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ANISOTROPIC AND ANELASTIC ROCK MODEL AND SEISMIC WAVE PROPAGATION

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Abstract. In geophysical prospecting, physical properties and effects of rocks can be studied by seismic waves that propagate through the subsurface. Thin layering, intrinsic structures, natural fractures and regional stress cause anisotropy and attenuation.

This work focuses on the development of an more complex and realistic anisotropic-viscoelastic model that can be used to accurately simulate seismic wave propagation. We represent a thinly layered medium by sandstone partially saturated with water and gas, using White's mesoscopic model and mudstone with a isotropic-elastic constitutive relation. Then, the resulting transversely isotropic medium with vertical and tilted axis is obtained through Backus averages and Bond transformation matrix. Velocities and dissipation factors for different wave modes are analyzed as a function of frequency and gas saturation with its corresponding anisotropic behaviors. Furthermore, we compute wave propagation in a two-dimensional medium expressing the equations in the space-frequency domain to deal in a natural setting with the presence of energy dissipation and wave attenuation.

Due to the high computational cost of the problem we implement a iterative domain decomposition procedure using nonconforming finite element method which is very adequate to run on computers with parallel architecture.

The work is completed with an analysis of the properties of the algorithm such as scalability, robustness and parallel performance.