Dynamic Investigation of a Mechanical Metamaterial Beam: A Numerical Study

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Abstract

The unique properties of mechanical metamaterial (MM) make them an exciting area of research for vibration attenuation applications in engineering fields including structural engineering and mechanical systems. In this research, the dynamic investigation of a simple and MM cantilever beam is presented using finite element analysis in ANSYS software. A simple and MM beam having attached resonators were modelled using beam element in design modeler ANSYS. Then the natural frequency and mode shapes of resonator, simple and MM beam were found out using modal analysis ANSYS. The numerically found first natural frequency of simple beam and resonator are found to be in close agreement with the available analytical results, hence validating the numerical model. To find out the response of the simple and MM beam modal analysis ANSYS was used. The displacement frequency response functions were calculated numerically for both simple and MM beam in modal analysis ANSYS. During the numerical simulations, appropriate mesh size and boundary conditions were used. Fixed boundary condition and force boundary condition were used during modal and harmonic analysis. It was found that the vibration displacement amplitudes of the MM beam having attached resonators is attenuated to greater extent as compared to original simple beam operating at its first natural frequency. It was found that the MM beam can attenuate the vibration amplitude in wide frequency range.

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