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# Smart Supergrouping Improves Residual Static Estimation in Areas with Challenging Seismic Data Quality

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## ABSTRACT

3D land seismic data in arid environments is often challenging for data processing and interpretation due to a low signal-to-noise ratio (SNR) and the presence of various types of noise. Traditionally, large source and receiver arrays have been utilized for noise suppression and signal enhancement. A trend in modern seismic data acquisition is the reduction of the size of the source and receiver arrays, aiming to record broadband signals for imaging and inversion purposes. For many processing steps, such as statics calculation and velocity model building, achieving a good pre-stack SNR may be more important. We propose a simple but effective supergrouping technique that significantly enhances pre-stack data quality. We demonstrate our approach on one 3D onshore dataset from the central part of Saudi Arabia. The data after enhancement was used for 3D residual statics calculations.

Supergrouping builds on a foundation of the group forming, but goes beyond to deal with large source/receiver intervals using simple assumptions and smart summation techniques that have proven to work well for field data of different complexity. We perform smart supergrouping with arrays of varying size involving up to 20 neighboring shot points (420 x 840m). All selected shot gathers are stacked with complex weights derived by singular value decomposition (SVD) analysis of the input traces in the frequency domain. These complex weights have amplitude and phase and aim to align signals between stacked traces. Therefore, a weighted stack approach highlights the similarity and tends to suppress difference between stacked shot gathers. The enhanced data was used for residual static estimation by stack-power maximization. In a case study we focus on a target window around main reflectors. Our tests show that increasing SNR by performing smart supergrouping leads to improvement in residual statics calculation. To preserve spatial resolution of the shot statics, we ensure that phase shifts for complex weights are referenced to an output location of a supershot. One may observe smoother and more geologically plausible spatial distribution of the residual statics as well as improvement in the final stack manifested as reduction of cycle skipping and better continuity of main horizons. This example shows good potential for the flexible smart supergrouping in residual statics estimation. We believe it is also useful for other processing steps such as velocity analysis and first break picking.