Exploring structural metamaterials: From single to multiple scales

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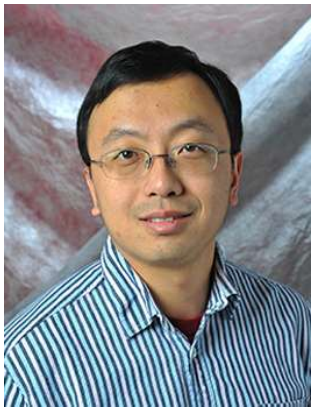
Abstract

This presentation provides a review of some of the current research status and issues with structural metamaterials. Structural metamaterials exhibit mechanical properties that are often unattainable from traditional materials, which if intentionally designed could achieve significant performance enhancement with structures. The outstanding potentials of the structural metamaterials have been demonstrated in many literature, and in many cases the structures exhibit hierarchical features that cross multiple dimensional scales. The effective design and realization of these structures require both thorough understanding of the structural design principles and the utilization of multi-scale manufacturing technologies, which are still largely unexplored. From the design perspective, traditional design theories such as cellular structure designs are relatively well-established on single scales, but knowledge is still lacking on how the designs on multiple scale levels interact with each other and how the overall properties of the metamaterial can be effectively determined. From the manufacturing perspective, even though the rapid evolution of additive manufacturing has enabled unprecedented geometry design freedom, its unique manufacturability challenges and material characteristics have yet to be adequately understood for the design of metamaterials.

Biography of Presenter (in 12 Pt Ariel Font)

Dr. Li Yang is an Assistant Professor in the Department of Industrial Engineering at University of Louisville. Received his Ph.D. degree in 2011 from the Department of Industrial and System Engineering at North Carolina State University, and master's and bachelor's degrees both in Department of Mechanical Engineering at Tsinghua University. Dr. Yang's research interest mainly focuses on the design aspects of the additive manufacturing such as lightweight structure designs and post-process designs, as well as the potentials of additive manufacturing in previously unexplored application areas such as multi-scale dimensions, novel materials and multi-physics functionality. Dr. Yang received the Emerald Engineering Outstanding Doctoral Research Award in 2013, Best Paper Award in 25th International Solid Freeform Fabrication (SFF) Symposium in 2014, International Outstanding Young Researcher in Additive Manufacturing Award in 2016, and BASF 3D-Printing Design Contest Winner Award in 2018.