Gabor Deconvolution: Improvements and Practical Considerations

Gary F. Margrave* David C. Henley Victor Iliescu, Jeff P. Grossman
Department of Geology and Geophysics, The University of Calgary,
Calgary, AB, T2N-1N4
margrave@ucalgary.ca

and

Michael P. Lamoureux
Department of Mathematics and Statistics, The University of Calgary

ABSTRACT

Gabor deconvolution is a new technique, introduced in 2002 at the CSEG convention, that corrects seismic data for source signature and anelastic attenuation techniques. It is a direct extension of Wiener deconvolution to the nonstationary setting and is able to estimate both the source waveform and the attenuation characteristics directly from the seismic record. The central enabling technique is the Gabor transform, essentially a Fourier transform localized in a rolling window, creates a time-frequency decomposition of a signal. Using the assumptions of minimum phase, white reflectivity, and frequency independent Q, the algorithm recovers a very broadband estimate of the reflectivity series.

In this paper we report on several extensions of the method that increase its practical utility and illustrate its response to coherent noise. In particular, we show how a simple modification of the standard Gabor transform reduces computation effort by as much as 100 times. We also present a method of smoothing the time-frequency spectrum to estimate the attenuation function that reduces any bias in the resulting reflectivity estimate. Finally, we illustrate the algorithm's response on synthetic and real datasets. Of special note is the robust behavior of Gabor deconvolution in the presence of strong coherent noise. Coherent noise can strongly disturb the estimates from a stationary Wiener approach. Such effects occur also in the Gabor method but are much more localized in time due to the temporal adaptivity of the nonstationary approach.