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Energy Harvesting with Stochastic, Subharmonic and Ultra-harmonic Vibrations[1] JI-TZUOH LIN, BRUCE ALPHENAAR, University of Louisville — Non-linear bi-stable systems have been shown to provide improved efficiency for harvesting energy from random and broad band vibration sources. This paper explores the distinct frequency response in the broadened spectrum of a particular non-linear energy harvester, a piezoelectric cantilever with magnetic coupling. The cantilever response evolves dynamically with frequency around the main cantilever resonance. Both stochastic and multi-frequency vibration responses are observed, and account for some of the improved efficiency. In addition, sub-harmonics and ultra-harmonics of the main resonance, along with various combinations of these appear. Taken together, the sub-harmonic and ultra-harmonic response produces an average of four-fold increase in voltage production. For energy harvesting purposes, the mixtures of the stochastic and various harmonic features together with the un-damped resonant response enhances the performance well beyond that of a standard energy harvester. An analytical model of the bi-stable dynamics produces results consistent with those observed experimentally.

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