CONSTRUCTING A COMMON MID-POINT STACKED SEISMIC SECTION

Objective - From the shot gather records of a roll-along seismic reflection profile, to create a Synthetic Zero Offset Seismic Time Section (SZOSTS) by common mid-point stacking of traces

Background - You are supplied with the data from a small 2D (profiling) seismic reflection survey over a part of the western Canadian basin where the strata are relatively uniform and flat-lying. The survey objective is a seismic P wave reflectivity cross-section in which even very minor lateral variations in the stratigraphy can be seen. Because the geological structure of this area is simple, it is acceptable to achieve poorer spatial resolution in the horizontal direction than in the vertical direction. For this very common sort of application, the desired imaging product is a "*synthetic zero offset seismic time section*" (SZOSTS) in which new traces are constructed by the common mid-point (*CMP*) stacking method. (See Lab Manual S3 for more detail)

CMP stacking is a data amalgamation process. It consists of:-

a) Reorganization of the field data from common shot gather to common mid-point gather format.
b) Applying a normal moveout (NMO) correction to each trace of the gathers.
c) Averaging (stacking) the traces of each gather to a single trace.
d) Constructing a new seismic cross-section with one trace for each mid-point location on the profile.

An accurate velocity model is required both for making the NMO correction in required in CMP stacking, and also for geological interpretation of the resulting seismic time section (SZOSTS).

Data supplied:- The data set provided is from the same survey as for exercises S1 and S2.It is located in C:\SEISDATA\STACKING\ CMPSTACK. Fifteen shot gathers of 120 traces each are provided in a single file called DEMOLINE.SGY. These records were extracted from a much longer survey. The survey profile is a straight line with stations (geophones) spaced at 33.0 metre intervals. The survey geometry for each shot gather (i.e. location of the shot and 120 geophones) is given in Table 1 and in other files in the directory. Another version of the seismic data with all the geometry information entered in the file headers in given in DLPLHR.SGY. This is the file you should start from.

You were also provided in exercise S2with three files containing a CMP "supergather" centred on the station number used in the file name. These were used to estimate the subsurface velocity structure below three points on the seismic profile . The resulting velocity pick file will be needed in this exercise. If none is available, use GFWPIKS.

In S1, you examined the data exactly as recorded and performed some basic filtering and scaling operations on it to enhance the visibility of the reflections. However, in preparation for

CMP stacking, the DEMOLINE data have been further processed to improve both the signal-to-noise ratio and character of the reflection events. For your information, these processing steps are described in Appendix 1.

Data files provided in D:\SEISDATA\STACKING for this exercise:-

DLPLHD.SGY

This is a large SEGY file that contains the 15 shot gathers of the file "DEMOLINE.SGY" all in sequence, with the trace headers loaded with all the geometrical information about shot and receiver locations.

DMLNGM

This is a text file that contains a listing of the geometrical information.it can be opened with the VISTA command GEOM.

CMP161.SGY, CMP201.SGY, CMP251.SGY

These are specially made selections of traces with mid points near the designated station. The velocity estimates in GFWPIKS were made from these data by G. F. West. You should have your own version from S2.

GFWPIKS

This is a text file containing estimates of the rms average velocity from the surface to various reflectors,at Stations 161, 201, 251. It provides the velocity information necessary to carry out NMO corrections on the data. You may use this file or your own..

Special VISTA operations you will need:-

BOTtom Annotation. This is a command like SET. It modifies how PLOT works. When you work with files that contain large numbers of traces, it is hard to tell how the traces group. With Bottom Annotation on, graphs or labels are plotted along the bottom of the section to helpyou sort outr the groupings. Use the menu to set "graphical" annotation based on trace "offset".

SORT This is a command that reorders the traces of an input register. You will use it to change from shot ordering to cmp ordering.

NMO This is a command that applies the normal moveout correction to a register of traces. It needs a file of velocity estimates for this purpose.

GEOM This is a command that creates or views a geometry file. You will use it to examine DMLNGM and print out a stacking chart via the "Sub" function key.

VPICK This is a command that allows one to determine rms velocities on a CMP gather. The input data files are a CMP gather in a register and the same file converted to "semblance".

SEMBlance This takes a cmp data file and converts it to "semblance", a quantity useful in vpicks.

Recommended Procedure:-

Before starting, check for your data in D:\USERS\TEMP\ using Windows Explorer. Copy it from SEISDATA, if necessary. If all is OK, start VISTA.

1. Locate the DLPLHD.SGY file and read it into a VISTA register. Plot a few shot gathers from it to compare with the corresponding unprocessed recordings. Note that this file contains 1800 traces and that you can only plot subsets of it on the screen (120 traces = 1 shot gather). SET the bottom annotation ON to indicate the shot receiver offset for the plotted traces. This will enable you to recognize individual shot gathers in the file.

2. You are now ready to sort the data into CMP gathers using the SORT routine. After sorting, plot about 100 traces near the centre of the sorted data file to see its structure; then look at the data near the ends of the line. Note that the number of traces in each CMP gather varies along the line. (See 5. below)

3. Remove the normal moveout from the CMP sorted data using the routine NMO. A file of stacking (rms average) velocities is required by NMO An example version has been provided for you and is called GFWPIKS but you should use the one you made in exercise S2. If you are doing step 3 for final results, use the time stretch mute criterion as described in the VISTA manual to remove first arrivals which are not reflections. 20% is a good limit.) Replot the same set of traces as plotted in 4 above to observe the changes.

4. Stack the NMO-corrected data using STACK, to obtain a time section. Plot the final result and examine it carefully for small facies changes in the strata.

5. Locate the header file (DMLNHDRS.sgy) and the geometry file (DMLNGM) for the demoline and open them using the GEOM routine (in VISTA Field Analysis) as if you were going to add more data. (NB: don't be afraid to respond that you are going to overwrite). Briefly examine the three menus SURV (F2), SHOT(F3), RECV(F4) files, but do not alter them. Use the SUB (F5 function key) function to plot the "stacking chart and subsurface fold" diagram to the screen. Make a hard copy of this diagram after leaving the GEOM program (F8 function key). However, do not write output files - choose NO in the menu before exitting from GEOM via its Finish Geometry command).

6. Review your plotted data, to make sure that you understand the steps you have taken, and that each process worked satisfactorily. Write some notes to accompany the figures.

Clear the TEMP directory of any files you have made.

APPENDIX 1:- *Previous processing of the Demoline data*

Steps were the following:-

a) a gain formula was applied to equalize trace amplitudes at early and late time and for receivers close to and far from the shot;

b) the data were then F-K filtered to attenuate surface waves;

c) an adaptive frequency filter (a shot-gather oriented deconvolution filter) was applied to compensate for changing source conditions along the line and to increase the high frequency content of the recordings;

d) amplitudes were further equalized using AGC.;

e) to compensate for varations in elevation and in thickness of the near surface low velocity layer along the profile, small shifts in the time origins of the traces (called static corrections) were applied.

TABLE 1 -Survey geometry of the DEMOLINE.SGY profile

LINE: unknown
AREA: unknown
TRACES: 120s
STATION INTERVAL: 33.0 m
SHOT INTERVAL: 264.00 m
COMMENT #1:demo data from ITA
# of shots=15, First column below gives shot #, last five columns give station #

sp#	sp_stn	tr#1	tr#60	tr#61	tr#120
30	165	105	164	166	225
29	173	113	172	174	233
28	181	121	180	182	241
27	189	129	188	190	249
26	197	137	196	198	257
25	205	145	204	206	265
24	213	153	212	214	273
23	221	161	220	222	281
22	229	169	228	230	289
21	237	177	236	238	297
20	245	185	244	246	305
19	253	193	252	254	313
18	261	201	260	262	321
17	269	209	268	270	329
16	277	217	276	278	337