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PROCEEDINGS

Low-Frequency Structural Vibration Suppression for Inertial Amplification Stiffened Composite Plate

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ABSTRACT

Metamaterials with inertial amplification components exhibit unique bandgap behaviors which can be utilized on the vibration suppression of mechanical structures. In this study, novel cantilever-type inertial amplification mechanisms are periodically attached to the stiffened composite plate to realize the low-frequency bandgaps and vibration suppression. This type of metamaterial mitigates the vibration by amplifying the inertia of the added small mass, which has great application potential in many industrial scenes. For the sake of the efficient calculations, a semi-analytical method based on the energy generalized variational principle is promoted, which can predict the bandgap behaviors and the vibration response of the proposed structure. The displacement of stiffeners and the host plate are derived based on the first-order shear deformation theory and expressed as Chebyshev orthogonal polynomials. The feasibility of the developed method for the present model is validated by finite element analysis. Numerical results clearly show that compared with the original orthogonally stiffened composite plate, the inertial amplification stiffened composite plate exhibits remarkable low-frequency bandgaps and vibration transmissibility dips, which are induced by the additional cantilever-type inertial amplification mechanisms. Finally, parametric studies of inertial amplification mechanisms and the composite plate are conducted to reveal the variations of bandgap behaviors. The present work can provide a significant theoretical guidance for the engineering application of stiffened composite metamaterial.

KEYWORDS

Metamaterials; inertial amplification; stiffened composite plate; vibration suppression

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