Recent ProMAX module upgrades

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SUMMARY

As part of the research results transmitted to sponsors every year, we release any software developed by CREWES that is deemed to be useful to sponsors for testing and using the techniques demonstrated in the research report chapters. While much of this software remains in rudimentary form, or in MATLAB scripts, certain key algorithms are selected for release as ProMAX modules, to enable application of the techniques to larger quantities of seismic data. We also attempt to maintain and upgrade ProMAX modules released in previous years.

In 2010, although we introduce no new modules, we have made significant modifications to three existing modules, Gabor2, Gabor_sc, and Timath, and we highlight those changes here.

INTO THE 64-BIT WORLD

Recently, we have begun doing more of our seismic processing on 64-bit Linux machines, as have some of our sponsors. We discovered early in 2010 that our current ProMAX modules would not run on these machines; so K.W. Hall determined what code changes were necessary to enable the modules to compile and run on 64-bit Linux machines. Consequently, all of the ProMAX modules on the CREWES website intended for Linux now have new versions which are suitable to run on either 32-bit or 64-bit Linux systems.

As in the past, our ProMAX software release consists of two files per module, one .pdf file containing only the module documentation, or "manual", and a .zip file containing not only the documentation, but all the source code needed to compile the module, as well as executables for both 32-bit and 64-bit systems, all in compressed format.

Figure 1 shows a portion of the ProMAX release table as it appears when accessed from the CREWES website. Clicking the "Manual" button retrieves the .pdf documentation for the module, while the "Module" button retrieves the .zip file containing the full download.

GABOR2 AND GABOR_SC

Both Gabor2 and Gabor_sc have been modified to enable "colour-correction", whereby spectral information from a well log is used to replace the "white" reflectivity assumption conventionally used in deconvolution.

We show below Figure 2, which is a plot of the 2D colour function created from the time-varying spectral analysis of a real well log, and Figures 3 and 4, which are plots of seismic traces deconvolved without and with colour correction in Gabor2. (Figure 2 was made using the diagnostic feature in Gabor_sc, which creates output trace ensembles representing the 2D time/frequency spectrum of a raw seismic trace, the source wavelet, the Q-function, the deconvolved seismic trace, or the function used for colour correction.)

FIG. 2. This is a 2D colour function used in either Gabor2 or Gabor_sc to modify the "white" spectral assumption conventionally used in deconvolution. This function was constructed within Gabor_sc from coefficients read from an external ASCII file created in MATLAB from spectral analysis of a well log reflectivity series. The plot was created using Gabor_sc in the diagnostic mode.

FIG. 3. This shot gather has been deconvolved using Gabor2, but with no colour correction. This is a standard nonstationary deconvolution result.

FIG. 4. This shot gather (same as Figure 3) has been deconvolved using Gabor2, but with colour correction using the colour function shown in Figure 2. Note bandwidth and amplitude differences between this figure and Figure 3, especially in the outlined area. Differences are subtle, but significant.

FIG. 5. This shows the spectral detail characteristic of the Discrete Fourier Transform of a very long seismic trace. Since the transform is computed from its explicit trigonometric formula, any length of time series can be analyzed, not just one with the number of samples padded to a power of two, as with the FFT.

FIG. 6. This shows the DFT of 4 seconds of a long mono-frequency seismic trace. From the relative amplitudes of the various harmonics, the mono-frequency is not very pure.

FIG. 7. This is the DFT of the same seismic trace as in Figure 6, but with the 4 second window extended by a single sample. Not only do the relative magnitudes of the harmonics change, but the leakage from main peaks into side-lobes increases significantly! Behold the peril of over-interpreting spectral analyses!