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Radial Basis Function-Based Stochastic Natural Frequencies Analysis of Functionally Graded Plates

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Abstract:

This paper deals with portraying the stochastic natural frequencies of cantilever plates made up of functionally graded materials (FGMs) by employing the radial basis function (RBF)-based finite element (FE) approach. The material modeling of FGM plates is carried out by employing three different distribution laws, namely power law, sigmoid law, and exponential law. A generalized algorithm is developed for uncertainty quantification of natural frequencies of the FGM structures due to stochastic variation in the material properties and temperature. The deterministic FE code is validated with the previous literature, whereas convergence study is carried out in between stochastic results obtained from full scale direct Monte Carlo Simulation (MCS) and MCS results obtained from RBF surrogate model of different sample sizes. The percentage of error present in the RBF model is also determined. The influence of crucial parameters such as distribution law, degree of stochasticity, power law index and temperature are determined for natural frequencies analysis of FGMs plates. The results illustrate the input parameters considered in the present study have significant effects on the first three stochastic natural frequencies of cantilever FGM plates.

Keywords:

Functionally graded plates, Material modelling, Stochastic natural frequency, Monte Carlo simulation, Radial basis function

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