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Transient response of an active nonlinear sandwich piezolaminated plate. (English)

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Summary: In this paper, the dynamic modelling and active vibration control of a piezolaminated plate with geometrical nonlinearities are investigated using a semi-analytical approach. For active vibration control purposes, the core orthotropic elastic layer is assumed to be perfectly bonded with two piezo-layers on its top and bottom surfaces which act as sensor and actuator, respectively. In the modelling procedure, the piezo-layers are assumed to be connected via a proportional derivative (PD) feedback control law. Hamilton's principle is employed to acquire the strong form of the dynamic equation in terms of additional higher order strain expressions by means of von Karman strain-displacement correlation. The obtained nonlinear partial differential equation (NPDE) is converted to a system of nonlinear ordinary differential equations (NODEs) by engaging Galerkin method and using the orthogonality of shape functions for the simply supported boundary conditions. Then, the resulting system of NODEs is solved numerically by employing the built-in Mathematica function, "NDSolve". Next, the vibration attenuation performance is evaluated and sensitivity of the closed-loop system is investigated for several control parameters and the external disturbance parameters. The proposed solution in open loop configuration is validated by finite element (FE) package ABAQUS both in the spatial domain and for the time-/frequency-dependent response.

MSC:

74H45 Vibrations in dynamical problems in solid mechanics
74K20 Plates
74F15 Electromagnetic effects in solid mechanics
74E30 Composite and mixture properties
74M05 Control, switches and devices ("smart materials") in solid mechanics
74S05 Finite element methods applied to problems in solid mechanics

Keywords:

geometrical nonlinearity; vibration control; semi-analytical approach; von Karman plate; finite element method

Software:

ABAQUS

Full Text: DOI

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