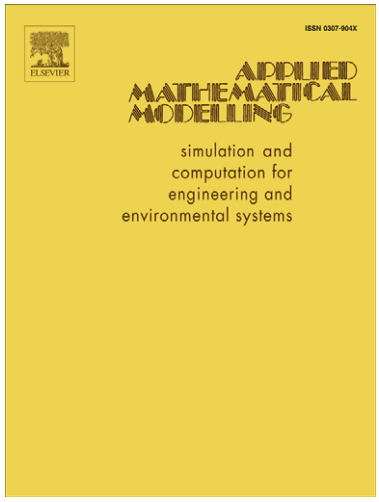

Post-buckling and nonlinear free vibration analysis of geometrically imperfect functionally graded beams resting on nonlinear elastic foundation

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Post-buckling and nonlinear free vibration analysis of geometrically imperfect functionally graded beams resting on nonlinear elastic foundation

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Abstract

In this paper, post-buckling and nonlinear vibration analysis of geometrically imperfect beams made of functionally graded materials (FGMs) resting on nonlinear elastic foundation subjected to axial force are studied. The material properties of FGMs are assumed to be graded in the thickness direction according to a simple power law distribution in terms of the volume fractions of the constituents. The assumptions of a small strain and moderate deformation are used. Based on Euler-Bernoulli beam theory and von-Karman geometric nonlinearity, the integral partial differential equation of motion is derived. Then this partial differential equation (PDE) problem, which has quadratic and cubic nonlinearities, is simplified into an ordinary differential equation (ODE) problem by using the Galerkin method. Finally, the governing equation is solved analytically using the variational iteration method (VIM). Some new results for the nonlinear natural frequencies and buckling load of the imperfect functionally graded (FG) beams such as the effects of vibration amplitude, elastic coefficients of foundation, axial force, end supports and material inhomogeneity are presented for future references. Results show that the imperfection has a significant effect on the post-buckling and vibration response of FG beams.

Keywords: Functionally graded beams; Imperfection; Nonlinear vibration; Post-buckling; Quadratic and cubic nonlinearity.

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