

# BME

50<sup>th</sup>  
1968-2018  
Anniversary  
Vanderbilt University  
Biomedical Engineering



VANDERBILT UNIVERSITY

## GRADUATE PROGRAM

- A research-based program focused in Biomaterials and Drug Delivery, Biomechanics and Mechanobiology, Low Resource and Microfluidic Diagnostics, Medical Devices and Modeling, Biomedical Photonics, and Medical Imaging
- Eighth-ranked Vanderbilt School of Medicine adjoins Vanderbilt BME
- Dynamic and accomplished faculty (8 BMES Fellows, 18 Fellows of AIMBE)
- Diverse secondary faculty across the School of Engineering, basic sciences, and Vanderbilt University Medical School
- Nationally recognized graduate students: 27 fellowships from 2013-2016: NSF GRFP (14), American Heart Association (5), NIH NRSA (3), NDSEG (2), others (3)
- Numerous training grants across the campus with opportunities to shadow clinicians, perform interdisciplinary work, and interact with students across campus
- Vanderbilt Institute in Surgery and Engineering (ViSE)
- Vanderbilt Center for Biophotonics (VCB)
- Vanderbilt Institute for Nanoscale Science and Engineering (VINSE)
- Vanderbilt University Institute of Imaging Science (VUIIS)
- New Engineering and Science Building (opened in 2017), housing BME faculty working in Drug Delivery, Biomaterials, and Cellular Engineering
- State-of-the-art microfabrication facilities, optical imaging, medical imaging, proteomics, genomics, single cell-analysis, transgenic mouse facilities, etc.

## GRADUATE CURRICULUM

Ph.D. students complete 27 semester hours of courses that span biomedical engineering, basic sciences, and medicine. Choose courses in consultation with program faculty to achieve breadth and depth and prepare for research and future career goals. There is no preliminary exam and most students complete their proposal in their third year. Feedback provided through meeting with a mentoring committee comprising three project-relevant faculty each semester.

## OTHER OPPORTUNITIES AS A GRADUATE STUDENT AT VANDERBILT

- **Clinical Immersive Experiences** involving observing surgical/interventional procedures and attending clinical conferences capitalizing from Vanderbilt's top-ranked medical school
- Numerous certificate programs including programs in **Surgical and Interventional Engineering and Technology Entrepreneurship**
- **Graduate Teaching Fellows Program**, which mentors students interested in faculty positions in teaching skills
- **TechVenture Challenge**, which consists of business plan competitions, educational workshops, and network events as a crash course in entrepreneurship and technology commercialization.
- Two semester-long sequence in **Innovation Realization**: a course where Ph.D. students, law students and MBA students work in teams to develop a strategy to take ideas and turn them into commercial products
- **ASPIRE**—Augmenting Scholar Preparation and Integration with Research-related Endeavors—a short course focused on entrepreneurship in the biomedical research area
- **NSF i-Corps Site**: prepares scientists and engineers to extend their focus beyond the university laboratory, and accelerates the economic and societal benefits of NSF-funded, basic-research projects that are ready to move toward commercialization.
- Multiple outreach opportunities in K-12 education and the broader community
- **Center for Technology Transfer and Commercialization**
- Recent major (\$300 million) university investments in graduate education and research
- Plans to build graduate and professional student housing near campus (estimated to be ready for occupancy in fall 2020).
- Professional/career development programs including access to a career counselor specifically for graduate students.

## ABOUT VANDERBILT AND NASHVILLE

Vanderbilt is a private research university founded in 1873. It enrolls 12,000 undergraduate, graduate, and professional students from all 50 U.S. states and more than 90 foreign countries in four undergraduate and six graduate and professional schools with more than 25% minority students and 10.5% international students. It is associated with the Vanderbilt University Medical Center, the only Level I trauma center in Middle Tennessee.

Nashville is a vibrant, engaging city known proudly as "Music City, U.S.A" and nicknamed "Nashvegas" for its fun atmosphere. Its music scene runs much deeper than only country music. It hosts the Country Music Awards and is close to the Bonnaroo Music and Arts Festival in addition to numerous other shows and festivals. Nashville is home to the Nashville Predators National Hockey League team (Western Conference Champions in 2017!), Tennessee Titans National Football League team, and Nashville Sounds (triple A) major league baseball team. Vanderbilt's campus is located just a little more than a mile from downtown. The entire Vanderbilt campus is an arboretum containing over 6,000 identified trees and shrubs of approximately 190 species. It is a park-like setting against the backdrop of thriving, urban Nashville.

## IMPORTANT DATES:

**JAN 1:** Application deadline, including all supporting credentials

**EARLY MARCH:** Visit dates

**APRIL 15:** Deadline to accept admission



VANDERBILT  
SCHOOL OF ENGINEERING

# RESEARCH AREAS

## BIOMATERIALS AND DRUG DELIVERY

- Craig L. Duvall, Ph.D.—Intracellular biologic delivery, environmentally-responsive polymeric materials, controlled release, biomaterials for wound healing, molecularly-targeted breast cancer therapeutics
- Michael R. King, Ph.D.—Nanoscale liposomes and nanoparticles for cellular delivery to disseminating tumor cells. Nanostructured surfaces for the isolation of rare cells. Genetic and molecular engineering for targeted cancer drug delivery
- Todd D. Giorgio, Ph.D.—‘Smart’ nanoscale gene and drug delivery agents designed for in vivo function and focused on cancer treatment, especially immunotherapy.
- Cynthia Reinhart-King Ph.D.—Biomaterials for the creation and utilization of engineered models of disease progression.

## BIOMECHANICS AND MECHANOBIOLOGY

- Brett Byram, Ph.D.—Shear wave based soft tissue mechanical assessment for disease staging
- Craig L. Duvall, Ph.D.—Surgical mechanical stress impact on vascular graft failure, load induced posttraumatic osteoarthritis
- Michael R. King, Ph.D.—Mechanotransduction of cancer and blood cells, responses to circulatory levels of fluid shear stress. Physical mechanisms of cancer metastasis.
- W. David Merryman, Ph.D.—Mechanobiology of cardiopulmonary fibrosis, with particular focus on pulmonary hypertension, heart failure, and heart valve disease.
- Michael I. Miga, Ph.D.—Soft-tissue biomechanics for image-guided surgery, biomechanics of tumor growth for use in therapeutic forecasting
- Cynthia Reinhart-King, Ph.D.—Mechanics of tissues and cells in metastasis, angiogenesis and atherosclerosis.

## BIOMEDICAL PHOTONICS

- Justin Baba, Ph.D.—Polarimetric imaging and sensing for non-invasive diagnostics and therapeutics
- Anita Mahadevan-Jansen Ph.D.—Light-based technologies for real time disease diagnosis and guidance of surgery, development of new microscopies, neurophotonics for modulating and detecting function in the nervous system
- Yuankai (Kenny) Tao, Ph.D.—High-throughput optical imaging and assay technologies for in vivo visualization of angiogenesis and regeneration mechanisms in the lung and retina.

## LOW RESOURCE AND MICROFLUIDIC DIAGNOSTICS

- Franz Baudenbacher, Ph.D.—NanoCalorimeter-based point of care assays technologies for the diagnosis of infectious and metabolic diseases.
- Frederick (Rick) Haselton, Ph.D.—Design and implementation of biomarker-based simple diagnostic devices for infectious diseases appropriate for low resource environments
- Anita Mahadevan-Jansen Ph.D.—Novel light-based technologies to solve specific challenges in global health
- Cynthia Reinhart-King, Ph.D.—Microfluidics and microfabricated devices to study disease progression

## MEDICAL DEVICES AND MODELING

- Brett Byram, Ph.D.—Low-cost devices for point-of-care diagnostics and ultrasonic wave propagation modeling.
- Franz Baudenbacher, Ph.D.—Cyber physical systems for advanced diagnostics and disease management.
- W. David Merryman, Ph.D.—Development of novel percutaneous devices to treat cardiac diseases.
- Michael I. Miga, Ph.D.—Integrated systems for image guided surgery and tissue measurement, finite element modeling for surgical and interventional applications (resection, neurostimulation, ablation, and chemotherapy)
- Todd D. Giorgio, Ph.D.—Early detection and advanced treatment devices for sepsis. Multifunctional ZnO nanowires for advanced biosensing. Integrating high dimensional data with preclinical studies to advance cancer biology and therapy.
- Anita Mahadevan-Jansen Ph.D.—Light-based technologies to solve specific challenges in real time diagnosis and guidance of surgery,
- Mikail Rubinov, M.B., Ph.D.—Network analysis and modeling of large-scale structural and functional brain circuits. Constraints on whole-brain network organization. Information transfer in neural systems.
- Yuankai (Kenny) Tao, Ph.D.—Portable multi-modality optical imaging systems for point-of-care ophthalmic diagnostics and therapeutic guidance.

## MEDICAL IMAGING

- Franz Baudenbacher, Ph.D.—Functional optical imaging in isolated heart preparations to study arrhythmogenesis.
- Justin Baba, Ph.D.—Motion corrected functional brain imaging
- Brett Byram, Ph.D.—Ultrasound beamforming and front-end processing for improved imaging in difficult to image patients and non-contrast ultrasound perfusion imaging.
- Mark D. Does, Ph.D.—Quantitative MRI method development and experimental evaluation; current applications for characterizing white matter microstructure and bone fragility
- William A Grissom, Ph.D.—RF pulses and parallel excitation systems for ultra-high field MRI, MRI for guided interventions
- Michael I. Miga, Ph.D.—Model-based inverse problems for diagnostic imaging, medical image processing and analysis
- Mikail Rubinov, M.B., Ph.D.—Network analysis and modeling of large-scale structural and functional brain circuits. Neuropsychiatric connectivity phenotypes
- Yuankai (Kenny) Tao, Ph.D.—Real-time image-guided ophthalmic surgery using augmented-reality
- Anita Mahadevan-Jansen Ph.D.—Optical imaging approaches for real time diagnosis and guidance of surgery

## CONTACT

Director of Graduate Studies, Cynthia A. Reinhart-King, [cynthia.reinhart-king@vanderbilt.edu](mailto:cynthia.reinhart-king@vanderbilt.edu), 615-875-8309  
Director of Graduate Recruiting, Craig Duvall, [craig.duvall@vanderbilt.edu](mailto:craig.duvall@vanderbilt.edu), 615-322-3598

