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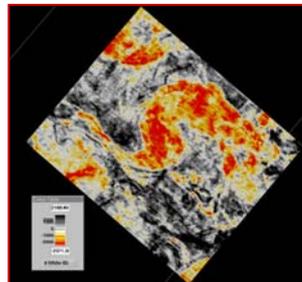
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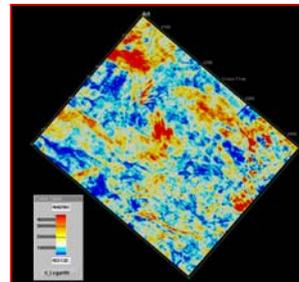
Subject: Spectral Decomposition

Spectral Decomposition (SD) is a powerful tool for "below resolution" seismic interpretation, sand thickness estimation and highlighting channels. In SD spectral properties, or scale properties are extracted from a small part of the reflectivity series through mathematical transformation. As a consequence of the small transform window the spectral response of the geological column is not "white" but contains effects such as spectral notches and tuning frequencies that relate to the local reflectivity only, hence geological properties such as stratigraphic units, layer thickness and stacking patterns are highlighted.

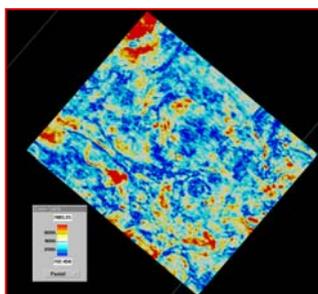
Combining spectral slices we can see subtle features, often below seismic resolution, which are not as clear on a single attribute section such as energy or instantaneous frequency. In the figure below, amplitude and energy attributes are contrasted against the three spectral bands. Different areas brighten up at different frequencies to highlight the main meandering, indicating variations of thickness within the channel (good connectivity), or channels composed of sedimentary sub-bodies, some of which may be deposited during catastrophic event like flooding (poor connectivity).



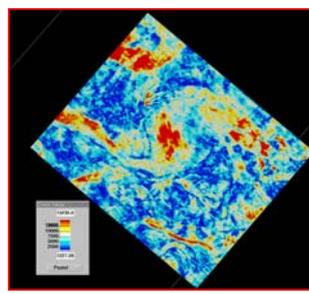
Amplitude slice



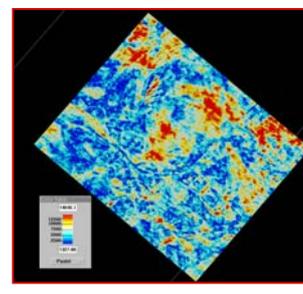
Energy Slice



15Hz



45Hz



75 Hz

SD in OpendTect

OpendTect supports SWFFT (Short Window FFT) and CWT (Continuous Wavelet Transform). The SWFFT calculates the Fourier spectrum in a short window around a horizon (and in volume mode it uses





a running window). In the ideal case this window should encompass one seismic event, which may be a superposition of multiple geological events which interfere in the seismic trace. The CWT maps the seismic trace on wavelets of different scales. In OpendTect spectral decomposition is applied in the "Attribute Set" window by pressing the "Evaluate Attribute" icon and specifying the number of frequency (wavelet scale) slices to be computed. Typically some 30 slices are computed which are inspected in a movie-style manner. Output cubes of selected frequencies (scales) can be created for further study.

New SD Features in OpendTect V2.0.2 Release

OpendTect v2.0.2 has many new features. The main enhancements made to its Spectral Decomposition capability include:

1. Both algorithms (FFT and CWT) have increased in speed.
2. CWT specifications are done in terms of (dominant) frequencies rather than wavelet scales.
3. Spectral decomposition of a horizon slice can now be saved and retrieved as follows:
 - a. Add a horizon to the tree and select this as the current visualization element.
 - b. Open the Attribute Set window and create (select) a Spectral Decomposition attribute.
 - c. Press the "Evaluate attribute" icon in the Attribute Set window and specify the number of frequencies to calculate. Use the slider to inspect the results movie-style. Switch the "Store slices on Accept" toggle on and press Accept to return to the Attribute Set window. The parameters are updated to the slice that you accepted as output value. The slices are saved as "SpecDecomp - Frequency [N]" slices under the horizon.
 - d. To retrieve slices at a later stage: add the horizon to the tree. Right-click on the horizon and select the Surface data sub-menu. Select the slices you want to load. Use "Page-Up" and "Page-Down" keys to switch to the next slice movie-style. Note that the name in the tree shows which slice is displayed.

Suggested reading:

- 1- Partyka, G., Gridley, J., and Lopez, J., 1999, The Leading Edge Volume 18, Issue 3, p. 353.
- 2- http://www.dgb-group.com/upload/files/publications/newsletter/2004_Newsletter_2.pdf

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