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Detection of microrotational effects and Cosserat moduli reconstruction using wave propagation

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We propose a method of detection of effects of internal rotation and reconstruction of the Cosserat elastic moduli using the measurements of velocities of the p-wave and the high frequency twist wave as well as the shear wave dispersion relationships. We consider the general isotropic, transverse isotropic and orthotropic Cosserat continua. A phase shift method and reconstruction algorithms are proposed that utilise the measurements of dispersion relationship. It is shown that in a general isotropic Cosserat continuum the information obtained from these wave measurements is insufficient for the complete moduli reconstruction. However the moduli that can be reconstructed provide sufficient information for detection of the presence of microrotational effects. The full moduli reconstruction is shown to be possible in the case of a 3D isotropic Cosserat continuum governed by at most 4 independent parameters. Such a continuum is suggested for a particulate material consisting of spherical particles connected by normal, shear and rotational links. Another case when the full reconstruction is possible consists of 2D orthotropic Cosserat continuum modelling particulate material with square packing of cylindrical particles and 2D isotropic Cosserat continuum modelling hexagonal packing of cylindrical particles. In the 2D materials the measurements of p-wave velocity and the shear wave dispersion relationship are sufficient for complete reconstruction of all moduli.