
G_Seis

Release 1.0.2

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Oct 19, 2022

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Simple 2D-Seismic data processing GUI application

1.1 Functionality

1. SEGY read/write (reads to binary file of format single)
2. visualize data with three keys sorting
3. surface-consistent first arrival (or amplitude) decomposition according to 2, 3, 4 factor model
4. interactively build velocity model based on decomposed arrival picks
5. perform static, amplitude and spectrum correction (deconvolution)
6. perform some basic header and data arithmetic

1.2 Usage

The main file is **G_Seis.m**

Before running the application one should:

1. set path to the root folder and include all the folders inside it
2. build mex function in /g_other folder. Commands `>> mex -setup` and `>> mex typecastx.c` (or `>> mex g_other/typecastx.c` depending on current path) may help
3. run the app: `>> G_Seis`

2.1 Read SEG Y

The screenshot displays the RStudio IDE interface with four main panes:

- Top Left (R Script):** Shows the R script editor with the following code:


```
Open C:\Users\lwm\Desktop\lwmtest\img
Save C:\Users\lwm\Desktop\lwmtest\img\Tracer_Seq1
Run Parallel Run View data
```
- Top Right (Plots):** Displays a table titled 'Description' with columns 'Start time', 'Length (ms)', and 'Value'. The table contains 20 rows of data, including '1. Jan event', '2. Jan event', '3. Jan event', '4. Jan event', '5. Jan event', '6. Jan event', '7. Jan event', '8. Jan event', '9. Jan event', '10. Jan event', '11. Jan event', '12. Jan event', '13. Jan event', '14. Jan event', '15. Jan event', '16. Jan event', '17. Jan event', '18. Jan event', '19. Jan event', and '20. Jan event'.

Description	Start time	Length (ms)	Value
1. Jan event	2017-01-01 00:00:00	1	1000
2. Jan event	2017-01-01 00:00:00	1	1000
3. Jan event	2017-01-01 00:00:00	1	1000
4. Jan event	2017-01-01 00:00:00	1	1000
5. Jan event	2017-01-01 00:00:00	1	1000
6. Jan event	2017-01-01 00:00:00	1	1000
7. Jan event	2017-01-01 00:00:00	1	1000
8. Jan event	2017-01-01 00:00:00	1	1000
9. Jan event	2017-01-01 00:00:00	1	1000
10. Jan event	2017-01-01 00:00:00	1	1000
11. Jan event	2017-01-01 00:00:00	1	1000
12. Jan event	2017-01-01 00:00:00	1	1000
13. Jan event	2017-01-01 00:00:00	1	1000
14. Jan event	2017-01-01 00:00:00	1	1000
15. Jan event	2017-01-01 00:00:00	1	1000
16. Jan event	2017-01-01 00:00:00	1	1000
17. Jan event	2017-01-01 00:00:00	1	1000
18. Jan event	2017-01-01 00:00:00	1	1000
19. Jan event	2017-01-01 00:00:00	1	1000
20. Jan event	2017-01-01 00:00:00	1	1000
- Bottom Left (Environment):** Shows the 'Tracer' object with a 'Tracer: 1' plot. The plot is a line graph showing the 'Tracer' value over time. The x-axis is labeled 'Time' and ranges from 0 to 1000. The y-axis is labeled 'Tracer: 1' and ranges from 0 to 1000. The plot shows a series of peaks and valleys, with the highest peak reaching 1000.

Time	Tracer: 1
0	0
100	1000
200	0
300	1000
400	0
500	1000
600	0
700	1000
800	0
900	1000
1000	0
- Bottom Right (Source):** Shows the R script code, which is the same as the code in the 'R Script' pane.

2.2 Write SEGY

SC write SEGY

Input/Output files

Open C:\Users\kserim\MATLAB\Projects\G_Seis\tmp\seismic.mat

Save C:\Users\kserim\MATLAB\Projects\G_Seis\tmp\seismic.sgy

Format

- ☒ 4-byte IEEE floating point
- ☐ 4-byte IBM floating point
- ☐ 4-byte two, complement integer
- ☐ 2-byte two, complement integer
- ☐ 1-byte two, complement integer

Endian

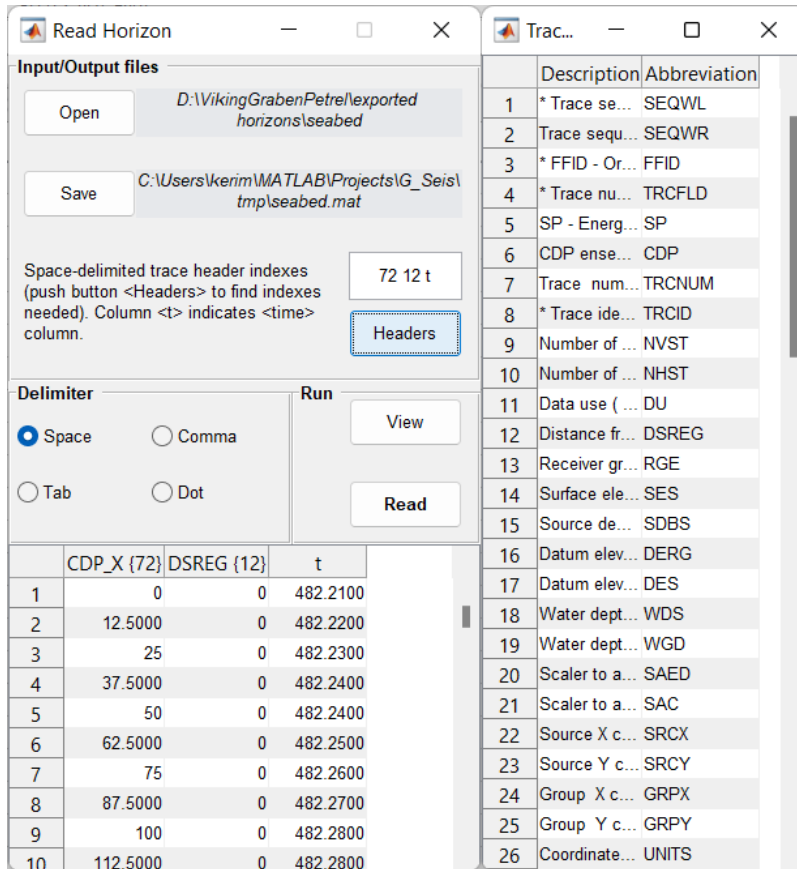
- ☒ Big
- ☐ Little

RUN

Note: IBM32 is known only in seismic exploration. Translation it to IEEE32 is pretty painful: that is why there is no support for writing it.

2.3 Read Horizon

Horizon reader translates textual column oriented files to Matlab's *.mat*-files.



Horizon files may be used when selecting areas for computing factors.

Use LineEdit widget to set trace header index for each column. For **Z** values use letter **t**.

Note: Use **View** button before reading.

2.4 Header Math

This module is dedicated to trace header calculations.

The screenshot shows the 'SC header math' window. The 'Input parameters' section includes an 'Open' button, a file path 'C:\Users\kerim\MATLAB\Projects\G_Seis\tmp\seismic.mat', a dropdown menu for 'CDP_X' set to '=', and a text box containing the formula '(SRCX+GRPX) ./2'. Below this are 'RUN' and 'Plot Table' buttons, and 'From trace:' (1) and 'To trace:' (100) fields. The main table displays header values for various parameters across 7 traces. The parameters are: SES, SDBS, DERG, DES, WDS, WGD, SAED, SAC, SRCX, SRCY, GRPX, and GRPY. The values for SRCX, SRCY, and GRPX are highlighted in blue.

	1	2	3	4	5	6	7
SES	-6	-6	-6	-6	-6	-6	-6
SDBS	0	0	0	0	0	0	0
DERG	0	0	0	0	0	0	0
DES	0	0	0	0	0	0	0
WDS	0	0	0	0	0	0	0
WGD	0	0	0	0	0	0	0
SAED	1	1	1	1	1	1	1
SAC	1	1	1	1	1	1	1
SRCX	3237	3237	3237	3237	3237	3237	3237
SRCY	0	0	0	0	0	0	0
GRPX	0	25	50	75	100	125	
GRPY	0	0	0	0	0	0	0

Use ComboBox to choose trace header that should be edited.

In LineEdit type a mathematical function using Matlab syntax for vectors.

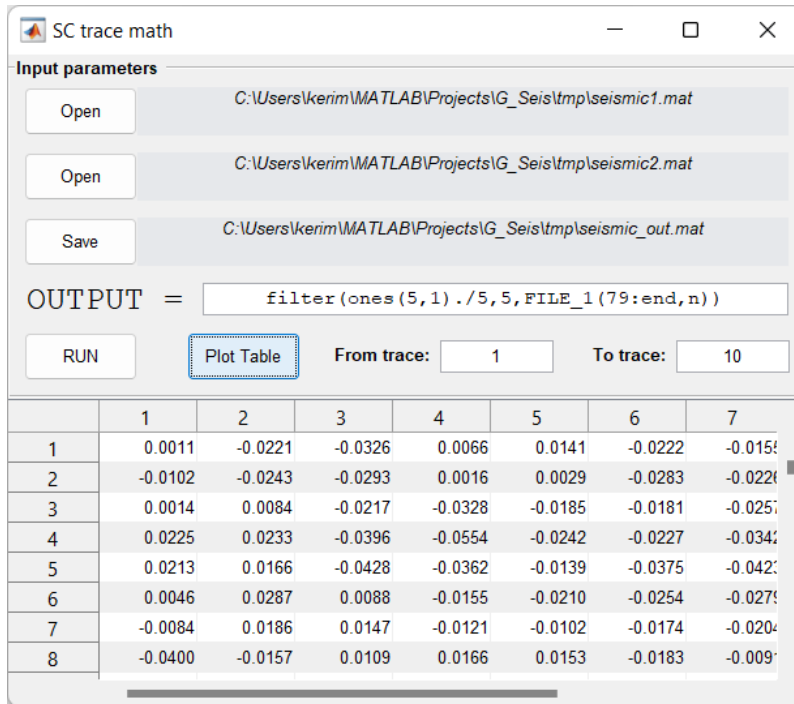
Select **From trace** and **To trace** LineEdits before displaying values in the table.

Examples:

1. compute **CDP_X**: $(SRCX+GRPX)/2$
2. make **DSREG** (offsets) absolute: $abs(DSREG)$

2.5 Trace Math

This module is dedicated to trace calculations.



In LineEdit type a mathematical function using Matlab syntax for column-vector.

Variables **FILE_1** and **FILE_2** may be used to perform computations on selected datasets.

Examples:

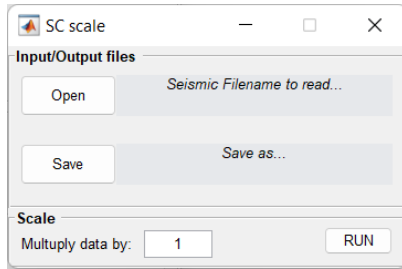
1. sum each trace from **FILE_1** with **FILE_2**: `FILE_1(79:end,n)+FILE_2(79:end,n)`
2. filter **FILE_1** with moving average filter: `filter(ones(5,1)./5,5,FILE_1(79:end,n))`

Note: **78** is the number of trace headers (they are skipped when computation starts with **79** index). **n** is the iterator used in loop by traces.

Note: **FILE_1** and **FILE_2** must have the same number of samples and traces.

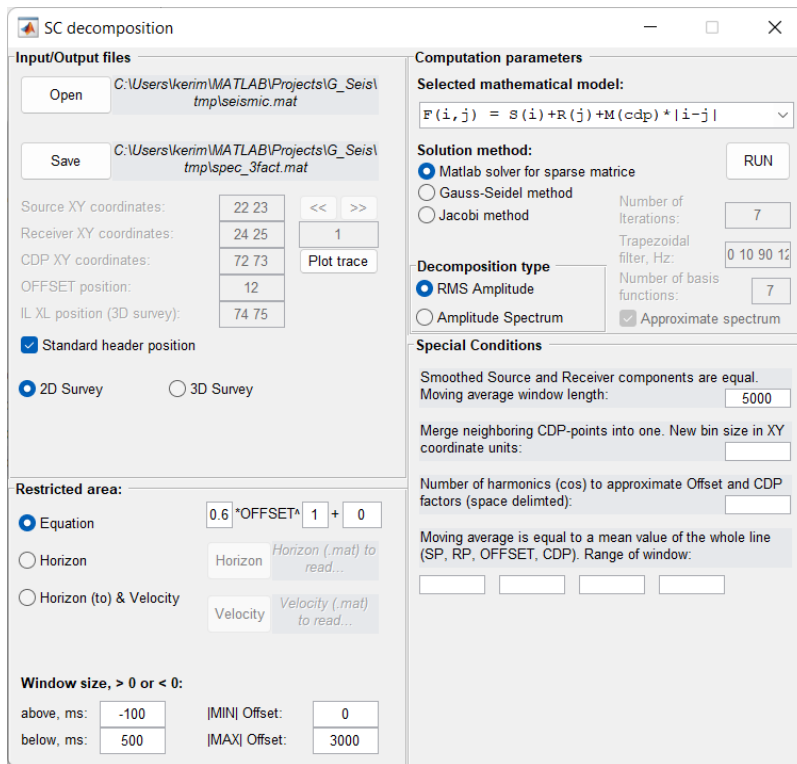
2.6 Scale Data

Performs traces multiplications by scalar.



2.7 SC Decomposition

Solves system of linear equations to decompose amplitudes or spectrums by factors. Computed factors then used by *SC Apply* module to apply amplitude correction or deconvolution.



2.8 SC Time Decomposition

Solves system of linear equations to decompose timefield by factors. Computed S (source) and R (receiver) factors then used by *SC Apply* module to apply static shifts and by *SC Build Vel Model* to perform interactive corrections.

The screenshot shows the 'SC time decomposition' software interface. It is divided into two main sections: 'Input/Output files' on the left and 'Computation parameters' on the right.

Input/Output files:

- Open:** C:\Users\kerim\MATLAB\Projects\G_Seis\tmp\seismic.mat
- Save:** C:\Users\kerim\MATLAB\Projects\G_Seis\tmp\spec_3fact.mat
- Source XY coordinates:** 22 23
- Receiver XY coordinates:** 24 25
- CDP XY coordinates:** 72 73
- OFFSET position:** 12
- IL XL position (3D survey):** 74 75
- ☒ Standard header position
- ☒ 2D Survey ☐ 3D Survey
- Horizon:** seabed.mat
- Restrict by:** ☒ Offset ☐ Picks
- LAYER_1 [MIN] Offset:** 0
- LAYER_1 [MAX] Offset:** 800
- LAYER_2 [MIN] Offset:** 1200
- LAYER_2 [MAX] Offset:** 2200
- LAYER_3 [MIN] Offset:** 2400
- LAYER_3 [MAX] Offset:** 3600
- LAYER_4 [MIN] Offset:**
- LAYER_4 [MAX] Offset:**
- LAYER_5 [MIN] Offset:**
- LAYER_5 [MAX] Offset:**

Computation parameters:

- Selected mathematical model:** $F(i, j) = S(i) + R(j) + M(cdp) * |i - j|$
- Solution method:**
 - ☒ Matlab solver for sparse matrice
 - ☐ Gauss-Seidel method
 - ☐ Jacobi method
- SPECIAL CONDITIONS**
 - Smoothed Source and Receiver components are equal.
 - Moving average window length: 5000
 - Merge neighboring CDP-points into one. New bin size in XY coordinate units FOR EACH LAYER:
 - Number of harmonics (cos) to approximate Offset factor FOR EACH LAYER (space delimited):
 - Moving average is equal to a mean value of the whole line (SP, RP, OFFSET, CDP). Range of window:

Choose horizon with first break picks.

Set the limits by offsets or by picks for each layer.

There are two mathematical models:

1. $F(i, j) = S(i) + R(j) + M(cdp) * |i - j|$ for refracted waves
2. $F(i, j) = S(i) + R(j) + M(cdp) * |i - j|^2$ for reflected waves

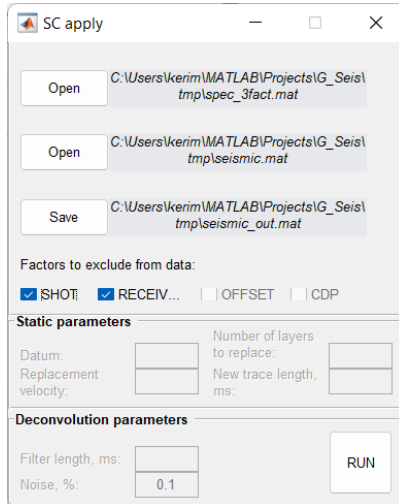
In **Special Conditions** section set the parameters to regularize the solution.

For more information see:

Taner T.M., Wagner D.E., Baysal E., Lu L. A unified method for 2-D and 3-D refraction statics // *Geophysics*, 1998, vol. 63 (1), pp. 260-274.

2.9 SC Apply

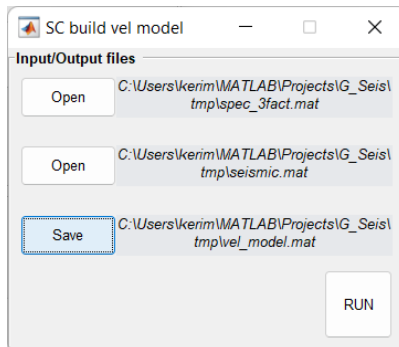
Exclude computed factors (amplitude or static shifts) from the data.



Note: Factors file is a .mat-file computed with *SC Decomposition* or *SC Time Decomposition*

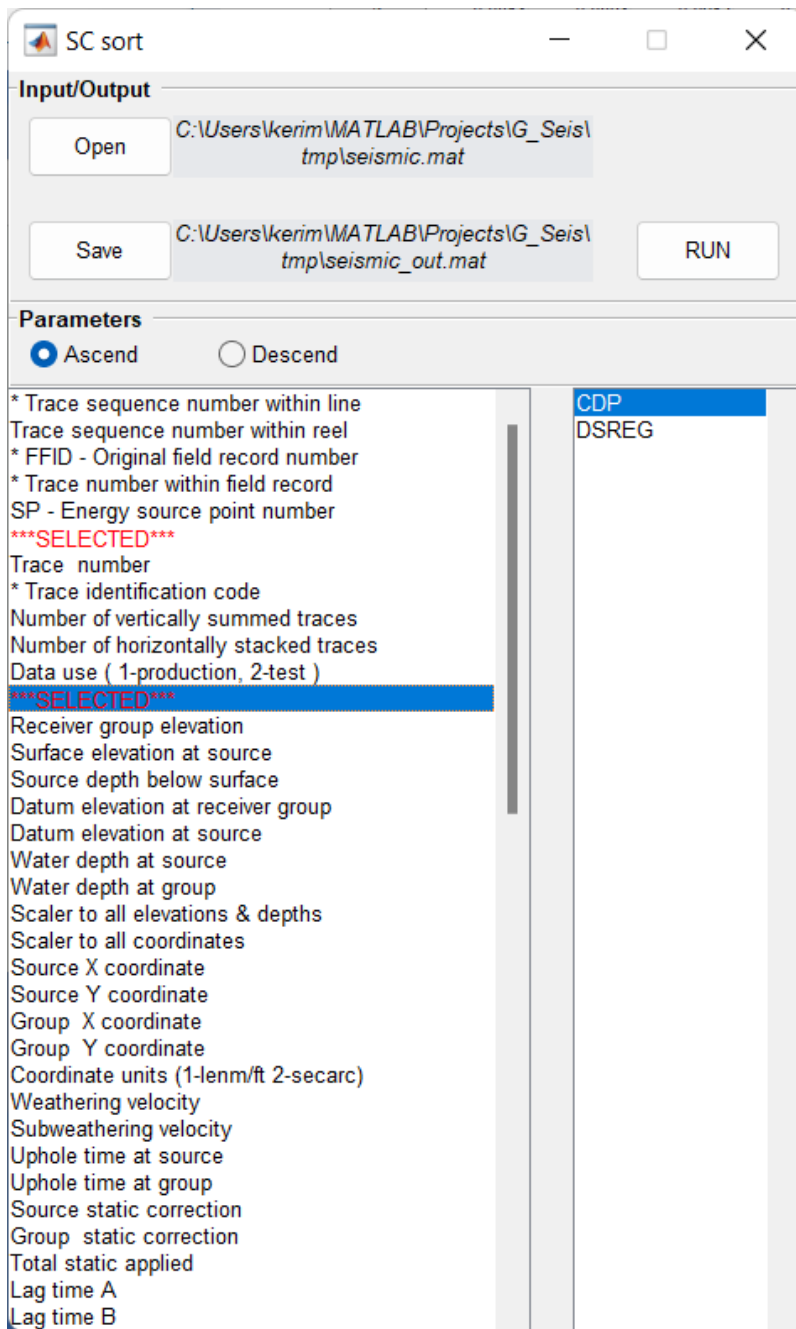
2.10 SC Build Vel Model

Interactive tool for building and editing layered velocity model from computed time factors.



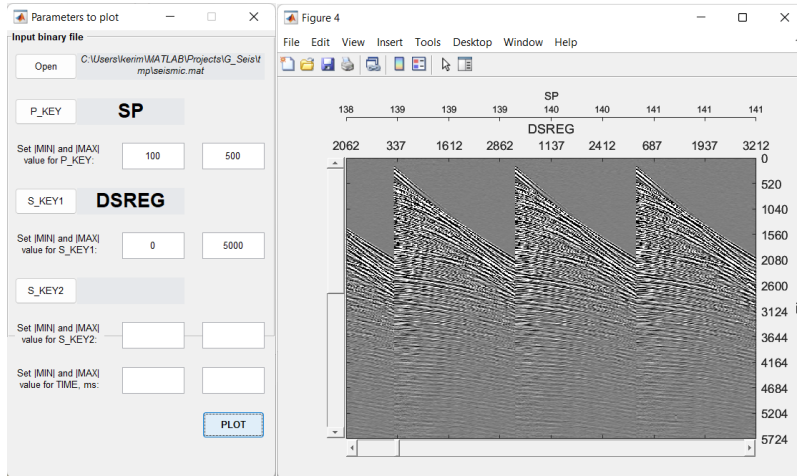
2.11 Sort Traces

Sorts traces in ascending or descending order



2.12 Plot Data

Plotting is for traces and computed factors visualization.



P_KEY - is primary key.

S_KEY1 and **S_KEY2** - secondary keys.

Keys are needed to sort data before displaying.

Absolute values of **MIN** and **MAX** values are helpful to restrict the desired data.

In case of displaying factors only **P_KEY** is used which should be set to **SEQWL**.

To display **S** (shot) factor for first layer choose **MIN** and **MAX** equal to 1. For the second layer use 11. For the third layer use 21.

To display **R** (receiver) factor for first layer choose **MIN** and **MAX** equal to 2. For the second layer use 12. For the third layer use 22.

To display **M** (offset) factor for first layer choose **MIN** and **MAX** equal to 3. For the second layer use 13. For the third layer use 23.

To display **G** (cdp) factor for first layer choose **MIN** and **MAX** equal to 4. For the second layer use 14. For the third layer use 24.

Note: Use *Header Math* module to view headers of computed factors.

INDEXES AND TABLES

- genindex
- modindex
- search