Spectral Decomposition Applications

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Abstract

Spectral decomposition has been used frequently in seismic data processing by way of spectral analysis, frequency filtering, wavelet characterization, etc., but in recent years it has been applied to 3D seismic data interpretation as well (Partyka et al 1999). Usually, seismic interpreters work with the amplitude anomalies that are based on the dominant frequency in the seismic data. Spectral decomposition allows interpreters to utilize the discrete components of the seismic bandwidth. Individual frequency components help in interpreting and understanding subtle details of the subsurface stratigraphy.

The basic concept behind the technique is that seismic reflections from a thin bed for example have characteristic expressions in the frequency domain – the higher frequencies imaging thinner beds and lower frequencies imaging thicker beds. So, if all the discrete frequency components are available, they can help in observing and discerning the response of the reservoir more accurately.

Two basic methods for spectral decomposition are presently being used, *viz* the Discrete Fourier Transform (DFT) method (Partyka et al 1999) and the Instantaneous Spectral Analysis (ISA) (wavelet transform) method (Castagna et al, 2003). We illustrate applications of spectral decomposition based on the instantaneous spectral analysis, depicting the anomalous behaviour of gas sands and the ability of wavelet transforms to resolve individual reflections. Matching pursuit decomposition has been found to have much better time and frequency resolution than the continuous wavelet transform with Morlet wavelets.

<u>References</u>

Partyka, G., Gridley, J. and Lopez, J., 1999, Interpretational applications of spectral decomposition in reservoir characterization, The Leading Edge, 22, no.3, 353-360.

Castagna, J. P., Sun, S. and Siegfried, R. W., 2003, Instantaneous spectral analysis: Detection of low frequency shadows associated with hydrocarbons, The Leading Edge, 22, no.2, 120-127.