A comprehensive study on energy harvesting from nonlinear dynamical systems

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The utilization of mechanical vibrations to generate electricity has gained significant traction in recent times. Driven by the European Union's energy mandates, exploration into novel energy extraction methods is underway. In many dynamical systems, we aim to minimize vibrations using various methods [1]. Incorporating a harvester into the vibration absorber mechanism yields additional energy extraction. This problem is quite challenging as it requires finding a balance between vibration mitigation and harvested power [2, 3].

This paper presents an analysis of two different strongly nonlinear dynamic systems. The first system is a harvester based on the oscillations of a levitating magnet inside a coil. The second system is a pendulum vibration absorber into which an energy recovery system has been implemented. A characteristic feature of the so-called absorber-harvester system is its ability to simultaneously recover and reduce vibrations. It has been demonstrated that the implementation of the harvester can enhance vibration reduction capabilities in the low-frequency range. Furthermore, its nonlinear response extends the operating bandwidth and increases power output. The numerical and analytical results have been verified through experimental analysis.

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