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Please fill in your abstract title.	Time-Frequency Analysis of Seismic Data Using a Specialised Curvelet Transform

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Abstract

Poor quality seismic data reduces the effectiveness of time-frequency analysis algorithms particular for data with low signal-to-noise ratios. We propose a new method time-frequency analysis method based on a curvelet transform that uses multi-azimuth and multi-scale characteristics to improve performance and assist in the identification of weak signals.

To ensure relative independence in the time and space dimesion the curvelet function was constructed in the space-time domain. The time domain is based on Morlet wavelet and the space domain uses the limited range of Hanning window. Once the curvelet transform has been performed we are able to compute an optimized time-frequency analysis which gives improved identification of signal and high time resolution but poor frequency resolution. To overcome this a new synchrosqueezing transform was added to the curvelet transform based on spectral reassignment. This can make nonstationary and nonlinear signals highly focused in time-frequency domain.

The time-frequency domain analysis method based on specialized curvelet transform presented in this paper maps the curvelet coefficients into the time-frequency domain. Tests on synthetic and real data show that this new method has an improved capability to identify underlying information in noisy systems when compared with other time-frequency techniques that use wavelet transforms. The multi-azimuth characteristics of curvelet transforms augment the multi-scale characteristics present in both wavelet and curvelet transforms to increase the adaptive ability of time-frequency analysis. Moreover the wavelet transform is known to be sensitive to noise, whereas the curvelet transform, due to its multi-azimuth characteristics is significantly less affected by noise. The immediate benefits of better signal identification in low SNR systems suggest further that the curvelet-based techniques may be more useful in the identification of anisotropic information.

This paper presents a technique using a new construction of a curvelet function and introduces rotation which solves an immediate problem; the improvement of signal extraction in low SNR data. It has the potential to go further in the improved analysis of anisotropic information which is particularly useful in the identification of fracture anisotropy and sweet spots for unconventional reservoirs. There are also opportunities to improve the resolution of geomechanical models leading to better drilling results and lower production problems.