Progress in Multiple Attenuation with Land Seismic Data in the Sultanate of Oman: Examples of Wave-Equation Deconvolution

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Abstract

Land seismic data often suffers from surface-related multiples, which mask primary events and interfere with true seismic amplitudes. In the southern Sultanate of Oman, a sequence of relatively thin near-surface sedimentary layers, which alternate between hard and soft materials, produces a curtain of multiples that obscure the primaries below. (Ernst et al., 2019). Eliminating such multiples is challenging due to the lack of near-surface information and shallow sparse sampling.

Multiple elimination using model-driven methods has produced encouraging results in land seismic data in several areas (Retailleau et al., 2012). However, such methods require prior information including suitable imaging and interpretation of the multiple generators and an accurate velocity model, which are often not available for shallow generators. In addition, special care is needed during the adaptive subtraction phase due to large amplitude and potential time differences between the real data and the predicted multiple model.

Recently, a new approach has emerged that overcomes the challenge of lacking realistic multiple generators image (Poole et al., 2022). This wave-equation deconvolution method involves two steps. The first step consists of using least-squares inversion to derive an image of the multiple generators from the data based on the multiple periodicities. The second step uses the output image of the multiple generators from previous step to predict the multiples. The resulting multiple model requires only mild adaptation prior to subtraction as it is more accurate in both timing and amplitude.

This new approach has proven to be effective in attenuating near-surface related multiples. In this presentation, we show various examples of its application to land seismic data from the Sultanate of Oman. Examples from both structured and flat geological environments, and from various shot and receiver geometries, demonstrate the benefit of the method when compared to other de-multiple techniques.

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Ernst, Fabian, 2019, Multiples in south Oman: Understanding their origin and sensitivity to near-surface geology: SEG workshop, Kuwait City, KuwaitPoole, G, 2022, Wave-equation deconvolution surface-related multiple attenuation for the land environment: SEG workshop, Al Khobar, Saudi Arabia Retailleau, M, 2012, Advanced 3D Land Internal Multiple Modeling and Subtraction: EAGE, Copenhagen, Denmark.