University of

ARKANSAS

2019 Department Newsletter

Biomedical Engineering

From the Department Head

Dr. Raj Rao

Dear Friends of UArk Biomedical Engineering:

Greetings from Fayetteville! In the heartland of America, we are expanding boundaries of research and education; and partnering with the Fulbright College of Arts and Sciences, Walton College of Business and multiple community partners in addressing unmet clinical needs with potential for broad impact in the region, the nation and the world. I am very pleased to share the developments in the department over the past year. Our faculty members have received numerous grants and showcased at research conferences. With two new awardees in 2019, we now have six faculty who have received NSF CAREER awards, clearly demonstrating our commitment to integration of research and education. Our students have received numerous accolades, and senior Samia Ismail was named a 2019 Truman Scholar. I also encourage you to read more about our recent research awards and 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 and in 2020! 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 2019 picnic with the professors, organized by EWH-UArk Chapter

Meet our Faculty

My lab investigates the role of mechanical forces on physiology, function and disease. We are interested in the interaction between structure and mechanics in regulating biological responses at different length-scales. We employ micro- and nano-fabrication tools to recreate the cellular and tissue environment in the laboratory via "organ-on-chip" platforms. We also utilize live imaging, cell/tissue mechanics and tissue engineering techniques to understand several cardiovascular bioengineering problems including cardiac valve calcification and blood-brain barrier dysfunction. Knowledge from these our work will guide the development of medical interventions and regenerative therapies.

Kartik Balachandran

Morten Jensen

My interdisciplinary lab bridges the clinical and engineering worlds with innovative approaches to solving critical problems. Using modalities such as ultrasound and MRI, combined with research techniques for measuring biomechanical parameters in soft tissue, the National Institutes of Health adopted these results for designing heart surgery repair devices. The lab employs both in vivo and in vitro techniques to deliver the best solutions for patients. Our team has more than 20 years of combined academic, clinical, and industry experience, providing the optimal balance of surgical technique and device development for cardiovascular intervention.

My lab creates novel technologies based on optical imaging or spectroscopic methods to aid clinicians in the diagnosis, management, or treatment of disease at the point-of-care. Our work focuses on developing new imaging techniques, methods, or devices, validating these technologies, and translating them into a clinical setting. Optical techniques offer great promise as point-of-care diagnostic tools. With the emergence and dissemination of highly sensitive detectors, light sources, imaging sensors and optical components, optical technologies as point-of-care clinical tools have become a potentially transformational field in the area of biomedicine.

Timothy Muldoon

Christopher Nelson

My lab develops new precision molecular therapeutics by addressing delivery challenges of genome and epigenome editors including CRISPR-Cas9. The lab cultivates biologically inspired biomacromolecule carriers for somatic genome editing to treat genetic disease. We are also using these technologies to identify and characterize mediators of tissue regeneration. Our current NIH-funded work is to develop strategies for in vivo delivery of CRISPR/Cas9 including preclinical characterization of gene editing, immunogenicity, and genotoxicity to create safer and more effective gene therapies.

My lab focuses on downstream purification of biopharmaceuticals using complementary experimentaland computational tools. In particular, we work on designing affinity ligands for capturing targeted protein therapeutics and responsive ligands for membrane-based hydrophobic interaction chromatography for the purification of biologics. In addition, we work with several major pharmaceutical companies as well as membrane manufacturers in validating virus clearance during the production of biologics. The mechanisms for virus removal and permeation are investigated. Our projects are funded by NSF, NIH and industry.

Xianghong Qian

Kyle Quinn

My lab cultivates non-invasive quantitative optical methods to characterize disease progression and tissue repair processes. We use label-free multiphoton microscopy to collect two-photon excited fluorescence, collagen second harmonic generation of collagen, fluorescence lifetime imaging, and coherent anti-Stokes Raman spectroscopy. We then obtain 3D maps of cell metabolism, tissue composition, and extracellular matrix organization. We also develop image analysis techniques to characterize extracellular matrix organization, intercellular arrangement and morphology, and subcellular organelle distributions. Our NIH and NSF funded research focuses on validating optical biomarkers for understanding cellular aging and impaired wound healing.

My lab studies the relationship between tumor oxygenation and metabolism and its role in cancer progression, metastasis, and treatment resistance. We develop clinically translational quantitative optical imaging technologies that measure the hallmarks of cancer in pre-clinical animal models and patients. We use diffuse optical spectroscopy to measure tumor oxygenation and biomolecular signatures in the tumor microenvironment that monitor and predict tumor response to therapy. We utilize high-resolution, label-free nonlinear microscopy to investigate changes in metabolism that drive cellular response to stresses. The NSF, NIH and Department of Defense currently fund our lab.

Narasimhan Rajaram

Raj Rao

My lab investigates the traits of stem cells such as their pluripotency, functional genomics, signaling pathways, genomic integrity, and smooth muscle/neuronal differentiation. Studies include the role of transcription factors, genotype and phenotype characterization, as well as multi-cellular behavior and the role of the extra cellular matrix. My lab utilizes interdisciplinary bioengineering approaches towards a mechanistic understanding of stem cell self-renewal, genomic integrity and use of biochemical/biophysical cues to commitment to specialized cell types. Through collaborations, the lab receives support from Department of Defense, National Science Foundation, National Institute of Health and the Arkansas Bioscience Institute.

My lab focuses on developing pre-clinical disease test beds and pro-regenerative scaffolds using natural biomaterials. We will use bioengineered 3D constructs of the tumor micro-environment to investigate tumor-stroma crosstalk and subsequent events. In addition, 3D physicochemical cues from stem/stromal cells can create scaffolds containing tissue-specific features and promote regeneration. Interdisciplinary collaborations on- and off-campus will lead to discoveries of molecular, cellular and tissue-level mechanisms of disease progression and tissue regeneration, as well as clinical relevance of our work.

Young Hye Song

Jeffrey Wolchok

My lab primarily explores the use of extracellular matrix (ECM) as a scaffolding material for the repair of damaged skeletal muscle after trauma. We also consider how ECM production by astrocytes is influenced by the mechanical stimuli (forces) that occur during traumatic brain injuries (TBI). This includes examining the mechanobiology of astrocytes, and investigating the hypothesis that the neurodegenerative ECM environment produced by astrocytes following traumatic brain injury is triggered by mechanical stimuli. These findings may define cellular mechanisms that lead to preservation of neuronal cells after TBI and thus help identify therapeutic targets.

I'm currently developing two new split-level courses: Entrepreneurial Engineering and Computational tools in Biomechanics. My primary research interests include investigating methods to promote an inclusive classroom environment for first-generation and underrepresented engineering students, the formation of engineers with an entrepreneurial mindset, and comparing traditional engineering education methods to the novel pedagogical theories such as active learning and hybrid classroom teaching. Additional research thrusts include studying the regeneration of the musculoskeletal and cardiovascular system by the integration of mechanobiology, immunology, and computational modeling.

Mostafa Elsaadany

Hanna Jensen

I teach Clinical Needs Finding in which third-year biomedical engineering students observe the operations of medical clinics and innovate ideas to contribute to the mission of such environments. The most feasible ideas from this course become Senior Design Capstone projects that students work on with their clinical mentors. In addition, I advise the diverse premedical student community on campus, and servs as a member of the Premedical Advisory Committee. I also work with University of Arkansas Medical Sciences Department of Surgery, coordinating clinical research within the UAMS Trauma team as an associate director.

Faculty Awards

$6,902,448 Awarded to Faculty for Research

26
Awards

ADHE

AHA

ABI

ARA

NIH

UAMS

NSF

MAST

DOD

$6.9 M

1. SURF 2019: A microscale view of astrocyte interactions with the blood-brain barrier. **Arkansas Department of Higher Education.** Principal Investigator: Kartik Balachandran. **$2,750**.
2. Label-Free Metabolic Biomarkers to Assess Early Pathophysiological Changes in Valve Endothelial and Interstitial Cells. **American Heart Association.** Principal Investigator: Kartik Balachandran. **$53,688**.
3. Organ-on-chip engineering facility for biomedical research. **Arkansas Biosciences Institute.** Principal Investigator: Kartik Balachandran. **$97,500**.
4. The role of fibroblast growth factor signaling in maintaining heart valve homeostatsis and preventing pathology. **Arkansas Biosciences Institute.** Principal Investigator: Kartik Balachandran. **$36,977**
5. Acute Ischemic Stroke Clot Dissolver and Capture Device. **Arkansas Research Alliance.** Principal Investigator: Morten Jensen. **$37,385.**
6. Force validated Heart Valve Surgical Planning Tool. **National Institutes of Health.** Principal Investigator: Morten Jensen. **$416,905.**
7. Peripheral Venous Pressure Waveform Analysis in Assessing the Volume Status of Circulation. **University of Arkansas Commercialization Fund.** Principal Investigator: Morten Jensen. **$47,017.**
8. Clinical Research within the Division of Acute Care Surgery and Trauma at UAMS. **University of Arkansas for Medical Sciences.** Principal Investigator: Hanna Jensen. **$41,475.**
9. A fiber-coupled time-correlated single photon counting system for biomedical and biophotonics research. **Arkansas Biosciences Institute.** Principal Investigator: Timothy Muldoon. **$40,000.**
10. In vivo endoscopic optical biomarkers of mucosal healing and disease remission in a murine model of ulcerative colitis. **Arkansas Biosciences Institute.** Principal Investigator: Timothy Muldoon. **$22,454.**
11. Non-viral delivery of CRISPR/Cas9 for targeted gene replacement. **National Institutes of Health.** Principal Investigator: Christopher Nelson. **$735,497.**
12. Virus Clearance. **AstraZeneca**. Principal Investigator: Xianghong Qian. **$180,000.**
13. Virus Filtration. **National Science Foundation.** Principal Investigator: Xianghong Qian. **$48,075.**
14. Water Treatment. **National Science Foundation.** Principal Investigator: Xianghong Qian. **$54,952.**
15. Bioreactor Harvesting. **Membrane Science, Engineering and Technology (MAST) Center**. Principal Investigator: Xianghong Qian. **$68,311.**
16. Membranes for Virus Capture. **Membrane Science, Engineering and Technology (MAST) Center**. Principal Investigator: Xianghong Qian. **$68,100.**
17. CAREER: Integrating quantitative biomarkers of mitochondrial structure and function through endogenous cellular fluorescence. **National Science Foundation**. Principal Investigator: Kyle Quinn. **$500,000.**
18. Development of Quantitative Biomarkers for Mitochondrial Disorders. **National Institutes of Health.** Principal Investigator: Kyle Quinn. **$395,112.**
19. Inverted Multiphoton Microscope for Collaborative Biomedical Research Projects. **Arkansas Biosciences Institute.** Principal Investigator: Kyle Quinn. **$198,788**.
20. Noninvasive molecular sensing of breast cancer response to therapeutics using Raman spectroscopy. **University of Arkansas for Medical Sciences**. Principal Investigator: Narasimhan Rajaram. **$75,000.**
21. Determination of functional and molecular biomarkers of treatment resistance with multimodal optical spectroscopy. **National Institutes of Health**. Principal Investigator: Narasimhan Rajaram. **$2,032,459.**
22. Identifying metabolic hallmarks of cancer initiation in lung tumor-adjacent normal tissue. **US Department of Defense.** Principal Investigator: Narasimhan Rajaram. **$145,082.**
23. CAREER: A multimodal imaging platform to investigate spatiotemporal changes in tumor bioenergetics that drive treatment resistance. **National Science Foundation**. Principal Investigator: Narasimhan Rajaram. **$500,000.**
24. Multidisciplinary Data Science (MDaS) to Better Prepare STEM Students with Emerging Data Science Skills. **National Science Foundation.** Key Personnel: Raj Rao. **$1,000,000.**
25. Intercellular mitochondrial transfer from human mesenchymal stem cells as a therapeutic strategy for mitochondrial diseases. **Arkansas Biosciences Institute.** Co-Principal Investigator: Raj Rao. **$32,318.**
26. Multimodal myogenic and angiogenic fiberscaffolds for the treatment of muscle injury. **Arkansas Biosciences Institute**. Principal Investigator: Jeffrey Wolchok. **$17,722.**

Interdisciplinary Faculty and Student Team Creates Science-Based Strategy Game

Making Cell Biology and Bioenergetics Generationally Accessible

How do we get students to spend more time engaged in independent thinking, group discussions and active learning? How do we make science more accessible and interesting to the next generation of researchers?

These are the questions many of our faculty members ask themselves daily. And this is where the university's new STEAM-H — short for Science, Technology, Engineering, Arts, Architecture, Mathematics and Health initiative — and the concept of "gamification" comes in.

Through a newly designed multi-semester interdisciplinary STEAM-H honors course, Shilpa Iyer, assistant professor in the Department of Biological Sciences at the J. William Fulbright College of Arts and Sciences, and Raj Rao, professor and department head in the Department of Biomedical Engineering in the College of Engineering worked with students from multiple disciplines to create and build science-based pedagogy games focused on explaining the concepts related to cell biology and bioenergetics. The focus of the course was to provide students an opportunity to integrate perspectives from art, design, science and technology to better understand and communicate difficult science topics in a fun and digestible manner.

"I teach cell biology to about 250 students every year and experience a wide variety of learners," Iyer said. "In order to make learning fun and to engage different types of visual, auditory, reading and kinesthetic learners, I decided to explore the option of creating science-based pedagogy games to empower users to learn cell biology and teach the importance of the mitochondria in a fun and meaningful way."

Inspired by topics in cell biology, the outcome has been a novel board game explaining the concept of intercellular communication of organelles within the cells, trademarked as The Great Cellular Reef.

"The game is for all levels of players and allows them to learn useful facts related to cell anatomy and physiology, with a mix of historical and trivia-based learning as well," Iyer said. "It plays much like other traditional board games with the objective of making learning fun.... [it] allows players to better understand the importance of mitochondria — the energy powerhouse within the cell — and the role of specific organelles and their function in impacting human health. It has also been designed to integrate well with school curriculums and learning objectives."

Rao said he ultimately hopes the game also impacts players' health. "It is our hope that players of all ages, particularly in middle schools, are able to better appreciate the inner workings of the cell and also understand the importance of making healthy lifestyle choices after playing The Great Cellular Reef," Rao said.

The game is being tested in pilot locations in two Arkansas schools, at Yellville-Summit High School, in Yellville and at Smackover High School, in Smackover. Iyer said the team plans to reach at least 500 high school students this academic year, as well as to continue with a new cohort of college students to develop additional games based on interdisciplinary STEAM-H approaches.

The Great Cellular Reef aims to engage and educate all ages.

Research

Researchers Test New Imaging Method for First Time on Human Patients

A new study by biomedical engineering researchers at the University of Arkansas could significantly improve methods for detecting and diagnosing congenital heart disease in infants and small children.

The researchers, collaborating with cardiologists at Arkansas Children's Hospital in Little Rock, tested a new ultrasound technology called vector flow imaging for the first time on pediatric patients to create detailed images of the internal structure and blood flow of the babies' hearts. The images can be still or moving, and can be taken from any angle.

"Vector flow imaging technology is not yet possible in adults, but we have demonstrated that it is feasible in pediatric patients," said Morten Jensen, associate professor of biomedical engineering at the U of A. "Our group demonstrated that this commercially available technology can be used as a bedside imaging method, providing advanced detail of blood flow patterns within cardiac chambers, across valves and in the great arteries."

Jensen performed the study with a multidisciplinary team, including Dr. Hanna Jensen, clinical assistant professor of biomedical engineering at the U of A; Dr. Thomas Collins, clinical associate professor of pediatric cardiology at Stanford University School of Medicine; and researchers at University of Arkansas for Medical Sciences (UAMS) and Cincinnati Children's Hospital Medical Center. Their findings werepublished in Progress in Pediatric Cardiology.

Roughly 1 percent of all babies are born with some type of congenital heart defect. Fortunately, the majority of these defects will never have any significant impact as the child grows into adulthood and old age. Pediatric cardiologists detect and diagnose congenital heart disease through multiple processes, including echocardiography. This imaging method is based on ultrasound and assesses the overall health of the heart, including valves and muscle contraction.

Although ultrasound provides essential information about cardiac valve function in babies and small children, it has critical limitations. It cannot accurately obtain details of blood flow within the heart. This is due primarily to the inability to align the ultrasound beam with blood-flow direction.

Using a BK5000 Ultrasound machine with built-in vector flow imaging, the researchers performed successful tests on two pigs, one with normal cardiac anatomy and one with congenital heart disease due to a narrow pulmonary valve and a hole within the heart. The researchers then compared the vector flow images to direct examination of the pigs' hearts. The researchers subsequently used the imaging system to take cardiac images of two three-month-old babies, one with a healthy, structurally normal heart and one with congenital heart disease because of an abnormally narrow aorta. With both patients, the technology enabled total transthoracic imaging of tissue and blood flow at a depth of 6.5 centimeters. Abnormal flow and detailed cardiac anomalies were clearly observed in the patient with congenital heart disease. All procedures, both animal and human, were performed at Arkansas Children's Hospital with assistance from Dr. Elijah Bolin, pediatric cardiologist at UAMS.

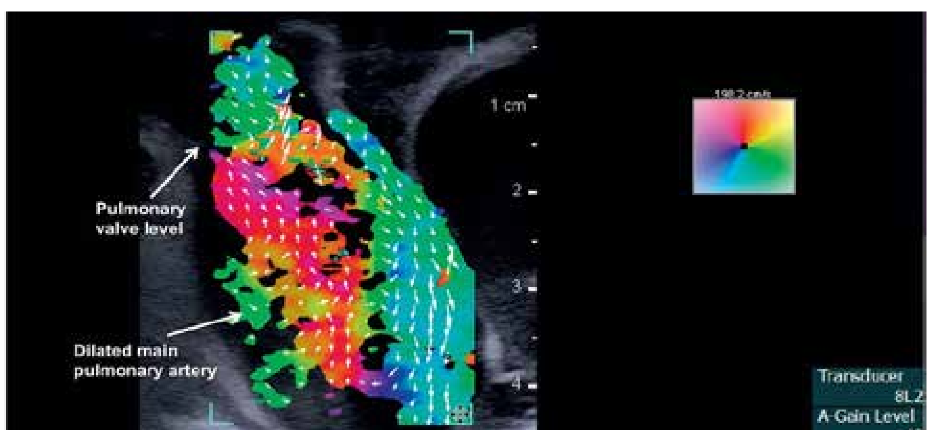
"We are still getting used to having this great, new information readily available, and we're excited about the future in both research and direct clinical advancements," Bolin said.

"This technology will increase our ability to provide the best possible bedside diagnosis and greatly enhances our understanding of what is happening in hearts with complex abnormalities," Stanford's Collins said.

The researchers will perform additional studies to further quantify images using this recently developed technology.

This project was supported by the Arkansas Children's Research Institute, the Collaborative Nutrition Pilot Grant and the Arkansas Research Alliance.

Jensen is an Arkansas Research Alliance Scholar.



A snapshot demonstration of vector flow imaging.

Biomedical Engineering Professor Receives NIH Award for Research in Genome Engineering

Dr. Christopher Nelson holds the 21st Century Professorship in Biomedical Engineering.

The National Institutes of Health awarded a University of Arkansas biomedical engineering faculty member a three-year, $735,000 award for research in genome engineering.

Assistant professor Christopher Nelson holds the 21st Century Professorship in Biomedical Engineering and has worked for five years on genome engineering approaches for genetic diseases. Nelson's previous research focused on Duchenne muscular dystrophy, a severe genetic disease. Patients with the condition have a life expectancy of 20 to 30 years.

Genome engineering is an alternative treatment to gene therapy. While gene therapy relies on delivery of external DNA, CRISPR permanently modifies the host genome directly. Because the effects of gene therapy fade overtime due to inevitable cell division, genome engineering is a more permanent solution, as the altered DNA is copied and transferred to the new cell.

Nelson's research, transitioned from his postdoctoral program at Duke University, has proven the longevity of genome engineering. Mice who suffered from Duchenne muscular dystrophy maintained edited DNA over their lifespans. The success of this research earned his lab their first NIH award, a three-year grant that will allow the expansion of genome engineering methods to other genetic diseases.

Nelson and his lab aim to focus first on Hemophilia, a genetic disease that affects the blood's ability to clot. Nelson's lab also intends to study the potential side effects of genome editing, as well as reduce the immune system's response, or immunogenicity, to the genome editing process, which currently alerts the immune system to attack the altered cell proteins.

"The immune system may be a barrier to genome engineering's efficiency in humans," Nelson said. "Overcoming this barrier will allow genome editing to be successful in the clinic."

"I am extremely excited Dr. Nelson has received this highly competitive NIH-R00 award as a follow-up to the NIH-K99 postdoctoral research award at Duke University," said Raj Rao, head of the Department of Biomedical Engineering. "The work Dr. Nelson will conduct combines new technologies in biomaterials and genome engineering and provides a new disciplinary focus for the department. His research over the next three years will allow graduate students to venture into biomaterials and gene delivery work and ultimately open new collaborative avenues for biomedical research on campus."

CAREER Awardee Quinn to Determine Role of Mitochondria and Metabolism in Age-Related Diseases

An assistant professor of biomedical engineering at the University of Arkansas received one of the National Science Foundation's most esteemed awards for early-career faculty members.

Dr. Kyle Quinn earned $500,000 to support his research and teaching. The NSF considers the Faculty Early Career Development program, known as a CAREER award, the "most prestigious awards in support of early-career faculty who have the potential to serve as academic role models in research and education and to lead advances in the mission of their department or organization."

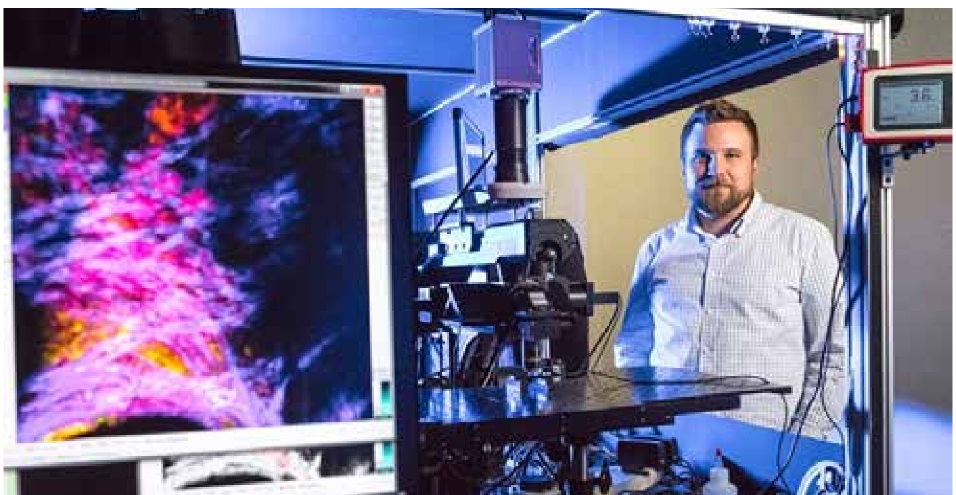
What began as a chance encounter as an undergrad led Quinn to a career using advanced imaging techniques to study health issues. His CAREER award is focused on monitoring cell metabolism over time and understanding the role mitochondria play in age-related diseases like Alzheimer's, cardiovascular disorders, cancer, diabetes and obesity.

"Mitochondria are the powerhouse of the cell, they're the energy producing structures." Quinn said. "We're trying to understand how dysfunction arises with age. There can be a difference between someone's chronological age versus their biological age. It's this idea that aging affects us all in different ways, and consequently, the function of our cells can change in different ways."

Quinn is looking to develop an understanding of how mitochondria change over a lifetime through novel optical imaging approaches. The hope is to unlock new information about how age-related diseases develop, which could provide clues into how those diseases could be treated or prevented.

"We don't have tools to non-invasively assess how age-related changes to our cells can occur and when they're occurring and what that means for certain diseases," Quinn said. "It's hard to tease out age-related problems versus all the other things that occur when you have a medical issue."

It's important to monitor mitochondria, Quinn said, because the structures demonstrate a variety of changes throughout the aging process.



NSF CAREER Awardee Dr. Kyle Quinn.

"With increasing age, there are increasing internal stresses on your cells and mitochondria," he said. "There is an accumulation of damage to different cell components produced by highly reactive molecules called free radicals, and the mitochondria become less efficient."

"Mitochondria are dynamic. They fuse together; they break apart. The cell will cordon off dysfunctional mitochondria. But, a lot of those dynamics have been reported to change with age." Being able to track those changes accurately could provide critical information about the nature of aging.

Monitoring those changes is not easy. Even with advanced imaging techniques, there are not many tools that allow researchers to watch those changes in tissue without disturbing the cells or tissue itself.

"It's hard because there aren't a lot of tools that allow us to non-invasively characterize mitochondria, especially within human or animal tissue," Quinn said. "A lot of this work ends up being conducted with cells in a petri dish, and even then you're going to stain your cells with something, put it under a microscope and then throw it away."

Quinn uses an imaging technique that resolves faint, naturally-occurring fluorescence from mitochondria. By measuring this "autofluorescence", researchers can monitor changes in the mitochondria without disturbing the cell directly.

"We don't have to stain anything. We can non-invasively bring a microscope down onto the cell or a tissue or even a live mouse and look at the cell metabolism and assess the function of the mitochondria," Quinn said. "All these changes that have been reported by biologists to occur with aging, we can potentially be evaluating with our imaging technique."

Quinn's CAREER research is unique because it will allow him to monitor the cells in one specimen for an extended period, giving a comprehensive look at what happens to the cells as they age.

"I don't know of any research group that has monitored the same mammal over its entire lifespan to see how their cells' mitochondria change," Quinn said. "If we can do that and say something meaningful about how their mitochondria change, I think that can be potentially really meaningful for understanding how age-related degenerative diseases develop."

The research isn't specific to one disease, and that's by design.

"This is very much a basic science type of grant — it's broadly applicable. There are all these different problems in neurodegenerative diseases, cancer, and diabetes where mitochondria can become dysfunctional, and we could have some really broad, transformative impacts," Quinn said.

Rajaram's CAREER Award to Target Radiation Resistance in Tumors

NSF CAREER Awardee Dr. Narasimhan Rajaram.

Dr. Narasimhan Rajaram, assistant professor of biomedical engineering at the University of Arkansas, recently received a 2019 CAREER award from the National Science Foundation for his research on radiation-resistant tumors.

Officially called the Faculty Early Career Development Award, NSF CAREER awards are the most prestigious awards the NSF grants to early-career faculty members who excel in both research and teaching.

The five-year, $500,000 grant will allow Rajaram to dive deeply into the root of radiation resistance in tumors and treatment.

Rajaram's research centers on head and neck cancer, but the idea has broad implications. If researchers can understand why some tumors become radiation-resistant and others don't, they might be able to switch patients with resistant tumors to other radiation treatment strategies earlier and potentially improve the effectiveness and efficiency of cancer treatments.

Radiation treatment uses intense beams of energy to kill cancer cells. It's used to treat nearly every type of cancer, and more than half of patients with cancer receive the therapy as part of the treatment process, according to the Mayo Clinic.

The beam of radiation is focused, much more focused than chemotherapy, but it's not perfect. Sometimes organs near the site of the tumor sustain collateral damage.

"Radiation therapy has advanced quite a lot these days," Rajaram said. "Now, it is pretty focused, and you can spare a lot of normal tissue. But, for example, with head and neck cancer, radiation has strong effects on normal tissue, such as the salivary glands."

The research could also help doctors provide more appropriate doses of radiation, potentially reducing or avoiding damage to normal tissue, Rajaram said.

That's why Rajaram and his team are working to identify a way to tell which tumors will respond to radiation treatment and which ones will not.

They hope to do that by building an instrument that can look at a tumor's oxygen supply, how that oxygen is being used and what that means for the cell's metabolism.

"We believe there is a metabolic link that can help us understand why tumors become radiation resistant," Rajaram said.

"For a long time, conventional thinking was that the more hypoxic (low-oxygen) a tumor is, the more resistant it is. For radiation therapy to work, you need oxygen. In the presence of oxygen, radiation causes irreversible DNA damage, which is why there is so much damage to normal tissue exposed to radiation. In the absence of oxygen, cancer cells have a way of repairing DNA damage."

"More recently, there is evidence from our lab and other labs that even if certain cancer cells are provided lots of oxygen, they don't necessarily wind up responding to treatment. They seem to be modifying their metabolic profile to avoid DNA damage. So, it could be well-oxygenated and you might draw the wrong conclusion about whether the tumor would respond to radiation therapy."

The primary oxygen carrier in the body is hemoglobin within blood vessels. Rajaram is working to build a microscope that can quantify oxygen supply within tumor blood vessels by imaging hemoglobin and simultaneously visualize the metabolism of cells adjacent to the vessels.

To quantify the metabolic profile, Rajaram will measure the fluorescence from two key cellular components — NADH and FAD. Fluorescence is the emission of light by a substance that has absorbed light or other electromagnetic radiation. The research combines the instrument-building side of biomedical engineering with tumor biology. With that perspective, Rajaram hopes to find solutions that can be implemented in a clinical setting.

"What we're saying is we're trying to visualize what causes treatment resistance. If we can do that, we'll not only improve scientific knowledge but on the clinical side can develop technologies that can go after markers of treatment resistance, and potentially drugs that can target markers of treatment resistance."

"We believe that what we learn here can eventually be packaged into something clinically translatable, a new technology that can help clinicians better understand why tumors respond to radiation," he said.

Alumni

After Graduation: Anne Pruet on Now Diagnostics

In November 2018, I started at Now Diagnostics (Springdale, AR) working as a Product Development Scientist. After graduation in May and a celebratory road-trip through the Southwest, I began the job hunt. Specifically, I was looking for a position that would challenge me, provide mentorship and positively impact healthcare through low-cost solutions and increased access for people. Now Diagnostics seemed to fit the description when a fellow graduate student at the University of Arkansas described the company to me. I reached out to see if and what positions were available.

Cold-calling can be intimidating, but I would like to take a moment to encourage students to email or call the companies that they are truly passionate about. It only takes a moment and what's the worst that can happen? The persistence paid off as I landed a phone interview with Vicki Thompson, who is my current boss. She then invited me to meet her Product Development Team as well as meet with the rest of the management team and CEO.

After the interview, I knew this was a company where I could develop professionally and build a career (and thankfully they hired me!). Skills such as image analysis and 3D printing that I gained through the Biomedical Engineering Graduate Program at the University of Arkansas have been instrumental to growing in this new position. Most importantly, I have continued to grow as an independent researcher and build on my previous experiences as a graduate research student.

Image analysis was instrumental in my thesis work as well as one of the most challenging and rewarding classes I took during graduate school. Understanding the basic principles of image analysis has been helpful as I work to scale-up the production of our hCG test. The equipment that I use includes a vision system to ensure that coating each membrane occurs in the programmed location. Additionally, understanding these principles has enabled me to effectively communicate with the manufacturer of the equipment.

Another core component to my thesis work was 3D printing in order to develop a neurovascular model. Using this knowledge, I initiated a unique solution to an issue on our scale-up equipment. We run multiple sizes of membrane on the equipment, which requires readjusting the dispense reels that hold the membrane rolls. Through the NWA Fab Lab in Fayetteville, AR I 3D printed components that appropriately space each membrane to be perfectly centered, which ensures coating in the desired locations. Although a simple solution, this minimizes setup time and ensures proper alignment of the membrane for every use.

As an undergraduate, I worked in three labs, yet graduate school gave me the opportunity to work independently driving my own research ideas through the guidance of my advisors, initiated through classes and collaboration with fellow graduate students. This has been the most instrumental in preparing me for my current position. Every day requires new iterations to my research as I work to scale-up our hCG test and prepare for the tech transfer for our Strep test.

Anne Pruet, third from left, with Now Diagnostic colleagues at the Hogeye Marathon.

Alumni Jared Greer, right, with business partners Flavia Arujo, left, and Michael Dunavant, center.

Alumni Startup Chosen for $225,000 NSF Grant

A medical device company started as part of a University of Arkansas entrepreneurship class has earned a $225,000 grant to finish development of a device to make minimally-invasive abdominal surgeries safer for patients and better for surgeons.

Lapovations LLC was formed in the graduate-level New Venture Development Course taught by Carol Reeves, associate vice chancellor for entrepreneurship and innovation. The team includes alumni from the College of Engineering and the Sam. M. Walton College of Business.

Lapovations' chief executive officer is Jared Greer, a 2018 graduate of the biomedical engineering department master's program. While at the U of A, the team, which included Walton College graduates Flavia Araujo and Michael Dunavant, won more than $300,000 in prize money from startup competitions across the country. The sum was a record for a University of Arkansas student startup team.

Lapovations' most recent support is a Small Business Innovation Research Phase I grant from the National Science Foundation.

The grant will allow the company to finish the development of AbGrab, a trademarked Class 1 medical device used to non-invasively lift the abdominal wall at the start of laparoscopic surgery. Major complications are rare in laparoscopic surgery but can be serious or even fatal when they occur.

Most often, major complications occur when instruments are first inserted into the abdominal cavity, prior to the insertion of the camera that provides visibility into the cavity. To minimize this risk, surgeons lift the abdominal wall away from vital organs that could be inadvertently punctured during these initial steps. Two lifting techniques are commonly used, but unlike those which use mechanical force, AbGrab utilizes suction and is more reliable and less invasive.

Its projected benefits include better surgical outcomes, increased surgeon and patient satisfaction and decreased patient post-op pain.

Greer said the ability to learn about engineering and business simultaneously played a key role in moving Lapovations forward.

"Our time at the U of A was a critical contributor to what Lapovations has accomplished so far," he said. "AbGrab was the focus of my biomedical engineering master's thesis, so we worked closely with the department on early product development and testing. Department Head Dr. Raj Rao and Dean John English are doing a great job fostering an entrepreneurial spirit within the College of Engineering that allows companies like ours to flourish.

"Another key contributor to our success has been what we learned in the New Venture Development class taught by Dr. Carol Reeves in the Walton College. Dr. Reeves is a tireless worker who, with the support of Dean Matt Waller, has built Walton College into an entrepreneurial powerhouse. We are very fortunate to have resources like the Walton College and the College of Engineering that allow a cross-disciplinary group such as Lapovations to achieve success."

Rao, head of the Department of Biomedical Engineering, said Greer's success was a positive indicator for the program.

"We are really excited one of our alumni is actively pursuing the entrepreneurial route based on guidance and training obtained in our graduate programs," Rao said. "Lapovations is a great example of the need to build an innovation ecosystem and graduate programs that will rely on collective expertise from engineering and business."

Graduate Students

Biomedical Engineering Graduate Student Earns American Heart Association Fellowship

Biomedical engineering doctoral student Ishita Tandon has earned a predoctoral fellowship from the American Heart Association to support her research into a cardiovascular disease that impacts 2.5 percent of Americans.

The fellowship will support Tandon's research into calcific aortic valve disease — the formation of calcific lesions in the aortic heart valve. Tandon is working to identify an early detection method for the disease, because current technology usually only allows doctors to identify the disease after irreversible damage has been done.

"Currently there are no drugs and no mitigation strategies," she said. "There are no early diagnostic strategies."

Under the guidance of Kartik Balachandran, associate professor of biomedical engineering, Tandon's research centers on developing a realistic 3D model of the aortic valve, then using multiphoton imaging to look for early changes that could indicate the onset of calcification. From there, researchers could develop ways to treat the disease before it intensifies

The imaging aspect of Tandon's research includes a collaboration with researchers in Kyle Quinn's lab. Quinn is an assistant professor of biomedical engineering whose lab specializes in tissue diagnostics, using advanced imaging techniques to provide non-invasive, real-time assessments of tissue structure and function.

Tandon hopes to leverage that existing technology to find a new perspective on the development of aortic calcification.

Ishita Tandon is a graduate doctoral student researching calcific aortic valve disease.

"We're developing proof of concept here," Tandon said. "This imaging technology is already used widely in cancer research. We're showing them this may have another application — in cardiovascular research."

One of the main advantages to multiphoton imaging is that it's minimally invasive and non-destructive, meaning it is more desirable for use in the human body because it doesn't involve inserting dyes or other materials into the tissue to form a clear image of the organ.

"[Balachandran] is very supportive. I am grateful for his mentorship," Ishita said. "When we come up with the ideas, he is with us every step of the way to guide us and steer us in the right direction."

Raj Rao, professor and department head of biomedical engineering, said the award reflected well on Tandon, Balachandran and the department.

"Ishita's receipt of the AHA predoctoral fellowship is an indication of the significance of the ongoing cardiovascular research programs in the department," he said. "It also demonstrates the caliber of our doctoral students and the important guidance provided by Dr. Balachandran."

Serena Munns, executive director of the Northwest Arkansas office of the American Heart Association, said researchers like Ishita Tandon are vital to the future of heart and brain health.

"We are committed to funding researchers early in their careers," Munns said. "Funding for training and early-career investigators represents a substantial portion of the millions that we invest into research each year."

"That commitment has brought results," she added. AHA-funded discoveries include the first implantable pacemakers, the first artificial heart valve, CPR techniques and cholesterol-lowering medications. "It's important to recognize that ground-breaking research is going on right here in our back yard."

"It is important to recognize that ground-breaking research is going on right here in our backyard."

- Serena Munns, Executive director of NWA AHA

Undergraduate Students

State and National Awards Reception: Biomedical Engineering Recipients

Department Head Raj Rao with recipients in late April.

University of Arkansas' State and National Awards Reception is held yearly at the end of the spring semester and commemorates the academic achievements of students in various departments. The Biomedical Engineering Department claimed several notable awards for both students and the department overall.

The Biomedical Engineering Department won the 2019 Departmental Gold Medal, received by Department Head, Raj Rao.

Harrison Dean won the Summer Undergraduate Research Fellowship from the American Heart Association, mentored by Heather Walker.

Alaa Abdelgawad was recognized for her Student Travel Award from the Biomedical Engineering Society, mentored by Narasimhan Rajaram.

Smit Patel was awarded the Hagan

Alaa Abdelgawad and **Jackson Hedrick** were recognized as Seniors of Significance.

Scholarship, mentored by Kartik Balachandran and Charles Robinson.

Mason Buele was recognized as an Outstanding Chapter officer by the National Biomedical Honor Society, mentored by Michelle Kim.

Various students won the National Science Foundation Research Experience for Undergraduates, including **Olga Brazhkina, Jarrod Eisma, Jessica Orton, Jack West,** and **Lucy Woodbury**. They were mentored by Morten Jensen, Connie Lamm, Jamie Hestekin, Bryan Hill, and Kyle Quinn, respectively.

Jessica Orton was also awarded the Student Undergraduate Research Fellowship (SURF), mentored by Jamie Hestekin.

Harrison Dean was also recognized for his acceptance into Texas A&M College of Medicine Summer Research Program, mentored by Heather Walker.

Samia Ismail was awarded theTruman Scholarship, mentored by Nicole Clowney.

Smit Patel was also recognized for his acceptance into the University of Arkansas for Medical Sciences Summer Undergraduate Research Program, mentored by Kartik Balachandran.

Andre Figueroa won the Upstate Medical University Summer Undergraduate Research Fellowship, also mentored by Kartik Balachandran.

Alaa Abdelgawad was also awarded the UT Health San Antonio Summer Research Fellowship, mentored by Narasimhan Rajaram.

Gianna Busch was recognized for her acceptance at Vanderbilt Biophotonics Center Summer Research Program, mentored by Kyle Quinn.

Track and Biomed: Questions for Katrina Robinson, Student Athlete

BME: When did you first become interested in biomedical engineering?

Robinson: To be completely honest, not until September of last year. I came into college unsure about what exactly I wanted to study, but I knew that I really enjoyed science classes and that my strongest classes were ones involving critical thinking. After settling in during the fall and thinking a lot about what was right for me, I decided that biomedical engineering would be perfect. It was the perfect blend of science and math and becoming an engineer really excited me. It also opens up doors into the health field which I have always been very interested in.

BME: Why the University of Arkansas?

Robinson: Growing up as a track runner in Australia, I always knew that I wanted to pursue my passion for run ning at an American college. The sport is so much bigger here than at home and the opportunity to run on scholarship was also one that I couldn't pass up. The University of Arkansas has such a renowned track program and when I took a visit here during my senior year I fell in love with the campus and fit right in with the team.

BME: How do you balance being a student athlete and a biomedical engineering student?

Robinson: I developed a lot of good habits in high school which I have been able to carry with me into college. It can definitely be tough trying to balance a full course load while also fitting in hours of practice each day and having to miss a lot of school days travelling to meets, but I always try to plan out my week in advance to figure out the best times to study. I try to set aside small but consistent study sessions througho ut the week instead of trying to cram it all in at one time, because I find this helps eliminate stress and gives me time each day to do other things I enjoy.

BME: Do you feel that your success as an athlete and a biomedical engineering student complement each other? Where do you think this ambition comes from?

Robinson: I think they definitely complement each other because both require a lot of hard work and commitment. Just like studying, running each day can be tough and there are days when a hard workout is the last thing I want to do. However, learning to put in the hard work consistently each day is what has helped me achieve my best results both on the track and in the classroom. I also find that running is a great way to destress when school feels overwhelming and it always helps me clear my mind. I have always been very ambitious which I have been able to apply to all aspects of my life.

Biomedical Engineering Students Earn National Recognition for Bioethics Work

Two University of Arkansas students placed third in a national bioethics essay competition held by the Institute of Biological Engineering in April. The team's essay focused on ethical issues surrounding artificial intelligence in healthcare.

Tasha Repella and Jordan Maass are seniors in biomedical engineering and have had undergraduate research experiences at U of A and study abroad experiences in Australia. The two partnered in Clinical Assistant Professor Hanna Jensen's Clinical Needs course in the spring to analyze artificial intelligence in healthcare. Under guidance from Jensen and Casey Lee Kayser, assistant professor of English in the J. William Fulbright College of Arts and Sciences, they expanded on the assignment to an abstract and eventual essay submission to the contest, and the two were selected as finalists among five students from other universities in early March.

The IBE is a professional organization that converges yearly to form connections between engineers and support scholarship among students in biological engineering. Alongside presentations by various professionals in the field, the organization holds essay, poster and design competitions for undergraduates and graduates. This year the essay contest concerned bioethics in healthcare.

Repella and Maass' essay, titled "Ethical Considerations of Artificial Intelligence in Healthcare," touched on various issues, including technological uses, potential biases and distribution of wealth. Their greatest intrigue, however, stemmed from personal experience. Repella, while working in a clinical setting, recounts an experience with a heart echocardiogram on a cancer patient that resulted in a diagnostic error.

This then led to Repella questioning the ethics of the situation: "Who does the responsibility lie with when these errors arise?"

Raj Rao, head of the department of biomedical engineering, praised the students for their success in tackling an issue on the cutting edge of healthcare policy.

"I commend Tasha and Jordan for researching a highly contemporary topic that relates to big data, machine learning, artificial intelligence in the context of healthcare applications and presenting their essay at a national stage," Rao said. "These experiences are extremely vital for our students to better understand the changing face of biomedical engineering research and applications as well."

Although their essay discusses the various issues of AI in healthcare, their essay does not dissuade the use of such technology. Instead, as their title suggests, the essay is a consideration of issues. The two found in their research that, although the FDA recently launched a forum to prompt discussion around regulations of AI, the Biomedical Engineering Society's ethical guidelines have not been updated since 2004. "It is technology that should be utilized and will be important for the future of health industry," Maass said, "but these concerns need to be raised."

Both Repella and Maass have gained jobs in the healthcare sector after graduation.

Jordan Maass, Tasha Repella, and Raj Rao, Department Head, at IBE in April.

U of A Junior Samia Ismail Is Named Harry S. Truman Scholar

Samia Ismail, 2019 Truman Scholar.

Samia Ismail, a University of Arkansas honors student from Fort Smith, has been named as one of this year's 62 Harry S. Truman Scholars. Ismail, a junior majoring in biomedical engineering, will receive up to $30,000 for graduate study, as well as priority admission and supplemental financial aid at premier graduate institutions, leadership training, career and graduate school counseling, and special internship opportunities within the federal government.

After Ismail graduates from the U of A in the spring of 2020, she plans to pursue a medical degree and a master's degree in public policy, applying to institutions like Michigan, Harvard, Stanford and UCLA. Her long-term goal is to return to Arkansas and enlist in the National Health Service Corps, serving as a doctor in a rural community and perhaps one day running for public office in the state.

The Truman Foundation notified U of A Chancellor Joe Steinmetz recently that Ismail had been selected as a 2019 Truman Scholar and encouraged him to follow a Truman tradition and surprise her with the news. She was invited to what she thought was a high-level budget meeting that required student input–only to find the chancellor, vice chancellors, deans, department chairs, faculty mentors, and advisers there ready to celebrate her success.

"I was completely taken aback," said Ismail. "I had convinced myself this could not possibly happen. It took me a moment to take it all in, but it was a wonderful surprise, and I feel very honored to be selected and to have had such strong support from faculty and friends across the campus and from the community. I am looking forward to the opportunities this award will bring and the ways it can help me achieve career and community goals."

"It was a real pleasure to share the news with Samia Ismail," said Chancellor Steinmetz. "She is a stellar student, who has accomplished so much already. She is clearly an excellent candidate for this recognition and for scholarship support. The Truman Foundation selects students who will make a meaningful difference at the national, state and community levels. Samia is clearly poised to do just that."

Samia Ismail participates in the honors program in the Department of Biomedical Engineering in the College of Engineering. She has excelled in demanding coursework while maintaining extensive involvement in community and campus organizations. She has received an Honors College Fellowship, the Governor's Distinguished Scholarship, and two Honors College Research Grants. She has conducted research both on campus and at the Schepens Eye Research Institute in Boston.

Ismail serves as an intern for the Office of Diversity and Inclusion, working with Vice Chancellor Yvette Murphy-Erby. She also serves as an Honors College ambassador and tutors in the College of Engineering. She is a member of the Associated Student Government, and, as vice chair of the Distinguished Lectures Committee, she has helped coordinate and host visiting lecturers.

Engineering Student Teams Highlight Collaboration, Innovation at Capstone Design Competition

Team Grip Strength Pen, created by students in biomedical and electrical engineering, won first prize in the 2019 Senior Capstone Design Poster Competition.

Students from six engineering departments gathered in April to show off the culmination of a year's work at the third annual Senior Capstone Design Poster Competition.

Students from biomedical, biological, computer, electrical and mechanical engineering, as well as computer science, presented their year-long projects to faculty, staff, family members and friends, who voted on the top three.

More than 60 posters were presented, showcasing engineering skills developed by students throughout their undergraduate career.

Robert Saunders, competition organizer and assistant department head of electrical engineering, said the competition is a chance to showcase student innovation.

"The poster competition puts the students in an environment where they talk about their projects with professors, other students and the general public," he said. "This gives the students a venue to proudly discuss their projects while practicing their communication skills in front of a widely varied audience."

First place went to Grip Strength Pen, a pen developed by electrical and biomedical engineers to monitor a person's grip pressure while wirelessly transmitting the information to a computer or any other device. Team members were Hailey Carter, Morgan Dawkins, Andre Figueroa, Emily Janowski and Marinna Tadros from the Biomedical Engineering Department; and Brad Matthews, Brooks Walker, Logan Walz and David Mathis from the Electrical Engineering Department. Second place went to teams from the Electrical and Mechanical Engingeering Departments for their work on an electronic lawnmower called Path to Independence.

Third place went to another team from the Biomedical Engineering Department. Multi-Drug Deliver Pump is a drug delivery pump created by biomedical engineers to inject medication at the correct time and dosage. Team members were Kaylee R. Henry, Alaa Abdelgawad, Jake Hopper, Katie Heath, Mason Belue and Gage Gabbard.

All three groups were recognized at the College of Engineering student awards on April 30.

Decision Day 2019: Meet the new undergraduates who are #ProudToBME

See more photos online:

@uarkbme

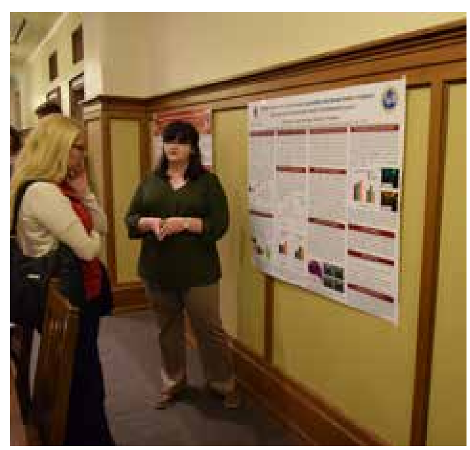
@uarkbme

@uarkbmeg

2019 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

253

Undergraduate Students

30

Graduate Students

53%

Female

22%

Ethnic Minority

17%

First Generation
Undergraduate

82%*

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

Active
Research Awards

(45) $15.6M

CY 2019 External Research Expenditures

$232k per faculty

Research Areas

Biomechanics and Mechanobiology

Biomaterials

Biomedical Optics and Imaging

Cell and Tissue Engineering

Molecular Engineering

40
Research Publications in 2018-2019

12 Full-time Faculty

Funding Sources

BMEG faculty have recently received research funding from:

American Heart Association

Arkansas Biosciences Institute

Department of Defense

National Institutes of Health

National Science Foundation

University of Arkansas for Medical Sciences

6
NSF CAREER Awardees
Balachandran, Muldoon, Qian, Quinn, Rajaram, 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

Ishita Tandon, class of 2020
2019 American Heart Association Predoctoral Fellow

Samia Ismail, class of 2020
2019 Harry S. Truman Scholar

New Faculty

Welcome Drs. Chris Nelson, Mostafa Elsaadany, and Young Hye Song!

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

Dr. Mostafa Elsaadany
Teaching Assistant Professor
PhD, University of Toledo
MS, The American University
BS, Cairo University

Dr. Young Hye Song
Assistant Professor
PhD, Cornell University
MS, Cornell University
BS, Carnegie Mellon University

Dr. Nelson previously pursued research at Duke University, supported by The Hartwell Foundation Postdoctoral Fellowship and the prestigious NIH Pathway to Independence Award (K99/R00). In the past he has developed biomaterial-based platforms for drug and gene delivery including a nanoparticle for systemic siRNA administration and a multifunctional scaffold for local gene silencing for regenerative medicine. His research aims include cultivating biologically inspired biomacromolecule carriers for somatic genome editing to treat genetic disease to identify and characterize mediators of tissue regeneration. His current NIH-funded work will develop strategies for in vivo delivery of CRISPR/Cas9 including preclinical characterization of gene editing, immunogenicity, and genotoxicity to create safer and more effective gene therapies.

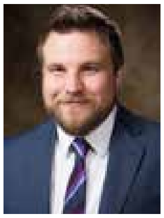
Before joining The University of Arkansas, Dr. Elsaadany took a faculty position at The Ohio State University in 2017 where he taught Fundamentals of Engineering, Statics, Mechanics of Materials, Engineering Economics, and Materials Science Engineering. His primary research interests include investigating the methods to promote an inclusive classroom environment for first-generation and underrepresented engineering students, the formation of engineers with an entrepreneurial mindset, and comparing traditional engineering education methods to the novel pedagogical theories such as active learning and hybrid classroom teaching. He also aims to study the regeneration of the musculoskeletal and cardiovascular system by the integration of Mechanobiology, Immunology, and Computational Modeling.

As a National Cancer Intitute Physical Sciences in Oncology Center Trainee at Cornell, Dr. Young Hye Song worked on utilizing tissue engeering approaches to assess the effects of different mammary tumor microenvironmental factors on pro-angiogenic behavior of adipose-derived stem cells and susequent sprouting angiogenesis. focuses on developing pre-clinical disease test beds and pro-regenerative scaffolds using natural biomaterials. Her current research involes utilizing bioengineered 3D constructs of the tumor microenvironment to investigate tumor-stroma crosstalk and subsequent events. In addition, her lab aims to focus on 3D physicochemical cues from stem/stromal cells to create scaffolds containing tissue-specific features and promote regeneration.

UNIVERSITY OF ARKANSAS

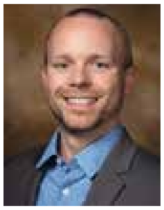
College of Engineering
Biomedical Engineering

Recipient's of the National Science Foundation's most prestigious Faculty Early Career Development (CAREER) Program Award.
In support of faculty exemplifying the role of teacher-scholar through outstanding research, excellent education and the integration of both education and research.



Dr. Kyle Quinn received the 2019 NSF CAREER Award for his research on integrating quantitative biomarkers of mitochondrial structure and function through endogenous cellular fluroescense.

Dr. Narasimhan Rajaram received the 2019 NSF CAREER Award for his research on a multimodal imaging platform to investigate spatiotemporal changes in tumor bioenergetics that drive treatment resistance.



Dr. Timothy Muldoon received the 2018 NSF CAREER Award for his research on a probe that can create high-quality images of living tissues in the human gastrointestinal tract.

Dr. Kartik Balachandran received the 2015 NSF CAREER Award for his research on understanding endothelial-mesenchymal transformation in the heart valve.

Dr. Xianghong Qian received the 2009 NSF CAREER Award for her research regarding molecular dynamics investigation of glucose to 5-hydroxymethylfurfurl conversion in biological systems.

Dr. Raj Rao received the 2008 NSF CAREER Award for his research on propagation systems for generation of chromosomally stable human stem cells.

University of

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