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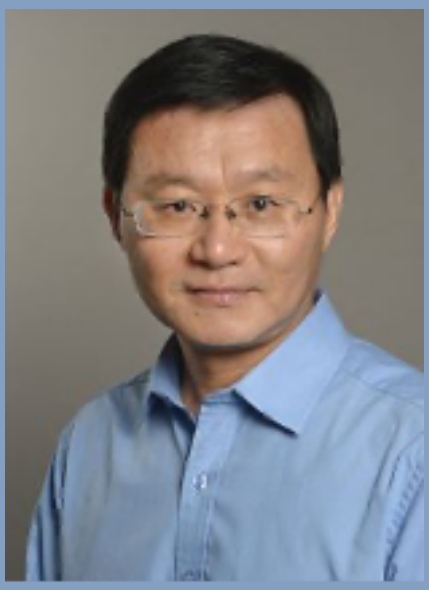
Active Mechanical Metamaterials: Design, Theory and Applications



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Abstract

Biological and artificial machinery systems have utilized the approach made by sensing, actuating, and information processing to adapt themselves to environmental changes, maintain dynamic equilibrium, and execute particular functions. Examples include octopuses that change their colors and shapes according to environments, a warm of ants that transport foods, smart thermostats, to self-driving cars. In this talk, we present how to take advantage of this approach to construct active mechanical metamaterials for enabling a range of unprecedent wave phenomena. The active mechanical metamaterials are composed of piezoelectric sensors and actuators connected with digital electronic circuits. The electrical degrees of freedom implemented allow for precisely and independently modulating mechanical properties through electromechanical coupling in the metamaterial. By means of theory, numerical simulations and experiments, we systematically demonstrate odd elasticity and odd density for unconventional wave control, independently wave transmission and reflection control and non-Hermitian skin effects.

Biography

Dr. Guoliang Huang is currently a Huber and Helen Croft Chair professor of mechanical and aerospace engineering at University of Missouri-Columbia. He received his Ph.D. degree from University of Alberta, Canada, in 2004. Dr. Huang's research interests include wave propagation and mechanics in elastic/acoustic metamaterials and structural materials, topological and active mechanics, structural dynamics, vibration and sound wave mitigation. Dr. Huang's research has been funded by NSF, Air Force Office of Scientific Research, Army Research Office, Office of Naval Research, DURIP, Department of Energy, NASA, and major industries. He has authored one book, 4 book chapters and more than 150 journal papers (include Nature Reviews Materials, Nature Communications, Proceedings of the National Academy of Sciences (PNAS), Advanced Materials, Physical Review Letters, Journal of Mechanics and Physics of Solids, et al.).