Geol 335.3

Lab 9: Bandpass Filtering and Automatic Gain Control

This exercise is designed to familiarize you with the basic filtering and amplitude scaling used for displaying seismic data. You will use the seismic processing package ProMAX to look at a several shot gathers, and see how direct wave, reflections, and ground roll look by using different filtering and display options.

Start ProMAXas described in linux_setup.html. Under the data home ‘Seismic Labs’, select project ‘Geol 335’ and sub-project ‘Lab 9’. In this sub-project (also called ‘line’ in some ProMAX descriptions), expand the 'Flows' folder. You can view and modify any flows, but better do not change ‘Load field SEGY’. It was used to create your dataset and can be used to restore it if you damage it.

You will work by modifying the 'Trace display' flow or making new flows. Select the 'Trace display' flow. Look at the sequence of tools used (only 'Disk data input' and 'Trace display'. When pointing at each tool, click middle mouse button and see the parameters used by these tools. Note that if you press on the right mouse button, the corresponding tool becomes activated or de-activated.

Execute the job by pressing 'Ctrl-L' (this can also be done from the menu on top). In the ‘Job Viewer window, you will see that the job is submitted in a parallel process, and after a couple seconds, the seismic trace display should appear. By pressing arrows < and > in the upper-hand corner, you can scroll through the shot records. (For some reasons, the ‘<’ operation does not work with this dataset, but this is unimportant).

The sampling interval of these data is 2000 μs = 2 ms (it can be found in the log files after running any flows). Knowing this, answer the following question:

1) What is the Nyquist frequency for this dataset?

Look through the sections by pressing ‘>’ in Trace Display screen. Try the zoom options.

In the parameters of tool ‘Data Input’ in ‘Trace Display’ flow, change the contents of the text field ‘Sort order list for dataset’ to “19,20/”. This will make the flow to only loads and display two shots with FFID = 19 and 20. We will work with these shots further.

2) In this flow, insert tool “Automatic Gain Control” (AGC) before the ‘Trace Display’. Select the AGC window equal 200 or 300 ms. This tool should equalize the trace amplitudes averaged within this time window. Execute the flow and note the results of AGC.

3) Make a screenshot and printout of the trace display. Label the main phases: direct waves, possibly head waves, reflections, and "ground roll" very slow and low-frequency arrivals. Mark several traces containing characteristic noise. How did you decide between them?

3) Use zoom button to zoom in into: a) a vicinity of first arrival, b) ground roll, c) on of the records looking like constant-amplitude periodic noise. Estimate the periods and frequencies of these signals?

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

- 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 ~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, in the flow, add tool 'Bandpass filter' before AGC. Use 'Ormsby' filter, which is the simple zero-phase, band-pass filter we discussed in class. Middle-click on the tool, and in its parameters window, set the frequency parameters in the F1, F2, F3, F4 fields as specified above. Once they are set, press Ctrl-L to execute the flow and view the results.

4) Make screen shots of the resulting panels - this is your set of *filter test panels*.

5) Which of these panels are mostly noise and which ones show the reflections best?

6) 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 frequencies contain information about the deeper reflections but also more ground roll - you have to balance between these two criteria.

7) Make a screen shot and 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:

Answers to the questions and the plots in a binder.