

# DEPARTMENT OF BIOMEDICAL ENGINEERING

340 Wickenden Building  
 Phone: 216.368.4063; Fax: 216.368.4969  
 Robert F. Kirsch, Chair  
 bmedept@case.edu

**More Information:** <http://bme.case.edu>

The Department of Biomedical Engineering was established in 1968 as a joint department between the Case School of Engineering and the School of Medicine at Case Western Reserve University. Biomedical Engineering uses engineering principles to develop innovative and unique insight into physiological mechanisms and solutions to a wide range of biomedical and clinical challenges. As one of the pioneering programs in the world, the department has established rigorous yet flexible educational programs that are emulated by many other institutions and is a national leader in cutting-edge research in several important areas. The department's educational programs provide training in cellular and subcellular mechanisms for understanding fundamental physiological processes, in dealing with biomedical problems at the tissue and organ system level, and in integrating this knowledge in systems approaches to solving clinical problems.

Current degree programs include the BSE, MS, ME, combined BS/MS, PhD, MD/MS, and MD/PhD in Biomedical Engineering. In all of the BME programs at Case, the goal is to educate engineers who can apply engineering methods to problems involving living systems. The Case School of Engineering and the School of Medicine are in close proximity on the same campus, and all Biomedical Engineering faculty members carry joint appointments in both of these two schools, participating in the teaching, research, and decision-making committees of both. The department is also tightly linked with several major nearby medical centers (University Hospitals, Cleveland Clinic, VA Medical Center, and MetroHealth Medical Center). Most faculty pursue research in collaboration with researchers and physicians in these institutions, and all of the Biomedical Engineering educational programs take advantage of these close relationships. The Biomedical Engineering department has established the Biomedical Engineering Alliance with the Department of Biomedical Engineering in the Lerner Research Institute of the Cleveland Clinic, resulting in a very large faculty cohort, research activities that are broad and deep, and strong cooperation on moving discoveries into products that improve health.

## Mission

To educate leaders who will integrate principles of both engineering and medicine to create knowledge and discoveries that advance human health and well-being. Our faculty and students play leading roles ranging from basic science discovery to the creation, clinical evolution, and commercialization of new technologies, devices, and therapies. In short, "Engineering Better Health."

## Background

Graduates in biomedical engineering are employed in industry, hospitals, research centers, government, and universities. Biomedical engineers also use their undergraduate training as a basis for careers in business, medicine, law, consulting, and other professions.

## Research

Several research thrusts are available to accommodate various student backgrounds and interests. Strong research collaborations with clinical and basic science departments of the university and collaborating medical centers bring a broad range of opportunities, expertise, and perspective to student research projects.

### Biomaterials/Tissue Engineering/Drug and Gene Delivery

Fabrication and analysis of materials for implantation, including neural, orthopaedic, and cardiovascular tissue engineering, biomimetic materials, liposomal and other structures for controlled, targeted drug delivery, and biocompatible polymer surface modifications. Analysis of synthetic and biologic polymers by AFM, nanoscale structure-function relationships of biomaterials. Applications in the nervous system, the cardiovascular system, the musculoskeletal system, and cancer.

### Biomedical Imaging

MRI, PET, SPECT, CT, ultrasound, acoustic elastography, optical coherence tomography, cardiac electrical potential mapping, human visual perception, image-guided intervention, contrast agents. In vivo microscopic and molecular imaging, and small animal imaging.

### Biomedical Sensing

Optical sensing, electrochemical and chemical fiber-optic sensors, chemical measurements in cells and tissues, endoscopy. Wearable sensor systems analytics and machine learning algorithm development for sports health and cardiovascular applications. Internet of Things (IoT) smart sensor and smart speaker systems translational research in support of medication management, dementia, and related patient care.

### Biomedical Artificial Intelligence

Radiomics, Radiogenomics, computer-assisted diagnosis, digital pathology, co-registration, cancer detection, decision making, precision medicine, bioinformatics, image informatics, machine learning, pattern recognition, artificial intelligence, deep learning.

### Neural Engineering and Neural Prostheses

Neuronal mechanisms; neural interfacing for electric and magnetic stimulation and recording; neural dynamics, ion channels, second messengers; neural prostheses for control of limb movement, bladder, bowel, and respiratory function; neuromodulation systems for movement disorders, epilepsy, pain mitigation, visceral functions; computational modeling and simulation of neural structures.

### Transport and Metabolic Systems Engineering

Modeling and analysis of tissue responses to heating (e.g., tumor ablation) and of cellular metabolism related to organ and whole-body function in health (exercise) and disease (cardiac).

### Biomechanical Systems

Computational musculoskeletal modeling, bone biomechanics, soft tissue mechanics, control of neuroprostheses for motor function, neuromuscular control systems, human locomotion, cardiac mechanics.

### Cardiovascular Systems

Normal cardiac physiology, pathogenesis of cardiac diseases, cardiac development, therapeutic technologies, including cardiac regeneration, electrophysiological techniques, imaging technologies, mathematical

modeling, gene regulation, molecular biology techniques, cardiac bioelectricity, and cardiac biomechanics.

## Primary Appointments

Abhinav P. Acharya, PhD  
(University of Florida)

*Assistant Professor*

Immunoengineering, Immunometabolism, Biomaterials, Drug Delivery

Robert F. Kirsch, PhD  
(Northwestern University)

*Professor and Chair; Executive Director, Functional Electrical Stimulation Center*

<http://engineering.case.edu/groups/BrainGate2/>

Restoration of movement using neuroprostheses; neuroprosthesis control system design; natural control of human movements; brain-computer interfacing; biomechanics of movement; computer-based modeling; and system identification

A. Bolu Ajiboye, PhD  
(Northwestern University)

*Elmer Lincoln Associate Professor; Associate Chair-Undergraduate Programs; Executive Vice Chair for BME*

Development and control of brain-computer-interface (BCI) technologies for restoring function to individuals with nervous system injuries

Jay Alberts, PhD  
(Arizona State University)

*Assistant Professor*

Research into how the brain controls skilled movements and how changes in brain function affect movement performance

Suneel Apte, PhD  
(Bombay University & University of Oxford)

*Associate Professor*

Examine how mutations in ADAMTS proteases cause birth defects that affect the heart, blood vessels, neural tube, eyes, palate and limbs

James P. Babilion, PhD  
(The University of Texas)

*Professor of Biomedical Engineering and Radiology*

High resolution imaging of endogenous gene expression; definition of "molecular signatures" for imaging and treatment of cancer and other diseases; generating and utilizing genomic data to define informative targets; strategies for applying non-invasive imaging to drug development; and novel molecular imaging probes and paradigms

Jeffrey Capadona, PhD  
(Georgia Institute of Technology)

*Leonard Case, Jr. Professor in Engineering; Associate Chair-Graduate Programs; Dean's Fellow for Research*

Advanced materials for neural interfacing; biomimetic and bio-inspired materials; host-implant integration; anti-inflammatory materials; and novel biomaterials for surface modification of cortical neuroprostheses

Margot Damaser, PhD  
(University of California at Berkeley)  
*Professor*

Conduct regenerative medicine, tissue engineering and device development research aimed at improving the health of individuals with pelvic floor dysfunction, including urinary and fecal incontinence and pelvic organ prolapse

Kathleen Derwin, PhD  
(University of Michigan)

*Assistant Professor*

Investigating the factors that influence clinical outcomes following rotator cuff repair, including extracellular matrix scaffold technologies to enhance healing

Colin K. Drummond, PhD (Syracuse University), MBA (Case Western Reserve University)

*Professor and Assistant Chair*

Medical device design; wearable sensor systems in sports health, urology and cardiology; advanced simulation for clinical decision support systems; and, clinical information systems for patient-centered care.

Dominique M. Durand, PhD  
(University of Toronto, Canada)

*Elmer Lincoln Lindseth Professor and Distinguished University Professor; Associate Chair-MS Program Development; Director, On-line MS Programs; Director, Neural Engineering Center*

Neural engineering; neural interfacing with peripheral nervous system; electric and magnetic field interaction with neurons; neural prostheses for restoring motor function; neurophysiology and computational neuroscience of neural activity generation and propagation; neuromodulation; electrical stimulation and control of epilepsy; bioelectric medicine.

Steven J. Eppell, PhD  
(Case Western Reserve University)

*Associate Professor*

Biomaterials; instrumentation; nanoscale structure-function analysis of orthopaedic biomaterials; and scanning probe microscopy and spectroscopy of skeletal tissues

Ahmet Erdemir, PhD  
(Pennsylvania State University)

*Assistant Professor*

Developing state-of-the-art computational representation of the human body to determine how movement patterns and loads on the joints affect tissues and cells

David Escobar, PhD  
(University of Minnesota)

*Assistant Professor*

Research integrates neurophysiology, feedback control engineering, signal processing, and data science to 1) characterize neural circuit dynamics underlying dysfunction in Parkinson's disease and epilepsy, and 2) advance the development of personalized neuromodulation therapies.

Stephen Fening, PhD  
(Ohio University)

*Professor; Managing Director, Case-Coulter Translational Research Partnership*

Patient care through translational research and commercialization

Aaron Fleischman, PhD  
(Case Western Reserve University)

*Assistant Professor*

Research into the application of micro and nano technology, including how to shrink high-functioning large systems into small computer-like chips for implantation or minimally invasive procedures

Kiyotaka Fukamachi, PhD  
(Kyushu University)

*Professor*

Pioneering surgical and device treatments for heart failure; investigating mechanical support devices, such as implantable heart pumps, the total artificial heart, and advanced heart valves

Chaitali Ghosh, PhD  
(Indian Institute of Toxicology Research & Hamdard University)

*Associate Professor*

Investigating novel therapeutic targets at the blood-brain barrier to improve drug efficacy, and devise strategies for early therapeutic intervention in pharmaco-resistant epilepsy

Emily L. Graczyk, PhD  
(Case Western Reserve University)

*Assistant Professor*

Cortical and peripheral neurostimulation to restore and augment human sensation; brain-computer interfacing; cognitive neuroscience; sensory neuroscience; computational modeling of neurostimulation; neuroprostheses for upper limb sensorimotor function

Linda Graham, MD  
(University of Michigan)

*Professor*

Investigating how oxidized lipids contribute to the build-up of scar tissue and block the movement of endothelial cells into an area of injury or onto a bypass graft

William Grissom, PhD  
(University of Michigan)

*Professor*

The Grissom lab develops RF pulse design and image reconstruction methods as well as RF coils for MRI from 47 mT to 7 T, and develops interventional MRI methods for guiding focused ultrasound and laser ablation and neuromodulation.

Kenneth Gustafson, PhD  
(Arizona State University)

*Associate Professor*

Neural engineering; neural prostheses; neurophysiology and neural control of genitourinary function; devices to restore genitourinary function; and functional neuromuscular stimulation

Vincent Hascall, PhD  
(Rockefeller University)

*Professor*

Investigate how the sugar molecule hyaluronan forms normal and abnormal matrices that are required everywhere, from successful fertilization, to the protection and repair of tissues, to cancer development

Peter S. Hovmand, PhD, MSW  
(Michigan State University)

*Pamela B. Davis MD PhD Professor of Medicine*

Computer modeling and simulation of multiscale nonlinear feedback systems; model equivalence; community engaged system design; implementation science; structural violence (gender based violence, structural racism)

Michael Jenkins, PhD  
(Case Western Reserve University)

*Associate Professor, Biomedical Engineering, Pediatrics; The Dr. Donald and Ruth Weber Goodman Professor of Innovative Cardiovascular; Director of the School of Medicine Light Microscopy Imaging Core (SOM-LMIC)*

Biomedical optics; optical neuromodulation; advanced 3D microscopy including tissue clearing, light-sheet microscopy, and deep learning; functional nerve imaging; Applications ranging from heart development, pain treatment, pathology, and ocular surface diseases

Efstathios (Stathis) Karathanasis, PhD  
(University of Houston)

*Professor, Associate Chair School of Medicine; Vice Chair for BME/SOM*  
Fabricating multifunctional agents that facilitate diagnosing; treating and monitoring of therapies in a patient-specific manner

Vijay Krishna, PhD  
(University of Florida)

*Assistant Professor*

Leveraging nanotechnology to design next-generation nano-engineered materials for non-invasive therapies and prevention of cancer, especially skin cancer

Vinod Labhasetwar, PhD  
(Nagpur University)

*Professor*

Explore the use of nanotechnology, such as nanoparticles that can find their way into specific cells or tissues to treat various diseases, including cancer, stroke, and cardiovascular conditions

Shuo Li, PhD  
(Concordia University)

*Associate Professor*

Innovating foundational machine learning to unlock the full potential of the complex and heterogeneous imaging-centered clinical data to enable innovative true clinical Artificial Intelligence (AI) applications, overcoming the current challenges in healthcare

Xiaojuan Li, PhD  
(University of California at Berkeley)

*Professor*

Exploring and developing advanced musculoskeletal imaging techniques to be applied in a range of orthopaedic and rheumatologic disorders

Zheng-Rong Lu, PhD  
(Lanzhou Institute of Chemical Physics, Chinese Academy of Sciences)

*M. Frank Rudy and Margaret Domiter Rudy Professor of Biomedical Engineering; Director, Case Center for Biomolecular Engineering*

Drug delivery and molecular imaging; novel targeted imaging agents for molecular imaging; novel MRI contrast agents; image-guided therapy and drug delivery; drug delivery systems; multi-functional delivery systems for nucleic acids; non-viral gene therapy

Dan Ma, PhD  
(Case Western Reserve University)

*Assistant Professor*

Magnetic Resonance Imaging (MRI); Magnetic Resonance Fingerprinting ; Quantitative MR; MR Acquisition and Modeling; Neuroimaging

Paul Marasco, PhD  
(Vanderbilt University)  
Investigating sensory integration with prosthetic devices to develop translational approaches for providing natural touch and movement feedback for artificial limbs

Edward Maytin, MD, PhD  
(University of Rochester)  
*Associate Professor*  
(1) Studying wound healing to learn how the extracellular matrix can regulate inflammation and fibrosis in healing wounds; (2) Studying photodynamic therapy of skin cancers in mice and humans in order to improve therapeutic response

Debra McGivney, PhD  
(Case Western Reserve University)  
*Assistant Professor; Co-Chair BME Undergraduate Education Committee (UGEC)*  
Magnetic resonance imaging, magnetic resonance fingerprinting, mathematical modeling, inverse problems.

Michael A. Moffitt, PhD  
(Case Western Reserve University)  
*Associate Professor*  
Mechanisms and therapeutic applications of photobiomodulation; deep brain stimulation for movement disorders; low amplitude spinal cord stimulation for the treatment of chronic pain; computational modeling of neural response to electrical stimulation

George F. Muschler, MD  
(Northwestern University)  
*Professor*  
Development and translation of methods for harvest, processing and quantitative characterization of human stem and progenitor populations. Translate these methods to advance automated methods for fabrication and characterization of safe and effective cellular therapy strategies and products

Ela Plow, PhD  
(University of Minnesota)  
*Associate Professor*  
Neurophysiology to guide movement rehabilitation and brain stimulation interventions in patients with paralysis following Stroke and spinal cord injury

Christopher Pulliam, PhD  
(Case Western Reserve University)  
*Assistant Professor*  
Functional recovery after neurological injury; Patient monitoring and impairment quantification; Clinical decision support systems; Precision rehabilitation

Andrew M. Rollins, PhD  
(Case Western Reserve University)  
*Professor; Faculty co-director, Center for Engineering Action*  
Biomedical optics; biomedical optical imaging; optical coherence tomography; cardiovascular and ophthalmic applications

Carl Saab, PhD  
(Brown University)  
*Staff, Cleveland Clinic Lerner Research Institute; Director of the Pain Science Technology and Research (STAR) Lab*  
Research to define the brain networks mediating pain, based on emerging scientific findings showing that pain is mediated by brain activity.

Anirban Sen Gupta, PhD  
(The University of Akron)  
*Professor*  
Targeted drug delivery; targeted molecular imaging; image-guided therapy; platelet substitutes; novel polymeric biomaterials for tissue engineering scaffolds

Sam Senyo, PhD  
(University of Illinois)  
*Assistant Professor*  
Cardiovascular regeneration; microenvironment; stable isotopes; biomaterials, microfabrication; and drug delivery

Andrew Shoffstall, PhD  
(Case Western Reserve University)  
*Assistant Professor; Vice Chair for BME/SOM*  
Development of minimally invasive neural interfaces; biomaterials; drug delivery; blood-brain barrier permeability

Ronald J. Triolo, PhD  
(Drexel University)  
*Professor, Orthopaedics, University Hospitals-Case Medical Center, VA Medical Center, MetroHealth Medical Center*  
Neural prostheses, rehabilitation engineering and restoration of lower extremity function, biomechanics of human movement quantitative analysis and control of gait, standing balance and seated posture

Dustin J. Tyler, PhD  
(Case Western Reserve University)  
*Kent Hale Smith Professor for the Case School of Engineering II*  
Neuromimetic neuroprostheses; laryngeal neuroprostheses; clinical implementation of nerve electrodes; cortical neuroprostheses; minimally invasive implantation techniques; and modeling of neural stimulation and neuroprostheses

D. Geoffrey Vince, PhD  
(University of Liverpool)  
*Professor*  
Developing a tool that will predict which patients are at increased risk of stroke to help physicians determine the best treatment approach

Satish Viswanath, PhD  
(Rutgers University)  
*Associate Professor*  
Medical image analysis, radiomics, and machine learning schemes for imaging data. Focused on designing unique image analytics tools that capture biologically relevant measurements and conducting cross-scale associations across imaging, pathology, and -omics. Applications explored in computer-aided diagnosis & disease characterization, decision support for treatment and targeting, as well as quantitative evaluation of response to treatment in vivo; for gastrointestinal cancers and digestive diseases.

Horst A. von Recum, PhD  
(University of Utah)

*Professor and Executive Vice Chair*

Affinity-based delivery of small molecule drugs and biomolecules for applications in device infection, HIV, orthopedics, cardiovascular, ophthalmology and cancer; directed differentiation of stem cells for tissue engineering applications, such as endothelial cells, cardiomyocytes, motor neurons and T-cells

Matthew R. Williams, PhD  
(Case Western Reserve University)

*Assistant Professor; Co-Chair BME Undergraduate Education Committee (UGEC)*

Experiential education including engineering design, programming, and fabrication; control of prosthetics and assistive technology for stroke and spinal cord injury

David L. Wilson, PhD  
(Rice University)

*Robert J. Herbold Professor of Biomedical Engineering*

Biomedical image processing; machine/deep learning; multiple modalities including OCT, CT, MRI, microscopy, and ultrasound; applications in cardiology, ophthalmology, and cancer

Xin Yu, ScD  
(Harvard-MIT)

*F. Alex Nason Professor II*

Development and application of magnetic resonance imaging and spectroscopy methods for understanding cardiovascular and metabolic diseases, including diabetes, stroke, and cardiomyopathy.

Maciej Zborowski, PhD  
(Warsaw University)

*Associate Professor Emeritus*

Investigating novel methods of cell separation for medical applications, including rapid screening for cancer cells in blood and isolation of blood-forming stem cells

Mei Zhang, PhD  
(Wuhan University)

*Assistant Professor*

Nanotechnology for Cancer Diagnosis and Treatment; Imaging and Manipulation of Tumor Microenvironment; Cancer Immunotherapy; Adoptive T cell Immunotherapy

---

## Secondary Appointments

Ozan Akkus, PhD  
(Case Western Reserve)

*Professor, Mechanical Aerospace Engineering*

Development of novel biomaterials that will substitute bone and soft tissues, bioinspired from the synthesis of bone such that ductile biocompatible polymer matrices are subjected to mineralization. Tendon replacement strategy involves alignment of collagen monomers by a novel electrochemical method to obtain strong bundles

Harihara Baskaran, PhD  
(Pennsylvania State University)

*Professor, Chemical Engineering*

Biotransport, Tissue/Cell metabolism, Cell transport, Microvascular tissue engineering, Cartilage tissue engineering

Jonathan Baskin, MD  
(New York University)

*Associate Professor, Section Chief Otolaryngology-Head & Neck Surgery, Cleveland VA Medical Center and faculty, University Hospitals-Cleveland Medical Center*

Peripheral Neuromodulation, Bioengineering of bone substitutes using nanotechnology

Martin Bocks, MD  
(Wayne State University School of Medicine)

*Associate Professor, Pediatrics, Division of Pediatric Cardiology*

Pediatric medical device development, including bioresorbable stents, wireless implantable pressure sensors, pediatric ECMO cannula

Kath Bogie, D.Phil  
(Oxford University)

*Associate Professor, Orthopaedics*

Primary and secondary prevention of chronic wounds through novel clinically-focused approaches. Translational clinical research includes studies to determine why some people experience a continuous cycle of pressure injuries while others remain pressure injury free, looking at both biomarkers and bioinformatics, complemented with smart technology development to address these issues.

Dennis Bourbeau, PhD  
(University of Pittsburgh)

*Assistant Professor, Physical Medicine and Rehabilitation, MetroHealth System*

Neuroprosthetics for restoring bladder and bowel function after spinal cord injury

M. Cenk Cavusoglu, PhD  
(University of California, Berkeley)

*Nord Professor of Engineering in Electrical, Computer, and Systems Engineering*

Robotics, systems and control theory, human-machine interfaces emphasizing medical robotics, haptics, virtual environments, surgical simulation, and bio-system modeling and simulation

John Chae, MD  
(Rutgers University - New Jersey Medical School)

*Professor and Chair, Physical Medicine and Rehabilitation, VP for Research and Sponsored Programs, MetroHealth System*

Neuromuscular Electrical Stimulation for motor relearning and neuroprosthesis in stroke; peripheral nerve stimulation for musculoskeletal pain; stroke rehabilitation

Vipin Chaudhary, PhD  
(The University of Texas at Austin)

*Kevin J. Kranzusch Professor and Inaugural Chair, Department of Computer and Data Sciences*

High Performance Computing and Applications to Science, Engineering, Biology, and Medicine; Artificial Intelligence and Machine Learning; Big Data and Datascience; Edge Computing; Computer Assisted Medical Diagnosis and Interventions; Medical Image Analysis; Computer Architecture; Quantum Computing.

Hillel J. Chiel, PhD  
(Massachusetts Institute of Technology)

*Professor, Biology*

Biomechanical and neural basis of feeding behavior in the marine mollusk *Aplysia californica*, neuromechanical system modeling, analysis of neural network dynamics

Angela Dixon, PhD  
(University of Michigan-Ann Arbor)  
*Assistant Professor*

William J. Dupps, Jr., MD, PhD  
(The Ohio State University)  
*Professor, Ophthalmology, Cleveland Clinic's Lerner College of Medicine*  
Corneal and ocular biomechanics, finite element modeling of the eye, simulation-based medicine

Mohamed S. Draz, PhD  
(Harvard University)  
*Assistant Professor*  
Development and translation of novel nano- and micro-systems.

Agata Exner, PhD  
(Case Western Reserve University)  
*Professor, Radiology, University Hospitals-Case Medical Center*  
Development of contrast agents for ultrasound molecular imaging and image-guided drug delivery.

Christopher Flask, PhD  
(Case Western Reserve University)  
*Professor, Radiology*  
Develops quantitative MRI techniques for both basic science and translation imaging research in multiple diseases including cancer, neurological diseases, cystic fibrosis, and chronic kidney and liver diseases

Roger French, PhD  
(Massachusetts Institute of Technology)  
*Professor, Materials Science and Engineering*  
Lifetime and degradation science, photovoltaics, OLED and LED lighting and displays, polymer degradation

Michael J. Fu, PhD  
(Case Western Reserve University)  
*Assistant Professor, Dept. of Electrical, Computer, and Systems Engineering*  
Virtual environments, human-computer interfaces, and functional electrical stimulation for neurorehabilitation

Hong Seng Gan, PhD  
(Xi'an Jiaotong - Liverpool University)  
*Adjunct Associate Professor*

Mark Griswold, PhD  
(University of Wuerzburg, Germany)  
*Professor, Radiology, University Hospitals-Case Medical Center*  
Rapid magnetic resonance imaging, image reconstruction and processing and MRI hardware/instrumentation

Amit Gupta, MD  
(Baba Farid University of Health Sciences, Faridkot, India)  
*Associate Professor, Radiology*  
Lung cancer, Artificial intelligence Cardiac imaging, Dual energy CT, 3D printing, Radiomics, Image coregistration

Umut A Gurkan, PhD  
(Purdue University)  
*Warren E. Rupp Associate Professor, Mechanical and Aerospace Engineering, Orthopaedics*  
Micro/nano engineered systems, biosensing, clinical Microfluidics, point-of-care diagnostics, microcirculation, sickle cell disease

Alex Y. Huang, MD, PhD  
(Johns Hopkins University)  
*Professor, Pediatrics, University Hospitals Cleveland Medical Center/UH Rainbow Babies & Children's Hospital*  
Tumor Immunity, immune landscape and behavior in tissue microenvironment, cellular adhesion and migration

Michael W. Keith, MD  
(The Ohio State University)  
*Professor, Orthopaedic Surgery, MetroHealth Medical Center*  
Restoration of motor function in hands

Kevin L. Kilgore, PhD  
(Case Western Reserve University)  
*Peckham & Picha Professor, Orthopaedics, MetroHealth System*  
Neuroprosthetics for spinal cord injury and electrical nerve conduction block.

Shanina C. Knighton, PhD, RN  
(Case Western Reserve University)  
*Instructor*  
Co-instructs multidisciplinary BioDesign course, senior advisor to undergraduate and graduate biomedical engineering students, research interests in technology-based self-management interventions and wearable sensors

Kandice Kottke-Marchant, MD, PhD  
(Case Western Reserve University)  
*Professor and Chair, Pathology, Cleveland Clinic Lerner College of Medicine (Lerner Research Institute)*  
Thrombosis, hemostasis and vascular disease, hypercoagulable states, bleeding disorders, endothelial cell function, atherosclerosis

Kenneth R. Laurita, PhD  
(Case Western Reserve University)  
*Professor, Medicine, MetroHealth Medical Center*  
Determining mechanisms of and therapy for cardiac arrhythmias, using innovative optical and electrical technologies

Seungyup Lee, PhD  
(Case Western Reserve University)  
*Assistant Professor, Department of Medicine (Cardiology)*  
Cardiac Electrophysiology, Mechanism of Atrial Fibrillation, and Developing Therapeutic Approaches Using Algorithms, Devices, and Neuromodulation for Atrial Fibrillation

Zhenghong Lee, PhD  
(Case Western Reserve University)  
*Professor, Radiology, University Hospitals Cleveland Medical Center*  
Quantitative PET and SPECT imaging, molecular and cellular imaging of cancer, metabolism, infectious diseases and cell-based therapies

Andrei Maiseyeu, PhD  
(M. V. Lomonosov Moscow State University, Russia)  
*Assistant Professor, Medicine*  
Cardiovascular drug development and delivery, immunometabolism, mechanisms of metabolic disease, imaging of atherosclerosis, MRI contract agents, controlled release nanomaterials, microfluidics

Pedram Mohseni, PhD  
(University of Michigan)  
*Goodrich Professor of Mechanical & Aerospace Engineering*  
Biomicrosystems, microelectronics for neurotechnology, wireless integrated sensing/actuating systems, point-of-care diagnostic platforms for personalized health

Raymond F. Muzic, Jr., PhD  
(Case Western Reserve University)  
*Professor, Radiology, University Hospitals-Case Medical Center*  
Quantitative analysis of biomedical imaging data, physiologic modeling, optimal experiment design, assessment of new radiopharmaceuticals, imaging response to therapy, radiation oncology applications of imaging, and artificial intelligence

Tarun Podder, PhD  
(University of Hawaii)  
*Professor, Radiation Oncology*  
Medical robotics; medical device design; system dynamics and control; image-guided radiotherapy; stereotactic body radiotherapy; brachytherapy; image-guided surgical intervention; application of AI in radiation therapy

Julie Renner, PhD  
(Purdue University)  
*Assistant Professor, Chemical Engineering*  
Development of protein engineered materials for use in and study of electrochemical systems

Steve Schomisch, PhD  
(Cleveland State University)  
*Assistant Professor, Surgery*  
Minimally Invasive Surgical Innovation

Aasef G. Shaikh, MD (Maharaja Sayajirao University), PhD (Wayne State University)  
*Associate Professor, Penni and Stephen Weinberg Chair in Brain Health and Vice Chair for Research, Department of Neurology, University Hospitals and Case Western Reserve University*  
Balance and Visuo-spatial navigation, Visual canning patterns, Cerebellar disorders, Deep Brain Stimulation for Parkinson's Disease, tremor and dystonia

Dawn Taylor, PhD  
(Arizona State University)  
*Associate Professor, Molecular Medicine, Cleveland Clinic Lerner College of Medicine (Lerner Research Institute)*  
Brain-controlled neuroprosthetics; Deep brain stimulation for Parkinson's disease; Neural signal processing

Jeffrey Ustin, MD  
(Stanford University School of Medicine)  
*Assistant Professor, General Surgery, University Hospitals*  
Synthetic platelet technology, robot assisted atrial fibrillation ablation, endotracheal tube technology

Russell Wang, DDS, MSD  
(Indiana University)  
*Professor, Comprehensive Care, School of Dental Medicine*  
Dental implant design, instrumentation, bone regeneration, 3D printing of biomaterials, biomechanics of bone fracture, biomaterials for maxillofacial reconstruction

Gary Wnek, PhD  
(University of Massachusetts, Amherst)  
*Professor and Chair, Macromolecular Science and Engineering*  
Bio-mimicking macromolecular constructs with attention to the design and irritable systems; Artificial cells; Advanced films and smart packaging systems; New approaches to impart fire resistance to common polymers

Xiong (Bill) Yu, PhD, P.E.  
(Purdue University)  
*Professor, Civil Engineering*  
Smart infrastructure for healthy built-Environment, sensors and non-invasive testing, smart multifunctional materials, 3D printing, data-driven decisions, machine learning

Nicholas P. Ziats, PhD  
(Case Western Reserve University)  
*Professor, Pathology, Biomedical Engineering & Anatomy*  
Biomaterials and Biocompatibility, Biomaterial Implant Retrieval and Analysis, Cardiovascular Disease and Devices, Vascular Biology

Christian Zorman, PhD  
(Case Western Reserve University)  
*Leonard Case Jr Professor of Mechanical Aerospace Engineering, Electrical, Computer, and Systems Engineering*  
Development of enabling materials and processing techniques for micro- and nanosystems

---

## Research Appointments

Musa L. Audu, PhD  
(Case Western Reserve University)  
*Research Professor*  
Human musculoskeletal modeling and development of control systems for rehabilitation of individuals with spinal cord injury and other balance disorders, design of rehabilitation devices for physically challenged individuals

Rasim Boyacioglu, PhD  
(Radboud University, Netherlands)  
*Research Assistant Professor*  
Large scale brain MR Fingerprinting for efficient exams with individualized reporting and adaptive control: Comprehensive free-breathing abdominal MR Fingerprinting; MR Quantitative Imaging

Hamid Charkhkar, PhD  
(George Mason University)  
*Research Assistant Professor*  
Neuroprostheses to restore sensorimotor function in people with limb loss or neuromusculoskeletal impairment; Sensory-enabled assistive devices to improve balance; Translational Neuroengineering

Chia-Chu Chiang, PhD  
(National Cheng Kung University)  
*Research Assistant Professor*  
Neural modulation on seizure control; non-synaptic seizure generation, and seizure propagation mechanisms; effect and mechanism of transcranial current stimulation.

Allison Hess-Dunning, PhD

(Case Western Reserve University)

*Research Assistant Professor*

Multi-modal neural interfaces to improve long-term recording functionality for brain-machine interfaces; Local therapeutic delivery from neural interfaces for managing neuroinflammation: Microfabrication processes to integrate novel materials for enhanced neural interface performance

Ammar Hoori, PhD

(Virginia Commonwealth University)

*Research Assistant Professor*

Specialist in CT medical imaging, deep and machine learning, cardiac research, R&D, statistical analysis, and time to event modeling

Maryse Lapierre-Landry, PhD

(Vanderbilt University)

*Research Assistant Professor*

Image processing and machine learning for microscopy and optical imaging. Analysis of spatial patterns in nerves and blood vessels in healthy and diseased conditions.

Juhwan Lee, PhD

(Dongguk University, South Korea)

*Research Assistant Professor*

Development of AI methods for the quantitative, comprehensive evaluation of coronary artery disease using intravascular imaging and computed tomography

Grant A. McCallum, PhD

(Case Western Reserve University)

*Research Assistant Professor*

Neural engineering; neural interfacing; neuromodulation; neurophysiology, application specific integrated circuits (ASICs) and wireless implantable systems

James Seckler, PhD

(Case Western Reserve University)

*Research Assistant Professor*

Mapping the human peripheral nervous system with 3D-MUSE enables the optimization of neuromodulatory devices; reversing opioid induced respiratory depression by employing a novel class of pharmaceuticals; Neuroimaging and Neuromodulation

Anuj Sharma, PhD

(Vanderbilt University)

*Research Assistant Professor*

MRI-guided interventions and therapy; RF pulse design to mitigate image artifacts from magnetic field inhomogeneity; AI-enabled pulse sequence design and image reconstruction.

Anandakumar Shunmugavel, PhD

(Manonmaniam Sundaranar University, TN, India)

*Research Assistant Professor*

Specific peripheral nerve activation related translational application in spinal cord injury and drug addiction.

Xinning Wang, PhD

(The Chinese University of Hong Kong)

*Research Associate Professor*

Development of novel molecular image probes for the diagnosis of cancer, development of molecular cancer therapeutic approaches

---

## Adjunct Faculty

Eben Alsberg, PhD

(University of Michigan)

*Adjunct Professor (University of Illinois, Chicago)*

Innovative biomaterials, microenvironments and bioactive factor delivery vehicles for functional tissue engineering, regenerative medicine and disease therapeutics; control of stem cell fate decision; precise temporal and spatial presentation of signals to regulate cell function; mechanotransduction and the influence of mechanics on cell behavior and tissue formation; organoids and organogenesis; therapeutic angiogenesis; and cell-cell interactions

Kenneth B. Baker, PhD

(University of Arizona)

*Adjunct Assistant Professor (Lerner Research Institute, Cleveland Clinic)*

Neuromodulation, Deep Brain Stimulation, Neurophysiology, Neural plasticity, Stroke, Parkinson's disease

Niloy Bhadra, MD, PhD

(Case Western Reserve University)

*Adjunct Associate Professor (PM&R, MetroHealth Medical Center)*

Experimental and computational studies of high frequency waveforms for reversible conduction block of peripheral nerves, design, testing and implementation of neuroprosthetic systems for the upper limb

Michael Bruckman, PhD

(University of South Carolina)

*Adjunct Assistant Professor (Haima Therapeutics LLC)*

Instructor for Masters of Engineering and Management (MEM) program

Scott Bruder, MD, PhD

(Case Western Reserve University)

*Adjunct Professor*

Product Development and Regulatory Affairs in Regenerative Medicine, and Advising Students Regarding Careers in Industry

Richard C. Burgess, MD, PhD

(Case Western Reserve University)

*Adjunct Professor (Neurological Computing, Cleveland Clinic)*

Magnetoencephalography, electrophysiological monitoring, EEG processing, medical informatics

Andrew Cornwell, PhD

(Case Western Reserve University)

*Adjunct Assistant Professor*

Education and training for faculty, staff, and students of commercializing research technology through startups or licensing

Isabelle Deschenes, PhD

(Laval University)

*Adjunct Professor (Chair, Department of Physiology and Cell Biology, The Ohio State University)*

Molecular mechanisms of cardiac arrhythmias, ion channels structure-function, transcriptional regulation of ion channels

Hossein Ghassemi, PhD

(McGill University)

*Adjunct Assistant Professor*

Organic Polymer Chemistry of high performance polymers, composites and adhesives. Novel materials for batteries and fuel cells. Bio-based polymers from renewable sources

Vikas Gulani, MD, PhD  
(University of Illinois)  
*Adjunct Professor (University of Michigan)*  
Diffusion tensor imaging and diffusion anisotropy, MRI microscopy, body MRI, and functional MRI

Elizabeth C. Hardin, PhD  
(University of Massachusetts)  
*Adjunct Assistant Professor (Louis Stokes VA Medical Center)*  
Gait mechanics and performance in health and disability, virtual reality, rehabilitation, prosthetics and orthotics, neural prostheses, modeling and simulation

Thomas Hering, PhD  
(Case Western Reserve University)  
*Adjunct Associate Professor*  
Cartilage biochemistry and molecular biology, alternative mRNA splicing, proteoglycans and neurotrauma

Allison Hess-Dunning, PhD  
(Case Western Reserve University)  
*Adjunct Assistant Professor (Louis Stokes VA Medical Center)*  
Micro- and nano-fabrication strategies for developing advanced neural interfaces aimed at long-term functionality

Michael Hill, PhD, MBA  
(Case Western Reserve University)  
*Adjunct Associate Professor*

Matthew Iorio, MSE, MBA  
(Case Western Reserve University)  
*Adjunct Instructor*

Joseph Jankowski, PhD, MBA  
(Case Western Reserve University)  
*Adjunct Professor (Case Western Reserve University Chief Innovation Officer)*

Administration of multi-party translation and commercialization programs, intellectual property management, technology-based opportunity assessment, commercialization

Fehmida Kapadia, PhD  
(The Ohio State University)  
*Adjunct Assistant Professor*  
Teaching innovation and commercialization, strategy and business development

Nicola Lai, PhD  
(University of Pisa, Italy)  
*Adjunct Associate Professor (University of Cagliari)*  
Quantitative understanding of regulation of energy transfer and metabolism

Mary Laughlin, MD  
(State University of New York)  
*Adjunct Professor (Cleveland Cord Blood Center)*  
Development of monocytes, hematopoietic stem cells

Yajuan Li, PhD  
(University of Rhode Island)  
*Adjunct Assistant Professor (Molecular Theranostics, LLC)*  
Research, development and commercialization of peptide-based pharmaceutical imaging drugs and therapeutics, regulatory affairs, formulation development.

Anant Madabhushi, PhD  
(University of Pennsylvania)  
*Adjunct Professor*

John McDaniel, PhD  
(University of Utah)  
*Adjunct Associate Professor (Kent State University)*  
Vascular health and blood flow regulation in individuals with spinal cord injuries

Matthew Moorman, (Colonel), MD, MBA  
(Ohio State University)  
*Adjunct Assistant Professor (Clinical Associate Professor of Surgery, Clinical Assistant Professor, Medical Sciences, Case Western Reserve University School of Medicine)*  
Trauma resuscitation, emergency surgery, and critical care, focusing on implementing quality, safety, and high-reliability health care behaviors in the early years of medical training. Special interest in high-fidelity, simulation-based medical education.

Aaron S. Nelson, MD  
(Medical College of Ohio)  
*Adjunct Assistant Professor, Chief Medical Officer, MIM Software Inc.*  
Multimodality and quantitative imaging for neurologic and cardiac disorders, oncology and radiation oncology

Leena Palomo, DDS, MSD  
(NYU College of Dentistry)  
*Adjunct Professor (Professor & Chair, Ashman Dept of Periodontology and Implant Dentistry)*  
Bone -prosthesis interface, wound healing in complex systemic conditions

Marc Penn, MD, PhD, FACC  
(Case Western Reserve University)  
*Adjunct Professor (Director of Research, Summa Cardiovascular Institute, Summa Health System)*  
Strategies for cardiovascular cell therapy to treat cardiac dysfunction

Todd Ritzman, M.D.  
(The Ohio State University College of Medicine)  
*Adjunct Associate Professor*  
Pediatric Orthopedic Surgery & Scoliosis

Ahlam Salameh, PhD  
(Case Western Reserve University)  
*Adjunct Assistant Professor (FES Center, Louis Stokes Cleveland VA Medical Center)*  
Corticomuscular coherence, intermuscular coherence, muscle co-contraction, joint movement coordination

Nicole Seiberlich, PhD  
(Universitat Wurzburg, Germany)  
*Adjunct Associate Professor (Radiology, University of Michigan)*  
Quantitative MRI, image reconstruction, pulse sequence development, cardiac imaging

Robert T. Ssekitoleko, EngD  
 (University of Strathclyde, Glasgow)  
*Adjunct Assistant Professor (Lecturer and Biomedical Engineering Program Lead in College of Health Sciences at Makerere University)*  
 Advisor to the student design teams in the CWRU Global Health Design Collaborative. Hosts CWRU's study abroad course in Uganda, Global Health Design

Da Sun, PhD  
 (Case Western Reserve University)  
*Adjunct Instructor; Senior Research Associate, Department of Biomedical Engineering, Case School of Engineering*

Animesh (Aashoo) Tandon, MD, MS  
 (University of Michigan Medical School)  
*Adjunct Assistant Professor (Cleveland Clinic Foundation)*  
 Wearable physiological biosensors; wearables; cardiovascular MRI for congenital heart disease; artificial intelligence; multimodal patient phenotyping; virtual and augmented reality

Antonie Van den Bogert, PhD  
 (University of Utrecht)  
*Adjunct Associate Professor (Cleveland State University)*  
 Biomechanics, Mechanics, and control of human motion

Pallavi Tiwari, PhD  
 (University of Wisconsin-Madison)  
*Adjunct Associate Professor*

Tina Vrabec, PhD  
 (Case Western Reserve University)  
*Adjunct Assistant Professor (Physical Medicine and Rehabilitation, MetroHealt Medical Centerh)*  
 Novel waveforms, electrode designs, and electrode materials for control of the nervous system as applied to motor block, pain, and the autonomic system

Zhong Irene Wang, PhD  
 (Case Western Reserve University)  
*Adjunct Associate Professor (Cleveland Clinic Foundation)*  
 Epilepsy imaging (3T and 7T, MR fingerprinting), MRI post-processing (voxel-based and surface-based methods), multimodal integration for pre-surgical evaluation, magnetic source imaging

Jun Yao, PhD  
 (Chinese University of Hong Kong)  
*Adjunct Professor*

Sean Zuckerman, PhD  
 (University of Wisconsin-Madison)  
*Adjunct Instructor*  
 Teaching, mentoring students, early stage commercialization and product development

Fredy R. Zypman, PhD  
 (Case Western Reserve University)  
*Adjunct Professor (Professor and Chairman, Department of Physics, Yeshiva University, New York)*  
 Theoretical and computational applied physics, reconstruction of forces at the nanoscale from experimental atomic force microscopy measurements, and applications to electric and mechanical phenomena in soft matter including interactions in electrolytes; friction at the nanoscale; random systems

---

## Emeritus Faculty

James M. Anderson, MD (Case Western Reserve University), PhD (Oregon State University)  
*Professor Emeritus of Pathology, Macromolecular Science and Biomedical Engineering; Distinguished University Professor Emeritus*  
 Blood and tissue/material interactions as they relate to implantable devices and biomaterials

Patrick E. Crago, PhD  
 (Case Western Reserve University)  
*Professor Emeritus*  
 Control of neuroprostheses for restoration of motor function; neuromechanics; and modeling of neuromusculoskeletal systems

Miklos Gratzl, PhD  
 (Hungarian Academy of Science and Techn. U. of Budapest)  
*Associate Professor*  
 Development and biomedical application of chemical sensing schemes.

J. Thomas Mortimer, PhD  
 (Case Western Reserve University)  
*Professor Emeritus*  
 Applied neural control and neural prostheses; electrical activation of neural tissue; and electron transfer processes occurring on neural stimulation electrodes

P. Hunter Peckham, PhD  
 (Case Western Reserve University)  
*Distinguished University Professor Emeritus, Donnell Institute Professor Emeritus, and Professor Emeritus, Department of Biomedical Engineering*  
 Rehabilitation engineering in spinal cord injury; neural prostheses; and functional electrical stimulation and technology transfer

Gerald M. Saidel, PhD  
 (The Johns Hopkins University)  
*Professor Emeritus of Biomedical Engineering*  
 Mass and heat transport and metabolism in cells, tissues, and organ systems; mathematical modeling and simulation of dynamic and spatially distributed systems; optimal nonlinear parameter estimation and design of experiments

W. Sanford Topham, PhD  
 (University of Utah)  
*Associate Professor Emeritus*  
 Cardiovascular system, primarily on the control of cardiac output

## Programs

- Biomedical Engineering, BSE
- Biomedical Engineering, Minor
- Biomedical Engineering, MS
- Biomedical Engineering, MS (Online)
- Biomedical Engineering, PhD

## Dual Degrees

- Biomedical Engineering, MS/Medicine, MD
- Biomedical Engineering (MSTP), PhD/Medicine, MD
- Programs Toward Graduate or Professional Degrees

## Facilities

The Department of Biomedical Engineering has major facilities in both the Case School of Engineering and the School of Medicine. In the Case School of Engineering, the Wickenden Building provides office space for many of the faculty, as well as extensive non-clinical research laboratories and centers. Also, a number of faculty have their offices and laboratories in the School of Medicine in the Biomedical Research Building and the Wood Building. In addition, many faculty also have major laboratory activities in the various medical centers in Cleveland.

Major interdisciplinary centers include: the Neural Engineering Center, the Case Center for Imaging Research (CCIR), the Center for Biomaterials, and the Center for Computational Imaging & Personalized Diagnostics. The Neural Engineering Center is a major facility for basic research and preclinical testing, with a focus on neural recording and controlling neural activity to increase our understanding of the nervous system and to develop neural prostheses. The Case Center for Imaging Research, located in the Department of Radiology at University Hospitals, has capabilities in imaging structure and function from the molecular level to the tissue-organ level, using many modalities, including ultrasound, MRI, CT, PET, SPECT, bioluminescence, and photonics/photoacoustics. The CCIR has the ability for full translation of discoveries along a continuum from molecules to mice to man. The Center for Biomaterials includes laboratories for biomaterials microscopy, biopolymer and biomaterial interfaces, and molecular simulation. The Center for Artificial Intelligence (AI) Enabled Discovery in Disease Biology develops, evaluates, and applies novel quantitative image analysis, computer vision, signal processing, segmentation, multi-modal co-registration tools, pattern recognition, and machine learning tools for disease diagnosis, prognosis, and theragnosis in the context of breast, lung, prostate, head and neck, and brain tumors. The center is also developing new radiogenomic and radio-path-omic approaches to study correlations of disease markers across multiple length scales, modalities, and functionalities - from gene and protein expression to spectroscopy to digital pathology and to multi-parametric radiographic imaging. Also available are biomedical sensing laboratories that include facilities for electrochemical sensing, chemical measurements in individual cells, and minimally invasive physiological monitoring. High-fidelity patient simulation and clinical decision-making research are done in collaboration with the School of Nursing's simulation center.

The FES (Functional Electrical Stimulation) Center, with laboratories at CWRU and in three medical centers, develops techniques for restoration of movement in paralysis, mitigation of pain, enhancement of brain health, and control of autonomic functions. The APT (Advanced Platform Technology) Center develops advanced technologies that serve the clinical needs of veterans and others with motor and sensory deficits, limb loss, and other disabilities.

The Human Fusions Institute (HFI) conceptualizes and delivers cutting-edge, socially responsible technologies that enhance the human experience and capabilities by linking to the neural system. This approach reimagines how people can interact with their devices to transcend the physical limitations of space and geography. HFI is developing technology in the service of humanity.

The Center for AI Enabling Discovery in Disease Biology (AID2B) is focused on harnessing the potential of artificial intelligence and machine learning toward predictive and prognostic modeling of disease outcomes, provide AI-informed medical decision-making across patient and population interfaces through computational and novel imaging techniques, as well as enable evolutionary modeling from pathway

to organelle to cell to organism toward next generation precision therapeutics.

The Case-Coulter Translational Research Partnership (CCTRP) is an endowed program that promotes the translation of discoveries in faculty laboratories to products that improve health care. It thus supports collaborative translational research projects to address unmet or poorly met clinical needs. The overarching goal of the program is to improve patient care and accelerate the delivery of healthcare technology from academia to the marketplace. The CCTRP, fosters collaborations between clinicians and engineering faculty to achieve its goals.

The Biomedical Engineering faculty and students have access to the many facilities and major laboratories of both the Case School of Engineering and School of Medicine. In addition, faculty have numerous collaborations at University Hospitals, MetroHealth Medical Center, Louis Stokes Cleveland VA Medical Center, and the Cleveland Clinic. These provide extensive research resources in a clinical environment for both undergraduate and graduate students.