

Bandwidth extension of seismic data and its applications

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Summary

The bandwidth extension of seismic data is a desirable goal in view of the relatively low bandwidth of the available data. Though significant efforts are expended during processing of seismic data, yet the shortcomings associated with the adopted processes such as multi-window statistical deconvolution, inverse-Q filtering as well as time-varying spectral whitening prove to be ineffective when the reservoir intervals to be characterized are thin. Consequently, advanced methods have been developed for spectral balancing as well as extension of the input seismic data. We describe the performance of a relatively new method for bandwidth extension using the sparse layer seismic reflectivity inversion carried out with the application of basis pursuit decomposition. This method yields a reflectivity series, which can be filtered to a desirable bandwidth that exhibits optimum resolution and reasonably accurate synthetic ties to wells and can also be used to derive relative acoustic impedance. We found that by extending the bandwidth of the input seismic data (5-70 Hz) to say 120 Hz high-end, more reflection cycles were seen which correlated well with the horizons picked on the input seismic as well as the synthetic seismograms generated with the individual bandwidth wavelets. Not only can the obtained high-resolution seismic lead to a more detailed interpretation, but the attribute computation carried out on it can show enhanced resolution. Finally, we drew comparisons of attributes such as inverted P-impedance, broadband and multispectral coherence attributes, long- and short-wavelength most-positive and most-negative curvature attributes, and spectral magnitude computed on input seismic data as well as their bandwidth extended versions. Our results indicate a higher level of detail, whether it is the lineaments corresponding to faults or the thin layered lithointervals. Such observations could motivate seismic interpreters to consider extending the bandwidth of their data volumes.