

## Signal Apparition Simultaneous Source Separation

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### ABSTRACT

The concept of signal apparition, introduced by Robertsson et al. (2016), offers a new perspective on the sampling of seismic wavefields. Signal apparition has range of applications in seismic data processing and imaging. In particular, for simultaneous source data acquisition, and through the use of periodic source modulation functions to encode sources during simultaneous shooting, energy can be partially injected or “apparated” along the wavenumber axis in the frequency-wavenumber (f-k) domain that would otherwise not be occupied by any signal. In the non-overlapping diamond-shaped regions of the f-k domain, the individual sources can be exactly recovered by using linear combinations of weighted versions of the apparated data. The exactly separated parts of the simultaneous source data are then used to reconstruct the individual contributions in regions of f-k space where there is an over-lap. In this fashion, the effort of acquiring a seismic survey can be reduced drastically depending on the number of simultaneously activated sources and the specific survey geometry – thus enabling very significant cost reductions and/or increased image quality. We briefly discuss how signal apparition is optimal in the sense that it can exactly recover the largest possible area in f-k space compared to other methods based on random dithers for instance. The ability to accurately decode fully superimposed wavefields renders the need obsolete to acquire data with techniques that rely on distance and/or time separation to limit the seismic interference as currently performed in the industry. We present results from a seabed cable simultaneous source field test carried out over a producing hydrocarbon reservoir in the North Sea in 2016. The test demonstrates excellent results with unprecedented low-noise separated results fit for time-lapse reservoir analysis. We discuss how signal apparition can be used both for single vessel and multi vessel simultaneous source acquisition configurations for two or more simultaneous sources in the presence of expected realistic perturbations. Robertsson, J. O. A., Amundsen, L. and Pedersen, Å. S. [2016]. Express Letter: Signal apparition for simultaneous source wavefield separation. *Geophys. J. Int.*, 206(2), pp:1301-1305.