Acquisition and processing of multiple-simultaneous-source data

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Land acquisition has some significant advantages over its marine counterpart with respect to simultaneous source data. In particular, it is practical to employ relatively large numbers of sources, and these sources do not have the constraints implicit in the continuous motion that is an inherent feature of towed-marine acquisition. The large channel counts available with modern land recording systems allow the sources to be spread over a significant area, and modern control systems allow complex rules to be used to determine optimum firing patterns dynamically, in order to maximize efficiency whilst meeting whatever constraints are necessary to ensure good data quality.

We consider an orthogonal land geometry consisting of a fixed receiver spread and a number of source lines. The available sources operate under rules that dictate when sources can fire simultaneously (with dithers), taking into account factors such as the distance between the sources and the distribution of the sources which are "on station". The resultant dataset consists of a collection of traces, each of which may, in principle, contain contributions from any number of sources (up to the total available). Whilst the shot spacing on each source line is specified, the traces corresponding to those shot points will not in general be contiguous within the dataset, and the resulting complexity is significantly higher than that of a typical marine simultaneous-source dataset. It is not, for example, possible to obtain subsets of the dataset that involve contributions from only two (or a few) source lines.

Until we have algorithms capable of processing simultaneous-source data directly, the simplest approach to processing these data is to separate the sources early in the sequence. Consequently, we compare results using passive separation, separation based on random noise attenuation, and separation based on sparse inversion. For the last case, we consider each source line to constitute a separate logical source, leading to a separation problem that involves as many sources as source lines. This method is shown to be practical, and to give superior results to the other methods.