World Academy of Science, Engineering and Technology
International Journal of Mathematical and Computational Sciences
Vol:14, No:12, 2020

Nonlinear Vibration of FGM Plates Subjected to Acoustic Load in Thermal Environment Using Finite Element Modal Reduction Method

Authors : Hassan Parandvar, Mehrdad Farid

Abstract : In this paper, a finite element modeling is presented for large amplitude vibration of functionally graded material (FGM) plates subjected to combined random pressure and thermal load. The material properties of the plates are assumed to vary continuously in the thickness direction by a simple power law distribution in terms of the volume fractions of the constituents. The material properties depend on the temperature whose distribution along the thickness can be expressed explicitly. The von Karman large deflection strain displacement and extended Hamilton's principle are used to obtain the governing system of equations of motion in structural node degrees of freedom (DOF) using finite element method. Three-node triangular Mindlin plate element with shear correction factor is used. The nonlinear equations of motion in structural degrees of freedom are reduced by using modal reduction method. The reduced equations of motion are solved numerically by 4th order Runge-Kutta scheme. In this study, the random pressure is generated using Monte Carlo method. The modeling is verified and the nonlinear dynamic response of FGM plates is studied for various values of volume fraction and sound pressure level under different thermal loads. Snap-through type behavior of FGM plates is studied too.

Keywords : nonlinear vibration, finite element method, functionally graded material (FGM) plates, snap-through, random vibration, thermal effect
Conference Title : ICSRD 2020 : International Conference on Scientific Research and Development
Conference Location : Chicago, United States
Conference Dates : December 12-13, 2020