Free vibration of functionally graded graphene-platelets reinforced composite (FG-GPLRC) plate with interval parameters

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Abstract

It has been theoretically and experimentally observed that addition of a very small amount of graphene nanoplatelets (GPLs) into pristine polymer matrix can dramatically improve its mechanical, thermal, and electrical properties (Wang et al., 2015). Recently, the concept of functionally graded materials (FGMs) has been introduced into the GPLs-reinforced composite (GRC), and mechanical performances of FG-GRC plates have been studied extensively (Song et al. 2017).

On the other hand, the material properties of composites are inevitably subject to some degree of uncertainty, owing to complicated manufacturing processes and inherent non-uniform dispersion of constituents. When the probability of uncertain quantity is unavailable while the variation bounds of uncertain quantities can be fixed, interval analysis can be used for uncertainty analysis in composites (Jiang et al. 2008).

To the authors' knowledge, the interval effect on the FG-GRC structures is still not clear and has been less studied. It is not known how the uncertainties of material properties propagate in the composites and affect their mechanical behaviors. The present work aims to investigate the free vibration of FG-GPLs/polymer composite plate with interval parameters. Upper and lower bounds of natural frequencies of the plate are obtained by solving interval eigenvalue problems. By numerical investigations, effects of uncertain Young's modulus of each layer on natural frequencies of the plate are explored.

References

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