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Waves in stratified geomaterials with sliding layers

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Wave propagation in stratified geomaterials with sliding layers is strongly anisotropic. The simplest representation of this behaviour is an elastic transverse-isotropic (orthotropic in 2D) continuum. Such a model is however only applicable when loading that is sufficiently uniform or when the wavelength is much larger than the layer thickness. In this case the stress non-uniformity over the layer thickness and the associated layer bending can be neglected. In an intermediate case when the wavelength is still higher than the layer thickness but not as high to neglect the stress non-uniformity at least bending moments and layer bending need to be taken into account. This is equivalent to retaining only the linear term of the normal stress variation over the layer thickness. The layer bending creates additional, rotational degrees of freedom. In 2D only one rotational degree of freedom exists, which considerably simplifies the modelling. The corresponding rotation is represented by the average gradient of layer deflection. The presence of rotations makes the stress tensor non-symmetrical. On top of that the rotation gradient creates moment stresses, which represent bending moments over the unit area in the layer cross-section. This requires the use of a 2D orthotropic Cosserat continuum to model the dynamics of such a stratified geomaterial. We show that in the stratified geomaterial shear-bending waves propagate. We determine the wave velocities and demonstrate that as the resistance to sliding reduces, the waves tend to localise over a line normal to the layering.