M09

Regularisation for Wide Azimuth Datasets

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SUMMARY

Wide-azimuth datasets allow us to incorporate more dimensions into data regularisation. Using a multi-dimensional Fourier transform that handles irregular data we can either output traces on a regular grid or interpolate additional source and receiver lines. This allows us to fill holes more effectively and regularise in the offset and azimuth directions whilst preserving AVO and AVAz. Data examples show an improvement in continuity and accurate reconstruction of missing data.

Data reconstruction strategies are important for the regularisation of data and/or the interpolation of extra data to increase the fold or improve spatial sampling and resolution. For conventional narrow azimuth acquisition, 2D and 3D reconstruction techniques have been effective and robust, as such data are relatively well sampled within this limited azimuth range.

In wide azimuth acquisition, the data are recorded over a much larger range of offset and azimuth. In such cases regularization algorithms need to use all of the input data rather than just a subset, as would be used by a 2D or 3D approach. This means that in addition to the inline and crossline directions, the offset and azimuth are also used (or equivalently offset-x and offset-y which are consistent with common offset vector (COV) processing). Such a strategy is appropriate for wide azimuth marine, land, and ocean bottom sensor datasets. By including the offset and azimuth dimensions we naturally respect the corresponding amplitude variations with azimuth and offset.

We utilize an algorithm that performs a forward irregular Fourier transform in all four spatial dimensions simultaneously to build a representation of the data in the frequency domain. The reverse transform can then be used either to output the data on a regular grid or to generate additional source and receiver positions to increase the fold of the dataset. As the input data are often coarsely sampled, it is important to use an algorithm that can decompose energy beyond aliasing. The approach makes use of all traces (i.e. pre-binning) and can perform regularization as well as missing trace interpolation in one process.

Such an algorithm has many uses for wide azimuth data. In the simplest case we can interpolate extra shot and receiver locations to increase the fold and improve the signal to noise ratio. Alternatively we can re-grid the data to different orientation for the merging of several wide azimuth datasets. Finally it is possible to regularise the data to bin centre in order to aid processes that require regular sampling, e.g. imaging or SRME. This also allows us to obtain perfect COV sampling from an irregular dataset.

The following figure shows a timeslice at 5000ms from a marine wide azimuth shot before and after data regularisation. Even though the holes along an inline are large, data in the extra dimensions in effect reduce the size of the holes to allow the success of the algorithm. The figure shows an improvement in the continuity of events and also that the character of the input data was preserved.