DECOUPLED P-WAVE MODELING AND REVERSE TIME MIGRATION IN VTI MEDIA IN THE TIME SPACE DOMAIN

Debanjan Datta and Mrinal K. Sen

Institute for Geophysics and Department of Geological Sciences
The University of Texas at Austin

ABSTRACT

The acoustic wave equation in VTI media has been traditionally solved in the time domain using pseudo acoustic wave equations. The system is comprised of a coupled pair of equations derived by setting the vertical shear velocity equal to zero. The solution of the system contains a spurious SV-wave, which introduces noise when modeling or migrating P-waves. This effect can be mitigated by using a decoupled system that separates P and SV-waves and is solved in the time-wavenumber domain. Converting the decoupled equations to the space-time domain is not straightforward because they contain mixed wavenumber terms. We propose an approximation to remove the mixed wavenumber terms and solve for a single P-wavefield instead of the two wavefields in the coupled form of equations. The spurious SV-wave is also removed in this implementation. This approximation is done by using directional derivatives to estimate the phase angle. This enables porting of the modeling algorithm to massively parallel architectures like GPUs to obtain maximum speed-up, which is not possible to achieve with mixed domain methods. We compare results from our proposed technique with those from coupled P-SV solution and demonstrate that they are in good agreement. We also carry out a reverse time migration of a synthetic anisotropic Marmousi dataset and demonstrate that the imaging is able to recover all the interfaces without any significant noise or artifacts.
Migrated anisotropic Marmousi model using our proposed method where almost all interfaces have been well imaged. The image is relatively noise free and does not contain any serious artifacts.