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Enhancing First-Break Picking in Land 3d Seismic Data using Smart Supergrouping Technique

Saud S. Saadi[1], Pavel Golikov[1], Maxim Dmitriev[1], Andrey Bakulin[1]

[1]EXPEC Advanced Research Center, Saudi Aramco, Dhahran, SAUDI ARABIA

ABSTRACT

Building near-surface velocity is typically done using travel-time tomography. It requires travel time picks for first arrival. The quality of the near-surface model is ultimately related to the quality of these picks that are obtained using automatic pickers. Land 3D seismic data usually suffer from low signal-to-noise ratio (SNR) and therefore automatic pickers often lead to inaccurate picks. We present a new supergrouping method that enhances the SNR and leads to better first-break picks.

The supergrouping method works as follows: every common shot gather (CSG) is stacked with neighboring CSGs, and the output is assigned to the reference (central) shot location. The output acquisition geometry and the size of the output data can be identical to the input data or decimated. The smaller the source and the receiver intervals, the higher the resemblance of adjacent CSGs will be, and so stronger signal enhancements are expected when they are stacked. Summation is performed using straight stacks, diversity stack or weighted stack. When shots from different shot lines are summed, we assume that velocity distribution has no lateral heterogeneity and apply common offset summation.

We tested this method on land 3D seismic data from the northern part of Saudi Arabia. The area has always been challenging and data has a low SNR. We processed the data to remove random and coherent noises, and then applied the supergrouping. The results show improved SNR of the supergrouped data with greatly enhanced refraction arrivals, especially at far offsets. The results also suggest that this method is an effective way to reduce random noise. We used an automatic picker that uses a 1D edge detection algorithm to pick first arrivals. The first- break time picks show a significant improvement after applying this method. It increases the number of accurate first arrival picks generated from automatic pickers without human intervention and so improves the quality of the near- surface velocity model.