Estimation of Shear wave anisotropy of Transeversely Isotropic medium by Full Waveform Inversion

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In reflection seismic survey, relatively low resolution information can be obtained over a wide range, whereas the borehole logging data contains a high precision data in a narrow range. It is important to estimate the physical properties by integrating these two kinds of information. Recently, anisotropic structure in the subsurface has drawn attention because of its impact on the seismic survey and interpretation. The velocity of seismic wave varies due to natural fractures, sediment structures and selective crystal structures of subsurface materials. Understanding anisotropic properties is important to estimate dynamic properties such as deformation and stress of rock inside the earth and to estimate the composition of minerals.
In this research, a numerical experiment is conducted on the sonic logging model which contains the anisotropic layer. A cross dipole, which consists of two orthogonal dipole sources, is used as a transmitter. For the anisotropic model, a transversely isotropic medium with a horizontal axis of symmetry with five independent elastic elements is set. According to previous studies, it is suggested that the received waveform obtained by the cross dipole measurement changes with the degree of anisotropy of the rock. Distinctive feature can be observed when shear wave passes through the anisotropic layer and splits into two polarized waves: fast shear and slow shear. We attempt to estimate the elastic parameters using the shear waves. Full waveform inversion (FWI) is applied to estimate the elastic parameters directly. FWI is one of the techniques to estimate the ground physical properties with high accuracy and resolution by updating the model parameters so as to minimize the residual between the observed and the calculated waveforms. As a result, it was suggested that highly accurate estimation of elastic parameters is achieved by applying FWI to the layer where anisotropy exists. Although the resolution depends on the receiver interval in conventional slowness time coherence method, it is suggested that FWI can estimate ground physical properties with high resolution.

Keywords: Anisotropy, Full Waveform Inversion, Borehole Geophysics

