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Simultaneous Source Separation - A New De-blended Approach via Multi-directional Vector-median Filter

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SUMMARY

A new approach aiming in the de-blending of seismic data acquired by simultaneous sources is presented based on Multi-Directional, Vector-Median Filtering.

This paper introduces a new, innovative Multi-Direction Vector-Median Filter (MD-VMF) to separate blended seismic shot gathers produced by acquisition with simultaneous sources. The vector median filter extends the conventional one from scalars to vectors. Moreover, the vector median filter is applied in multiple directions centered at any sample in a seismic gather (Shot or CMP) and the filtered result in the most coherent direction is selected as the output. Tests on both synthetic and real marine seismic data simulating blended acquisition confirm the effectiveness of our proposed MD-VMF approach.

The concept of simultaneous source acquisition can significantly enhance field acquisition efficiency as well as improve the quality of seismic data. Processing of blended seismic data could produce acceptable results, but separation of the blended data by MD-VMF or other technologies (e.g. sparse radon transform) can further improve the quality of the final seismic images. Figure 1 shows an example by using a modeled data set generated by blending the Pluto synthetic data, where every two adjacent shot gathers are merged with a random time-delay into one new “raw blended” gather. Figure 1a depicts one NMO-corrected CMP gather sorted from blended raw shot gathers, all the events from the first source are coherent and flattened and the energy from the second source appears randomly. Figure 1b exhibits the gather after the application of MD-VMF while Figure 1c shows the ideal non-blended gather. By comparing Figures 1b and 1c note that all the unwanted randomly distributed signals have been eliminated, and the MD-VMF based result is nearly identical to the ideal solution.

Figure 1. Application of multi-direction vector-median filter on NMO-corrected CMP gather. (a) Input raw blended CMP gather, (b) Result after MD-VMF, and (c) Ideal non-blended data.