

## **High Density 3-D**

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3-D seismic surveys have seen increasing usage since the mid-1970s and have been acknowledged as a primary reason for increased oil exploration success over the last two decades. In the early years of 3-D seismic acquisition, most survey designs were restricted by a combination of cost, equipment limitations, and a lack of understanding of the benefits of good spatial and offset sampling. Also, owing to some of the above limitations, many surveys were designed with a narrow range of azimuths. Recently, there have been significant improvements in technology that now permit the acquisition of surveys with much higher trace densities than previously possible, with improved spatial, offset, and azimuth sampling.

It is generally recognized by most geophysicists that the "perfect 3-D" would essentially have "stack array" in both X and Y. The necessary subsurface spatial sampling would be calculated, and for every shot there would be an area or "disc" of receivers surrounding the shot with the required receiver spacing. The radius of the disc would be the limit of the useful/useable offset contributions. The patch would then be repeated with equally sampled shots in both X and Y. This would result in a survey with very high trace density that would potentially be very expensive and might also have high environmental impact. However, from a geophysical standpoint, it would have both excellent azimuth sampling and excellent offset sampling along all azimuth ranges. Since we cannot normally afford to acquire the perfect survey, we normally need to acquire a subset or some subsets of the above geometry.

This paper will show data examples illustrating the benefits of high-density 3-D and how this can be achieved cost effectively today, both onshore and offshore.