Dip-Steered Gridding – A 'Win-Win' for Seismic Interpretation

New technique enables interpreters to do less work and requires fewer resources, and it produces higher quality output horizons.

Contributed by dGB Earth Sciences

Every few years a new but simple seismic interpretation technique has a major impact on the industry, becoming a default interpretation tool within just a few months. Examples include coherency cubes and spectral decomposition – both vital elements of a seismic interpreter's toolkit today.

At SEG this year, dGB Earth Sciences, one of the leading providers of open source seismic interpretation software to the oil and gas industry, believes another technique is shortly to be added to this list – that of dip-steered gridding. Dip-steered gridding fulfills two key criteria for interpreters today – it enables them to do less work and requires fewer resources, and it produces higher quality output horizons.

Traditionally, seismic interpretation workflows are performed through the mapping of seismic horizons and combining manual and automated approaches. The manual horizon mapping approach is used to track a horizon by connecting the dots based on any polynomial fitting method, and the auto-tracking of horizons is mostly preferred for a phase consistent reflector in a 3-D seismic dataset.

However, for seismic events that are phase-inconsistent but chronostratigraphically consistent, auto-tracking is mostly ineffective. In such cases, an alternative approach is required – the gridding of the horizon. A gridded horizon mostly contains interpolation artifacts as it assumes a model between known positions. It also assumes that an interpreter is not interested in extracting detailed information between the two known locations and that a best-fit interpolation is the next best thing.

Such gridding methods, however, come with limitations – primarily the fact that the approach is mathematical and model-driven rather than adopting a full 3-D seismic data-driven approach. No one had previously thought of using full seismic data in interpretation.

At SEG this week, dGB will be presenting its new dip-steered gridding algorithm. The new seismic interpretation algorithm is being integrated within OpendTect, dGB's open source seismic interpretation software.

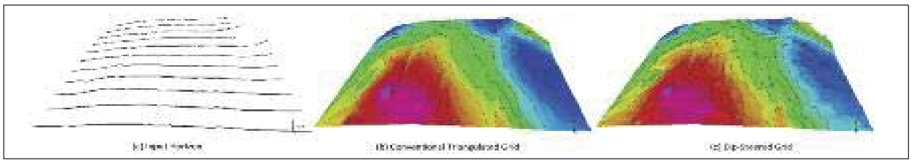
As interpreters look to maximize their knowledge of seismic data by extracting more information, it has become clear that the dip and azimuth attributes of the seismic data offer the best means of generating such information. Such attributes are commonly described in the SteeringCube – a seismic volume containing the dip azimuth values at each seismic sample.

Even if one uses such an approach of precomputed dip/azimuth information, such an approach still needs an interpreter's knowledge to decipher (map) a reflector on the seismic data.

This is what is being achieved through the new dip-steered gridding approach from dGB that grids a seismic horizon by using a precomputed dip volume. The approach not only honors the interpreted data (as conventional gridding algorithms do as well) but also uses the actual seismic data through the dip of the pre-calculated SteeringCube. This proposed method is termed as the dip-steered gridding of a 3-D seismic horizon because the gridding algorithm is steered by a precomputed dip of seismic data.

The method takes the seismic dip and azimuth information at all known and unknown sample positions that lie within a given radius. It then uses the information to grid a horizon by following the dip azimuth. The method generates few artifacts and does not assume any initial models such as distance-weighted or triangles.

This data-driven rather than model-driven approach enables seismic interpreters to extract detailed geometrical information along a coarsely mapped seismic horizon, interpret fewer input lines, and produce superior results.



Input seismic horizons (a) are mapped in one direction; (b) gridded using a conventional triangulation gridding algorithm; and (c) dip-steered, highlighting a superior data-driven result compared to the "b" gridding result. (Image courtesy of dGB Earth Sciences)

Such an approach not only accelerates seismic mapping, but it also provides interpreters with the ability to extract geomorphologic features with greater confidence and better delineate stratigraphic traps. The method also can be extended into incorporating faults, geobodies, and polygon objects as boundary value conditions.

The new dip-steering approach was recently applied to a 3-D seismic data set in F3 Block of the southern North Sea. The horizon was manually mapped on inlines at a fixed distance of 1,250 m (4,101 ft). The dip-steered gridding was performed on the horizon to create a regular grid of 25 sq m by 25 sq m (269 sq ft by 269 sq ft).

The resultant dip-steered grid map is presented in Figure 1, clearly showing the detailed structural and geomorphologic features present along this horizon.

Few techniques offer such tangible benefits to seismic interpreters today as dip-steered gridding. To find out more, visit dGB at booth 3243. ■