Practical solutions for large single-element sources

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ABSTRACT

We outline challenges and practical solutions for acquiring seismic data with large single-element sources (Brittan et al., 2020), such as Gemini (Undengaard et al., 2024) and TPS™ (Chelminski et al., 2019), in modern streamer and OBS (Ocean Bottom System) surveys.

Wider spreads mean longer air umbilicals, which increase the demands on air delivery systems. This affects all sources, not just large single-element sources. However, conventional sources have many more points where the air can exit the system into the water, each with its own air chamber. This means that the individual air gun chambers can be refilled in parallel. Large single-element sources do not have this advantage and are much more susceptible to changes to the air flow system. Thus, they are less dependent on compressor capacity alone. We discuss how air pressure regulators help to solve this problem (Large et al., 2025).

Next, we describe the challenge of acquiring quality NFH (Near Field Hydrophone) data when the source bubble is so large (Wang et al., 2024). We solved this problem by developing systems that move the NFH outside of the range of the bubble. One such system is called an HEB (Hydrophone Extender Bar) and is shown in Figure 1 and Figure 2.

Moving the NFH outside of the bubble allows for more reliable source monitoring and also significantly improves our ability to generate accurate shot by shot far field source signatures (Tabti et al., 2017).

Finally, we examine the construction of dither tables for blended acquisition. The common approach is to blend the data by applying random dithers to the shot times (Beitz et al., 2016). If one wishes to take advantage of the enhanced low frequency energy generated by large single-element sources (Rocke et al., 2023), one might choose to maximize the range of these dithers, increasing the temporal diversity between shots (Bekara et al., 2024). This creates additional challenges that require practical solutions.

We describe the optimization problem that needs to be solved to achieve temporal diversity between shots while adhering to all of the operational constraints and also meeting the practical objectives of the project, including maintaining high vessel speeds, high shot densities, and ensuring consistent and high firing pressures.

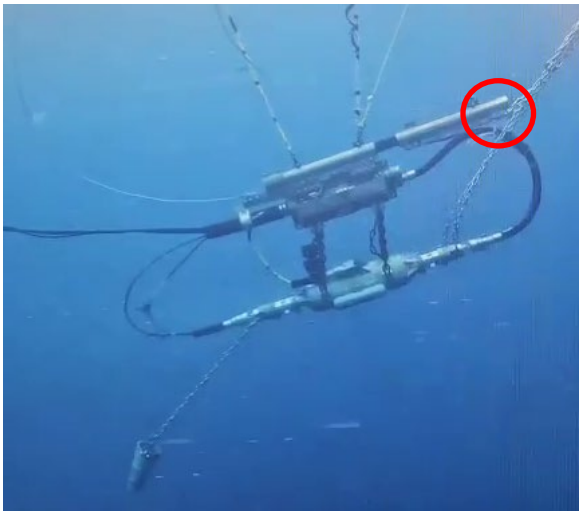

Figure 1: A large single-element source just before it is fired. The red circle indicates the position of the NFH.

Figure 2: A large single-element source just after it is fired. The red circle indicates the position of the NFH.

Together, these topics provide a practical framework for ensuring stable pressures, quality NFH data, and efficient blending strategies when deploying large single-element sources in complex seismic environments.