

Study of Ultrasonic Waves in Unidirectional Fiber-Reinforced Composite Plates for the Aerospace Applications

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Abstract : The article is concerned with the motion of ultrasonic guided waves in a unidirectional fiber-reinforced composite plate under acoustic sources. Such unidirectional composite material has orthotropic elastic properties as it is very stiff along the fibers and rather compliant across the fibers. The dispersion equations of free Lamb waves propagating in an orthotropic layer are derived that results in the dispersion curves. The connection of these equations to the Rayleigh-Lamb frequency relations of isotropic plates is discussed. By the use of reciprocity in elastodynamics, closed-form solutions of elastic wave motions subjected to time-harmonic loads in the layer are computed in a simple manner. We also consider the problem of Lamb waves generated by a set of time-harmonic sources. The obtained computations can be very useful for developing ultrasound-based methods for nondestructive evaluation of composite structures.

Keywords : lamb waves, fiber-reinforced composite plates, dispersion equations, nondestructive evaluation, reciprocity theorems

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