Nonlinear Multimodal Vibration Suppression of Beams using Tuned Shunt Circuits

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Abstract

In this work, tuned passive shunt circuits are used to study the vibration attenuation of the multimode linear and nonlinear responses of cantilever beams. Vibration control is accomplished by optimizing the R-L circuit parameters using MATLAB's Particle Swarm Optimization (PSO) technique to achieve the highest vibration attenuation over the frequency domain of interest. A mathematical model that takes into account several modes is created for the coupled response of a cantilever beam connected to a piezoelectric (PZT) shunt circuit. The cantilever beam's geometrical and inertia nonlinearities are taken into account. The optimization method's goal function over the intended frequency domain is to minimize the area under the frequency-response plot. The impact of PZT size and position is investigated. It is discovered that the tuned shunt circuit characteristics greatly reduce the beam's multi-mode nonlinear vibration.

Keywords

Vibration control, cantilever beams, geometric nonlinearity, shunted circuit, Optimization.