

**Mechanical Engineering
Transformative Science and Technology Engineering Lecture Series**

**Acoustic Radiation, Propagation, and Sensing with Bioinspired Design
and Metastructures**

Abstract: There has been a newfound and growing interest in acoustic research in the last two decades due to the emergence of bioinspired designs and metastructures. For example, male cicadas possessing superior sound producing ability have been well studied by entomologists and ethologists and shinned light on new acoustic designs; novel metastructures originated from traditional art and fractal space-filling curves have been developed and applied for acoustic propagation and sensing. However, the lack of fundamental research in acoustics has hindered new developments and applications. This research aims to investigate the fundamental acoustic radiation, propagation, and sensing with bioinspired acoustic structures and metastructures. The first study aims to model the dual resonances of male cicadas and to develop a novel sound generator with high sound radiation efficiency. Results demonstrated that buckled beam, which is a fundamental model of the main resonator of male cicadas, offers promising vibrations and unique sound radiation characteristics. The second study investigated the acoustic propagation of recent emerged reconfigurable Kirigami metastructures and thereafter demonstrated their tunable band structures. Finally, focusing on the application of metastructures for health monitoring, the third study explored the acoustic sensing ability of membrane transducers with patterned holes modified from Hilbert curves.



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Bio: Xiaolei Song is a Ph.D. candidate supervised by Dr. Haijun Liu in the Department of Mechanical Engineering at Temple University. Since joining the Laboratory for Intelligent Sensor Technology Enlightened by Nature (LISTEN) in 2017, Xiaolei has been involved in multiple projects on acoustofluidics, bio-inspired sensors, acoustic structures, and acoustic metamaterials. His dissertation aims to conduct fundamental research on the acoustic radiation of cicada-inspired sound generators with dual resonance. Xiaolei received a bachelor's degree in Process Equipment and Control Engineering from Zhengzhou University in 2009 and a Ph.D. in Mechanical Engineering from Beijing University of Technology in 2014.

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