Big Seismic Era – Time to Change the Old Ways? How High-Density Seismic Technology Affects Way We Acquire and Process Land Data

Anastasia Poole[1], Phillip J. Bilsby[2]

[1]Land, WesternGeco, Gatwick airport, West Sussex , United Kingdom.
[2]Geosolutions, WesternGeco, Gatwick, West Sussex , United Kingdom.

ABSTRACT

Recent developments in land seismic acquisition technologies have resulted in a shift towards high-density, full-azimuth, broadband acquisition. In the past decade, seismic land surveys have not only dramatically increased in size, but also in trace density, which means that there will be several orders of magnitude more data to process. This data will be broadband, with increased emphasis on the low frequencies. With the industry trend to point-source point-receiver acquisition, raw traces will also have lower signal-to-noise ratio. Care is required in data processing to preserve the amplitude and phase characteristics of this broadband signal through to the final deliverables, including the azimuthal variations. Over the past several years, processing and imaging technology has advanced considerably. Data-driven, non-uninform noise attenuation algorithms were developed to deal with coherent noise, near-surface variations, and irregular sampling. 5D regularization and interpolation are now used, not only to fill the gaps in the surface coverage, but also for data preconditioning for azimuthal attributes extraction. So what is the problem? Many established industry rules, beliefs, and perceptions have their foundations in acquisition and processing practices and capabilities that are now many years out of date. During the survey design and acquisition stage, we often use best practices established in the early years of low-fold sparse 3D surveys. This can result in increased survey costs and may also have a negative impact on the final results. In data processing, the escalation in land data volumes poses its own set of unique challenges in terms of data management, processing, and sorting. With the advent of high-density and full-azimuth 3D data, the number of traces and the data volumes to be manipulated for each step explode, increasing the complexity of data management, the compute resource requirements, and impacting the turnaround time. In this paper we describe the advantages of an integrated approach where acquisition and data processing are seen as a single, holistic system as compared to the traditional segmented approach where acquisition and processing are treated as separate sequential steps. We will discuss the new challenges in dealing with high-density broadband land 3D data, and demonstrate that overcoming these challenges is the key for moving forward, delivering the full benefits of high-density broadband acquisition.