Parametric probabilistic analysis in the uncertain dynamics of magneto-electro-elastic beams resting on elastic foundations

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ABSTRACT

In this paper, the authors are concerned with the dynamic behaviour of magneto-electro-elastic (MEE) beams mounted on elastic foundations. The MEE beams are a type of composite structures that can be employed as imbedded subsystem in high performance aero spatial structures, control of motion and attenuation of vibrations, energy harvesting, etc. The structure consists of a sandwich beam with ceramic/metallic materials whose elastic behavior can be modified by influence of electro-magnetic fields. Although most of the research work related to the mechanics of MEE structures was done for dynamics [1] and statics [2], it is remarkable the scarcity of papers analyzing the uncertainty propagation in the dynamics of a MEE beam structure.

Many structural models have uncertainties related to the parameters or the models themselves, for example uncertainties are present due to loads and/or material properties and/or the hypotheses invoked to develop the model, among others.

In order to perform studies about the uncertainty quantification of the MEE beams, a 3D beam approach (implemented in the context of finite element method) is employed as a mean basis to the studies on stochastic modeling. Then, the probabilistic model is constructed by adopting random variables for the uncertain parameters such as the coefficients of the elastic foundation and/or the material properties among others. The probability density functions of the random variables are derived appealing to the Maximum Entropy Principle. Once the probabilistic model is constructed, the Monte Carlo method is used to perform a number of simulations with independent random variables as uncertain parameters.

Studies with several types of stacking schemes are carried out in order to characterize the Magneto-elastic and/or piezoelectric coupling and response of the aforementioned MEE beams.

REFERENCES

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