Full waveform inversion in the frequency domain using classified time-domain residual wavefields

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We perform the acoustic full waveform inversion in the frequency domain using residual wavefields that have been separated in the time domain. We sort the residual wavefields in the time domain according to the order of absolute amplitudes. Then, the residual wavefields are separated into several groups in the time domain. To analyze the characteristics of the residual wavefields, we compare the residual wavefields of conventional method with those of our residual separation method. From the residual analysis, the amplitude spectrum obtained from the trace before separation appears to have little energy at the lower frequency bands. However, the amplitude spectrum obtained from our strategy is regularized by the separation process, which means that the low-frequency components are emphasized. Therefore, our method helps to emphasize low-frequency components of residual wavefields. Then, we generate the frequency-domain residual wavefields by taking the Fourier transform of the separated time-domain residual wavefields. With these wavefields, we perform the gradient-based full waveform inversion in the frequency domain using back-propagation technique. Through a comparison of gradient directions, we confirm that our separation method can better describe the sub-salt image than the conventional approach. The proposed method is tested on the SEG/EAGE salt-dome model. The inversion results show that our algorithm is better than the conventional gradient based waveform inversion in the frequency domain, especially for deeper parts of the velocity model.