

# Technological Informal Example Project

GEOLOGY 4068 – Reflection Seismology

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## **About the Data**

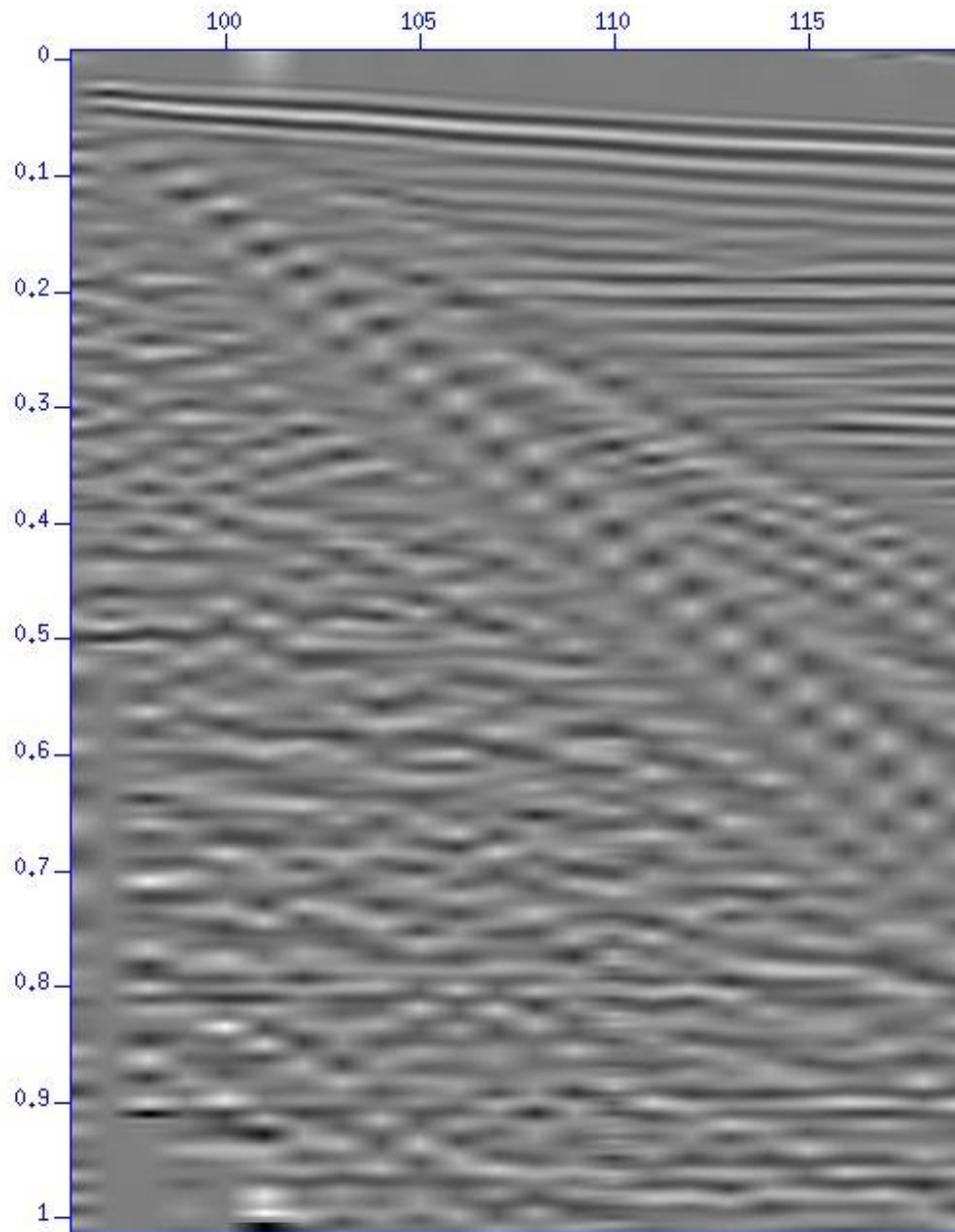
The T.J. Hughes dataset was obtained from a land seismic reflection survey along a Mississippi River levee. The data was located on the machine LGC01 in the seismic reflection

laboratory. The network address of the machine was 'lgc01@geol.lsu.edu'. The original data was found in the directory '/home/refseis10/LSU1\_1999\_TJHughes/seismics/data/1999/Z/dat'. The first shotpoint gather was more northerly than the last shotpoint gather. Below is a table showing information about the experimental layout and the data.

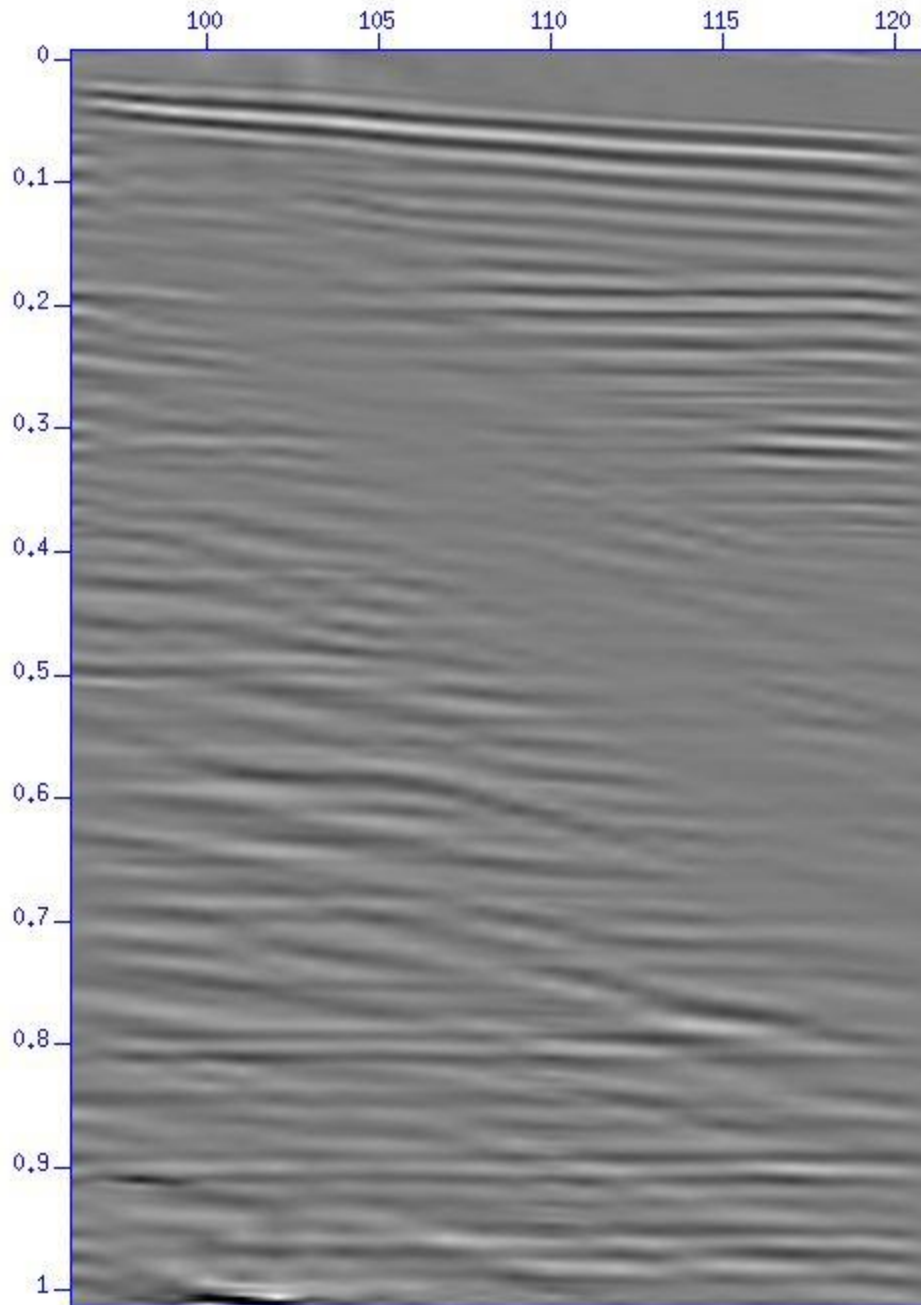
Number of shot gathers:	100
Offset of 1 <sup>st</sup> geophone from shot:	4.5 meters
Geophone spacing:	3 meters
Number of traces per shot:	24
Shift between successive shots:	3 meters
Recording duration:	1s
Samples per trace:	2048
Delay between shot and recording start:	10 milliseconds before shot
Time between samples:	500 microseconds

### **Minimizing Ground Roll**

Ground roll is the direct arrival of a Rayleigh wave. This often cuts directly through the data diagonally making it difficult to see features under the ground roll arrival. Ground roll is best taken care of using f-k filtering. Filtering in the f-k domain is based on samples per trace slopes that you wish to eliminate from the data. The slopes I chose to eliminate were those from 30 samples per trace to 60 samples per trace. Most all negative slopes were eliminated from -100 to 0. Below are images of data before and after f-k filtering. Filtering is achieved by the use of the program sudipfilter.pl (in appendix). Shown below are pre and post f-k filtering.



No f-k filtering



With f-k filtering

## References

Liner, Christopher L. (2004). *Elements of 3D Seismology – Second Edition*. Tulsa, Oklahoma: PennWell Corporation

David Forel, Thomas Benz, and Wayne D. Pennington (2005). *Seismic Data Processing with Seismic Unix – A 2D Seismic Data Processing Primer*. Tulsa, Oklahoma: Society of Exploration Geophysicists

Lorenzo, Juan. GEOL 4068 Seismic Reflection – Lecture Notes

Reflection seismology - Wikipedia. Retrieved December 8, 2010, from [http://en.wikipedia.org/wiki/Reflection\\_seismology](http://en.wikipedia.org/wiki/Reflection_seismology)

## PROGRAMS DEVELOPED SO FAR

### Convert.pl

```
#!/usr/bin/perl

# PROGRAM NAME : convert.pl
# SEG2SU
# This file does the following:
# It runs perl scripts which convert
# a SUnix seg2 binary file to segy file for
# a PC

# INPUT SEG2 DIRECTORY
$DATA_seismics_SEG2 =
'/home/jamec/LSU1_1999_TJHughes/seismics/data/1999/Z/dat';

# OUTPUT SU DIRECTORY
$DATA_seismics_SU =
'/home/jamec/LSU1_1999_TJHughes/seismics/data/1999/Z/su';

# OUTPUT SEG2 DIRECTORY
$DATA_seismics_SEGY =
'/home/jamec/LSU1_1999_TJHughes/seismics/data/1999/Z/sgy';

@mv2segyDIR = (" mv          \\
                $DATA_seismics_SEG2/*.sgy  \\
                $DATA_seismics_SEGY       \\
                ");

# if number of files =8 but first file is "1004.su"
$number_of_files = 1;

# INPUT FILE NAMES
for ($i=1,$j=1002; $i <=$number_of_files ; $i += 1,$j +=1){
    $j_char = sprintf("%u",$j);
    $file_name[$i] = $j_char;
}
}
```

```

# CONVERT SEG2 FILES TO SEGY FILES
for ($i= 1 ; $i <= $number_of_files ; $i += 1) {

    @seg2segy = (" ./seg2segy $file_name[$i].SG2 1 ");

    system @seg2segy;

    system 'echo', @seg2segy;

}

# MOVE SEGY FILES TO SEGY DIRECTORY
system @mv2segyDIR;

system 'echo', @mv2segyDIR;

# CONVERT SEGY FILES TO SU FILES
for ($i= 1 ; $i <= $number_of_files ; $i += 1) {

    @seg2su = (" segyread                                \\
                tape=$DATA_seismics_SEGY/$file_name[$i].sgy  \\
                endian=0
\\
                > $DATA_seismics_SU/$file_name[$i].su          \\
                ");

    system @seg2su;

    system 'echo', @seg2su;

}

```

---

## Rev.sh

```

#!/bin/sh
set -x
# rev.sh
# Reverses traces 13 through 24
# James Chatagnier
# November 22, 2010

# set up working directories

SU_DIR='/home/jamec/LSU1_1999_TJHughes/seismics/data/1999/Z/su'

first=1001

```

```

last=1100

#rm $SU_DIR/$output_file.su

for ((file=$first; file<=$last; file=$file + 1))
do

    suwind <$SU_DIR/$file.su \
        key=tracf \
        min=1 max=12 \
        > $SU_DIR/$file.temp_1to12.su

    suwind <$SU_DIR/$file.su \
        key=tracf min=13 max=24 \
    |
    suop op=neg \
        > $SU_DIR/$file.temp_13to24.su

    cat $SU_DIR/$file.temp_1to12.su \
        $SU_DIR/$file.temp_13to24.su \
        > $SU_DIR/$file.r.su

done

rm -f $SU_DIR/*temp*

# plotting concatenated data

# sugain <$SU_DIR/$output_file.rev.su \
#     agc=1 wagc=0.1 \
# |
# sufiler f=3,6,100,160 \
#     | suxwigb title="$output_file'_polrev'.su"

```

---

## Sufft.sh

```

#!/bin/sh

# Program Name: SUFFT script
# Programmer: James Chatagnier
# Purpose: Displays Fast Fourier Transform for a file
# Version: 1
# Date: December 3, 2010

# DATA DIRECTORY
SU_DIR='/home/jamec/LSU1_1999_TJHughes/seismics/data/1999/Z/su'

# fourier analysis fo data

```

```
file_name='1010.su'

sufft <${SU_DIR}/${file_name} \
| suamp mode=amp \
| sugain wagg=.1 agc=1 \
| suximage legend=1 clip=1
#| suxwigg legend=1 clip=5
```

---

### Gainandfilter.sh

```
#!/bin/sh
set -x

#Filename:gainandfilter.sh
#Purpose: Gains and filters files, makes new file
#Written by: James Chatagnier
#Date:December 5, 2010

#Set up working Directory and files

SU_DIR='/home/jamec/LSU1_1999_TJHughes/seismics/data/1999/Z/su'

first=1001
last=1100

#Loop to apply gain and filter

for ((file=$first; file<=$last; file=$file + 1))
do
    sugain < $SU_DIR/$file.rk.su \
    agc=1 \
    wagg=0.1 \
    | sufilter \
    f=5,10,100,150 \
    > $SU_DIR/$file.rkgf.su
done
```

---

### concatall.sh

```
#!/bin/sh
set -x
# cat.sh
#March 24 2010
# Program to concatenate many files together
# and review the results
# Juan M. Lorenzo

# set up working directories
SU_DIR='/home/jamec/LSU1_1999_TJHughes/seismics/data/1999/Z/su'
output_file='1001_1100.rk'

rm $SU_DIR/$output_file.su
touch $SU_DIR/$output_file.su
```



```

# cat all S from E and W

first=1001
last=1100

for ((file_num=$first; file_num<=$last; file_num=$((file_num+1)))
do
    cat $SU_DIR/$file_num.rk.su >> $SU_DIR/$output_file.su
done

#sugain <$SU_DIR/$output_file.su agc=1 wagc=0.5 \
#| \
#sufilter f=3,6,1000,1500
#suximage clip=5 &

```

---

```

sudipfilt.pl

#! /usr/bin/perl

# SCRIPT NAME
# Suspecfk.pl
# Purpose: f-k spectral analysis
# Juan M. Lorenzo
# Feb 15 2008

# Use shell transparently to locate home directory before compilation

    my $library_location;

    BEGIN {
        use Shell qw(echo);

        $home_directory = `echo \${HOME}`;
        chomp $home_directory;
        $library_location = $home_directory.'/lsu/libAll';
    }

# LOAD GENERAL PERL LIBRARY
use lib $library_location;

# library path
use lib './libAll';

# use library
use System_Variables2;

# import system variables
my ($DATA_SEISMIC_SU) = System_Variables2::DATA_SEISMIC_SU();

```

```

#sample rate = us
# dl = sample rate in s = .000XXX

# sufile names
$sufile_in[1]      = '1001_1100.rk';
$sufile_out[1]     = $sufile_in[1].'gf_fk';
$inbound [1]      = $DATA_SEISMIC_SU.'/'. $sufile_in[1].'.su';
$outbound [1]      =
$DATA_SEISMIC_SU.'/'. $sufile_out[1].'.su';
#print("$sufile_in[1]\n");

# GAIN DATA
@sugain[1] = (" sugain          \\\
              pbal=1          \\\
              ");

# GAIN DATA
@sugain[2] = (" sugain          \\\
              wagc=0.1       \\\
              agc=1          \\\
              ");

# FILTER DATA
@sufilter[1] = (" sufilter      \\\
                f=5,10,100,150 \\\
                ");

# WINDOW DATA by shot point
# in this case fldr
# is equivalent to sequential shot point gather number
@suwind[2] = (" suwind         \\\
              key=fldr        \\\
              min=1001        \\\
              max=1100        \\\
              ");

# F-K SPECTRAL ANALYSIS
@suspecfk[1] = (" suspecfk     \\\
                dt=1 dx=1     \\\
                ");

# LINEAR MOVEOUT
@sureduce[1] = (" sureduce     \\\
                rv=1.5        \\\
                ");

# LINEAR MOVEOUT
@sureduce[2] = (" sureduce     \\\
                ");

```

```

                rv=-1.5                \\
                ");
# APPLY DIP FILTER
    @sudipfilter[1] = (" sudipfilt                \\
        dt=1 dx=1                                \\
        amps=1,0,0,1                            \\
        bias=0                                    \\
        slopes=15,25,65,75                      \\
        ");
# APPLY DIP FILTER
    @sudipfilter[2] = (" sudipfilt                \\
        dt=1 dx=1                                \\
        amps=1,0,0,1                            \\
        bias=0                                    \\
        slopes=-100,-90,-5,0                   \\
        ");
# DISPLAY DATA
    #key=offset                                  \\
    @suxwignb[1] = (" suxwignb                  \\
        title=$sufilename_in[1]                \\
        label1='No. samples'                   \\
        label2='No. traces'                    \\
        d1=1 d2=1 f1=1 f2=1                    \\
        wbox=300 hbox=370 xbox=370 ybox=0      \\
        n2tic=1 d2num=20                       \\
        va=1                                    \\
        xcur=3                                  \\
        clip=2.5                                \\
        ");
# DISPLAY DATA
    #key=offset                                  \\
    @suxwignb[5] = (" suxwignb                  \\
        title=$sufilename_in[1]                \\
        label1='No. samples'                   \\
        label2='No. traces'                    \\
        d1=1 d2=1 f1=1 f2=1                    \\
        wbox=300 hbox=370 xbox=370 ybox=440   \\
        n2tic=1 d2num=20                       \\
        va=1                                    \\
        xcur=3                                  \\
        clip=3                                  \\
        ");
# DISPLAY DATA
    @suximage[1] = (" suximage                 \\
        title=$sufilename_in[1]                \\

```

```

        style=seismic                                \\
        x1beg=0.5 x1end=0.                           \\
        label1='Frequency (Hz) dt=1 Nf=0.5'          \\
        label2='k (1/m) dx=1 Nk=0.5'                \\
        n2tic=1 d2num=0.2 f2num=-0.5                \\
        n1tic=1 d1num=0.1                            \\
        wbox=300 hbox=370 xbox=0 ybox=0              \\
        ");

# DISPLAY DATA
    @suximage[2] = (" suximage                        \\
        title=$sufilename_in[1]                      \\
        label1='Time (s)'                            \\
        label2='No. traces'                          \\
        n2tic=1 d2num=20                              \\
        wbox=300 hbox=370 xbox=670 ybox=0            \\
        ");

# DISPLAY DATA
    @suximage[4] = (" suximage                        \\
        title=$sufilename_in[1]                      \\
        x1beg=0.5 x1end=0.                           \\
        label1='Frequency (Hz) dt=1 Nf=0.5'          \\
        label2='k (1/m) dx=1 Nk=0.5'                \\
        n2tic=1 d2num=0.2 f2num=-0.5                \\
        n1tic=1 d1num=0.1                            \\
        wbox=300 hbox=370 xbox=0 ybox=440           \\
        ");

# DISPLAY DATA
    @suximage[6] = (" suximage                        \\
        title=$sufilename_in[1]                      \\
        label1='Time (s)'                            \\
        label2='No. traces'                          \\
        d1=XX f1=0                                    \\
        n2tic=1 d2num=20                              \\
        wbox=300 hbox=370 xbox=670 ybox=440         \\
        ");

# DEFINE FLOW(S)
    @flow[1] = ("                                     \\
        @suwind[2]                                    \\
        < @inbound[1] |                              \\
        @sugain[2] |                                  \\
        @sufilter[1] |                               \\
        @suspecfk[1] |                               \\
        @suximage[1]                                 \\
        &                                             \\
        ");

# DEFINE FLOW(S)
    @flow[2] = ("                                     \\

```

```

        @suwind[2]                \\
        < @inbound[1] |           \\
        @sugain[2] |              \\
        @sufilter[1] |           \\
        @suxwign[1]                \\
        &                          \\
        ");                          \\

# DEFINE FLOW(S)
    @flow[3] = ("                \\
        @suwind[2]                \\
        < @inbound[1] |           \\
        @sugain[2] |              \\
        @sufilter[1] |           \\
        @suximage[2]              \\
        &                          \\
        ");                          \\

# DEFINE FLOW(S)
    @flow[4] = ("                \\
        @suwind[2]                \\
        < @inbound[1] |           \\
        @sugain[2] |              \\
        @sufilter[1] |           \\
        @sudipfilter[1] |        \\
        @sudipfilter[2] |        \\
        @suspecfk[1] |           \\
        @suximage[4]              \\
        &                          \\
        ");                          \\

# DEFINE FLOW(S)
    @flow[5] = ("                \\
        @suwind[2]                \\
        < @inbound[1] |           \\
        @sugain[2] |              \\
        @sufilter[1] |           \\
        @sudipfilter[1] |        \\
        @sudipfilter[2] |        \\
        @suxwign[5]                \\
        &                          \\
        ");                          \\

# DEFINE FLOW(S)
    @flow[6] = ("                \\
        @suwind[2]                \\
        < @inbound[1] |           \\
        @sugain[2] |              \\
        @sufilter[1] |           \\
        @sudipfilter[1] |        \\
        @sudipfilter[2] |        \\

```

```

        @suximage[6]                \\
        &                            \\
        ");
# DEFINE FLOW(S)
    @flow[7] = ("                    \\
        @suwind[2]                  \\
        < @inbound[1] |             \\
        @sugain[2] |                \\
        @sufilter[1] |             \\
        @sudipfilter[1] |          \\
        @sudipfilter[2]           \\
        > @outbound[1]            \\
        &                            \\
        ");
# RUN FLOW(S)
    system @flow[1];
    #system 'echo', @flow[1];

    system @flow[2];
    #system 'echo', @flow[2];

    system @flow[3];
    #system 'echo', @flow[3];

    system @flow[4];
    #system 'echo', @flow[4];

    system @flow[5];
    #system 'echo', @flow[5];

    system @flow[6];
    #system 'echo', @flow[6];

    system @flow[7];
    #system 'echo', @flow[7];

```

---