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Visualization of Wave Propagation in Monocoupled System with Effective Negative Stiffness, Effective Negative Mass, and Inertial Amplifier

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Abstract : A periodic system with only a single coupling degree of freedom is called a monocoupled system. Monocoupled systems with mechanisms like mass in the mass system generates effective negative mass, mass connected with rigid links generates inertial amplification, and spring-mass connected with a rigid link generateseffective negative stiffness. In this paper, the representative unit cell is introduced, considering all three mechanisms combined. Further, the dynamic stiffness matrix of the unit cell is constructed, and the dispersion relation is obtained by applying the Bloch theorem. The frequency response function is also calculated for the finite length of periodic unit cells. Moreover, the input displacement signal is given to the finite length of periodic structure and using inverse Fourier transform to visualize the wave propagation in the time domain. This visualization explains the sudden attenuation in metamaterial due to energy dissipation by an embedded resonator at the resonance frequency. The visualization created for wave propagation is found necessary to understand the insights of physics behind the attenuation characteristics of the system.

Keywords : mono coupled system, negative effective mass, negative effective stiffness, inertial amplifier, fourier transform
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