Analysis of plane wave reflection from boundary of piezothermoelastic medium with impedance

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Mechanical waves and their behaviour with different media has emerged as an important area of research due to its applications in the analysis and optimization of smart materials and devices such as sensors, actuators, and transducers. The present study investigates the behaviour of a plane wave incident on the boundary of a thermoelastic medium exhibiting coupled mechanical and thermal responses. Emphasis is placed on examining the influence of the impedance parameter on the amplitudes and energy distribution of the reflected waves.

Analytical expressions for the amplitude ratios are derived, and the corresponding secular equations are obtained. Using a representative material model, the variation of these amplitude ratios with the angle of incidence is examined and compared under different established theories of thermoelasticity. The analytical results further provide an approximate estimate of the impedance parameter and the angle of incidence required to achieve a desired partition of energy among the reflected wave modes.

The numerical findings reveal that an increase in the impedance parameter enhances the amplitude of the quasi-longitudinal (qP) wave while simultaneously reducing that of the quasi-shear vertical (qSV) wave, thereby promoting the reception of a clearer and more dominant qP wave signal.

References

[1] Pang,Y., Wang,Y.-S., Liu, J.-X., Fang, D.-N.: *Reflection and refraction of plane waves at the interface between piezoelectric and piezomagnetic media.* Int. J. Eng. Sci. 46(11), 1098–1110 (2008)

[2] Godoy, E., Durán, M., Nédélec, J.-C.: *On the existence of surface waves in an elastic half-space with impedance boundary conditions.* Wave Motion 49(6), 585–594 (2012)

[3] Lord, H.W., Shulman, Y.: *A generalized dynamical theory of thermoelasticity.* J. Mech. Phys. Solids 15(5), 299–309 (1967)

[4] Green, A.E., Lindsay, K.A.: *Thermoelasticity.* J. Elast. 2(1), 1–7 (1972)

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