Reanalysis assisted stochastic analysis with IGA for free vibration problems of variable-stiffness composite laminate

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Abstract

A method for evaluating the uncertainties of free vibration of variable-stiffness composite laminates with uncertain parameters of path functions is presented. Since curvilinear fiber path can be exactly represented by the Non-Uniform Rational B-Splines (NURBS) basis functions, it is particularly appropriate to apply Isogeometric analysis method (IGA) to free vibration problems of variable-stiffness composite laminates. Therefore, high accuracy can be obtained with low degrees of freedom (DOFs) while traditional finite element analysis (FEA) needs a much more refined mesh size with high DOFs. Monte Carlo simulation (MCS) whose computational cost is very expensive because of the full analysis is employed to obtain the accurate stochastic results. In order to improve the efficiency of stochastic analysis, the reanalysis algorithm, a fast and accurate solver, is utilized. Several numerical examples are presented to verify the performance of the proposed method. The results show that the reanalysis assisted stochastic analysis with IGA is much more efficient as well as a good agreement with MCS for the free vibration problems of composite laminates.

Keywords: Uncertainty; IGA; Variable-stiffness; Reanalysis

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