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How to separate intrinsic and artificial anisotropy

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The effect of anisotropy on seismic waves and on the inversion for 3D tomographic models of velocity and anisotropy is not negligible and is used for different applications in geodynamics for both regional and global scale (Montagner, TOG, 2007). The exact determination and interpretation of anisotropy (amplitude and orientation) are quite difficult because the observed or inverted anisotropy is usually a mixture of intrinsic and artificial anisotropies, which may partly hide the true properties of the medium. The artificial anisotropy is due to two reasons: first of all, to the inversion technique and second of all, to the the fact that seismic waves do not see the real details of medium but a filtered (and imperfect) version of the earth model. Backus (1962) constructs the effective elastic coefficients for layered medium to present what is "seen" by the wave field at long periods which is called the "long-wavelength equivalent" effect. The homogenization method developed by Capdeville et al., (2007, 2010) uses a two-scale homogenization expansion to construct a new more continuous model based on filtering technique which can adapt the scales of the model to the seismic wavelengths. Such homogenized model is quite effective to compute full waveform seismograms in heterogeneous anisotropic medium.
In this paper, we propose a strategy in order to separate artificial and intrinsic anisotropy. For the inversion technique, we use a quasi-Newton method (Tarantola, 2005) together with the GMRES method based on the first-order perturbation theory. We try to find and interpret the real and artificial anisotropy by introducing different prior information on both data and the reference model. We investigate a 1D isotropic smooth model and an isotropic discontinuous PREM model, together with their homogenized models which are anisotropic VTI models (Capdeville et al., 2007), try to estimate the amplitude of artificial radial anisotropy associated with the inversion technique and the homogenization as the effect of filtering. Actual seismic data for the 3D problem is left to the future for demonstrating the separation of intrinsic and artificial anisotropy.