AN APPROXIMATION TO SPARSE-SPIKE REFLECTIVITY USING THE GOLD DECONVOLUTION METHOD

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ABSTRACT (12 pt)

Deconvolution is generally used to improve temporal resolution of the seismic sections. In this paper we extract Earth's sparse-spike reflectivity series from seismic traces using Gold deconvolution. The method uses a recursive approach and requires the source waveform to be known. It starts with an initial model and converges iteratively to a final solution. We tested the performance of the method on both real and synthetic seismic data and results are presented .Gold deconvolution method reduces noise of all data.

INTRODUCTION

Science data duo to their characteristic limited frequency band cannot be considered data with temporal resolution. In addition, earth is considered as a low- pass filter, so diminishes the temporal resolution of the seismic sections obviating this problem, it is necessary a method has to be set to widen frequency band of seismic data and subsequently improve temporal reduction of seismic data. The most popular deconvolution method is sparse-spike. Reflectivity introduced by Peacock and Treitel(1969)[1], has a precise performance on minimum phase wavelets but this method is not used to interpret traces obtained with zero or complex phase wavelets. Various methods has been developed to estimate spare-spike reflectivity series. These methods consist of minimum intropy (1987 Wiggins)[2], kalman filter (Mendel and Kormylo1978)[3], frequency domain methods (Bilgeri and Carlini, 1981)[4], sparse-spike inversion (Oldenburg et al., 1983)[5], maximum likelihood method (Özdemir, 1985)[6] and blind deconvolution method(Van der Baan and Pham, 2008)[7]. Considering suppositions, each of these methods have some advantage and limitations. Using Gold [8] deconvolution, in this research we improve the preciseness of thin layers boundaries. In this method there is no limitation to us wavelets.

Theoretical principals of method

When there is some noise, output trace of deconvolution is response of earth and input wavelets in addition to noise effect one is:

$$y(t) = w(t) \times x(t) + n(t); \qquad (1)$$

Where: $y(t)$ output trace, $w(t)$ seismic trace, $n(t)$ random noise and $x(t)$ impales response.Omitting random noise:

$$y = Wx \qquad (2)$$

Asuming a known wavelet in equation (2) and multiplying both side of this equation in W^T:

$$W^T y = W^T W x \qquad (3)$$

Equation (3) roots are calculated using least- square method $\|wx - y\|^2$ Rewriting this equations yields:

$$z = Tx \tag{4}$$

Where T is a symmetric and sparse- spike matrix. So, assuming

$$x^{(0)} = [1,1,...,1]^T .$$

$$x^{(k+1)}(i) = \frac{z(i)x^{(k)}(i)}{d(i)} \qquad i \in \langle 0, N-1 \rangle; \tag{5}$$

Where N is the number of sample wavelets and reflectivity series and also $d = Tx^k$. Necessarily input wavelet must be estimated using existing method before utilizing method.

Using the method on synthetic data

In fig(1) three type of wavelets in first column (minimum phase, mix phase and zero phase respectively) have been shown with central frequency of 100HZ. Using sparse-spike synthetic reflectivity series (second column) and wavelets of first column, three type of trace that have been produced shown with the proportion signal to noise of 10/2 forth column shows Gold deconvolation is a proper method to estimate reflectivity sere. In second seismic trace consists of a layer with wedge cross- section. This section consists of 50 trace with three various type wavelet with central frequency of 100HZ.

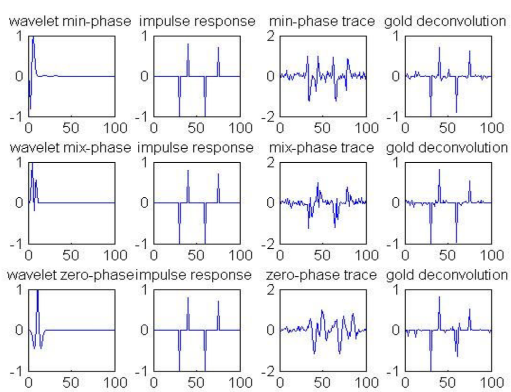

Fig 1. Gold deconvolution on one trace

(fig 2 , first row). As figure 2 shows, the sharp edge of wedge in first row with wavelets(a) minimum phase, (b) mix phase and (c) zero phase with signal/noise10 to 2 have been merged due to interference of reflections and the vertical resolution has been decreased. In second row of fig (2), the resolution of the wedge edge has been improve using Gold deconvolution method with 5000 iterations. Gold deconvolution reduce noise.

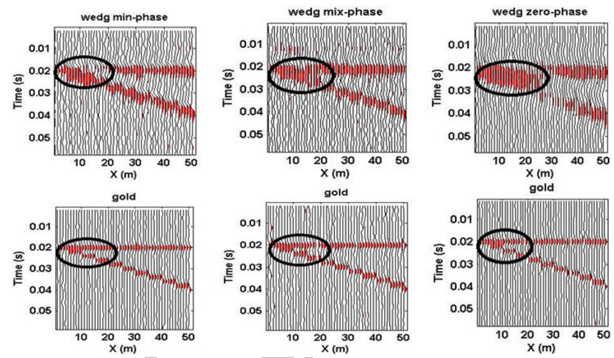

Fig 2. Gold deconvolution on section.

To study the preciseness of this method we also utilize Gold deconvolution on real data in seismic section of the figure (3.a). Real data consist of 250 traces with 400ms lag time. In this section input wavelet was not known, so we estimated wavelet using petrel software. The right section shows results of 8000 iterations of Gold deconvolution. Clearly, we see the resolution has been improved.

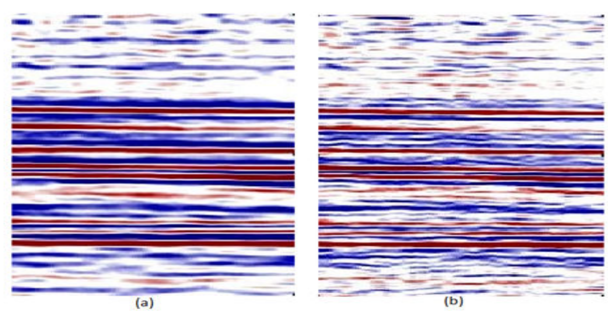

Fig 3. (a) Real data. (b) After Gold deconvolution.

CONCLUSIONS

In this paper produced Gold deconvolution method and show application of this method on wavelets. Also show power of gold method on real data. Gold deconvolution has no assumption on put wavelet. Gold deconvolution method reduce noise of all data.

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