Fast Beam Migration Tomography On Dispersed Source Array Blended Data

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Abstract

Objectives/Scope: Understanding the subsurface complexity is critical for a successful exploration and development campaigns. In this proposal, we combine the application of tomography and fast beam migration to generate a robust velocity model with minimal processing time. We apply Fast Beam Migration (FBM) and Tomography to a special type of seismic acquisition survey to achieve an accelerated velocity model update with higher resolution. This product can serve as an initial model for advanced geophysical imaging algorithms.

Methods, Procedures, Process: Fast Beam Migration and Tomography is an algorithm that accelerates the velocity model building process. A typical beam migration workflow consists of beam forming, depth migration and image forming. Alternatively, beam tomography combines aspects of beam migration and traditional tomography to create a computationally efficient velocity model. The tomography tackled a special blended seismic acquisition survey to achieve a high resolution velocity model. The dispersed source array acquisition is a blended type of acquisition based on simultaneous source propagation that efficiently reduces acquisition time. We further evaluate the algorithm by applying a de-blending operator as a pre-processing step prior imaging.

Results, Observations, Conclusions: Subsurface reflectivity images were retrieved through a successful application of the fast beam migration tomography on the blended and de-blended datasets. A typical de-blending process aims to differentiate between overlapping energy sources and produce subsequent seismic gathers for processing. Comparable high resolution velocity models were achieved through running Fast Beam Tomography on both datasets. Furthermore, the achieved velocity models matched the low frequency behavior of several wellbore interval velocity data within the area of acquisition. This suggests that FBM Tomography is a powerful algorithm even for a blended type of data acquisition. It further provides an ultra-fast and automated solution for velocity model building and accelerate the performance of advanced geophysical imaging techniques such as Least-square Reverse Time Migration and Full Waveform Inversion.

Novel/Additive Information: The application of fast beam migration tomography on both datasets succeeded in achieving comparable velocity model updates. Nevertheless, we further realize that de-blending is an unnecessary step for a successful beam migration tomography. The latter will accelerate the velocity model building process that delineates subsurface structures of potential hydrocarbon resources. The ultra-fast nature of Fast Beam Migration Tomography may also serve as an intelligent solution for seismic monitoring of CO₂ sequestration projects through accelerated imaging.