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Effect of Damping on Performance of Magnetostrictive Vibration Energy Harvester

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Abstract : This article presents an analytical model to estimate the harvested power from a Magnetostrictive cantilevered beam with tip excitation. Furthermore, the effects of internal and external damping on harvested power are investigated. The magnetostrictive material in this harvester is Galfenol. In comparison to other popular smart materials like Terfenol-D, Galfenol has higher strength and machinability. In this article, first, a mechanical model of the Euler-Bernoulli beam is employed to calculate the deflection of the harvester. Then, the magneto-mechanical equation of Galfenol is combined with Faraday's law to calculate the generated voltage of the Magnetostrictive cantilevered beam harvester. Finally, the beam model is incorporated in the aforementioned combination. The results show that a 30×8.5×1 mm Galfenol cantilever beam harvester with 80 turn pickup coil can generate up to 3.7 mV and 9 mW. Furthermore, sensitivity analysis made by Response Surface Method (RSM) shows that the harvested power is only sensitive to the internal damping coefficient.

Keywords : internal damping coefficient, external damping coefficient, euler-bernoulli, energy harvester, galfenol, magnetostrictive, response surface method
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