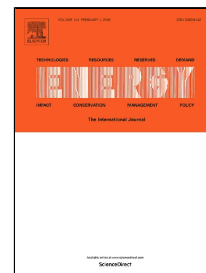


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A novel energy harvesting device for ultralow frequency excitation

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Abstract

In recent decades, energy harvesting from external vibration with ultralow frequency has been investigated intensively. A novel energy harvesting device with adjustable nonlinearity for ultralow frequency excitation is proposed and analyzed in this study. The energy harvesting device is made of a mass attached to the base by Elastic Steel Slices (ESSs) and a pair of Quadrilateral-Linkage Structures (QLSs). With the mathematical model, theoretical studies are carried out. The analysis shows that the device is capable for ultralow-frequency vibration energy harvesting since it has adjustable resonance frequency band. With the appearance of the adjustable nonlinearity, the system has a wide band for resonance by the utilization of multi-steady states. Experimental prototypes are assembled and tested. The experimental results show that the beginning frequency of effective energy harvesting can be reduced by over 50% by assembling the QLSs to adjust the stiffness property of the system. In addition, although the stiffness of the device is expressed by nonlinear irrational function, we find that the output voltages generated are large, smooth and stable. The results of this study illustrate that the proposed device is a feasible design for collecting energy from ultralow frequency

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