Ocean-bottom node data interpolation by matching pursuit Fourier interpolation using priors derived from a combination of time-lapse data set

Matheus F. F. Tomaz* , Carlos A. N. da Costa, Mesay G. Gebre, Tiago Barros, Jaime A. C. Gonzalez, Katerine D. J. R. Perez, Daniel N. Pinheiro and Gilberto Corso (Federal University of Rio Grande do Norte)

Abstract

Time-lapse (4D) seismic has become an important technique for reservoir monitoring. However, its application requires 4D data set with a good repeatability seismic acquisition between baseline e monitors surveys. Ocean-bottom node (OBN) seismic surveys are attractive seismic acquisitions for time-lapse projects due to the facility to reduce the 4D noise level in the data set caused by source and receiver error position. On the other hand, in a conventional OBN seismic acquisition the data set is acquired with sparse receiver sampling along the lateral directions (inline ad crossline direction), and in some cases, with nodes placed irregularly in some areas as well, which can cause problems for further processing. In order to deal with this irregularly and sparsely sampled acquisition, seismic data interpolation is often used to transform the data to any desired dense regularly sampled data and hence it is one of the crucial steps in seismic data processing. Depending on the different patterns of seismic data acquisition, seismic interpolation can be roughly classified into two groups: regular and irregular sampled data interpolation. Several types of seismic data interpolation methods have been developed based on a variety of principles, such as prediction error filter, Fourier-based interpolation, and rank-reduction method. Interpolation for coarsely sampled data is challenging, especially for regular receiver spacing, which is strongly affected by the aliasing problem. Matching pursuit Fourier interpolation (MPFI) is a powerful tool beyond-aliasing interpolation methodology. However, for application in regular sparse data sets with aliasing, prior information is necessary to stabilize the data reconstruction process. In this work, we propose a MPFI interpolation using prior information from shot-gathers formed from the baseline and monitors data sets. Our methodology is based on the technique of using priors information derived from a second data set, in our case, it is a combination of the baseline and monitor data sets, to mitigate the aliasing problem of the original shot-gather to be interpolated. However, to apply our interpolation scheme, it is required that the baseline or monitor data set has to be recorded with an irregular receiver sampling and/or with different receiver spacing between them to build our prior information. In this way, assuming that we have a small difference between baseline and monitor, we can combine the traces from different surveys to build a dense shot-gather to be used as prior to the interpolation process.