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Band-gap mechanical metamaterial design based on perforation layout optimization of low porosity perforated sheets

Perforated mechanical metamaterials providing unique physical properties, such as band gaps for wave propagation and negative poison ratio, have recently attracted significant interest. Despite numerous works on configuration optimization, however, relatively few studies have explored the role of perforation layout (holes arrangement) on the dynamic behavior of metamaterials. Here, we report two kinds of perforation layout based on regular configuration to investigate the effect of perforation layout on wave attenuation properties and mechanical behaviors. The proposed layouts are characterized by the redistribution of the construction material via pore rotation. Our analysis not only shows that the proposed layouts obtain broad and multiple band- gaps in low-frequency range and exhibit extreme Poisson's ratio and Young's modulus variations, but also reveals how the reduction of connector thickness and geometric symmetry contribute to the unusual response. Our numerical study provides a new perspective to design auxetic perforated metamaterials with low porosity and wide and low-frequency band gaps.

Biography

Shutian Liu completed his PhD from Dalian University of Technology, China in 1994. He is the professor of Dalian University of Technology. His research interests focused on the structural and multidisciplinary optimization, metamaterial design, and smart material and structures. He has over 150 publications that have been cited over 500 times.

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