Two Prestack Anisotropic Depth Migration Methods for Tilted TI Media

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Abstract

Seismic anisotropy in dipping shale layers causes imaging and positioning problems for underlying structures. Two 2D anisotropic depth migration algorithms, anisotropic phase-shift-plus-interpolation (A-PSPI) and anisotropic reverse-time (A-RT), are presented for tilted transversely isotropic media (TTI). These two algorithms inherit the accuracy of wavefield extrapolation migration methods. Different from using an approximated solution of vertical wavenumber, such as table-driven interpolation and interpolation polynomial, we solve vertical wavenumber analytically from the derived quartic dispersion equation. With certain assumption for the relationship between anisotropic parameters and variable velocities, A-PSPI algorithms can handle an arbitrary distribution of velocities and anisotropic parameters. Also, we derive the P-wave and SV-wave equations for tilted TI media from the frequency-dispersion equations. With these equations, the anisotropic reverse-time migration is implemented with psedo-spetral method.

In principle, A-PSPI belongs to the downward continuation methods that use one-way wave equation to extrapolate wavefields, while ART is a full wave equation method. We focus our research on the differences between accuracy and efficiency. In addition, we evaluate the calculation cost between isotropic and anisotropic migrations. Examples demonstrate that A-PSPI and A-RT have excellent performance for arbitrary velocity and anisotropic parameters media. Although ART does not suffer from the dip limitation of one-way downward continuation algorithms, it faces the expensive calculation.