

Waveform inversion of seismic reflection data and its application to fault structure survey

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Seismic waveform inversion (Tarantola, 1984) is a novel technique of imaging subsurface structures. It reconstructs a model of physical parameters that best explains waveforms of observed seismic data by incorporating a nonlinear least-squares inversion. Waveform inversion provides high-resolution model than that from travelttime tomography. Recent development of computational environment accelerates studies on practical application of the method to 2-D/3-D field data.

In this study, we investigate an application of the method, originally developed for crosswell seismic data, to reflection seismic data. The problems are (1) singular nature of sensitivity near sources and receivers at the surface, (2) attenuation of sensitivity in deeper part of the section, and (3) contamination of surface wave. We introduced a weight increasing with depth on the gradient, and near-offset trace mute to reduce the effects of the problems listed above. Using the synthetic waveform data numerically generated from a given structure model, we proved that a clear structure image was successfully retrieved after iteration.

Then, we applied the method to the field data of wide-angle reflection survey acquired in the Fujikawa-kako fault zone - ISTL seismic reflection survey conducted in 2012 (2012FIST)(Ito et al, 2013) to reveal the detailed structure of Omiya fault. Although the reconstructed velocity structure is consistent with the recent interpretation that the Omiya fault is a reverse fault, it was far from convergence due to the insufficient number of seismic sources used in the survey. Problems and requirements for future survey design will be discussed in the presentation.

Keywords: seismic reflection method, waveform inversion, fault structure, non-linear inversion