Full-Waveform Inversion by Multi-Scale Temporal Integration

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Abstract

Full-waveform inversion (FWI) has been proved to be a powerful tool in resolving complex geological structures and gained great interest in recent years. However, the nonlinearity of the inversion and the induced existence of many local minima of the FWI could make it less robust than the conventional velocity model building methods. Inspired by the wide use of the temporal integration of signal in acoustic motion detection, we present a new numerical scheme to accelerate and stabilize the FWI based on a multi-scale temporal integration of the wavefield. The multi-scale integration of the original wavefield invokes new state variables and satisfies the wave equation through a temporal integrated source wavefield.

The new method is validated using the Marmousi synthetic velocity model. Using the simulated data with a dominant frequency at 10 Hz, the classic implementation of the FWI could be easily trapped in local minima. In contrast, the FWI with a multi-scale temporal integration is more robust and faster in recovering the true velocity model. In conclusion, our preliminary synthetic study illustrates the robustness of the new scheme.