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System size resonance in a 1-D array of noisy bistable piezoelectric harvesters

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Abstract: Research studies in the past have shown from time to time that bistable harvesters offer a lucrative solution for harnessing substantial magnitude of power across frequency broadband. This exciting potential of bistable harvesters has bred interest towards investigating the possibility of enhancement in power by coupling multiple of them. In this regard, the present work analyzes the behavior of a finite 1-D array of bistable piezoelectric harvesters mechanically coupled in the nearest-neighbor configuration under a noise perturbed periodic base excitation. A reduced order model has been developed for the same and preliminary investigations have been carried out to characterize the energy harvesting capabilities of the system under study. The dynamics of the system is studied mainly focusing on the total power harvested by the system. The numerical study reports a resonant-like behavior in the system size where the total power exhibits a non-monotonic dependence on the number of harvesters for certain noise levels of excitation. The parametric regimes to which the system size resonance effect is confined have been identified. The feasibility of exploiting the intricate bifurcation structures found in these regimes for significant wideband power generation has also been probed. The present study attempts to provide an intuitive understanding into the role of system size on the total harvested power under a noisy environment. Hence, the outcomes of this analysis shall aid in the proposition of efficient system design for broadband energy harvesting.

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