BIOMEDICAL SYSTEMS, SENSORS & SIMULATION

…Sensing, Modeling, and Analysis

Research in biomedical systems, sensors, and simulation involves acquiring biological information at multiple scales with state-of-the-art methodologies, multi-scale integration of mechanisms and phenomena with computational models, and simulation and analysis of acute and chronic physiological system behavior.

Biomedical Sensors

Biomedical sensing integrates biologically derived sensing components with a transducer for in vitro and in vivo measurements of chemical and biological substances. Research includes the development and use of electrochemical, optical mini- and micro-sensors, micro-fabricated devices such as BioMEMS chips, quantitative analysis of cellular transport and communication, cost-effective in vitro diagnostics, and continuous in vivo diagnostics.

Metabolic Systems

Mathematical modeling and computer simulation are used to analyze changes in cellular metabolism of tissues, organs, and the whole body. Non-invasive or minimally invasive measurements are obtained with human exercise studies under normal and diseased conditions. Cellular metabolic changes are quantitatively related to physiological changes. Projects include cellular metabolic mechanisms of myocardial ischemia, cellular metabolism and energetics in skeletal muscle, adipose tissue metabolism with insulin resistance, and whole-body energy balance.

Cardiac and Vascular Systems

Cellular and molecular imaging technologies and mathematical modeling are combined with molecular, cellular, and tissue measurements to analyze mechanisms of heart disease. Therapeutic strategies are developed related to biomechanical, vascular, and electrophysiological functions. Cardiovascular physiology and metabolic regulation are studied using ECG signals, magnetic resonance imaging, optical mapping, and spectroscopy. Projects include cellular mechanisms of sudden cardiac death, cell and gene therapy for arrhythmias, ion channel structure and function, and myocardial ischemia.

Musculoskeletal Mechanics

Engineering mechanics is applied to study the structure and function of musculoskeletal systems. This research leads to the design of clinical interventions including artificial joints, prosthetic limbs, dental implants, bone healing, and methods to counteract loss of bone and muscle during space travel. Projects include computational musculoskeletal modeling, bone biomechanics, muscular control systems, human locomotion, and exercise to reduce loss of musculoskeletal function in space.

CASE WESTERN RESERVE UNIVERSITY EST. 1826

Department of Biomedical Engineering

A joint department of the Case School of Engineering and the Case Western Reserve University School of Medicine

BIOMEDICAL SYSTEMS FACULTY

Primary Faculty

Biomedical Sensors Faculty

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Biochemical sensing and diagnostics in vitro and in vivo; electrochemical and optical micro-techniques; MEMS for assessing cellular transport; cancer pharmacology at the single cell level; sliver sensor for multianalyte patient monitoring
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Cardiac Systems Faculty

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MRI and MRS for characterization of cardiac disease
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Metabolic Systems Faculty

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Mass and heat transport and metabolic analysis in cells, tissues, and organs; mathematical modeling, simulation, and parameter estimation; optimal experimental design; metabolic dynamics; minimally invasive thermal tumor ablation; slow release drug delivery
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Musculoskeletal Mechanics Faculty

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Associated Faculty

Cardiac Electrophysiology Associated Faculty

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Novel biological therapies for sudden cardiac death; cellular mechanisms of cardiac arrhythmias using fluorescent imaging of transmembrane potential and intracellular calcium; instrumentation and software design for real-time cardiac mapping
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Cellular mechanisms of cardiac arrhythmias; fluorescent imaging of cardiac repolarization; impulse propagation and block; novel ECG signal processing techniques for assessing arrhythmia risk

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Cardiac electrophysiology; cardiac excitation mapping; mechanisms of cardiac arrhythmias and conduction

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Cardiac Systems Faculty

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Optimization of cardiac function following myocardial infarction with an emphasis on developing novel strategies for cell and gene based tissue engineering

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Cardiac imaging, image processing, echocardiography, MRI, and cardiac CT imaging; cardiac mechanics and valvular dysfunction; structural and fluid dynamics modeling of the cardiovascular system cardiac alterations and telemedicine in manned space flight

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Metabolic Systems Associated Faculty

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Modeling and control of metabolic processes; metabolic regulation in hypoxia, ischaemia and exercise

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Musculoskeletal Mechanics Associated Faculty

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Computational musculoskeletal modeling and experimental analysis of human posture and locomotion

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AFFILIATED LABS AND CENTERS

- Laboratory for Biomedical Sensing (http://bme.case.edu/gratzl)
- Experimental and Computational Mechanobiology Laboratories (http://bme.case.edu/mechbio)
- Cardiovascular Research and Imaging Center (http://bme.case.edu/yu)
- The Heart and Vascular Research Center (HVRC), MetroHealth Medical Center (http://www.metrohealthresearch.org/hvrc.html)
- Modeling and Analysis of Physiological Systems (http://casemed.case.edu/maps/)

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