Analysis of Wave speed in magneto-thermoelastic nonlocal micropolar orthotropic medium

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ABSTRACT

In this article, the governing partial differential equations for nonlocal micropolar orthotropic magneto-thermoelastic half space in context of generalized theory of thermo-elasticity for x-z plane are obtained. The velocity equation is derived and the plane wave solution shows the existence of four coupled quasi plane waves in the plane namely quasi-longitudinal displacement (qCLD) wave, quasi transverse displacement (qCTD) wave, quasi transverse micro-rotational (qCTM) wave and quasi thermal wave (qCT). The speeds of these waves are calculated for a particular material. The variation of speeds of these waves due to magnetic field, nonlocal parameters, micro-polarity is studied and are shown graphically.

Keywords Magneto-thermo-elasticity, micro-polarity, orthotropic.

INTRODUCTION

Orthotropic materials like wood, sheet metal, topaz, unidirectional fibre-reinforced composites, the outer carbon fibres, carbon fibre reinforced polymer (CFRP), glass fibre reinforced plastic (GFRP) and nano-materials. These materials have great engineering importance.

Metamaterials are composite manmade materials that are engineered to have a property that are not found in naturally occurring materials. These are made from assemblies of multiple elements fashioned from composite materials to exhibit unique electromagnetic properties such as negative refractive index. Metamaterials are used optical filters, medical devices, remote aerospace applications, sensor-detection lenses for high-gain antennas, infrastructure monitoring, smart solar power-management, crowd control, redomes, high-frequency, battlefield communication, and even shielding structures from earthquakes. Acoustic, seismic, nano-science and semiconductor metamaterials are also research areas.

Eringen [1,2] established micropolar theory of elasticity to model the behaviour of granular materials, multimolecular bodies, and composite materials, and Eringen [3] proposed a theory, called nonlocal continuum mechanics. The wave propagation in an anisotropic medium is studied by Keith and Crampin [4], Singh and Yadav [5,6] studied wave propagation in rotating magneto-thermoelastic anisotropic solid half space and obtained the reflection coefficients. Yadav [7] studied the reflection of plane waves from the free surface of a rotating orthotropic magneto-thermoelastic solid half-space with diffusion.

MODEL

Plane wave method, Normal mode analysis can be applied to study the waves in micropolar orthotropic medium. Earth modelled for this problem as orthotropic layers are found in the earth.

CONCLUSIONS

Magnetic field, nonlocal parameters and micro-polarity have significant effect on speeds, of these waves.

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