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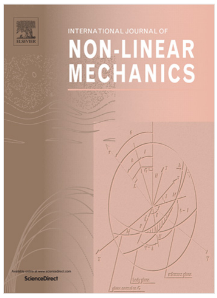

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Metamaterial Beam with Embedded Nonlinear Vibration Absorbers

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Abstract

In this work the multi-mode vibration absorption capability of a nonlinear metamaterial beam is investigated. A Euler-Bernoulli beam is coupled to a distributed array of nonlinear spring-mass subsystems acting as local resonators/vibration absorbers. The dynamic behavior of the metamaterial beam is first investigated via the classical approach employed for periodic structures by which the frequency stop bands of the single cell are determined. Subsequently, the frequency response is obtained for the metamaterial beam to study a multi-frequency stop band system by adding an array of embedded nonlinear local resonators. A path following technique coupled with a differential evolutionary optimization algorithm is adopted to obtain the optimal frequency-response curves of the metamaterial beam in the nonlinear regime. The use of the local absorbers, via a proper tuning of their constitutive parameters, allows a significant reduction of the metamaterial beam oscillations associated with the lowest three vibration modes.

Keywords: Metamaterial beam, Vibration absorbers, Nonlinear vibration damping, Multi-mode control

1. Introduction

The concept of metamaterial structures tailored for vibration damping is based on the idea of embedding localized resonant systems into the main cellular-like structure. The resulting periodic structure can behave as a material with tailored dynamic properties to be exploited in different fields of