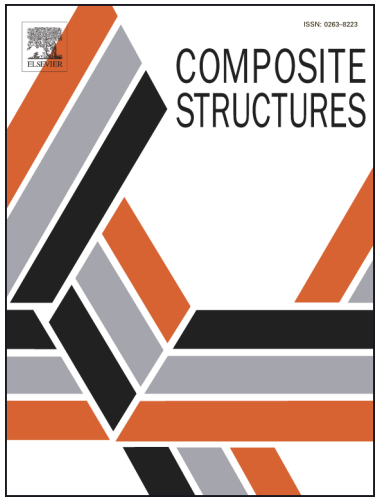

Finite element modeling of functionally graded piezoelectric harvesters

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Abstract:

Piezoelectric energy harvesting from mechanical vibrations has attracted considerable attention during the last decade. In the practical usages to overcome the brittleness issue of Piezoceramics and small coupling coefficient of piezoelectric polymers, composites material including both Piezoceramics and piezoelectric polymers are fabricated. For avoiding the stress concentration and consequently crack propagation, these composite materials are fabricated as a functionally graded material. The homogeneous harvesters were studied experimentally or numerically by various models such as single degree of freedom (SDOF) modeling, finite element modeling as well as using analytical solutions. In the present work finite element models for simulating the functionally graded piezoelectric harvesters in unimorph or bimorph (series or parallel connections) configurations are developed. In order to develop the finite element models, the Generalized Hamilton's principle for electro-mechanical materials with Euler Bernoulli beam assumptions is used. The predictions of the results of the finite element models are verified by that of the analytical solutions.

Keywords: mechanical vibration, energy harvesting, piezoelectric, functionally graded material, finite element method