Geol 335.3

LAB 9: Seismic data filtering and displays

The most common use of bandpass filtering of real data is to try to remove noise when the signal and noise don't overlap too much in frequency. In this exercise, you will use the seismic processing package Vista to look at a shot gather with a (hopefully) obvious noise problem, and remove it using a bandpass filter. You will also test a set of "filter panels" to learn how filtering reveals different depths in the subsurface and various aspects of the data.

Before you begin, copy to yourself this zipped archive and unpack it in some directory on your machine. This should give you directory "project1" with the Vista project. Go into this directory and locate project file named "project1.vwn".

Assignments

Open "project1.vwn" using Vista. To open, start Vista by clicking on the appropriate icon, then go to File->Open Project. You will see a spreadsheet listing the available datasets. Only one dataset will be available, named "NEW 2-D DATA". From this spreadsheet, note that the sampling interval (shown in column SR) is 2000 μs = 2 ms.

1) (5%) What is the Nyquist frequency for this dataset?

Click on the second column (a tiny icon next to the number '1' of the dataset). This will open the seismic data display.

On the "MAIN SEISMIC TOOLBAR", locate the "Sort Display Order" button, click it, and **select "Shot Order Spread-sheet".** You will see the data now being displayed one shot at a time. Double-click on the tab in the lower-left corner of the plot panel, and in the resulting pop-up window, select "11: LINE 1 SHOT 163". We will work with this shot.

2) (20%) Make an image of the display (use File->Print, perhaps it would be easier to use hardcopy), label the main phases, and sketch the areas that you think are mostly signal and those where there is a lot of noise. How did you decide between them?

3) (10%) What periods/frequencies can you see in the noisy area?

Now you will **test two series of filters** 1-octave slopes at each end and a 1-octave bandpass (i.e. four numbers with frequency doubling each time: 2-4-8-16 for example). The two series need to overlap: often a series such as

- 2-4-8-16
- 3-6-12-24
- 4-8-16-32
- 6-12-24-48

- 8-16-32-64
- 12-24-48-96

You need to choose series that start below the lowest frequencies you can see in the data (typically seismic sources don't have much energy below about 6Hz), and extend up to the Nyquist frequency. This means that we can choose corner frequencies to within half an octave anywhere in the frequency range of our data.

To apply the filters, on the "MAIN SEISMIC TOOLBAR", click the "Seismic Data Plot Parameter" button (the leftmost one). In the popup, choose "Process" tab, check the "Apply Ormsby Filter" box, and set its frequency parameters in F1, F2, F3, F4, as specified above. Then click Apply or OK to apply the filter.

4) (15%) Make hardcopies of the resulting panels - this is a set of filter test panels.

5) (5%) Which panels are mostly noise and which are mostly signal?

6) (10%) Now mix the filter panel ranges to choose a single bandpass filter that includes the range of the signal but excludes the noise. What are the four corner frequencies? Note that lower-frequency contains information about the deeper reflections yet more ground roll - you have to balance between these two criteria.

6) (5%) Make a hardcopy plot the data with this bandpass filter and compare to the original and to the filter panels. Did this bandpass remove anything you think was significant in the data?

Hand-in

Make paper, PDF, or PNG copies of the most important displays and explain their ideas. Note that the other displays are combinations of these three basic modes.