

Dynamic analysis of FGPM (Functional Graded piezoelectric Material) beams under Mechanical and Electrical Loading

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Abstract

Recently, considerable interest is the use of smart structures. The particular smart structures are get information from the structure position and control ability from the information. Sensors is a devices for information receipt and actuator is a devices that using for control. The piezoelectric sensors and piezoelectric actuators has excellent particulars, in the kinds of the smart structures. In this study, using finite element approach based on two dimensional theory of elasticity, force vibration of functionally graded piezoelectric beam under different sets of mechanical and electrical loading is investigated. Mechanical, electrical and electromechanical properties are following power law distribution through the thickness. By employing Hamilton's energy principle governing equation are obtained, and by applying two dimensional finite elements the equations are solved for two state, sensors and actuator. Also with using Newmark-beta method investigated response dynamics in time domain and frequency spectrum of Fast Fourier transform method is used in frequency domain. The effect of various parameters such as volume fraction indices, boundary conditions and slender ratio on the dynamic response and natural frequencies of the beam has been studied. The results show that changing any of these parameters have a significant impact on the dynamic response and natural frequencies of the functionally graded piezoelectric beam.

Keywords: Functionally graded, piezoelectric material, two dimensional theory of elasticity, Dynamic analysis, Finite Element Method.

1. Introduction

New materials are those engineering materials that have been highly developed in recent years and have opened new windows for human beings. The unique properties of these materials such as high strength and hardness, flexibility and wear resistance, interesting electrical and magnetic properties and unique, has led to increased interest and attention to these materials [1]. With these materials, smaller, lighter, smarter and more versatile products can be produced. In general, new materials can be divided into different categories, including composites, target materials, smart materials,