Wavefront Picking for 3D Tomography and Full-Waveform Inversion

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ABSTRACT

Making and quality controling (QC) seismic firstbreak traveltime picks is critical for a successful tomographic inversion and maturation of a reliable near surface solutions. To minimize the picking and QC time, I propose an efficient approach for picking first-break wavefronts on coarsely-sampled time slices of 3D shot gathers. The objective of our work is to compute a smooth initial velocity model for multiscale full-waveform inversion (FWI). Using interactive software, we geometrically model first-break wavefronts on few time slices with a minimal number of picks. Then, we perform traveltime tomography using the picks, and compare the predicted traveltimes to the data in-between the picked slices. We begin with large intervals between the slices, and the picking interval is refined with iterations until the errors in traveltime predictions fall within the limits necessary to avoid cycle-skipping in early-arrivals FWI. This approach is applied to a 3D ocean-bottom-station (OBS) dataset. For the case presented, results indicate that wavefront picking time has 28% fewer slices to pick compared to picking traveltimes in shot gathers. In addition, using sparse time samples for picking, data storage is reduced by 88%, and therefore allows for a faster visualization and quality-control (QC) of the picks. The final traveltime tomogram is sufficient as a starting model for early-arrival FWI. In addition to being more efficient, the proposed wavefront picking approach, coupled with FWI, will produce high quality near surface solutions that will improve imaging of the subsurface, and, in turn, will increase the chance of success in finding hydrocarbons.