Graduate Study in Area VII

The BioMedical Sciences and Engineering Area within EECS is composed of EECS faculty and students who work at the cutting edge of engineering and/or medicine. Our collective goal is to understand complex biological systems and/or engineer systems that solve important biological problems. We welcome inquiries from graduate students who wish to work at this interface.

In general, Area VII draws graduate students from a broad range of backgrounds, and with a wide variety of objectives for graduate study. It is the culture of MIT to encourage students to take the initiative to tailor their graduate program accordingly. Please visit the website for more complete information. http://www.eecs.mit.edu/grad/area7/.

—Collin Stultz and Louis Braida, Area VII co-chairs

Scope

Although the interests of faculty in BioMedical Sciences and Engineering are diverse, the areas in which they work can be categorized into 5 core sub-areas:

Cellular and Molecular Engineering

Primary focus is engineering as it applies to biomolecules or tissues. Some examples include synthetic biology, tissue engineering, regenerative biology, systems biology and macromolecular simulations.

Medical Imaging

Primary focus is the development of technologies that improve our ability to visualize living systems at high resolution. Some examples include bio-optics, Magnetic Resonance Imaging (MRI), and functional Imaging of tissues.

Medical Devices and Microsystems

Primary focus is the development of devices that facilitate biomedical monitoring and/or high throughput screening. Some examples include microelectromechanical systems (MEMS), Bioinstrumentation, medical devises for non-invasive physiologic monitoring and sensory aids for the deaf and blind.

Clinical Inference and Learning in Medicine

Primary focus is the use of sophisticated algorithms to facilitate clinical decision making. Some examples include building predictive models to identify high risk patient subgroups and natural language processing to extract meaningful data from clinical narratives.

Physiological Modeling

Primary focus is the development of sophisticated models to understand and/or model important features of complex biological organisms. Some examples include auditory physiology, human speech recognition, and the construction of models to assess overall cardiovascular health.

These areas do not have rigid boundaries and many faculty members and students work on problems which have components in several sub-areas.

Graduate Preparation

Every graduate student in Bioelectrical Engineering is free to plan an individual program of study subject to the advice and consent of his faculty counselor and research advisor. A sample of courses that fall within each sub-area is listed below.

Cellular and Molecular Engineering

- 6.581 (Algorithms and Computational Techniques in Systems Biology â€“ not on grid)
- 6.561 (Fields, Forces and Flows in Biological Systems)
- 6.582 (Molecular Simulations)
- 6.580J (Synthetic Biology)
- 6.524J (Molecular, Cellular, and Tissue Biomechanics)
- 6.521 (Cellular Biophysics)
- 6.874 (Computational Systems Biology)

Medical Imaging

- 6.341 (Discrete-Time Signal Processing)
- 6.556J (Data Acquisition and Image Reconstruction in MRI)
- 6.631 (Optics and Photonics)
- 6.555J (Biomedical Signal and Image Processing)
- 6.637 (Optimal Signals, Devices, and Systems)

Medical Devices and Microsystems

- 6.522 (Quantitative Physiology)
- 6.561 (Fields, Forces and Flows in Biological Systems)
- 6.376 (Ultra Low Power Bioelectronics)
- 6.777J (Design and Fabrication of Microelectromechanical Systems)
- 6.775** (CMOS Analog and Mixed-Signal Circuit Design)

Clinical Inference and Learning in Medicine

- 6.436J (Fundamentals of Probability)
- 6.437 (Inference and Information)
- 6.438 (Algorithms for Inference)
- 6.867 (Machine Learning)
- 6.872 (Biomedical Computing)

Physiological Modeling

- 6.521 (Cellular Biophysics)
- 6.522 (Quantitative Physiology)
- 6.345 (Automatic Speech Recognition)
- 6.863 (Natural Language and the Computer Representation of Knowledge)
- 6.551 (Acoustics of Speech and Hearing)
- 6.555J (Biomedical Signal and Image Processing)

GEMS Training Program

The Graduate Education in Medical Sciences (GEMS) program is a certificate program that students in the MIT Schools of Engineering and Science may take concurrently with doctoral studies and research to gain exposure to biomedical and clinical sciences, including translational medicine. The GEMS program is currently offered through the Division of Health Sciences and Technology (HST) and represents a collaboration with MIT, Harvard Medical School and three Harvard teaching hospitals (Massachusetts General Hospital, Brigham and Women's Hospital, and Beth Israel Deaconess Medical Center).

The GEMS program runs concurrently with the normal course of an MIT graduate education and can be completed in 1 1/2 years without prolonging a normal PhD career. In addition to coursework in pathology and pathophysiology, GEMS students attend seminars with HST students and participate in an individually tailored clinical experience. GEMS scholars develop lasting relationships with medical students, other PhD students with complementary skill sets, Biomedical Enterprise students, and active physician-scientists and clinicians.

Further information including Area VII Faculty and Staff, visit:

http://www.eecs.mit.edu/grad/area7/facultyandstaff.shtml