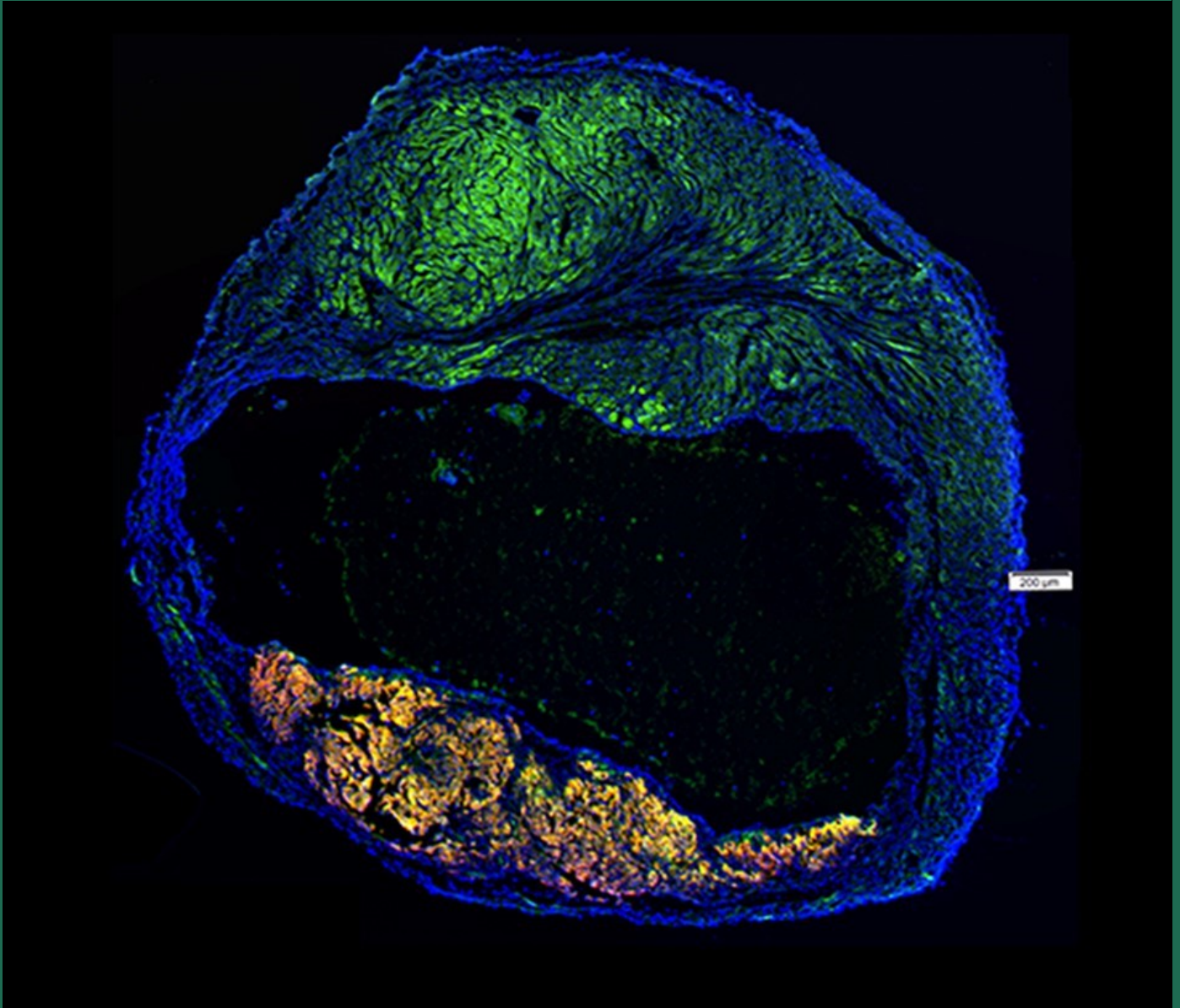


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THE UNIVERSITY OF ALABAMA AT BIRMINGHAM



BIOMEDICAL ENGINEERING

2018

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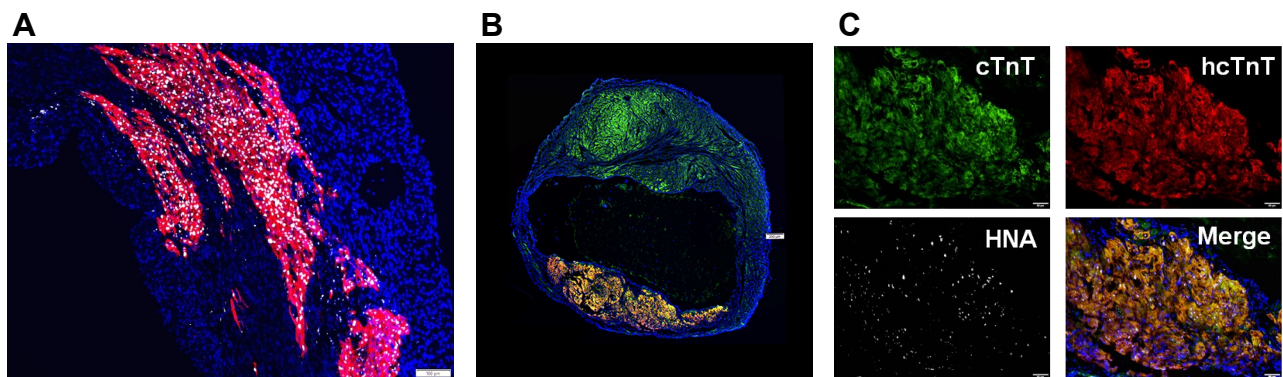
UAB Schools of Engineering and Medicine

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On the Cover



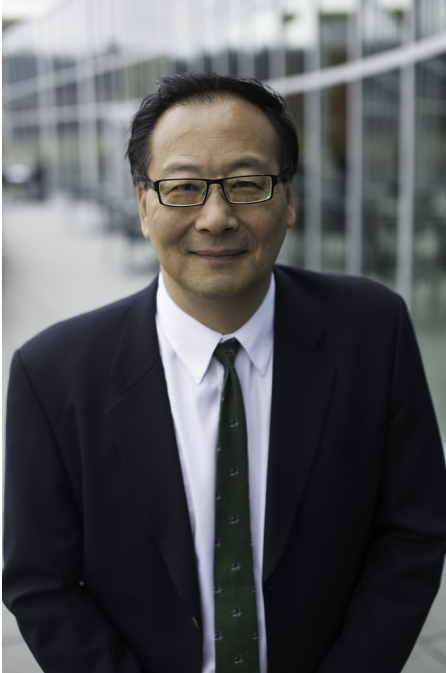
Cover Image features image shown as Panel B in the figure above (Courtesy J Zhang Lab)

Typical “human induced pluripotent stem cells” (hiPSCs)-MHC-CCND2^{OE}-cardiomyocytes grafts in immune deficient postinfarction mouse heart at Week 4 (A), and Month 6 (B) post acute myocardial infarction and cell transplantation. Green, non-specific cTnT; Red, human specific cTnT; White, human specific nuclear antigen; and Yellow, merged aforementioned panels. (C) Remuscularization of injured left ventricle can be achieved by activating cell cycling of the transplanted cardiomyocytes. **More at:** labs.uab.edu/jayzhang

Message from the Chair

“WE ARE NOW ENTERING A 3RD REVOLUTION IN LIFE SCIENCES— THE **CONVERGENCE REVOLUTION.**”

— *Jianyi (Jay) Zhang, MD, PhD*



P ERIODS OF GREAT ADVANCEMENT

in the history of civilization have often been propelled by a convergence between engineering and science, such as the development of paper in China, the steam engine in Europe (which gave birth to the Industrial Revolution), and more recently, computers in the United States. We are now entering a 3rd revolution in life sciences— the **Convergence Revolution**— as science and engineering discoveries made during the last handful of decades are having a revolutionary impact on the economy, industry, life sciences, and public health. The new joint Department of Biomedical Engineering at UAB is the product of this 3rd revolution.

To our new students, I take this opportunity, on behalf of the entire BME faculty, staff, and student body, to welcome you to UAB BME. You have made the important choice to enroll at UAB during a time when the world may seem chaotic and the country divided. We are here to provide a peaceful environment that will ensure the success of your education and prepare you for excellence after graduation.

Our department has grown in many fields of research. One of our most prominent topics of investigation is cardiovascular tissue engineering, which has evolved through the convergence of innovations in engineering, biomaterials, and human pluripotent stem-cell (hPSC) technology. The work of our faculty, research fellows, and students has been recognized both nationally and internationally, and our department has become one of the most prestigious of its kind by striving to provide a collaborative and nurturing environment for all members of our academic circle. This year, we welcome the expertise of our newly appointed joint faculty members, including Dr. Philippe Menasché, a prominent physician-scientist who has been a pioneer in the field of cardiac cell therapy for more than 20 years and has recently completed the first clinical trial to test the use of hPSC-derived cardiac muscle patches in patients with heart failure. The insights and discoveries of leading scientists from our own campus and around the world will continue to be highlighted through our series of groundbreaking seminars and at the annual NIH-sponsored Cardiovascular Bioengineering (CVBE) Symposium, which we have hosted each year since its inception in 2017 after two earlier years as annual workshops. I am grateful to have witnessed first-hand the exceptional talent and dedication of all members of our education and research community, and I look forward to working with our current and future faculty and students of UAB BME.

With Best Wishes,

Jianyi (Jay) Zhang, MD, PhD

Chair, Department of Biomedical Engineering

T. Michael and Gillian Goodrich Endowed Chair of Engineering Leadership

Professor of Medicine, of Engineering

School of Medicine, School of Engineering

UAB | The University of Alabama at Birmingham



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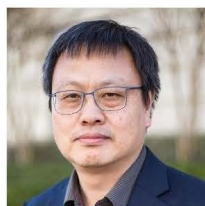
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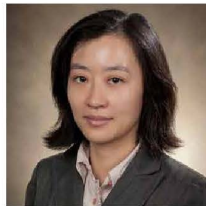
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ABET Reaccreditation for UAB SOE, BME

Originally accredited by ABET in 2007, in 2018 UAB School of Engineering's undergraduate programs, including BME, successfully completed rigorous site visits and evaluations for reaccreditation by ABET, the global accreditor of university programs in engineering, maintaining the distinction of being ABET-accredited. Notably, no shortcomings were noted by the reviewers for any of the UAB SOE undergraduate programs. ABET accreditation means that students, employers, and society can be confident that a program is producing graduates ready to enter the global workforce.

The ABET evaluation processes determine that a program is meeting the needs of industry and continuously improving the education they offer their students. ABET accreditation impacts the professionals who create and maintain technology not only in the United States, but around the world. Major companies such as Boeing, Caterpillar, and IBM prefer or require their new hires to come from ABET-accredited programs*, which is a mark of the assurance ABET's globally-recognized standards bring to industry. Special thanks to Dale Feldman, Associate Professor of BME, for his work as BME's ABET Representative for the reaccreditation process; to Ms. Julie Calma for her organization and administrative support in preparation for the ABET reaccreditation; and to the entire SOE and BME administration, faculty, and staff for the strong ongoing commitment to excellence.

*Source: www.abet.org

Celebrating 40 Years of Biomedical Engineering at UAB

2019 marks UAB BME's 40th anniversary— faculty members reflect:

BME turns 40!

By Alan Eberhardt, PhD — Professor and Associate Chair of Education, BME

In 1979, I was 16. Jimmy Carter was president, a horrible nuclear accident occurred at Three Mile island, and Pink Floyd released its magnum opus, "The Wall." At the same time, a small upstart university in Birmingham, Alabama, launched a Master of Science in Biomedical Engineering (BME). With four faculty and a focus on dental and orthopedic biomaterials, the program grew rapidly. In 1983, the PhD program was approved and over the course of the next twenty years evolved to include two of the top research programs in the country – one in biomedical imaging and the other in cardiac electrophysiology. In 2000, the undergraduate program was approved. This program has now grown to be among the largest in the School of Engineering and has been accredited by ABET three times – originally in 2007, then again in 2012 and 2018. To date, nearly 250 undergraduates have received their Bachelor's degree from UAB BME, and over 400 MS and PhD degrees have been awarded.

With the new year, BME will turn 40 years old. Under the leadership of Dr. Jay Zhang and an expanding faculty that includes world leaders in cardiovascular tissue engineering, we are poised to rise to new levels of greatness. As a joint department with the UAB School of Medicine and the UAB School of Engineering, and currently ranked in #4 in NIH funding, starting one of a few NIH engineering training grants (T32) in the country, the mechanisms for collaboration are in place to develop truly translational and transformational knowledge that will change our world.

Now, if only Pink Floyd would go back on tour...

Memories from a faculty member of 40 years

By Jack Lemons, PhD — UAB University Professor Emeritus, Schools of Dentistry, Engineering, and Medicine

Four decades past, considerable discussion followed recommendations to integrate Bio into the educational programs of Electrical, Materials, and Mechanical Engineering at the University of Alabama in (prior to at) Birmingham. The content of opinions was similar to the prior interactions about where to locate a biomedical engineering center grant and the Department of Engineering Biophysics within the School of Medicine; and if dental materials should be continued to be called biomaterials. As Chair of the Dental School Department of Biomaterials, Director of the Research Laboratory in the Division of Orthopaedic Surgery, and the faculty member providing much of the lecture content of the evolving components of Biomaterials and Biomechanics in the Department of Materials Engineering, I participated in the various discussions. This was an extension of completing a five-year NIH-sponsored fellowship in Clinical Medicine and Dentistry. It was fun teaching macro- and micro- anatomy and other courses to engineering students after completing the related courses and clinical rotations in the medical center. Central laboratory collaborations were with R. Buchanan, Chair of Materials Engineering, who focused his research on the corrosion of metallic biomaterials. Forming and approving the Department of Biomedical Engineering in the late 1970s focusing on a graduate program was an initial step, and the first PhD graduate was Linda Lucas. She returned to UAB as a faculty member and subsequently Chair, Dean, and Provost, after an international post-doctoral fellowship. The discussions about offering a BME-BS degree were equally educational and as time and experience has demonstrated, the decisions were correct. Over the decades the central research focus has been redirected as faculty and administrators have changed and throughout, I have appreciated and enjoyed the programs; especially the many outstanding students (>300) and the faculty collaborations and leadership. Going forward, I am very pleased that the longer-term requests to form a Joint Department with the School of Medicine was completed and current leadership has significantly expanded the Joint Department.

Professor **Philippe Menasché, MD, PhD** joins UAB BME Faculty

It is our pleasure to announce the appointment of **Philippe Menasché, MD, PhD**, as a Professor in the Department of Biomedical Engineering at UAB.

A prominent physician-scientist and a pioneer in the field of cardiac cell therapy for more than 20 years, Dr. Menasché recently completed the first clinical trial to test the use of hPSC-derived cardiac muscle patches in patients with heart failure. His appointment at UAB is in conjunction with NIH-funded U01 grant (U01 HL134764, PI: J Zhang), "*Integrated Cellular & Tissue Engineering for Ischemic Heart Disease*", which is expected to continue until June 2023, when the 7-year U01 grant ends.

Dr. Menasché has outstanding abilities and a stellar international reputation. After earning his MD, he went on to earn his PhD in Natural Sciences in 1987 from the Université de Paris XI (Center of Orsay), embarking on a remarkable career of discovery and advances in cell therapy and cardiac surgery that quickly catapulted him to the top of the field. Since 1988, he has served as Professor of Cardiovascular Surgery at the Public Assistance Hospitals of Paris, University Paris Descartes, as an expert in stem cell therapy and tissue engineering in cardiology and cardiac surgery, as well as the senior staff surgeon in the Department of Cardiovascular Surgery of the European Hospital Georges Pompidou in Paris, France. He is lead or co-author on over 325 articles cited over 13,500 times in leading international publications in the field, including *European Journal of Cardiothoracic Surgery*, *Cell Transplant*, *Journal of Thoracic Cardiovascular Surgery*, *Canadian Journal of Cardiology*, and *American Journal of Transplantation*.

Welcome to UAB BME, Dr. Menasché!



Philippe Menasché, MD, PhD

New **NIH T32 Research Training Grant** from NIBIB for UAB BME

Written by **Grant Martin**, *Director of Communications, UAB SoE*

The UAB Department of Biomedical Engineering was recently awarded a Ruth L. Kirschstein NRSA Institutional Research Training Grant (T32) to support pre-doctoral students in UAB's BME and Graduate Biomedical Sciences programs.

The grant from the National Institutes of Health's National Institute of Biomedical Imaging and Bioengineering (NIBIB) is the first of its kind awarded to an engineering department in the state of Alabama.

The five-year \$750,000 grant, titled "*Development and Functional Assessment of Cardiovascular Tissue Engineering Therapy*", is co-directed by BME Professor **Jack Rogers, PhD**, and BME Chair **Jianyi "Jay" Zhang, MD, PhD**.

"Cardiovascular tissue engineering (CVTE) has tremendous, but as yet unrealized, potential to treat disease," said Rogers. "Future scientists and engineers will need expertise in a broad range of subfields, including cardiovascular pathophysiology, cell/scaffold engineering methods, and other diverse technologies to evaluate the electromechanical safety and efficacy of prototype therapies."

To that end, the T32 grant funding will be used to support up to four predoctoral students per year. The new program builds on research strengths in CVTE-related fields in the BME department and across UAB.

"We are excited and thankful for the new support from NIH, and we look forward to training a cadre of professionals in academia, government and industry who will accelerate the safe clinical adoption of CVTE technology," said Zhang.



UAB BME Chair Jay Zhang (top) and Professor **Jack Rogers** serve as Co-Directors on this new NIBIB engineering pre-doctoral training grant, the 1st of its kind to be awarded in Alabama.

For more information on this training grant opportunity, please contact Kelly M. Hillard, BME Program Director, at kellybme@uab.edu.

UAB BME climbs the ranks in NIH funding 3 years in a row

2016

Long recognized as a leader in biomedical engineering research, the UAB Department of Biomedical Engineering took a big step forward in 2016, ranking in the top five joint BME departments nationally in the amount of funding it receives from the National Institutes of Health (NIH).

With **\$4.1M** in funding for fiscal year 2016, the department ranked **4th** in NIH-funded joint BME departments (joint within Schools of Medicine and Engineering), behind those of Stanford (1st), Johns Hopkins University (2nd), and Oregon Health & Science University (3rd). The rankings are published annually by the *Blue Ridge Institute for Medical Research* (BRIMR.ORG), which lists all NIH funding for U.S. medical schools.

The UAB BME Department was included in that medical-school listing for the first time in 2016, after becoming a joint department in the UAB Schools of Engineering and Medicine in 2014. The high ranking was due in large part to department chair Jianyi “Jay” Zhang, MD, PhD, who brought substantial funding when he was hired in 2015. Between 2015 and 2016, Zhang recruited additional new faculty, such as Prasanna Krishnamurthy, MVSc, PhD, Margaret Liu, PhD, Gangjian “GQ” Qin, MD, and Chunxiang “Kevin” Zhang, MD, PhD. Those hires helped increase research funding further

2017

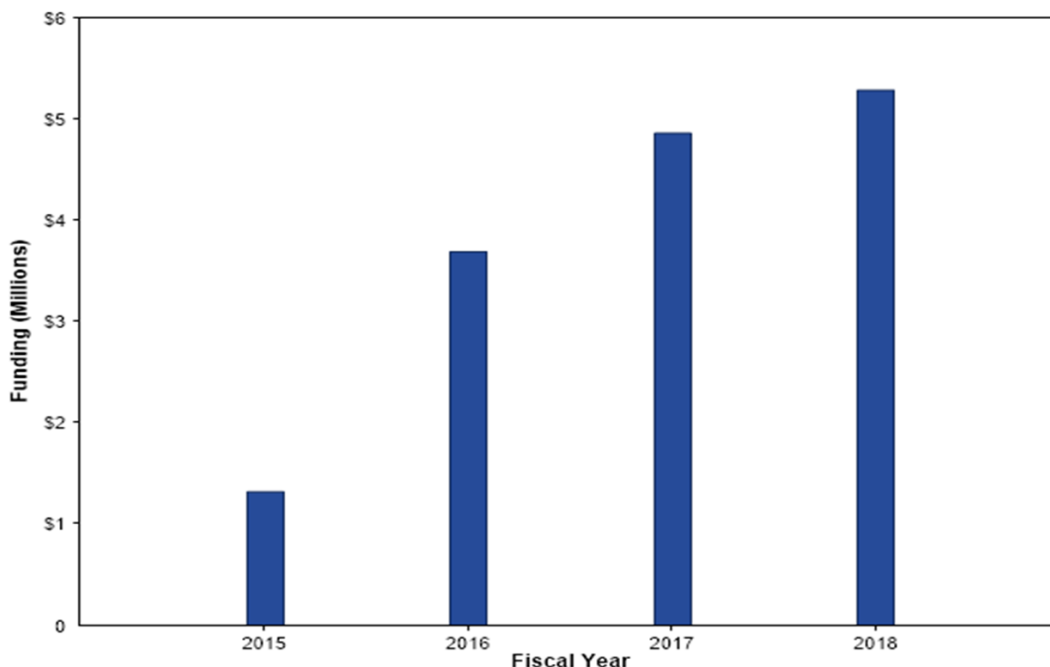
UAB BME was awarded **\$4.9M** in NIH funding for FY17, and once again ranked **4th** in research funding among the NIH-funded joint BME departments (joint within Schools of Medicine and Engineering) in the US. The convergence of life sciences and bioengineering brings about integration of stem cell biology, tissue engineering, and cardiovascular science. The interdisciplinary nature of our program affords a tremendous opportunity to bring forth advances in new scientific discoveries and technological development to foster improved quality of life. Led by national leaders and dedicated faculty members, UAB research is cutting-edge, translating regenerative medicine to health care practice.

2018

In FY18, UAB BME was awarded **\$5.3M** in funding by the National Institutes of Health. Once again a banner year, we are looking forward to the release of the rankings published by the Blue Ridge Institute for Medical Research (BRIMR.ORG) for 2018!

NIH Funding: UAB BME Department

SOURCE: NIH Research Portfolio Online Reporting Tools (RePORT)



New Faculty Grants Boost UAB BME Research

Gangjian ‘GQ’ Qin, MD, Professor of BME, received an NIH R01 grant from the National Heart, Lung, and Blood Institute (NHLBI). This \$2.6 million 4-year multi-PI grant will be in collaboration with Dr. Hongyu Qiu at Loma Linda University and supports investigation of valosin-containing protein (VCP), an ATPase-associated protein previously uncharacterized in the heart, in the protection of cardiac ischemic injury. The project, titled “*Role of VCP in Coronary Ischemic Injury*”, will advance our understanding of the molecular mechanisms underlying the benefit of ischemic pre-conditioning in cardiac protection and potentially lead to novel therapy for coronary artery disease.

Wuqiang ‘Wuk’ Zhu, MD, PhD, Assistant Professor of BME, received an NIH R56 grant from the National Heart, Lung, and Blood Institute (NHLBI) for his project entitled “*Myocardial Repair with a Novel Engineered Cardiac Muscle Patch*”. Cell-based therapy has emerged as a promising therapeutic approach for myocardial repair. However, poor donor cell engraftment is a major roadblock limiting the clinical implementation of this approach. Wuk and his team have recently developed a novel strategy exploiting genetically induced donor myocyte proliferation to enhance graft size which resulted in improvement of cardiac function in a rodent model of ischemic injury (Zhu W, et al. *Circ Res*. 2018). In this grant, they will test the myocardial regenerative potency of this approach in a clinically relevant large animal model. In addition, they will delineate the mechanisms by which grafted cells contribute to cardioprotection.

Massimo A. Fazio, PhD, Associate Professor in the Departments of BME and Ophthalmology at UAB, in collaboration with mPI Dr. Christopher Girkin, Chair of the EyeSight Foundation of Alabama and UAB Callahan Eye Hospital, was awarded a new NIH R01 grant from the National Eye Institute. The \$1.8 million 5-year grant is titled “*Determinants of the Biomechanical Behavior of the Human Lamina Cribrosa*”, aims at understanding some crucial aspects of the ocular tissue biomechanics related to onset and progression of glaucoma. Thanks to a collaboration with the Alabama Organ Center, the PIs built a testing platform to perform experimental imaging and mechanical tests directly in the living human eye.

X. Margaret Liu, PhD, Associate Professor of BME, received a new 2-year research award from the North American Neuroendocrine Tumor Society (NANETS) to support her work with Co-PI Dr. Renata Jaskula-Sztul from the UAB Department of Surgery. The aim of the project, “*Novel Antibody-Drug Conjugate (ADC) for Pancreatic Neuroendocrine Tumor (PanNET) Targeted Therapy*”, is to develop a novel targeted biotherapy to target a newly identified surface receptor and effectively kill NE cancer.

Jianyi “Jay” Zhang, MD, PhD and **Prasanna Krishnamurthy, DVM, PhD**, Associate Professor of BME, have been awarded a multiple-PI NIH R01 grant from NHLBI. The new 5-year, \$2.64 million grant, titled “*Mesenchymal Stem Cell Exosome in Efferocytosis of Apoptotic Cardiomyocytes and Repair after Myocardial Ischemia*”, will study how diabetes influences inflammation in the injured heart and whether mesenchymal stem cells or their exosomes can boost dead cell removal and reduce damaging inflammation after heart attacks in animal models of diabetes.



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Heart-Muscle Patches Created from Human Cells Improve Recovery from Heart Attacks

Written by Jeff Hansen for UAB News

Large, human cardiac-muscle patches created in the lab have been tested, for the first time, on large animals in a heart attack model. This clinically relevant approach showed that the patches significantly improved recovery from heart attack injury.

The results are a step closer to the goal of treating human heart attacks by suturing cardiac-muscle patches over an area of dead heart muscle in order to reduce the pathology that often leads to heart failure.

The research was led by Jianyi “Jay” Zhang, M.D., Ph.D., the chair of University of Alabama at Birmingham Biomedical Engineering, a joint department of the UAB School of Medicine and the UAB School of Engineering.

Each patch is 1.57 by 0.79 inches in size and nearly as thick as a dime. Zhang and colleagues found that transplanting two of these patches onto the infarcted area of a pig heart significantly improved function of the heart’s left ventricle, the major pumping chamber. The patches also significantly reduced infarct size, which is the area of dead muscle; heart-muscle wall stress and heart-muscle enlargement; as well as significantly reducing apoptosis, or programmed cell death, in the scar boarder area around the dead heart muscle. Furthermore, the patches did not induce arrhythmia in the hearts, a serious complication observed in some past biomedical engineering approaches to treat heart attacks. A key to success of the patches is how they are engineered.

Each patch is a mixture of three cell types — 4 million cardiomyocytes, or heart-muscle cells; 2 million endothelial cells, which are well-known to help cardiomyocytes survive and function in a micro-environment; and 2 million smooth muscle cells, which line blood vessels. The three cell types were differentiated from cardiac-lineage, human induced pluripotent stem cells, or hiPSCs, rather than using hiPSCs created from skin cells or other cell types. Each patch was grown in a three-dimensional fibrin matrix that was rocked back and forth for a week. The cells begin to beat synchronously after one day.

This mixture of three cell types and the dynamic rocking produced more heart muscle cells that were more mature, with superior heart-muscle physiological function and contractive force, as compared with patches made from a monolayer of cells that are not dynamically rocked.

This mixture of three cell types and the dynamic rocking produced more heart muscle cells that were more mature, with superior heart-muscle physiological function and contractive force, as compared with patches made from a monolayer of cells that are not dynamically rocked. The patches resembled native heart-muscle tissue in their physiological and contractile properties.

Past attempts to use hiPSCs to treat animal models of heart attacks — using an injection of cells or cells grown as a very thin film — have shown very low rates of survival, or engraftment, by the hiPSCs. The present study had a relatively high rate of engraftment, 10.9 percent, four weeks after transplantation, and the transplantation led to improved heart recovery.

Part of the beneficial effects of the patches may occur through the release of tiny blebs called exosomes from cells in the patches. These exosomes, which carry proteins and RNA from one cell to another, are a common cell-to-cell signaling method that is incompletely understood. In tissue culture experiments, the researchers found that exosomes released from the large heart-muscle patches appeared to protect the survival of heart-muscle cells.

Additionally, the patches appeared to prevent or reverse detrimental changes in protein phosphorylation in the sarcomeres of the heart-muscle tissue bordering the infarcted area of the heart. This result is the first to suggest that hiPSC-derived heart cells may improve contractile function after heart attacks by lessening maladaptive changes in phosphorylation states of sarcomeric proteins. The sarcomere is the contractile unit in a heart-muscle cell myofibril.

Co-authors with **Zhang** of the paper, “*Large Cardiac-Muscle Patches Engineered from Human Induced-Pluripotent Stem-Cell-Derived Cardiac Cells Improve Recovery from Myocardial Infarction in Swine*,” are **Ling Gao, Wuqiang Zhu, Saidulu Mattapally, Yasin Oduk, Xi Lou, Ramaswamy Kannappan, Anton V. Borovjagin, Gregory P. Walcott, Andrew E. Pollard, Vladimir G. Fast, and Steven G. Lloyd**, all of the **UAB Department of Biomedical Engineering**; **Ying Ge and Zachery R. Gregorich**, Department of Cell and Regenerative Biology, University of Wisconsin-Madison; and **Xinyang Hu**, Zhejiang University, Hangzhou, China.

This work was supported by National Institutes of Health grants R01 HL099507, R01 HL114120, R01 HL131017, U01 HL134764, R01 HL128086, and R01 HL109810; and by Shared Instrumentation Grant Program OD018475.

2018 NIH Cardiovascular Bioengineering Symposium a Success

The 4th annual NIH NHLBI PCTC Cardiovascular Bioengineering (CVBE) Symposium was held on the campus of The University of Alabama at Birmingham (UAB) on March 1-2, 2018. The symposium, organized by UAB BME Chair Jay Zhang and faculty members Drs. Gangjian Qin and Joel Berry, continues to be unique in the world, featuring a combination of top researchers in cardiovascular bioengineering with trainees in the field while maintaining the intimacy of UAB's cardiovascular bioengineering community and the Southern hospitality of Birmingham.

The symposium also provided a forum for trainees and junior investigators to present their work in the areas of gene editing, induced pluripotent stem cells, and cardiac stem cells in the context of heart failure as well as general topics in cardiovascular bioengineering. Additional topics included vascular tissue engineering, cardiac development, exosomes, microRNA, and mitochondria. Cardiac gene and cardiac cell therapy were center stage. Nearly 200 people attended the conference, which featured prominent speakers from the North American, European, and Asian cardiovascular bioengineering communities.

PICTURED: Many of the esteemed invited speakers and organizers of the 2018 CVBE. Details at www.uab.edu/bme.



2019 NIH PCTC CVBE Symposium to be held in Sydney, Australia

The 5th annual NIH Progenitor Cell Translational Consortium (PCTC) Cardiovascular Bioengineering (CVBE 2019) Symposium will be held in Sydney, Australia on March 1-2, 2019. The meeting, led by **Dr. Jay Zhang** of UAB and **Dr. James Chong** of the University of Sydney, will bring together a faculty of internationally leading scientists from North America, Europe, Asia, and Australia. The symposium will cover a spectrum of fundamental and translational topics related to the fields of cardiac cell therapy, cardiovascular sciences, bioengineering, and stem cell biology. This meeting has previously been held at UAB in Birmingham, Alabama from 2016-2018. Details of previous meetings are published in *Science Translational Medicine*, *JACC*, and *Circulation Research*^{1, 2, 3, 4}.

We anticipate a highly stimulating and informative meeting with attendees from a diverse spectrum of basic and translational scientists and cardiologists hailing from prestigious research centers from around the world. This meeting is a unique opportunity to join an international audience that will be developing the breakthroughs of the future. We are excited to invite you to join us in Sydney and look forward to sharing additional details of this exceptional event with you soon!

1. Ogle BM, et al. *Sci Transl Med*. 2016;8:342ps13.
2. Kannappan R & Zhang J. *Circ Res*. 2016;119:981-983.
3. Zhu W & Zhang J. *Circ Res*. 2017;120:1709-1712.
4. Yanamandala M, et al. *J Am Coll Cardiol*. 2017;70:766-775.

Student Honors & Awards



Emma Latham

Emma Latham, undergraduate student in the UAB Department of Biomedical Engineering, was selected as UAB's *Outstanding Undergraduate Student Engineer* for 2018. Emma received a scholarship and recognition at the 2018 Annual Engineering Council of Birmingham (ECOB) Awards Banquet at The Harbert Center.



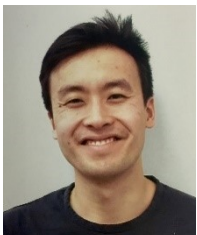
Jervaughn Hunter

Jervaughn Hunter, Post-Bac Research Education Program (PREP) Scholar in the **Jay Zhang Lab**, has accepted an offer of admission from UC San Diego's Bioengineering PhD program. In addition to his admission, the UCSD BME department has also awarded Jervaughn the Sloan Scholar Fellowship at \$40,000 for 4 years. Jervaughn received his BS in BME from UAB in 2017 before joining Zhang Lab, where he investigated maturation of human induced pluripotent stem cell derived cardiomyocytes via electrical stimulation.



Patrick Ernst

Patrick Ernst, Biomedical Engineering Graduate Student, was awarded a 2-year American Heart Association (AHA) Pre-doctoral Fellowship. Patrick's project, co-mentored by **Dr. Lufang Zhou** and **Dr. Jay Zhang**, focuses on mechanism of cell death in hiPSC-CM using mitochondrial optogenetics approach.



Eric Zhang

Eric Zhang, Graduate Student in the laboratory of **Dr. Gangjian "GQ" Qin**, was awarded a 2-year American Heart Association (AHA) Pre-doctoral Fellowship for his research proposal, titled "*Role of SDF-1/CXCR4 Signaling in Recruitment of C-kit+ Bone Marrow Progenitor Cells to the Ischemic Myocardium*". The project focuses on stem cell trafficking in the cardiovascular system. Eric's application was ranked in the 1st percentile in the nation-wide competition.



Nick Pensa

Nick Pensa, BME graduate student in the laboratory of mentor **Dr. Susan Bellis**, was awarded a NIH Kirschstein-NRSA Predoctoral Fellowship (F31) for his project, titled "*Tunable Co-delivery of VEGF and BMP2 Mimetic Peptides to Enhance Bone Regeneration*", which will introduce a novel method of delivering/releasing bone promoting factors, BMP-2 and VEGF on implanted commercial bone grafts within the injury site to enhance bone regeneration.



Shiyue Xu

Shiyue Xu, PhD, a postdoctoral fellow in the laboratory of **Dr. Gangjian "GQ" Qin**, was awarded an American Heart Association (AHA) Post-doctoral Fellowship with a near-perfect score of 1.01 for his proposal based on his recent publication in *Circulation Research*, "*E2F1 Suppresses Oxidative Metabolism and Endothelial Differentiation of Bone Marrow Progenitor Cells*". The award provides Xu with \$114,000 for 2 years to study the relationship between stem cell metabolism and differentiation.

2019 AHA Predoctoral Fellowships Awarded to BME Students



(Above, L-R) 2019 AHA Predoctoral Fellowship awardees, Wesley LaBarge & Asher Kahn-Krell.

Wesley LaBarge and **Asher Kahn-Krell** have each been awarded 2-year American Heart Association (AHA) Predoctoral Fellowships. Funding includes a stipend matching NIH scale for predoctoral fellows, as well as additional supplements for project support and health insurance. They begin January 1, 2019.

LaBarge, a PhD student in Biomedical Engineering, will focus his research project on improving the maturation of Cyclin D2 overexpressing, human-induced pluripotent stem cell-derived cardiomyocyte tissues to be used in repairing the injured myocardium after a myocardial infarction.

Kahn-Krell, an MD-PhD (MSTP) student, will focus his research project on developing novel Cyclin D2 overexpressing cell line that can be turned on or off with the presence of the antibiotic doxycycline in order to create cardiac patches with a safe proliferative ability.

Both trainees are mentored by Prof. **Jay Zhang, MD, PhD**.

UAB BME team wins award at World Congress on Biomechanics

A team of UAB BME students took 2nd place at the *World Congress on Biomechanics* in Dublin, Ireland for their work on a mechanical umbrella design for power wheelchair users.

The design was created as a senior design project by **Jessica Pieczynski**, **Gerardo Hernandez-Moreno**, **Tess Vessels**, and **Seth Patterson**.

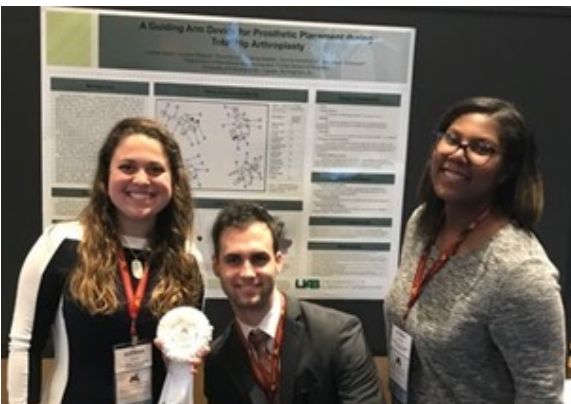
More than 150 abstracts were submitted to the international competition, and the UAB team was one of only six chosen for the final competition in Dublin.

Pieczynski and Patterson represented the team at the Congress, along with BME faculty mentor **Alan Eberhardt, PhD**. "This team did an awesome job," said Eberhardt. "Jessica and Seth gave a very professional talk that emphasized both the engineering and business aspects of their device. They made me very proud."

(L-R) Seth Patterson & Jessica Pieczynski.



BME Senior Design Team Places in National Design Competition



A UAB BME Senior Design team took 3rd place in the 2018 annual *Design of Medical Devices Conference* in Minneapolis, Minnesota.

BME students **Sydney Watkins**, **Dave Monaco**, **Katrina Hatch**, and **Dania Mallah** entered their project and won 3rd place for UAB. Rice University and Johns Hopkins received 1st and 2nd place, respectively.

The UAB group's design helps orthopedic surgeons properly align a revision hip stem in total hip arthroplasty.

(L-R) Katrina Hatch, Dave Monaco, Sydney Watkins.

Biomedical Workforce Program

proves successful in encouraging diversity, receives additional grant for support

Written by Alicia Rohan for UAB News

To be competitive for doctoral graduate programs, students must have previous research experience alongside strong writing and presentation skills. The University of Alabama at Birmingham PREP Scholars Program supports underrepresented students who have recently obtained their undergraduate degrees and are looking to pursue doctoral studies in the biomedical sciences in leading graduate programs. **Jervaughn Hunter**, a 2018 graduate of the PREP program, will begin his pursuit of a PhD in bioengineering this fall at the University of California-San Diego because of the support received from the program.

"I grew up picturing the human body as a finely tuned machine and wanted to know more of what I could do to help repair the body after injury or disease," said Hunter, a Port Gibson, Mississippi, native. "After taking my first biomaterials class, I became interested in research. My fascination stemmed from reading scientific articles and the scientific breakthroughs coming from this field of study." Hunter began looking for research opportunities in the UAB School of Engineering Project Lab, a course that allows students to redesign and upgrade previous senior design projects within the UAB Department of Biomedical Engineering, ultimately refining their skills as engineers. Hunter worked as a student assistant in the electrophysiology core of the UAB Department of Neuroscience.

"Both of these opportunities catalyzed my affinity for research," Hunter said. "During my senior year, I began looking for research opportunities and identifying my next career step. I was instantly drawn to the UAB PREP Program's mission to expose students to intensive and rigorous research, as well as guide and prepare them for graduate studies."

After receiving his Bachelor of Science degree in Biomedical Engineering with a concentration in biomaterials and tissue engineering from UAB, Hunter was accepted in the UAB Graduate School's PREP Program. As part of the PREP Program, Hunter joined Jianyi Zhang's lab, which focuses on cardiovascular tissue regeneration research. Hunter's long-term goal is to contribute to the methods and technologies that heal and repair damaged heart tissue as a result of ischemic heart disease. Hunter prepared for the GRE test and began graduate level classes as part of the program, while taking weekly workshops and working closely with faculty to begin research and prepare for graduate school. Through the program, Hunter presented his research, "Investigating the maturation and cell cycle of human induced pluripotent stem cell derived cardiomyocytes after genetic modification and electrical stimulation," at the Annual Biomedical Research Conference for Minority Students.



PREP Scholar Jervaughn Hunter in the Jay Zhang Lab, conducting cardiovascular tissue regeneration research.

"All of these experiences combined through the PREP Program further boosted my confidence while applying for graduate school," Hunter said. "My ultimate goal is to receive a PhD in bioengineering or biomedical engineering and focus on repairing damage to the myocardium caused by ischemic heart disease through cardiovascular tissue regeneration. With the help of UAB, I'm now taking the next step toward this goal."

The UAB PREP Program supports recent minority undergraduates looking to pursue a doctoral graduate degree in biomedical sciences by providing extra experience students need to gain acceptance into science programs in leading graduate schools. UAB's program grant was recently renewed for \$1.79 million by the NIH to support eight PREP students per year over the next five years.

"UAB has an outstanding record of successful training for graduate students and a strong commitment to training doctoral students from diverse backgrounds," said Daniel C. Bullard, Ph.D., co-director of the program and associate dean for Recruitment, Retention and Diversity in the UAB Graduate School. "UAB has established several programs to help both undergraduate students from underserved groups who aspire to doctoral careers and graduate students who need financial support to pursue graduate studies. Specifically, the PREP Scholars Program provides an additional pathway for a diverse pool of post-baccalaureate applicants to enter doctoral programs in the biomedical sciences."

Jeffrey Engler, PhD, former associate dean in the Graduate School, established the UAB PREP Scholars Program in 2009. Since its inception, approximately 70 percent of the UAB PREP program's participants have gone on to a graduate studies program, including at UAB, Emory University, Stanford University, Duke University, Vanderbilt University, and the University of Iowa. Many of the students who participated in the early years of the program are now obtaining doctoral degrees.

"Students undergo a complete transformation over the course of the program," said Cristin Gavin, PhD, co-director of the PREP program and assistant professor in the UAB Department of Neurobiology. "We observe dramatic increases in scholars' self-confidence, professionalism and competency in the lab. In short, they transform into capable scientists."

Students who received their baccalaureate degrees in the past three years train for one to two years based on an individually developed plan and are paired with faculty for hands-on research projects. Students obtain the necessary research experience needed to become competitive for entry into a top graduate program in the biomedical sciences. The program includes GRE workshops and practice exams, poster presentation sessions, the Annual Biomedical Research Conference for Minority Students, and presenting at UAB Graduate Student Research Day. Each student in the program receives a yearly stipend of \$27,200, plus health insurance and tuition for up to 11 credit hours of academic instruction.

UAB BME *Frontiers in Cardiovascular Bioengineering* Seminar Series

UAB BME sponsors the *Frontiers in Cardiovascular Bioengineering* seminar series with the goal of bringing top researchers to campus to benefit faculty, students, and broader research community.

Our esteemed speakers have included, in alphabetical order:

Victor J. Dzau, MD

President, National Academy of Medicine (NAM)

"Rebuilding the Failing Heart: Bypassing Roadblocks in Cardiac Cell Therapy"

Joseph A. Hill, MD, PhD

Professor of Medicine and Molecular Biology

James T. Willerson, MD, Distinguished Chair in Cardiovascular Diseases

Frank M. Ryburn, Jr. Chair in Heart Research

Chief of Cardiology

UT Southwestern Medical Center

"Heart Failure: The Path Ahead"

Steven P. Jones, PhD

Professor of Medicine

Institute of Molecular Cardiology

University of Louisville

"Glucose in the Heart: Not Just Another Fuel"

Christopher M. Kramer, MD

Ruth C. Heede Professor

Director, Cardiovascular Imaging Center

University of Virginia School of Medicine

"Comprehensive Magnetic Resonance in

Peripheral Arterial Disease"

Philippe Menasché, MD, PhD

Professor, Thoracic and Cardiovascular Surgery,

University of Paris Descartes

Chief, Heart Failure Surgery Unit

Professor of BME, Univ of Alabama at Birmingham

"Pluripotent Stem Cells in the Clinics:

The ESCORT Trial and Beyond"

Jalees Rehman, MD

Professor of Medicine, Pharmacology, and BME Director of Research, Division of Cardiology

University of Illinois at Chicago

"Studying Vascular Regeneration & Endothelial Heterogeneity using Lineage Tracing and

Transcriptomic Analyses"

Michael Sacks, PhD

W. A. "Tex" Moncrief, Jr. Endowment in Simulation-Based Engineering and Sciences

Chair and Professor of Biomedical Engineering

The University of Texas at Austin

"Multi-Resolution Models of the Mitral Heart Valve: From Mechanobiology to Surgical Repair"

Kâmil Uğurbil, PhD

McKnight Presidential Endowed Chair Professor

Director, Center for Magnetic Resonance Research

University of Minnesota Medical School

"Harnessing Ultrahigh Magnetic Fields for Imaging Organ Function and Physiology"

Joseph Woo, MD

Norman E. Shumway Professor and Chair, Department of Cardiothoracic Surgery

Stanford University School of Medicine

"Engineering, Science, and Surgery Converging to Cure Cardiovascular Diseases"

Wolfram-Hubertus Zimmermann, MD

Director, Institute of Pharmacology University Medical Center

Göttingen Georg-August University, Göttingen, Germany

"Tissue Engineered Heart Repair"



From left, UAB BME Chair Dr. Jay Zhang is pictured with NAM President Dr. Victor J. Dzau, School of Engineering Dean Iwan Alexander, and Cardiovascular Division Director Dr. Sumanth Prabhu. (Photo by Dr. Ram Kannappan)

FEATURED PUBLICATIONS

LEFT: Cover Image from J Zhang Lab article —

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