

Leveraging Acoustics: From Damage Diagnosis to Matter Manipulation

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Abstract:

Acoustic waves carry both information and energy that allow them to inspect material damage and create invisible robotic hands (i.e., acoustic tweezers) capable of manipulating matter. This talk will cover our studies on leveraging acoustics for damage diagnosis and manipulating nano-to-millimeter scale matter for applications in aerospace, energy, health, and manufacturing. The first part of the talk is about damage diagnosis using ultrasonic phased arrays and laser ultrasonics for detecting different types of defects such as delamination in composites, disbonding in honeycomb sandwich panels, and corrosion in metal plates. The second part of my talk focuses on acoustic tweezers that leverage transducer arrays to dynamically control acoustic fields for achieving noncontact, versatile manipulation of objects across multiple length scales. Their functions and applications will be discussed including (i) constructing diverse lattice-like patterns of micro/nanoparticles and dynamically transforming the patterns, (ii) printing anisotropic tissues with aligned cells, (iii) stimulating and disrupting single cells, and (iv) delivering DNA into cells. Lastly, I will share some of our studies on developing metamaterials, acoustic blackhole structures, and phononic crystals for manipulating (e.g., guiding, trapping, and filtering) of acoustic waves and enabling unique acoustic tweezing capabilities.

Biography:

Dr. Zhenhua Tian received his Ph.D. in mechanical engineering at the University of South Carolina in Dec 2015 and completed postdoc training at Duke University in Aug 2019. Currently, he is an Assistant Professor in the Department of Mechanical Engineering at Virginia Tech. His research focuses on structural health monitoring, ultrasonic imaging, metamaterials, and acoustofluidics with applications in aerospace, manufacturing, health, and energy. He has published 60+ journal articles with 11 of them in widely circulated journals such as Nature Materials, Nature Communications, Science Advances, and PNAS.

***This seminar counts towards the ME 600 seminar requirement for Mechanical Engineering graduate students.**

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