Using diffracted wavefield to improve seismic impedance

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Abstract:

Seismic diffraction encodes the information on medium and small-scale subsurface objects in the subsurface. Last decade diffraction imaging is used for fault, pinch-out and fracture detection and localization. Very little research, however, has been done about taking diffraction into account in the impedance inversion. Usually, in the standard inversion scheme, the input is the migrated data and it is supposed that the energy of diffraction is focused. But it is true only for a perfect velocity model and true amplitude migration algorithm, which is rare in practice. Besides, the input of impedance inversion is the migrated data, where the amplitude of diffracted wavefield is distorted and covered during standard inversion process. Therefore, a new approach is proposed to implement impedance inversion using the unmigrated data and diffracted wavefield without distortion. The input data for inversion is an amplitude-preserved zero-offset section with identified diffraction events. Forward modelling operator, designed for the impedance inversion, includes the classical specular reflection plus asymptotic diffraction modelling schemes. In the impedance inversion process, the Bayesian theory is utilized to estimate the model perturbation with given prior information. During the optimizing work, in order to generate models and update movements efficiently, the improved Markov chain Monte Carlo simulation is implemented by adaptive particle swarm optimization, which potentially has better efficiency compared with Genetic Algorithm.