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Dynamic and control applied to a non-ideal portal frame structure to energy harvesting

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Abstract: In this work, we present a method for energy harvesting from a simple portal frame structure excited by a non-ideal energy source, that is of limited power supply, with a chaotic behavior. The energy harvesting is computed by using of a nonlinear piezoelectric material. The dynamical response of the system is examined, when the vibration energy transfer (saturation phenomenon) takes place between the symmetric (vertical) mode and the horizontal (sway) mode. The chaotic system behavior is studied numerically, by its time history and phase portraits, and the results are validated by the existence of a positive maximal Lyapunov exponent. A passive controller was designed by means of a nonlinear substructure with properties of a nonlinear energy sink. The numerical results show the displacement of the structure and the maximum power harvested by the device with and without the passive nonlinear energy sink. The obtained numerical results demonstrate the vibration levels of the structure and the maximum power harvested by the device with and without the passive nonlinear energy sink.

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