GEOP 415 - Spring 2016 – Wavelet Estimation Project
Due on: 4/5/2016

Introduction

- The objective of this project is to write a program that estimates the source wavelet from a real seismic trace using the double-inverse method.
- The grade of this project will be equivalent to 20% of the total course grade distributed as follows:
    - 10% on the program.
    - 10% on the presentation.

Background

The wavelet will be estimated using the double-inverse method, which states that the source wavelet is the inverse of the best spiking deconvolution operator (inverse filter) of the data. The idea can be summarized in the following steps:

1. Use predictive deconvolution to estimate the spiking prediction error filter a(t).
2. Use normal equations to find the inverse filter $w_{ne}(t)$ of a(t). $w_{ne}(t)$ is your estimated wavelet.
3. Use the z-transform to find the inverse filter $w_{zt}(t)$ of a(t). $w_{zt}(t)$ is your estimated wavelet.

Input

- s.txt: A synthetic noiseless seismic trace in text-table format. The time sampling interval is $\Delta t = 2$ ms and there are 501 samples in the trace.

Exercises

You are charged of the following tasks.

(a) Writing programs that:
    (1) Read the input file above.
    (2) Perform spiking predictive deconvolution of the trace s(t) and compute a(t).
    (3) Use normal equations to estimate the wavelet $w_{ne}(t)$ from a(t).
    (4) Use z-transform to find the inverse filter $w_{zt}(t)$ of a(t).
    (5) Estimate the earth response e(t) using a(t).
    (6) Repeat steps (1)-(5) above using the noisy trace sn.txt.

(b) Give a presentation in which you will present:
    (1) Summary of the project's objectives, background, and software description.
    (2) Results.
    (3) Comparison of your results to the true wavelet w(t) given in w.txt and true earth response e(t) given in e.txt.
    (4) Comments on the limitations of each program.
    (5) Answers to the questions below.
    (6) Plots of all inputs, intermediates, and outputs.

Questions

1. What is your approach for selecting the length of the wavelet? Why?
2. What is the number of terms you used in the z-transform method? Why?
3. Write the equations you used to calculate a(t) from s(t) and those you used to calculate $w_{ne}(t)$ from a(t). Explain why you selected the specific dimensions and values of your equations.
4. Write the equations you used to calculate $w_{zt}(t)$ from a(t). Explain why you selected the specific dimensions and values of your equations.
5. Estimate the dominant frequency of your estimated wavelet?
6. Are your estimated wavelets minimum-phase or zero-phase? Why?
7. Are there possible sources of errors? Suggest ways to reduce them.