



Seismic data analysis and pattern classification using prediction error filters

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In this study we propose the use of Prediction Error Filters, PEF's, as a method to analyse and classify seismic data in order to identify geological patterns. Given y_t and y_{t-1} from a time series Y , we can predict y_{t+1} using a PEF. The prediction could be a scaled sum or a difference of y_t and y_{t-1} . To find the scale factors we should optimize the fitting objective, i.e. the prediction filter (f_1, f_2):

$$\begin{pmatrix} 0 \\ 0 \\ 0 \\ 0 \end{pmatrix} \approx r = \begin{pmatrix} y_1 & y_0 \\ y_2 & y_1 \\ y_3 & y_2 \\ y_4 & y_3 \end{pmatrix} \begin{pmatrix} f_1 \\ f_2 \end{pmatrix} - \begin{pmatrix} y_2 \\ y_3 \\ y_4 \\ y_5 \end{pmatrix}$$

The residual r is the prediction error obtained after applying the PEF to the time series Y . In the approach we have developed, the PEF is constructed from a reference seismic data segment that represents the pattern of interest of the time series. The residual r , calculated after applying the obtained PEF to the study segment, is the parameter used to analyse and classify the seismic data. Segments of the data with r values close to that of the reference path, will classify as high similarity zones. The difference between the r values obtained after applying the PEF to the analysed segment and to the reference one, is also calculated. Difference values close to zero indicate high similarity between both segments. We have applied the method to 2D synthetic and 3D real data from an oil field in Venezuela. The 2D seismic section classified according to the PEF, clearly indicates low and high similarity zones with respect to the selected reference segment. For the 3D data, the PEF volume was obtained after comparing all the data with a reference segment from a time interval at a well position where sand bodies were identified. This volume shows trends which can be correlated with geological features previously observed in the area, associated to the development of sand bars. Nevertheless, additional trends, not related to these geological features, can be observed in the PEF volume. These trends are probably linked to other petrophysical properties of the area.