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Abstract

The present paper framed to study the impact of heterogeneity on propagation of Love wave in a heterogeneous micropolar layer over an elastic inhomogeneous stratum, when both rigidity and density are assumed to vary linearly with depth. The equations of motion have been formulated separately for layer and half-space under suitable boundary conditions. Analytical solution for the dispersion equation has been obtained using method of separation of variables by means of the Airy function and Whittaker function. Some particular cases have also been investigated. Further, as a special case the velocity equation for isotropic layer over a homogeneous half-space coincides with the standard result of Love wave. Numerical calculations of frequency relation have been performed and depicted by means of graphs to exhibit the substantial impact of heterogeneity, micropolar parameters and wave number on the phase velocity of Love wave. The wave velocity is strongly influenced by these parameters.

Keywords: Love waves, Micropolar medium, Heterogeneity, Dispersion, Airy function, Whittaker function

1. Introduction

The classical theory of elasticity illuminates the mechanical behavior of common solid materials, e.g., concrete, wood and coal. However, this theory is inadequate to exhibit the behavior of motion of inner framework of some modern engineering structures such as polycrystalline materials and materials with fibrous or coarse grain. To overcome this drawback of the classical theory of elasticity, Voigt [1] developed the inferences that interaction between two particles of a body through an area element lying with the material is not only transmitted by force vector but also by a couple (moment) vector. This gave rise to couple stresses in elasticity. The micropolar theory of elasticity absorbs a local rotation of points as well as the translation assumed in classical elasticity; and a couple stress (a torque per unit area) and the force stress (force per unit area). Hence, in the case of microelasticity, each element or grain of microstructure can not only translate but also rotate about its centre of gravity. Thus, the appearence of such microstructure in the Earth's crust plays an important role for explaining the problems of wave propagation. Many problems of waves and vibrations have been studied in micropolar elastic solid by several researchers. However, the complete theory was developed by Cosserat and Cosserat [2]. Further, the generalized interpretation of this theory was establised by Eringen et al. [3, 4], which enlighten the deformation of elastic media with oriented particles. They showed that not only displacement vector but also rotation vector involved in the motion in a granular structure material. Singh et al. [6] studied the propagation of Rayleigh waves in a rotating orthotropic micropolar elastic half-space. Shear wave propagation in vertically heterogeneous viscoelastic layer over a micropolar elastic half-space was discussed by Sharma et al. [7]. Problems of waves and vibrations in micropolar elastic solids are receiving greater attention from many researchers like, Tomar [8], Midya [9], Kumar [10] etc.

Since the generation of seismic waves is characterized by the natural resources buried inside the Earth such as oils, gases, minerals, deposits and other useful hydrocarbons. So it is necessary to develop techniques that can consider sources in a heterogeneous environment and that do not depend on the commonly used assumption of local homogeneity near the source. Many problems of waves and vibrations have been discussed in heterogeneous medium by several researchers. Bhattacharya [11] discussed some possible exact solution of SH-wave equation for inhomogeneous media. Kakar and Kakar [12] investigated Love waves in a non-homogeneous elastic media. Propagation of Love waves in non-homogeneous layer

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