Nonlinear free flexural vibrations of functionally graded rectangular and skew plates under thermal environments

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The nonlinear formulation developed based on von Karman's assumptions is employed to study the free vibration characteristics of functionally graded material (FGM) plates subjected to thermal environment. Temperature field is assumed to be a uniform distribution over the plate surface and varied in the thickness direction. The material is assumed to be temperature dependent and graded in the thickness direction according to the power-law distribution in terms of volume fractions of the constituents. The effective material properties are estimated from the volume fractions and the material properties of the constituents using Mori-Tanaka homogenization method. The nonlinear governing equations obtained using Lagrange's equations of motion are solved using finite element procedure coupled with the direct iteration technique. The variation of nonlinear frequency ratio with amplitude is highlighted considering various parameters such as gradient index, temperature, thickness and aspect ratios, and skew angle. For the numerical illustrations, silicon nitride/stainless steel is considered as functionally graded material. The results obtained here reveal that the temperature field and gradient index have significant effect on the nonlinear vibration of the functionally graded plate.

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