عنوان مقاله:

A Distributed Parameters Model for Broadband Energy Harvesting From Nonlinear Vibration of the Piezoelectric System

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خلاصه مقاله:

To the extent of the usable bandwidth of the piezoelectric energy harvesters (PEH) and progress the harvesting proficiency, a ۲-DOF bistable PEH (۲D-BPEH) with an elastic substructure is developed to show the strengthened nonlinear large-amplitude periodic vibration performances. Introducing the substructure, which is demonstrated by the mass-spring sub-system added between the distributed bimorph beam and exciting base, dynamic motions of the beam is expected to reproduce high energy trajectories and large deflections. Due to raising the accuracy of the model and results, the key novelty of the present study is to consider the mathematical model of composite smart bimorph beam with the aid of distributed parameters model and Von Karman strain relations. With the help of Hamilton's principle, Electro mechanic modeling of the ۲-DOF system has been derived and three coupled equations are consequent utilizing the Galerkin method. Primarily deflection and voltage frequency response curves are calculated analytically; then, the model has been compared and validated by the results of the ۲-DOF PEH model with lumped parameter beam in the literature. Numerical results indicate that accurate designing of ۲-DOF piezoelectric energy harvester parameters could intensely enhance the generating voltage and at a broader exciting frequency band. The results have shown that the ۲-DOF bistable PEH coupled with elastic substructure as a magnifier harvests extra electrical power at specific input frequencies and operates at larger bandwidth than routine PEHs.

کلمات کلیدی:

۲D-BPEH, Distributed parameter model, Nonlinear vibration, Harvesting voltage, Time and frequency responses

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