

Hybrid Approach for Least Squares Migration

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Least-squares migration (LSM) has been implemented in many ways focusing on various applications. Each has different advantages as well as limitations. To maximize the effectiveness of LSM, we have been taking hybrid approaches to combine the strengths and mitigate the known weakness of different algorithms.

One-way wave propagator is efficient for high frequency imaging and improving the vertical resolution, but lacks the power of imaging steeply dipping structures. On the other side, two-way wave propagator has virtually no limitations on dips in depth imaging, but the cost increases dramatically with frequency. In our broadband LSRTM, we integrate the one-way and two-way propagators in the inversion to obtain high-resolution images in both vertical and lateral directions with reduced cost compared to conventional high frequency LSRTM.

LSM has also developed in both data domain and image domain. The data-domain approach iteratively suppresses the artifacts in migration and removes the wavelet effect to gain high resolution and focusing. However, its convergence on amplitude toward true reflectivity is usually slow. The inverse Hessian based image-domain LSM needs only a single iteration to improve the amplitude fidelity to make the image/gathers AVO compliant. By hybridizing the data-domain and image-domain approaches we can achieve structurally refined image with improved amplitude fidelity by minimum number of iterations.