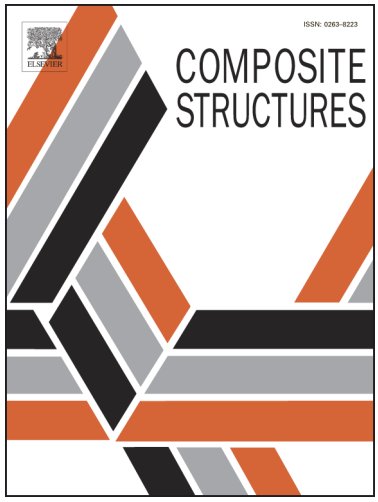

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An Analytical Solution for Dynamic Behavior of Thick Doubly Curved Functionally Graded Smart Panels

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Abstract

In this paper, an analytical solution is presented for free vibration and dynamic behavior of doubly curved laminated shell consisting of a functionally graded core layer and surface attached functionally graded piezoelectric layers. Shell through-thickness kinematics is based on higher order shear deformation theory of shells, whereas a quadratic variation is assumed for electric potential. Using Hamilton's principle and Maxwell's equation, the governing equations of motion under mechanical loads are derived as seven highly coupled partial differential equations. Implementing Laplace transformation, doing few mathematical operations and using Laplace inverse method, time dependencies of displacement components are expressed in explicit phrases. Besides numerical results for shell natural frequencies, effects of different material properties and shell geometries on the transient response are discussed in details. In particular the influence of shell curvature on the spectra of maximax response has been studied. It is found that, these parameters play major roles on determining the time-histories of the electric potential and displacement components.

Keywords: Doubly curved panel; Functionally graded piezoelectric material; Free vibration; Transient responses; Analytical solutions; Third order shear deformation shell theory.

Introduction

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