Carpet Geometries with a Hexagonal Grid

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Abstract

When we moved from acquiring 2D surveys to acquiring 3D surveys, some three to four decades ago, we took a long time before we found the best way to do so. We started by acquiring parallel 2D lines. We went via geometries such as ‘brickwall’ and a variety of others to eventually land on the cross-spread geometry. After its introduction it took years before it was widely accepted as the best land geometry, and applied globally. Additional goals were symmetric sampling of the main parameters (SP and RP intervals, SP line and RP line intervals, and inline and crossline offsets), defining three aspect ratios that we would like to all be equal to 1. We allowed the second of these goals to be waived if SPs and RPs came at significantly different costs, and make the line interval of the expensive one a bit larger than the line interval of the cheaper one, thus saving money while accepting a small degradation in quality. The trade-off between cost and quality has always played and will always play a key role.

It has long been assumed that we would not (perhaps never) use carpet geometries except maybe in some exceptional cases. They would be far too expensive. That assumption has turned out to be too pessimistic. Now that we are in the midst of a (gradual) move by the industry to a single geophone for every RP, and a single (point) source for every SP, several surveys with carpet geometries have already been acquired. Carpet geometries have some important advantages over cross-spread geometries, and with the massive cost reduction brought about by single point RPs and SPs they have started to become realistic alternatives. It is time therefore to consider what would be the best way to acquire carpet geometries.

Hexagonal versus square n the surveys recently acquired with carpet geometries, square grids have been used. To move from a cross-spread geometry to a carpet geometry we (just) place RP lines or SP lines closer together until SP or RP line intervals are the same as SP and RP intervals. Like we gradually turned 2D into 3D, we have now turned a cross-spread geometry into a carpet geometry by gradual changes. This naturally results in square grids. There is no reason however not to take a step back and reconsider whether this should be the case. A hexagonal grid with the same density of points as a square grid provides a better coverage of a two-dimensional surface. In a hexagonal grid the largest distance between any surface point and the nearest grid point is about 12% less than in a square grid. This means that when using a hexagonal grid instead of a square grid we can either opt for better data quality with the same density of grid points, or for a reduction in cost by using slightly larger distances between grid points, thereby reducing the number of points needed for the same data quality.

In this presentation implications of using a hexagonal grid instead of a square grid will be discussed.