GEOP 415
Spring 2010
Programming Project B
Wavelet Estimation by Reflectivity Deconvolution

(Due date: 7/6/2010)

Introduction

- The objective of this project is to write a program that estimates the source wavelet from the data by deconvolving the actual trace with the earth reflectivity measured in a well near the trace location.
- The grade of this project will be equivalent to 10% of the total course grade. The project grade will be extra credit used to offset the course grade. The 10% will be distributed as follows:
    - 5% on the program.
    - 5% on the presentation.

Background

The wavelet will be estimated using the trace-reflectivity deconvolution method. The idea can be summarized in the following steps:

1. Use normal equations to calculate the inverse filter of e(t), the earth reflectivity measured in a well near the trace location. Call this filter f(t).
2. Convolve f(t) with the given trace sb(t) to get the estimated wavelet ew(t).
3. Compare ew(t) with the actual wavelet wb(t) used to generate the given trace sb(t) by calculating the sum of squared error (SSE) between the two.
4. You might have to shift, extract, and/or scale ew(t) to match it better with wb(t).

Input

- Actual seismic trace sb(t) in text column format (plotted in Figure 1). The time sampling interval is $\Delta t = 4$ ms and there are M = 1,001 samples in the trace. The filename is sb.txt.
- Earth reflectivity e(t) in text column format (plotted in Figure 2). The time sampling interval is $\Delta t = 4$ ms and there are M = 1,001 samples in the trace. The filename is e.txt.
- Actual wavelet wb(t) used to generate the given trace sb(t) (plotted in Figure 3). The time sampling interval is $\Delta t = 4$ ms and there are M = 26 samples in the wavelet. The filename is wb.txt.

Exercises

You are charged of the following tasks.

(a) Writing a program that:
    (1) Reads and plots the input files above.
    (2) Performs the steps mentioned in the Background above.
    (3) Outputs the best estimated wavelet ew plotted with wb on the same plot.

(b) Give a presentation in which you will present:
    (1) Summary of the project's objectives, background, and software description.
    (2) Results.
    (3) Comments on the limitations of the program.
    (4) Answers to the questions below.
    (5) Plots of all inputs, intermediates, and outputs.

Questions

1. What is the value you used for the operator length? Why?
2. Did you have to shift, extract, and/or scale ew (t)? If yes, why?
3. What type of wavelet is ew(t) in terms of its phase? Estimate its dominant frequency.
4. What are the possible sources of errors? Suggest ways to reduce these errors.

Figure 1: Trace sb(t) with 1% additive random noise

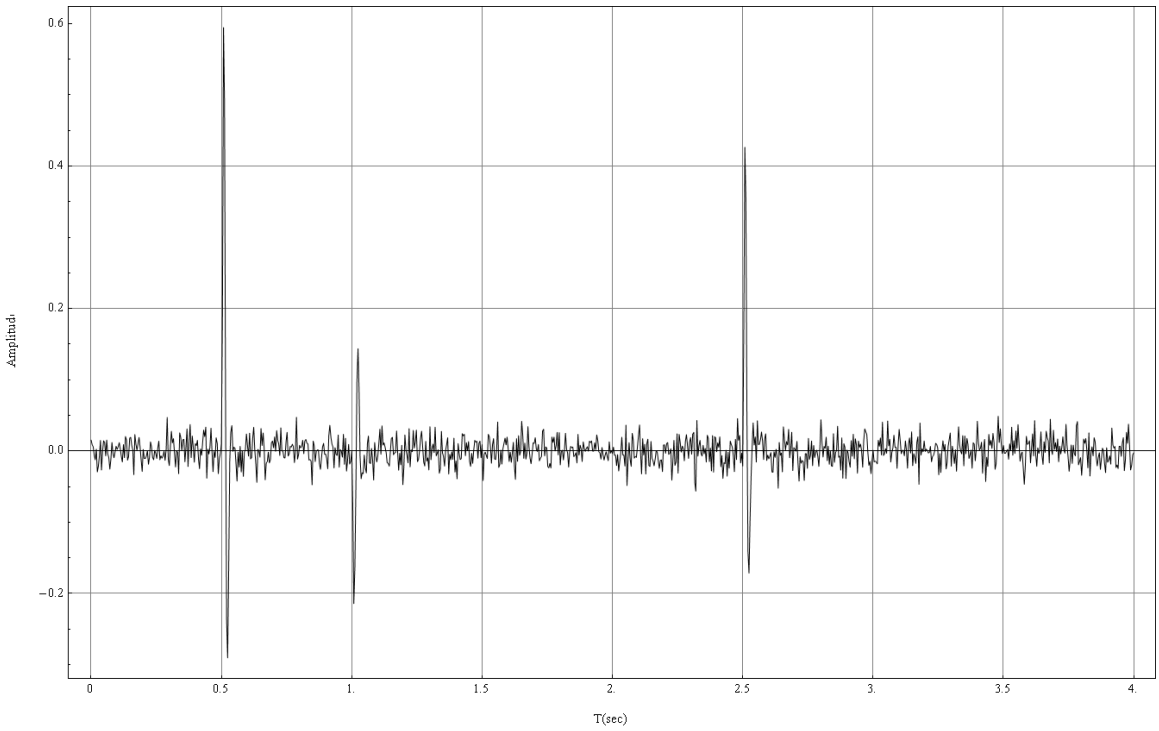

Figure 2: Reflectivity e(t) with no additive random noise

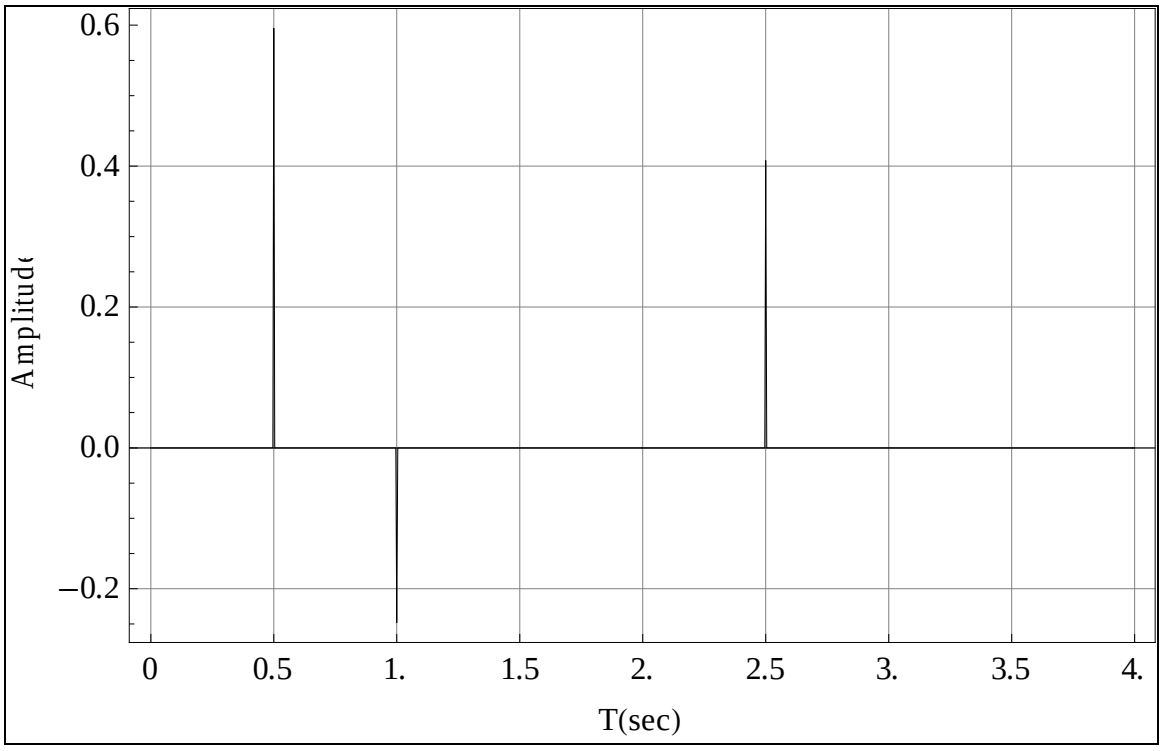

Figure 3: Actual wavelet wb(t) used to generate the actual trace sb(t).