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Reflection Full Waveform Inversion in Migration Based Travel Time formulation

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Building a smooth velocity model in the depth domain, which is responsible for correct travel-times of wave propagation, is the main challenge in the present technology of seismic data processing in areas with complex geology. Formally it seems be possible to achieve, along with the subsurface structure, by the Full Waveform Inversion (FWI) technique matching the observed and the synthetic seismograms (Tarantola, 1984). To minimize the misfit function and to find the elastic parameters of the subsurface, a variety of non-linear iterative descent methods are usually used. Such approach, proposed originally by Tarantola (1984), has been developed and studied in a great number of publications (Virieux and Operto, 2009, and the references therein).

Nevertheless, its straightforward application to the data reconstructs reliably only the reflectivity component of the subsurface but fails to recover a smooth component of a velocity model (propagator). To overcome this hardship G.Chavent with colleagues introduced FWI in Migration Based Travel-Time (MBTT) formulation (2001). The main idea of this approach is to decompose model space into two orthogonal subspaces - smooth propagator and rough reflector with subsequent reformulation of the cost function.

We apply this idea to formulate the Reflection FWI algorithm in frequency domain within the concept of MBTT. A series of numerical experiments demonstrates its advantages in reconstruction of macrovelocity using reflected input data with reasonable offsets and frequency ranges.