VIDEO ARTICLE

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Innovative Designs of Structural Materials and Metamaterials through Topology Optimization

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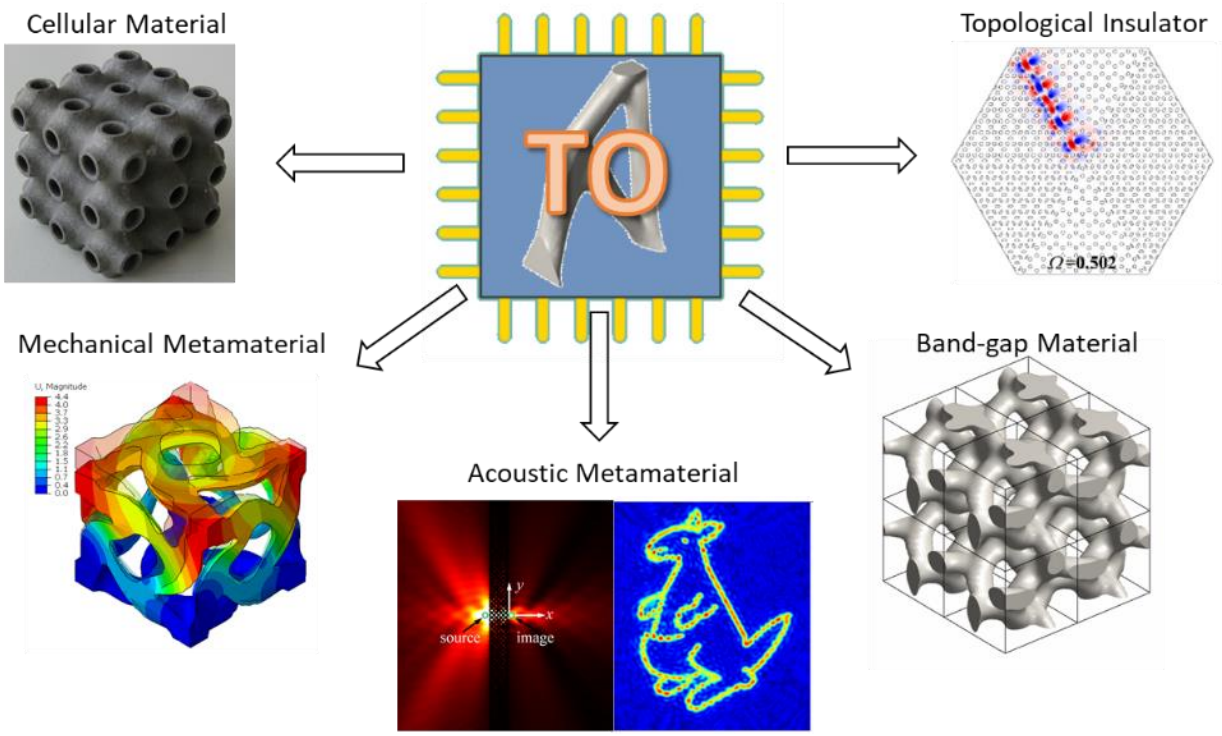
Graphical Abstract



Abstract

The topology optimization (TO) technique originated from structural engineering seeks the material distribution within a specified domain so that the resulting structure has the best performance. Structural materials and metamaterials have artificial periodical structures, and their properties mainly derive from the geometry of their unit cells. This presentation will demonstrate that topology optimization can be extended to find innovative designs of structural materials and metamaterials driven by the desired extreme or unusual properties. Through the reformulation of the objective and constraint functions, a series of structural materials and metamaterials can be found through topology optimization, including cellular materials with maximum bulk or shear modulus [**1**], chiral metamaterials [**2**], negative refraction of metalens for acoustic focusing and imaging [**3**], photonic and

phononic band gap materials [**4**], and topological insulators for robust transport of acoustic and electromagnetic waves [**5**].

Keywords: Topology optimization; structural materials; metamaterials; band-gap materials; topological insulators.

Acknowledgement

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Biography

Xiaodong Huang is the Professor of Engineering Mechanics and Australian Research Council (ARC) Future Fellow at the School of Engineering, Swinburne University of Technology, Australia.

Dr Huang's research mainly focused on topology optimization and its multidisciplinary applications. He is the innovator of the modern bi-directional evolutionary structural optimization (BESO) method and the floating projection topology optimization (FPTO) method. The developed topology optimization methods have been applied to the design of various engineering structures. Meanwhile, they have also been applied to find various structural materials and metamaterials with extreme or unusual properties. So far, Dr Huang has authored one monograph and more than 160 SCI journal articles with over 8,000 citations. H-index is 46. His research has been funded by ARC and industries.

Over his academic career starting from 2004, Dr Huang has won a number of research and teaching awards, including ARC APD fellowship; Early-Career Research Award by the Australian Academy of Science, and ARC Future Fellowship.

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