COLLEGE OF ENGINEERING
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Mechanical Engineering Seminar Series

Acoustofluidics: Merging Acoustics and Fluid Mechanics for Biomedical Applications

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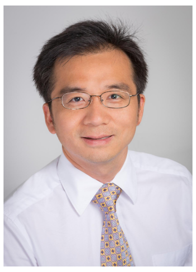

Room 1200 EECS

Tuesday, April 11, 2023

3:00 PM

ME Seminar Zoom link

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Abstract

The use of sound has a long history in medicine. Dating back to 350 BC, the ancient Greek physician Hippocrates, regarded as "the father of medicine," devised a diagnostic method for detecting fluid in the lungs by shaking patients by their shoulders and listening to the resulting sounds emanating from their chest. As acoustic technology has advanced, so too has our ability to "listen" to the body and better understand underlying pathologies. The 18th-century invention of the stethoscope allowed doctors to gauge the health of the heart; the 20th-century invention of ultrasound imaging revolutionized the field of biomedical imaging and enabled doctors to diagnose a range of conditions in the fields of obstetrics, emergency medicine, cardiology, and pulmonology. In the last decade, a new frontier in biomedical acoustic technologies has emerged, termed acoustofluidics, which joins cutting-edge innovations in acoustics with micro and nano-scale fluid mechanics. Advances in acoustofluidics have enabled unprecedented abilities in the early detection of cancer, the non-invasive monitoring of prenatal health, the diagnoses of traumatic brain injury and neurodegenerative diseases, and have also been applied to develop improved therapeutic approaches for transfusions and immunotherapies. In this talk, I summarize our lab's recent progress in this exciting field and highlight the versatility of acoustofluidic tools for biomedical applications through many unique examples, ranging from the development of high-purity, high-yield methods for the separation of circulating biomarkers such as exosomes and circulating tumor cells, to highly precise, biocompatible platforms for manipulating cells and studying cell-cell communication, to high- throughput therapeutic approaches for platelet isolation and enrichment, to strategies for high-resolution 3D bioprinting, to programable, contact-free technologies for digital fluid manipulation. These acoustofluidic devices can precisely manipulate objects across 7 orders of magnitude (from a few nanometers to a few centimeters). Thanks to these favorable attributes (e.g., versatility, precision, and biocompatibility), acoustofluidic devices harbor enormous potential in becoming a leading technology for a broad range of applications, playing a critical role for translating innovations in technology into advances in biology and medicine.

Bio

Tony Jun Huang is the William Bevan Distinguished Professor of Mechanical Engineering and Materials Science at Duke University. Previously he was a professor and the Huck Distinguished Chair in Bioengineering Science and Mechanics at The Pennsylvania State University. He received his Ph.D. degree in Mechanical and Aerospace Engineering from the University of California, Los Angeles (UCLA), in 2005. His research interests are in the fields of acoustofluidics, optofluidics, and micro/nano systems for biomedical diagnostics and therapeutics. He has authored/co-authored over 260 peer-reviewed journal publications in these fields. His journal articles have been cited more than 28,000 times, as documented at Google Scholar (h-index: 87). He also has 26 issued or pending patents. Prof. Huang was elected a fellow (member) of the National Academy of Inventors (USA) and the European Academy of Sciences and Arts. He was also a fellow of the following six professional societies: the American Association for the Advancement of Science (AAAS), the American Institute for Medical and Biological Engineering (AIMBE), the American Society of Mechanical Engineers (ASME), the Institute of Electrical and Electronics Engineers (IEEE), the Institute of Physics (UK), and the Royal Society of Chemistry (UK). In addition, he has been selected to receive many prestigious awards and honors, including a 2010 National Institutes of Health (NIH) Director's New Innovator Award, a 2012 Outstanding Young Manufacturing Engineer Award from the Society for Manufacturing Engineering, the 2014 IEEE Sensors Council Technical Achievement Award from the Institute of Electrical and Electronics Engineers (IEEE), the 2017 Analytical Chemistry Young Innovator Award from the American Chemical Society (ACS), the 2019 Van Mow Medal from the American Society of Mechanical Engineers (ASME), and the 2019 Technical Achievement Award from the IEEE Engineering in Medicine and Biology Society (EMBS). In 2022, he was named to a global list of the most highly cited researchers (cross-field) by Clarivate (Web of Science).