FREQUENCY-DOMAIN FULL WAVEFORM INVERSION WITH PLANE-WAVE DATA

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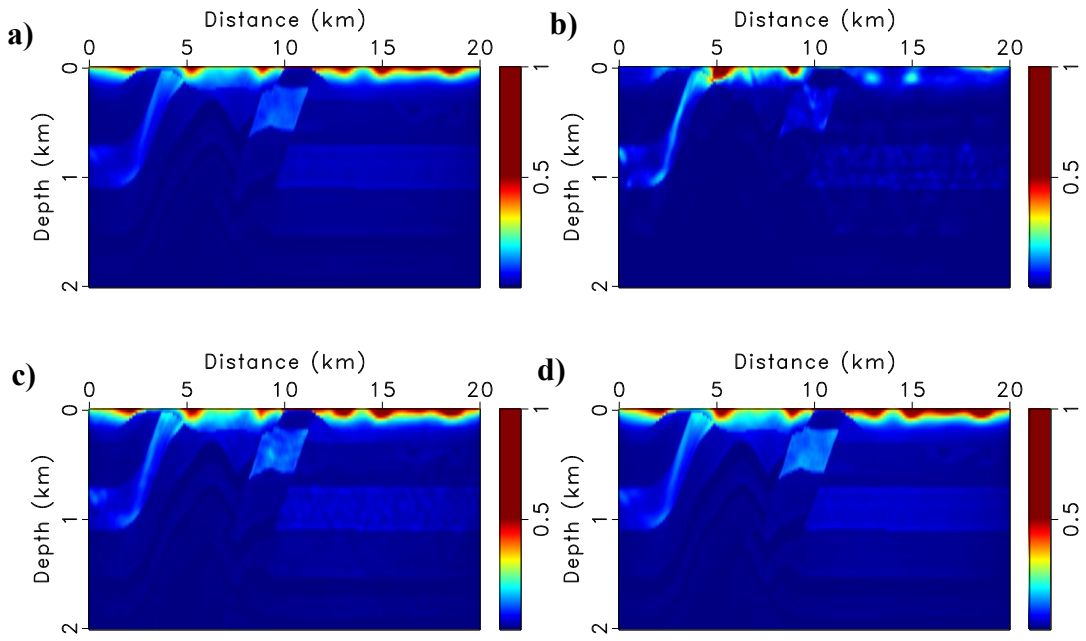
ABSTRACT

We propose an efficient frequency-domain full waveform inversion (FWI) method using plane-wave encoded shot records. The forward modeling involves application of position dependent linear time shifts at all source locations. This is followed by propagation of wavefields into the medium from all shot points simultaneously. The gradient of the cost function needed in the FWI, is calculated first by transforming the densely sampled seismic data into frequency-ray parameter domain and then back-propagating the residual wavefield using an adjoint-state approach. We use a Gauss-Newton framework for model updating. The approximate Hessian matrix is formed with a plane-wave encoding strategy, which requires a summation over source and receiver ray parameters of the Green's functions. Plane-wave encoding considerably reduces the computational burden and cross-talk artifacts are effectively suppressed by stacking over different ray parameters. It also has the advantage of directional illumination of the selected targets. Numerical examples show the accuracy and efficiency of our method.



Comparison of the diagonal Hessian for the true model with different parameters. (a) true Hessian with 401 sources and 401 receivers; (b) plane-wave Hessian with 9 source and receiver ray parameters; (c) plane-wave Hessian with 41 source and receiver ray parameters; (d) plane-wave Hessian with 81 source and receiver ray parameters.