Bioengineering

COMPETENCIES AND RESEARCH

Bioengineering at Tufts crosses departmental and disciplinary boundaries, combining the principles of engineering with insights from the life sciences. Research continues to bear fruit as we contribute to the pioneering advances in a field that has seen many unexpected and often astonishing developments in the last decade. Tufts has established strong programs in a variety of bioengineering sub-areas, including:

- **Tissue engineering**: Basic research in this area includes deepening our understanding of how to control the biological synthesis and processing of polymers and of how living cells respond to them. We are making advances in accelerating wound healing with bioactive dressings. We are also using silk to develop biodegradable sensors with optical properties that could lead to applications such as monitoring the freshness of food and measuring blood glucose levels in diabetics. Other work focuses on microfabrication with applications that can include abating or reversing hearing loss.

- **Noninvasive optical imaging**: Work in this area includes developing techniques for monitoring pre-cancerous cells for early disease detection and for tracking cancer cells to better understand disease progression during treatment. Other research at Tufts is looking at things such as measuring blood flow, oxygen consumption, and oxygen saturation of hemoglobin in skeletal muscle; detecting breast cancer with non-invasive and painless techniques; and brain imaging.

- **Metabolic engineering**: This area of research uses mathematical models of metabolic pathways in conjunction with experimental biochemistry techniques to quantitatively study health risks such as obesity, diabetes, cardiovascular disease, and some forms of cancer.

- **Minimally invasive surgery**: The long-term goals of this research are to improve the development and integration of robotic technology into surgical practices and surgeon training, which will have a significant impact on patient safety and improved healthcare delivery. Work at Tufts focuses on creating a virtual reality simulation of the surgical environment.

- **Robotics**: Research at Tufts is aimed at developing devices based on the highly adaptive mechanisms of animal movement. Tufts' primary research on soft-body robots and chemical communication devices will have direct applications in robotics (e.g., manufacturing, emergency search and retrieval, repair and maintenance of equipment in space) and in medical diagnosis and treatment (e.g., endoscopy, remote surgery).

- **3D tissue fabrication**: Bioengineered 3D tissues to study human disease provide more reliable correlations between in vitro studies and in vivo outcomes during human clinical studies. 3D tissue biology now serves as a pre-clinical setting that is accelerating development of potential therapeutics that can be efficiently identified for clinical application. These human, "surrogate" tissues can facilitate the pharmaceutical design, screening, and therapeutic application of lead candidate molecules targeted to human disease. Toward these goals, Tufts has established the Center for Integrated Tissue Engineering (CITE) that serves to facilitate experimentation in 3D tissues and integrates and synergizes research in this experimental paradigm. CITE is playing a pioneering, strategic role, providing a novel focus on clinical relevance by linking discovery directly to the behavior of normal and diseased human tissues.

Bioengineering CONTINUED

PARTIAL LIST OF INVESTIGATORS

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SELECTED RESEARCH SPONSORS

- Armed Forces Institute of Regenerative Medicine (AFIRM)
- Defense University Research Instrumentation Program (DURIP)
- Keck Foundation
- Lufkin Memorial Fund
- National Institutes of Health
- National Science Foundation (NSF)
- Organogenesis, Inc.
- Procter & Gamble
- U.S. Defense Advanced Research Projects Agency (DARPA)

LABS AND GROUPS

- The Advanced Technology Laboratory (ATL) group
- The Center for Integrated Tissue Engineering (CITE)
- Nanoscale Integrated Sensors and Circuits Laboratory (Nanolab)
- Near-infrared tissue optics group
- Optical Diagnostics for Diseased and Engineered Tissues (ODDET) group
- Tissue Engineering Resource Center (TERC)
- Tufts Biomimetic Devices Laboratory
- Tufts Micro and Nano Fabrication Facility (TMNF)
- Ultrafast Nonlinear Optics and Biophotonics Group