Department of Biomedical Engineering
UNIVERSITY OF WISCONSIN–MADISON

Spring 2023 Seminar Series

Acoustic-soft material interactions: Improved mechanistic understanding driving innovative biomedical applications

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The primary application of ultrasound in medical sciences has traditionally been limited to imaging. Meanwhile, tremendous advancements in adjacent applications of acoustic-structure interaction such as wireless energy transfer, remote stimulation, and soft robotics have been made. The past decade features rapid growth of research bringing together these areas towards developing innovative biomedical technologies for non-invasive diagnostics and therapeutics. In this talk, we will discuss fundamental aspects of the interaction of ultrasound with soft materials and resulting contemporary applications using different acoustic intensities. The interactions are investigated for three material-types leading to different biomedical applications: shape memory polymers for drug delivery, piezoelectrics for wireless powering of implants, and biological materials such as blood clots for therapy. A concept of achieving spatiotemporal control on drug release using ultrasound-responsive shape memory polymer-based capsules will be presented. We will uncover the underlying mechanism and the use of nonlinear sound waves to enhance the polymer response controlling drug release. Next, we will discuss how nonlinearity in ultrasound waves can enhance power output from piezoelectric receivers, thus minimizing low efficiency issues in existing wireless energy transfer systems. Finally, we will explore the interaction of ultrasound with biological tissues in the context of histotripsy, a potential adjuvant for treating blood clots. Histotripsy is a mechanism to disintegrate tissues using bubbles generated via ultrasound shock waves. We will demonstrate the changes in histotripsy bubble dynamics in the presence of drug-carrying liposomes, and their potential to enhance treatment efficiency.

ABOUT the SPEAKER

Aarushi Bhargava is a Humboldt postdoctoral fellow in the Physical Intelligence department at the Max Planck Institute for Intelligent Systems, Stuttgart, Germany. She received her bachelors in Mechanical Engineering and masters in Biological Sciences in 2015 from Birla Institute of Technology and Sciences, Pilani, India; and Ph.D. in Engineering Mechanics in 2020 from Virginia Tech. She then continued her research as a postdoctoral scholar during 2020–2022 in the School of Medicine at University of Chicago. Her research interests lie in understanding the acoustic-soft material interactions through modelling and experiments (in vitro and in vivo) for biomedical applications. Her research has been appreciated via two best paper awards, and received funding support from Humboldt, Batra, and Liviu Librescu fellowships.

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