a medical facility, clinic or hospital. The course is currently open to juniors majoring in biomedical engineering and will be offered in both the spring and fall semesters.

Designed to introduce students to the technical, professional, and ethical responsibilities faced by a biomedical engineer in the context of engineering product design and development, the course will prepare students to subsequently engage in team-based capstone senior design projects they identify after completing a clinical rotation at UAMS.

"I feel this course will prepare us to work with people with special needs and at the same time, will serve us as biomedical engineers to have hands on experiences," said Alexandra Vega, a junior majoring in biomedical engineering. "Since we are given all these tools, it is a good chance to start applying this knowledge for other people and for ourselves."

In completing their projects, students had a chance to engage with the full scope of the engineering design process, and explore issues related to sustainability, bioethics, and health care economics. By the end of the course, students will be able to work successfully in a self-directed, project-focused team to develop a biomedical device or process design that addresses a real-world problem. They will also be prepared to select and complete a project in their senior capstone design course.

Clinical Observations and Needs Finding sudents present their capstone senior design project idea.

Clinical Observations and Needs Finding sudents present their capstone senior design project idea.

"We are excited about the partnership with UAMS as it provides our biomedical engineering students the opportunity to gain first-hand experience in what happens in clinical settings," said Raj Rao, professor and department head of biomedical engineering, who spearheaded the development of the course and the program. "Through active engagement with clinicians, patients and caregivers, the students will also research and validate unmet medical needs, invent novel health care technologies, and potentially translate their products or processes into patient care."

Graduate Student Successes

Nasya Sturdivant

Nasya Sturdivant is a doctoral student in biomedical engineering. She is presently at work building an effective synthetic blood-brain barrier that will help improve the treatment of traumatic brain injuries.

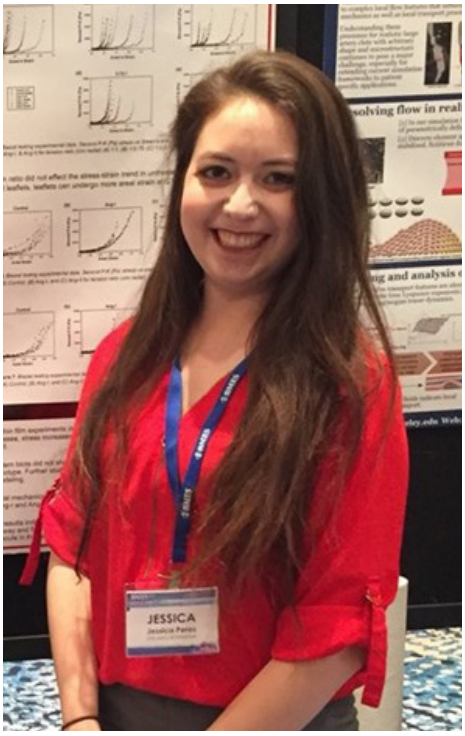
UArk BME: How will your research help to improve the treatment of traumatic brain injuries?

Sturdivant: It is my hope that my research project (the BBB-on-Chip) will one day be used as a tool to test the efficacy of potential pharmaceutical treatments to pass through the BBB and mitigate the secondary injuries of a traumatic brain injury (TBI), such as BBB breakdown, inflammation, swelling, and apoptosis.

UArk BME: What have been the greatest challenges in your research work?

Sturdivant: My greatest challenge has been the fabrication of an elastic porous membrane for my chip. The purpose of this membrane is to separate the astrocytes from the MvECs while still allowing for paracellular communication. The membrane needs to be thin, elastic (to withstand the high speed TBI stretch) and the pores need to be smaller than 5 microns (the cell size). Such a membrane is not commercially available so I have had to try many different methods and techniques to abricate such a membrane. I was able to overcome this challenge by employing photolithographic, soft lithographic, and spincoating techniques.

Jessica Perez

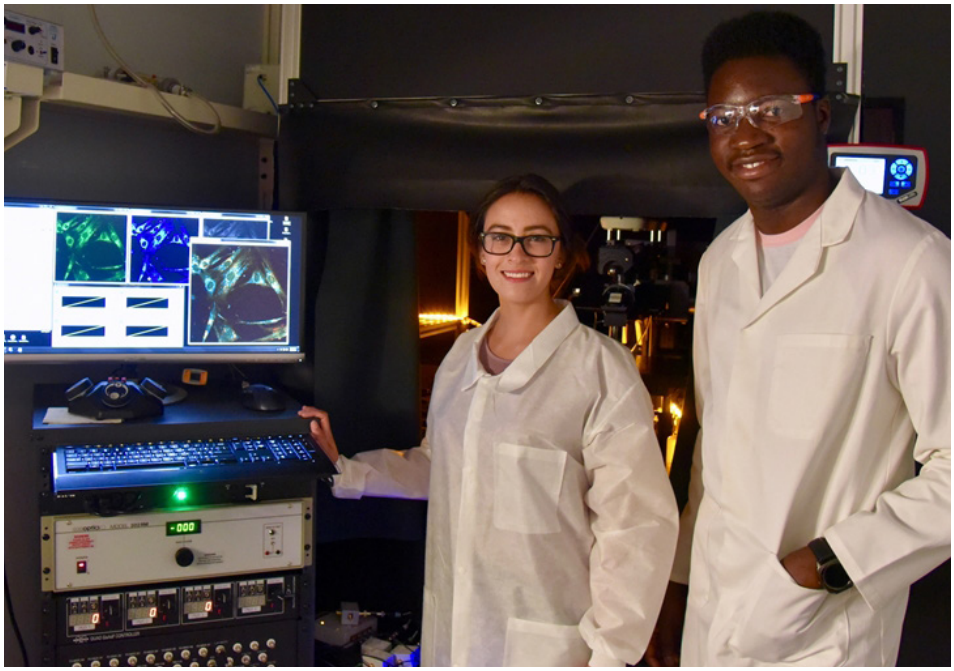


Master's student Jessica Perez was recently awarded a Diversity Travel Award to attend the 2018 World Congress of Biomechanics in Ireland.

Perez, a former Honors College Bodenhamer Fellow, was also selected as a finalist for the American Society of Mechanical Engineers Bioengineering Division in the M.S. Level Student Paper Competition in the category "Cardiovascular Biomechanics, Sport Biomechanics, Devices, and Emerging Areas." Perez's travel was also supported in part by a Master/Educational Specialist travel grant from the University of Arkansas Graduate School and International Education.

Her graduate research, overseen by associate professor Kartik Balachadran, focuses on investigating how the local renin-angiotensin signaling (RAS) pathway affects the mechanical function of the aortic valve at the cellular and whole-tissue levels, and their effects on cell phenotype to determine the role of RAS mediators on early calcific aortic valve disease initiation and progression. More than 5 million Americans are annually diagnosed with heart valve disease, of which 1.5 million people suffer of aortic stenosis (AS) in which calcific aortic valve disease (CAVD) is the most common cause. Successful completion of this project will result in the development of therapies for the treatment or prevention of CAVD, for which there currently is no drug-based treatment option.

Olivia Kolenc and Ajibola Bakare



Interdisciplinary collaboration is paying off for two University of Arkansas doctoral students. Biomedical Engineering student Olivia Kolenc and Cell and Molecular Biology student Ajibola Bakare each received recognition at conference presentations based on their collaborative research into mitochondrial disease.

The pair's research focuses on Leigh's Disease, a progressive neuromuscular disorder that usually becomes apparent in infancy or childhood. The disease affects the brain and muscles, and is characterized by progressive loss of mental functioning and movement. Depending on the severity of the defect, individuals often live anywhere from a few years to the mid-teens. Ultimately, they die from complications arising from abnormalities in mitochondrial energy production, resulting in respiratory or cardiac failure.

The prognosis for Leigh's disease is poor. There is an urgent need to better understand the disease in order to develop meaningful tools to diagnose it. The pair's research uses complementary approaches involving state-of-the-art advanced biochemical and imaging techniques to correlate the gene mutations to the abnormalities in mitochondrial energy production, using skin cells from Leigh's patients.

These studies could eventually help clinicians better diagnose mitochondrial disorders like Leigh's Syndrome, and develop drug testing guidelines to combat the disease.

In June, Kolenc received a travel award to present the findings at the 2nd Britton Chance International Symposium on Metabolic Imaging and Spectroscopy in Philadelphia. Bakare earned a "best poster" award when he presented the findings at the United Mitochondrial Disease Foundation Annual Symposium dedicated to Mitochondrial Medicine in Nashville. Both students also received funding from the University of Arkansas Graduate School and International Education to help make the trips possible.

Kolenc is mentored by Kyle Quinn, assistant professor of biomedical engineering. Bakare is mentored by Shilpa Iyer, assistant professor of biological sciences in the J. William Fulbright College of Arts and Sciences.

"Attending the Britton Chance Symposium was my first opportunity to meet other researchers in my field.Being exposed to their work in this way gave me new ideas for improving my own work and increased my drive to fill in gaps in the knowledge base that could advance metabolic imaging and its application in diagnostics, therapeutics and other scientific studies."
- Olivia Kolenc

Entrepreneurship

New biomedical company VIVAS LLC helps train clinicians and test medical equipment

Two University of Arkansas engineering professors and an engineering doctoral student have formed Vivas LLC, a new company with licensed technology that can be used to train clinicians in various procedures and test medical imaging equipment.

Vivas has partnered with Humimic Medical LLC, a Fort Smith company that produces medical gels for training, testing, and device development. These medical gels are clear or opaque models, made of synthetic gelatin, that accurately simulate human tissue.

The U of A researchers – Morten Jensen, associate professor of biomedical engineering; Jamie Hestekin, professor of chemical engineering; and Megan Laughlin, a doctoral student in biomedical engineering – used Humimic's medical gel to create a unique model with small interior channels that simulate human blood vessels. The researchers can pump fluid through these models to simulate blood flow.

Their technology addresses many clinical training problems–repeated needle sticks on patients by physicians and nurses, for example. Providing models for these practices ensures that equipment works properly and helps build confidence before performing procedures on humans. The medical staff can practice inserting syringe needles into the artificial blood vessels, and the correct positioning of a syringe needle in the blood vessel can be confirmed by the presence of blood-mimicking fluid that enters the syringe from the artificial vessel during the procedure.

The gel models also mimic human tissue in consistency and firmness. They can be transparent for demonstration purposes or opaque, like real tissue, with a variety of skin colors. When an ultrasound transducer is applied to the opaque gel, the ultrasound images appear the same as those taken on the human body. When blood-mimicking fluid is introduced, ultrasound images show multi-colored areas to indicate the presence of this fluid, just as an ultrasound detects blood flow in real human tissue.

"We use models of the human fluid flow system extensively in our cardiovascular biomechanics research laboratory," Jensen said. "This project was a natural byproduct of those efforts."

The researchers filed an invention disclosure in November 2017, and in January, the University of Arkansas Board of Trustees approved a license agreement for the new technology. Vivas and Humimic Medical started shipping the first products at the end of February.

Jensen said the companies have also received international orders, including national government health systems in Europe. "This industry partnership is already funding university research," said Hestekin. "It's our hope that it will also create high-tech jobs in Arkansas in the next couple of years."

The Office of Industry Engagement assisted with bringing all partners together with the university, and Startup Junkie, a Fayetteville consulting firm focused on innovation and entrepreneurship, provided guidance on company development and strategy.

Funding for the research leading to these technologies was made possible in part by the Arkansas Research Alliance.

The gel model created by Vivas and Humimic has small interior channels that simulate human blood vessels.

On launching a startup: Jared Greer, BSIE 2002, MBA 2009, MS BME 2018

Jared Greer, a former master's student in biomedical engineering, is currently launching Lapovations, a startup company designed to create novel technologies that contribute to safe and reliable laparoscopic surgeries.

Greer himself acts as CEO of the company, and works with several other partners: Chief Financial Officer Michael Dunavant, Chief Operating Office Ben McGuire, and Chief Marketing Officer Flavia Araujo, as well as a surgeon, a life sciences executive, and a venture capital general partner who advises the team. Said Greer, "We are looking at a number of potential improvement areas, but our initial focus is on exploring opportunities for improvement in the lifting of the abdominal wall using the closed insertion technique. Our initial target product is a patent pending device developed in part through my graduate research."

For Greer, who received his bachelor's degree in industrial engineering from the U of A in 2002 and his MBA from the Walton College of Business in 2009, Lapovations is a chance to combine his graduate research with his experience as medical sales rep. "Our surgeon partner has completed over 4,000 laparoscopic procedures and has identified a number of areas in need of improvement," he explained. "The BMEG department has allowed me to focus my research on developing products to address these needs. I have also been involved in medical sales for about 15 years in Northwest Arkansas which has provided me with a pretty good understanding of the complexities of developing and marketing products for healthcare related uses and how important it is to understand and address the needs of the various stakeholders involved."

To help launch the company, Greer also enrolled in the New Venture Development class taught by Dr. Carol Reeves, known to many as "The Coach" because of her success in helping so many student startups procure funding through business plan competitions. Since 2009, business teams mentored by Reeves have won over $2M in prize money and over 20 national business plan competitions, double that of any other university. Lapovations has been the most successful of all the business teams that have participated; to date, they've been awarded over $250,000 and taken top place in 10 national startup competitions.

Undergraduates

On Track and Field and Biomedical Engineering: A Q & A with senior Gabe Moore

UArk BME: As a BME major, what have been your favorite classes or labs so far?

Moore: I would say biomaterials and biomolecular engineering were my two favorite classes and labs. The subject matter was extremely interesting to me because it was all about solving problems and implementing solutions, while taking into consideration the body's response to them. It also helps that Dr. Kim is an awesome professor and works with her students well to ensure they have success and grasp the content.

UArk BME: You're also a highly successful student athlete. Can you tell us more about what you do as an athlete / which events you compete in?

Moore: I am a decathlete on the track team. I compete in 10 events throughout two days of competition. The first day I do the 100 meter dash, long jump, shot put, high jump, and 400 meter dash. The second day I do the 110 meter hurdles, discus throw, pole vault, javelin throw, and 1500 meter run. (All in that order.) It sounds like a lot of events, but it is actually super fun and really rewarding when I do well and see success on the track. I have been an All-American four times throughout my seasons here and I hope to have a great senior year this year!

UArk BME: Are there ways in which track and field and biomedical engineering complement one another? Does your work in one area ever help you in the other?

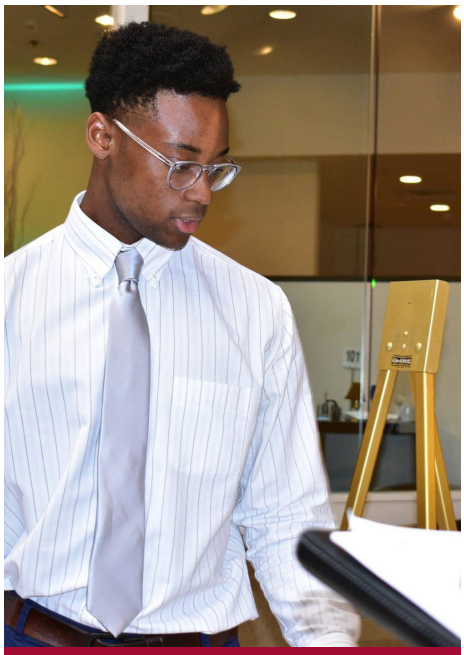
Moore: I think some aspects of track and field go hand-in-hand with engineering. The mechanics of the body and how force is applied is a huge part of track and field, along with angles of contact and posture. Also, I'm very interested in prostheses and one of my fellow athletes has artificial legs from the shin down to where his feet would be. I have been able to learn a great deal about his challenges and how his prostheses have played a role in his success, but also how they could be improved. Gaining insight into a personal situation involving one of my main interests has been amazing.

On the 2018 National Society of Black Engineers Conference: Kristianna Jones reports

Being an African American student in the STEM field, it's not very often that I meet people who look like me and have the same goals and aspirations as me. Well, at least not until you go to a NSBE conference. The National Society of Black Engineers (NSBE for short) hosts multiple regional conferences every year and this year, many University of Arkansas chapter members and myself had the privilege of attending the Region V Fall Regional Conference in Tulsa, OK. The Fall Regional Conference (FRC) was a 3-day conference full of workshops, speakers and even a career fair with a plethora of well-known companies such as Cerner, Google and General Motors!

The first day of the conference was filled with various workshops about topics ranging from studying abroad to how to strengthen your personal brand. A few of these workshops were hosted by current and former University of Arkansas students. As the chapter secretary, I was often asked to help assist with and coordinate the events that the chapter would be attending so I even got to help prepare a few workshops for the entire conference! It was rewarding to see how the work I put in helped better the conference experience for students I had never even met before.

Attending this conference was more than just all business all the time. There were also plenty of fun competitions such as NSBE Debaters, the Google Hackathon, and the elevator pitch competition. Even though I was on the University of Arkansas debate team who won the competition last year (2016), we decided to not participate again this year. However, we did have members of our chapter who did participate in competitions and our very own Chidubem Egbosimba, also a biomedical engineering student here at the U of A, won first place in the Technical Research Exhibition!



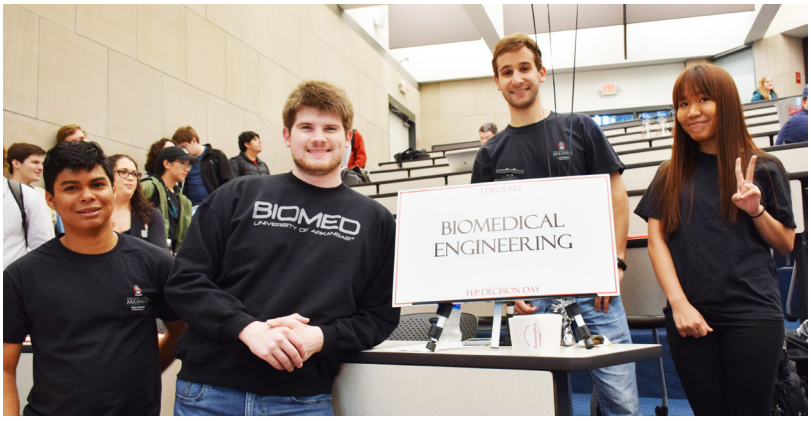
Chidubem Egbosimba surveys the poster of a competing graduate student as judges review and critique.

The UArk NSBE Chapter at the Region V Zone Meeting

My biggest takeaway was the chance to network with not only great companies, but also with other biomedical engineers just like me! It's always nice to know that even though I am sometimes struggling to figure out what I would like to do after graduation, there are other people in the same boat as me. Conferences such as this are always a great chance to look at and appreciate the bigger picture of what engineering is as a whole. It is so much more than difficult classes and long study hours. It is a community of people who truly want to utilize their skills and resources to make the world a better place. And if I got all of this from just the Regional Conference, I can't wait to see what the National Convention has in store for me!

Undergraduates

Decision Day 2018: Meet the new undergraduates who are #ProudToBME



See more photos online:

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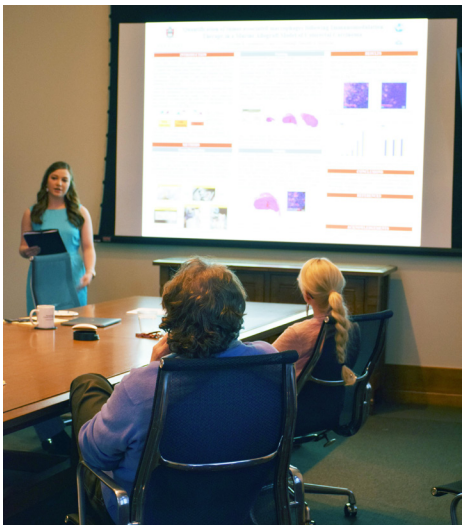
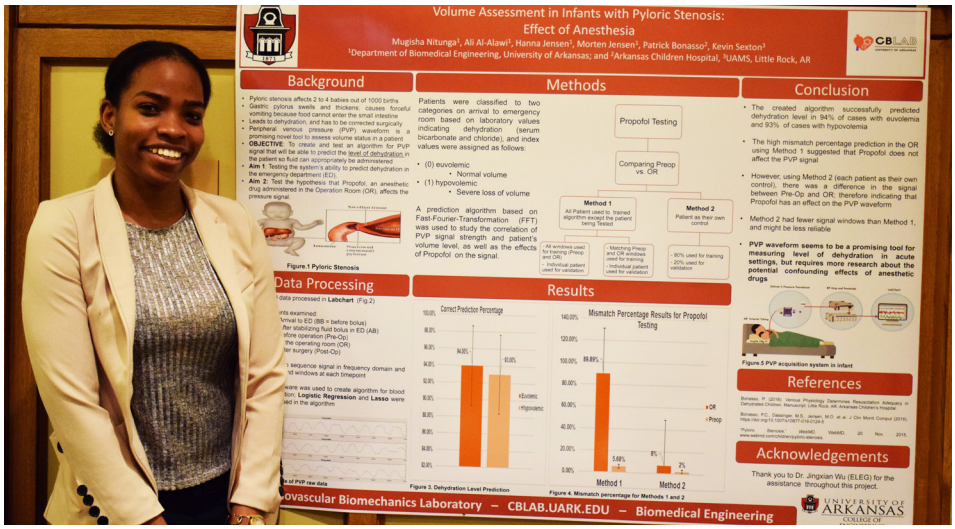
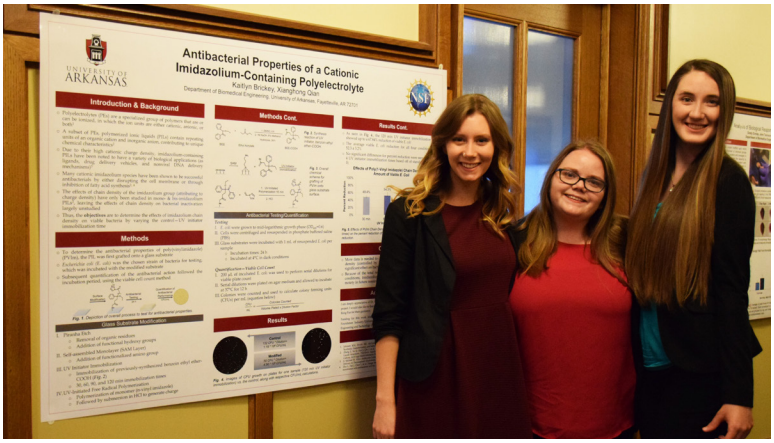
2018 Undergraduate Research Symposium: seniors present their research to faculty and peers





"The Symposium was created to reflect the style of presentations that students, post-docs, and faculty encounter at professional scientific meetings. Students are required to distill their experiences and results down to a single poster and brief presentation to communicate what is often a complex, multi-year project. This can take a lot of work and many revisions to get right."

- Tim Muldoon,
Associate Professor



UARK BMEG By the Numbers:

Fayetteville, AR
named one of the top

5

best U.S. cities to live in by
U.S. News and World Report

State of the Art Facilities

John A. White
Engineering Hall

Engineering
Research Center

Student Statistics

239

Undergraduate Students

40

Graduate Students

53%

Female

37%

Ethnic Minority

20%

First Generation
Undergraduate

86%*

Placement

* Self reported percentage of students graduating in the past two years who were employed as engineers or attending graduate school within three months of graduating.

Biomedical Enginering/
Engineering
Student Organizations:

5

Biomedical Engineering
Society

Engineering World
Health

Alpha Eta Mu Beta,
Natl. Biomedical
Engineering
Honors Society

Natl. Society of
Black Engineers

Society of
Women Engineers

Study Abroad Partnerships
designed for BMEG students

3

Aarhus University
Aarhus, Denmark

Universidad Carlos III
Madrid, Spain

University of Technology
Sydney, Australia

FY 2018
Research Awards

$2.3M

External Research
Expenditures

$196k per faculty

Research Areas

Biomechanics
and Mechanobiology

Biomaterials

Biomedical Optics
and Imaging

Cell and Tissue
Engineering

Molecular Engineering

41
Research Publications
in 2017-2018

10 Full-time Faculty

Funding Sources

BMEG faculty have recently
received research funding from:

American Heart
Association

Arkansas Biosciences
Institute

National Institutes
of Health

National Science
Foundation

U.S. Department of Defense

4
NSF CAREER Awardees
Balachandran, Muldoon, Qian, Rao

Lucrative fellowships
available to supplement
graduate stipends:

Doctoral Academy
Fellowship offers
an additional

$12,000

per year for four years

Distinguished
Doctoral Academy
Fellowship offers
an additional

$22,000

per year for four years

Current Students / Alumni Recent Awards

Olga Brazhkina, class of 2019
2018 Goldwater Scholar

Alex Khang, class of 2016
2017 NSF Grad Research Fellow

Paolo Garcia, class of 2018
2018 UArk Razorback Classic

New Faculty

Welcome Dr. Chris Nelson!

We are excited to welcome Dr. Christopher Nelson to the University of Arkansas Department of Biomedical Engineering. Dr. Nelson will join the department as an assistant professor in June 2019.

Dr. Nelson completed his Bachelor's Degree in Biological Engineering at the University of Arkansas, and his PhD from Vanderbilt University. Dr. Nelson is currently pursuing research at Duke University supported by The Hartwell Foundation Postdoctoral Fellowship and the prestigious NIH Pathway to Independence Award (K99/R00).

Dr. Nelson's primary research interests are in developing new technologies for therapeutic genome engineering. Previously, he has developed biomaterial-based platforms for drug and gene delivery including a nanoparticle for systemic siRNA administration (*ACS Nano* 2013) and a multifunctional scaffold for local gene silencing for regenerative medicine (*Advanced Materials* 2014).

More recently, he has applied a genomic engineering approach to treat the genetic basis of Duchenne muscular dystrophy in vivo (*Science* 2016). Dr. Nelson now plans to apply gene and drug delivery to genome engineering to create precision molecular therapies, study regenerative medicine, and interrogate gene function and regulation.

Dr. Christopher Nelson
Assistant Professor,
starting June 2019
PhD, Vanderbilt University
BS, University of Arkansas

Congratulations

Dr. Kartik Balachandran and Dr. Tim Muldoon both promoted to Associate Professor

Dr. Balachandran's Mechanobiology and Soft Materials Laboratory investigates the role of mechanical forces on physiology, function, and disease. In particular, Balachandran is interested in understanding the interaction between structure and mechanics in regulating biological responses at different length-scales. He and his lab team employ live cell imaging, cell/tissue mechanics, and tissue engineering techniques to focus on several cardiovascular bioengineering problems including cardiac valve calcification, valve fusion, and blood-brain barrier dysfunction. Balachandran is a recipient of the 2015 NSF CAREER Award.

Dr. Muldoon's research interests include multimodal microendoscopy, multiphoton imaging for gastrointestinal cancer, light sheet confocal microscopy, and whole blood analysis. He has authored 18 publications and over 35 conference papers to date, and has served as principal investigator on two National Institutes of Health research grants, including an Academic Research Enhancement Award (R15) from the National Cancer Institute for his work on developing multimodal endoscopic imaging and spectroscopy technologies. He was also recently awarded the 2018 NSF CAREER Award to develop a novel method of three-dimensional imaging via an endoscopic catheter.

University of

ARKANSAS

Biomedical Engineering

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