Wavepath Imaging for Passive Data

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Abstract

Passive sources can be located using three different techniques; (1) methods based on seismic event picking, which is not easy in case of noisy data and could be time-consuming, (2) migration techniques such as the diffraction stack method, here the seismic energy is smeared along the whole image volume, which may increase the level of artefacts, and (3) using wave-equation-based migration techniques such as reverse-time migration, however it requires a lot of computing resources and it could produce artefacts in case of complex velocity models. We propose to locate the passive sources using a wavepath migration technique which back-propagates the seismic event along a 1.5D fat ray described by quasi-ellipsoid. Our advocated method is named wavepath imaging (WI). In the proposed method, we use slant stacking to calculate the apparent velocity values, hence finding the direction of raypath shooting. The seismic energy is then smeared only along that raypath and covers an area equal to the Fresnel zone. The advantage of our proposed method over other standard techniques is we smear the seismic energy along a smaller area which will decrease the generated artefacts. One challenging problem of our method is its dependency on the angle of incidence. Moreover, in an elastic medium, different wave modes will lead to some artefacts, we could consider utilizing some post-imaging process to eliminate these artefacts. Synthetic tests show that the proposed WI method produces an improved migration image when compared to diffraction stack migration or the Time Reversal Imaging (TRI) method.