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Three-Dimensional Free Vibration Analysis of Triclinic Piezoelectric Hollow Cylinder

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Abstract

Triclinic materials are categorized as anisotropic elastic materials with no existence of a symmetry plane. To characterize such materials, 21 elastic constants are required. The previous studies have not investigated *triclinic* materials due to a high number of material constants considered in the modeling. This paper presents a closed-form 3D piezoelectric model to investigate the free vibration of an arbitrary thick triclinic piezoelectric hollow cylinder. The piezoelectric cylinder is assumed to be infinitely long and short circuit boundary conditions are applied at the inner and outer surfaces of the shell. The natural frequencies of the cylinder are calculated using the transfer matrix approach along with the state space method. The effects of different anisotropic piezoelectric properties including orthotropic, monoclinic, and triclinic materials on the dispersion curve of natural frequencies are studied. The numerical results show that if the value of the axial wave number, the circumferential wave number, or natural frequency increase the resonant frequency of triclinic material deviates from other anisotropic materials such as orthotropic. Finally the validity of the proposed model is confirmed by comparing with simplified cases studied in the literature.

Keywords: Exact Theory of Linear Piezoelectricity, Fully Anisotropic, Triclinic, Monoclinic, Ferquency Reponse

1. Introduction

The exceptional electro-mechanical coupling properties of piezoelectric materials plays a preeminent role in the advancement of various electro-

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