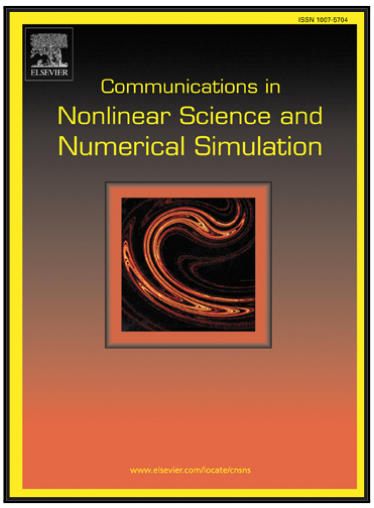

Vibrational energy harvesting by exploring structural benefits and nonlinear characteristics

Chongfeng Wei , Xingjian Jing

PII: S1007-5704(16)30520-2
DOI: 10.1016/j.cnsns.2016.12.026
Reference: CNSNS 4066

To appear in: *Communications in Nonlinear Science and Numerical Simulation*

Received date: 24 August 2016
Revised date: 21 November 2016
Accepted date: 23 December 2016

Please cite this article as: Chongfeng Wei , Xingjian Jing , Vibrational energy harvesting by exploring structural benefits and nonlinear characteristics, *Communications in Nonlinear Science and Numerical Simulation* (2017), doi: 10.1016/j.cnsns.2016.12.026

Vibrational energy harvesting by exploring structural benefits and nonlinear characteristics

Chongfeng Wei[1] and Xingjian Jing[1,2,3]*

1 Department of Mechanical Engineering, The Hong Kong Polytechnic University, Hong Kong, China

2 Hong Kong Polytechnic University Shenzhen Research Institute, Shenzhen, China

3 Hong Kong Branch of National Rail Transit Electrification and Automation Engineering Technology Research Center, Hong Kong, China

* The corresponding author: xingjian.jing@polyu.edu.hk

Abstract

Traditional energy harvesters are often of low efficiency due to very limited energy harvesting bandwidth, which should also be enough close to the ambient excitation frequency. To overcome this difficulty, some attempts can be seen in the literature typically with the purposes of either increasing the energy harvesting bandwidth with a harvester array, or enhancing the energy harvesting bandwidth and peak with nonlinear coupling effect etc. This paper presents an alternative way which can achieve tuneable resonant frequency (from high frequency to ultralow frequency) and improved energy harvesting bandwidth and peak simultaneously by employing special structural benefits and advantageous displacement-dependent nonlinear damping property. The proposed energy harvesting system employs a lever systems combined with an X-shape supporting structure and demonstrates very adjustable stiffness and unique nonlinear damping characteristics which are very beneficial for energy harvesting. It is shown that the energy harvesting performance of the proposed system is directly determined by several easy-to-tune structural parameters and also by the relative displacement in a special nonlinear manner, which provides a great flexibility and/or a unique tool for tuning and improving energy harvesting efficiency via matching excitation frequencies and covering a broader frequency band. This study potentially provides a new insight into the design of energy harvesting systems by employing structural benefits and geometrical nonlinearities.

Key words: Vibrational energy harvesting; Displacement-dependent nonlinear damping; Lever-like structures