

# PURDUE MECHANICAL ENGINEERING

## GRADUATE SEMINAR SERIES: ME 691



### Dr. Mehmet Toner

Helen Andrus Benedict Professor of Biomedical Engineering  
Massachusetts General Hospital (MGH)  
& Harvard Medical School

*Thursday September 21, 2017  
4:30pm, WALC 1055 (Hiler Theatre)*

### **Extreme Microfluidics: Large-volumes and Complex Fluids**

#### **Abstract:**

Microfluidics gained prominence with the application of microelectromechanical systems (MEMS) to biology in an attempt to benefit from the miniaturization of devices for handling of minute samples of fluids under precisely controlled conditions. Microfluidics exploits the differences between micro- and macro-scale flows, for example, the absence of turbulence, electro-osmotic flow, surface and interfacial effects, capillary forces in order to develop scaled-down biochemical analytical processes. The field also takes advantage of MEMS and silicon micromachining by integrating micro-sensors, micro-valves, and micro-pumps as well as physical, electrical, and optical detection schemes into microfluidics to develop the so-called “micro-total analysis systems ( $\mu$ TAS)” or “lab-on-a-chip” devices. However, the ability to process ‘real world-sized’ volumes efficiently has been a major challenge since the beginning of the field of microfluidics. This begs the question whether it is possible to take advantage of microfluidic precision without the limitation on throughput required for large-volume processing? The challenge is further compounded by the fact that physiological fluids are non-Newtonian, heterogeneous, and contain viscoelastic living cells that continuously responds to the smallest changes in their microenvironment. Our efforts towards moving the field of microfluidics to process large-volumes of fluids was counterintuitive and not anticipated by the conventional wisdom at the inception of the field. We metaphorically called this “hooking garden hose to microfluidic chips.” We are motivated by a broad range of applications enabled by precise manipulation of extremely large-volumes of complex fluids, especially those containing living cells or bioparticles. This presentation will provide a summary of our efforts in bringing microfluidics to large volumes and complex fluids as well as various applications such as the isolation of extremely rare circulating tumor cells from whole blood. The use of high-throughput microfluidics to process large-volumes of complex fluids (*e.g.*, whole blood, bone marrow, bronchoalveolar fluid) has found broad interest in both academia and industry due to its broad range of utility in medical applications.

#### **Bio:**

**Mehmet Toner** is the Helen Andrus Benedict Professor of Biomedical Engineering at the Massachusetts General Hospital (MGH), Harvard Medical School, and Harvard-MIT Division of Health Sciences and Technology. Mehmet received a BS degree from Istanbul Technical University and an MS degree from the Massachusetts Institute of Technology (MIT), both in Mechanical Engineering. Subsequently he completed his PhD degree in Medical Engineering at Harvard-MIT Division of Health Sciences and Technology in 1989. Mehmet is the co-founding Director of the Center for Engineering in Medicine, and BioMicroElectroMechanical Systems Resource Center (BMRC) at the MGH to explore the applications of bioengineering in basic biology, systems biology, diagnostics and clinical medicine. He is also the Director of Research at the Shriners Hospital for Children Boston. Mehmet holds over 50 patents, has more than 350 publications, and is a co-founder of multiple biotechnology start-ups. Mehmet is a “Fellow of the American Institute of Medical and Biological Engineering”, “Fellow of the American Society of Mechanical Engineers”, and “Fellow of the Society for Cryobiology.” In 2012, he was given the “Luyet Medal” by the Society for Cryobiology. In 2013, he received the “H.R. Lissner Medal” from the American Society of Mechanical Engineering. He is a member of the Board of Trustees of Özyeğin University in Turkey, and served as a member of the President’s Council of Olin College of Engineering. He is a member of the “National Academy of Inventors” and “National Academy of Engineers.”

*Reception & Students Poster Session @ 3:00 p.m. – Atrium of Mechanical Engineering Building*

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