REMOVING NON-STATIONARY ARTIFACTS FROM SEISMIC VELOCITY DATA SETS BY M-FACTORIAL KRIGING

Cedric Magneron[1], Jacques Deraisme[2] and Matthieu Bourges[3]
[1]Estimages (cedric.magneron@estimages.com)
[2]Geovariances (deraisme@geovariances.com)
[3]Geovariances (bourges@geovariances.com)

Seismic velocities are often polluted by acquisition or processing artifacts which should be identified and removed as they may have a non-negligible impact on subsequent processing such as migration, stack, angle analysis (AVO), litho-pressure analysis, time to depth conversion, etc.

Artifacts encountered in seismic velocity data sets can be parted into:

§ acquisition artifacts, mainly footprint effect

§ processing artifacts such as white noise due to software picking resolution, inline oriented picking effect, smoothing operator imprint, etc.

Factorial kriging is a geostatistical filtering technique developed by Georges Matheron in 1982, which enables to extract artifacts from a velocity data set. Factorial kriging relies on a simple additive model where the spatial variable under study is modeled by a random function, V(x), which is parted in terms of independent factors:

$$V(x) = V1(x) + V2(x) + \ldots$$

Artifacts extraction issues can be easily handled into the framework of this model, as far as the artifacts part of a data set can be considered independent of a complementary geological part:

$$V(x) = VARTIFACTS(x) + VGEOL(x)$$

In such a way, factorial kriging, by estimating VGEOL(x), allows to filter out the artifacts component VARTIFACTS (x) of the data set.

During recent years in the petroleum industry, factorial kriging has been applied with success for removing artifacts from seismic velocity data sets. Nevertheless it appeared sometimes limited when faced with non-stationary artifacts, i.e. of intensity or geometrical characteristics varying spatially.

M-GS (Moving-GeoStatistics) is an innovative technology which is fully dedicated to the local optimization of parameters involved in variogram-based models. By optimizing spatially varying model parameters, M-GS guarantees a better adequacy between geostatistical model and data.

This paper demonstrates how M-GS technology, combined with factorial kriging process, provides an optimal way for extracting properly non-stationary artifacts from velocity data sets. The computation of local structural parameters related to the artifacts part of data, as well as the gain in quality obtained by this approach, are illustrated on a real migration velocity cube.