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Anisotropic priors for probabilistic AVA inversion

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Summary

Anisotropy is well known to have an impact on AVA inversion, sometimes causing false quantitative interpretations. Probabilistic inversions, while powerful in that they provide posterior uncertainties through a more complete exploration of model space, require prior information. We construct anisotropic priors using both log data and rock physics. Sonic scale anisotropy is obtained from advanced sonic waveform processing in conjunction with tensor completion to produce logs of anisotropic moduli. The sonic-derived shear VTI parameter is generally reliable for low permeability formations but porous sandstone formations can cause negative shear VTI due to the impact of pore fluid mobility on the Stoneley wave. Not widely known, however, is that negative anisotropy in sandstones is actually expected due to stress sensitivity and larger vertical effective stress. We incorporate recently developed rock physics modelling in sonic tensor completion to include negative anisotropy in sandstone formations. The impact of the upscaled log anisotropy on AVA is demonstrated on a shale/sandstone interface. To illustrate how the anisotropy logs may be used as a prior, we use an automatic facies classification from unsupervised machine learning. Each facies is then defined by means and covariance matrix for density and anisotropic moduli. These are used to build the statistical parameter set for geological sequence realizations in the probabilistic AVA inversion. VTI and orthotropic symmetry are considered.

Theory / Method / Workflow

Results, Observations, Conclusions

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References

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