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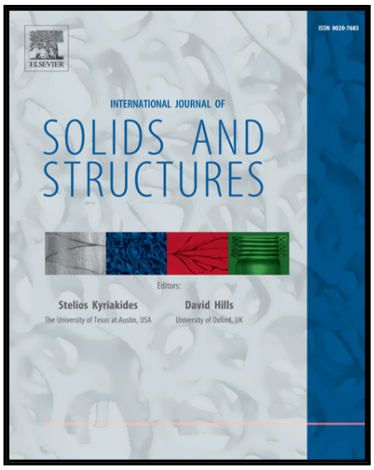

Wave propagation in elastic metamaterial beams and plates with interconnected resonators

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Wave propagation in elastic metamaterial beams and plates with interconnected resonators

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Abstract

In this work, new beam and plate metamaterials with interconnected local resonators are proposed. This design promotes the splitting and coupling between transverse and rotational vibration modes of the resonator chain. It produces a particular band structure with two band gaps: a wide band gap opens at the in-phase transverse natural frequency of the resonator chain and a second band gap, with narrower width, appears at higher frequencies. The Timoshenko beam and Mindlin-Reissner plate models are used to compute the band structure as well as the dynamic forced response. A parametric analysis of the band gaps is performed by varying the interconnection properties. The metamaterial plate presents a directional wave propagation pattern due to partial band gaps. In addition, a metamaterial beam manufactured by additive manufacturing is investigated. The experimental results are in agreement with the numerical predictions. Therefore, the proposed concept showed to be promising for metamaterial design aiming at creating singular band gaps with broadband absorption and directional/focalization features.

Keywords: band gap, broadband vibration absorption, directional wave propagation, metastructure, 3D printing.

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