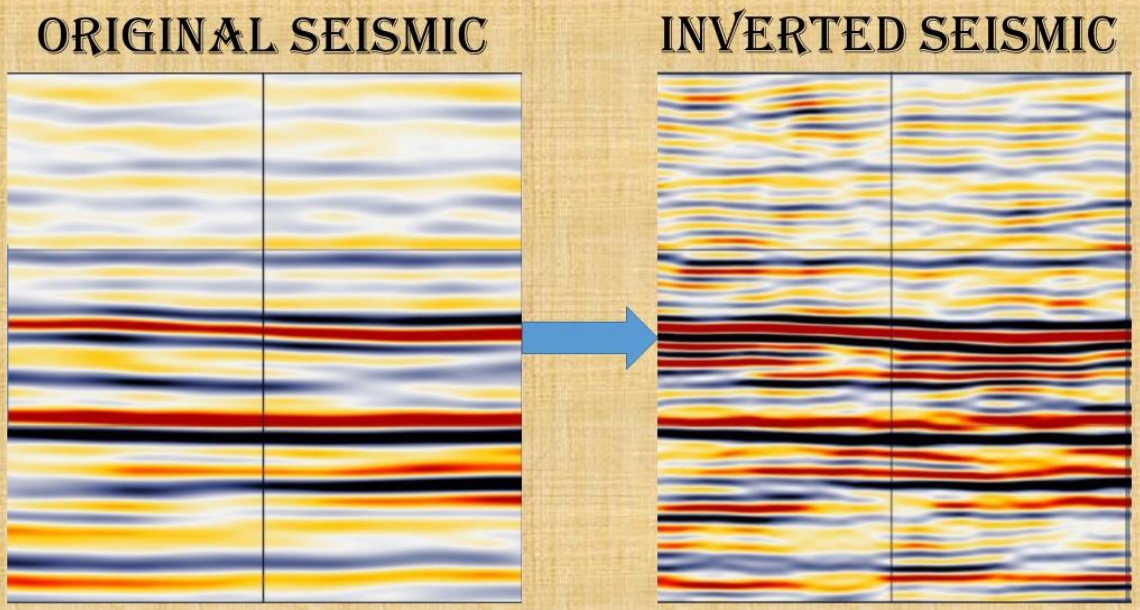
SPARSE LAYER INVERSION

SLI: V1.0

User Manual



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About this manual

This training manual is prepared for geo-physicists who want to learn how to use the Sparse Layer Inversion (SLI) software for Seismic inversion. This manual teaches both parts. Theory and background of some of the more advanced work flows are given but the focus is on hands-on exercises that are executed. Before installing SLI, you need to install the runtime for MATLAB 2018a from MathWorks site.

The training manual consists of the following parts:

- Data Loading
- Visualisation and Basic Interaction
- Time-Frequency Analysis
- Sparse Layer Inversion
- Result Analysis

**Not all extensions of this package are introduced in this manual.*

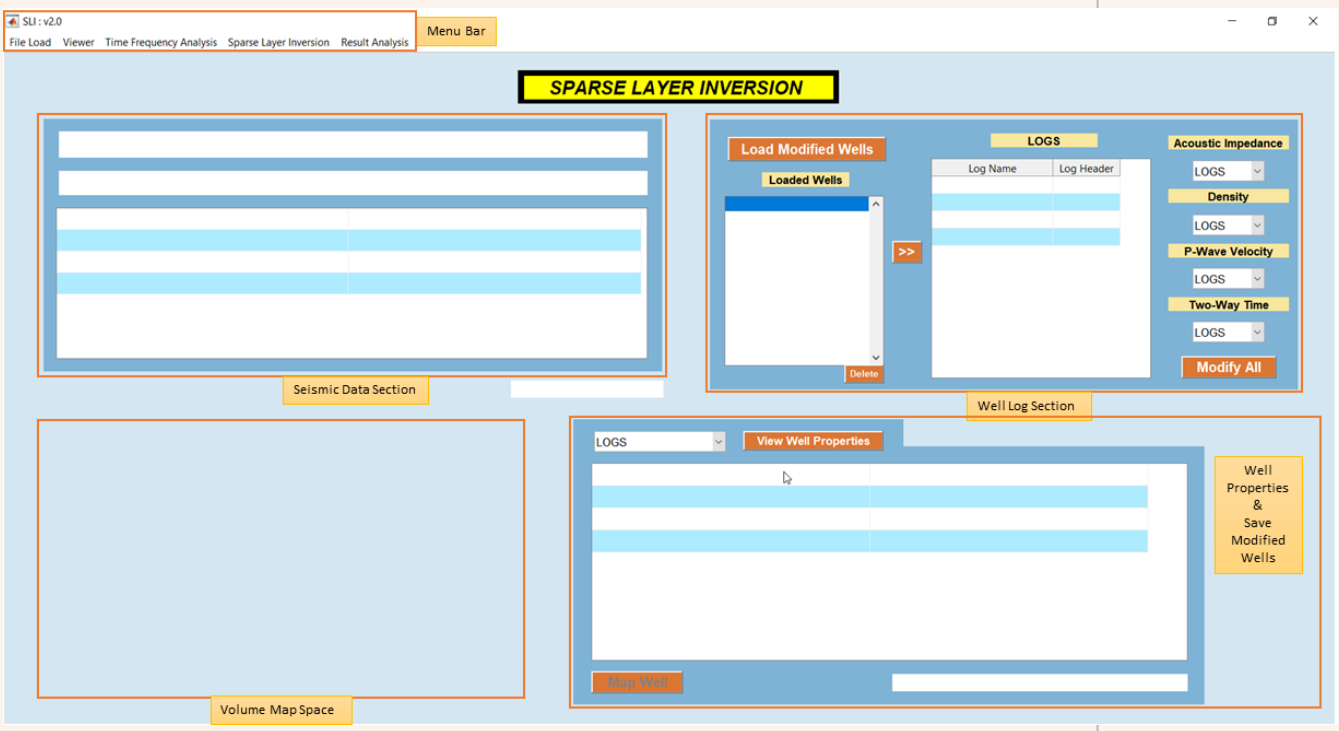
SLI is supported on PC- Windows (7, 8, 10 32/64 bits).

Dataset

The dataset used in this manual is from WADU dataset located in western part of India. The area is related to hydrocarbon and coal-beds. The dataset contains Seismic data, well data, check shots and stacking velocities.

1. Main Window

The main window of SLI v2.0 is shown to the user without any pre-loaded data set as follows.



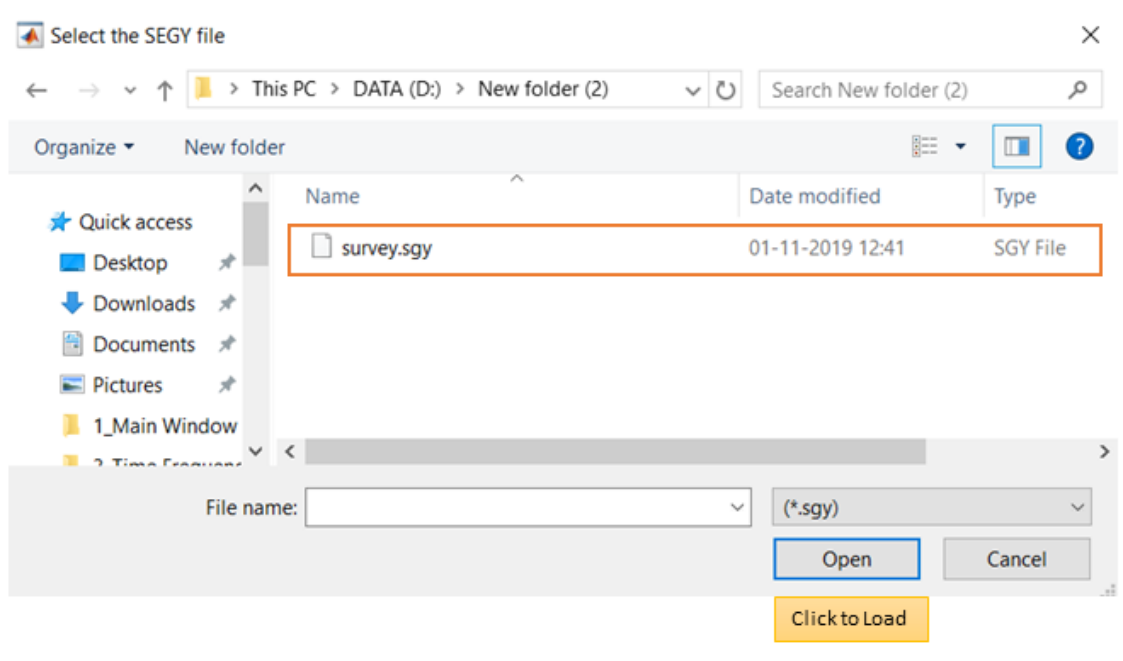
The Menu bar shows the available operations given in SLI v2.0. The user needs to load relevant data first in the ***File Load*** section before proceeding to other sections. The main window provides an easy loading interface to the user and verifies the dataset before going into further complex operations. User can proceed into Seismic operations without loading Well data. But in order to verify the inversion results, user will be prompted to load the modified Well data when necessary.

a. Seismic Data Loading

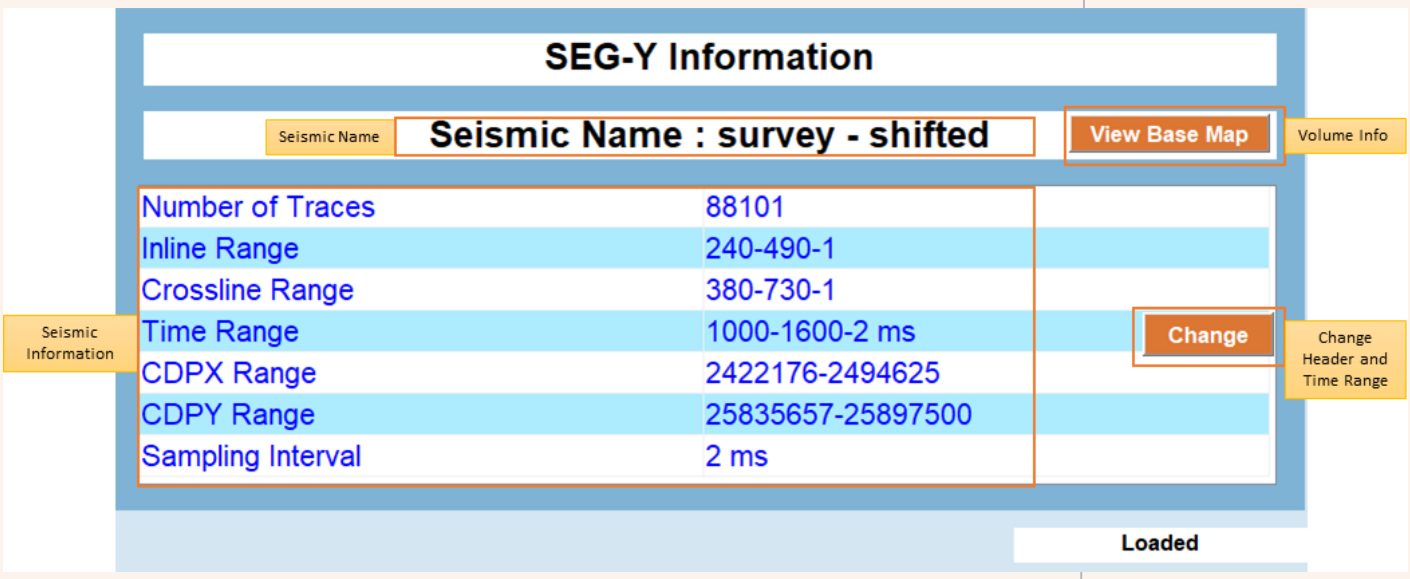
Seismic data can be loaded into SLI by choosing ***File Load >> Load Seismic***

(*.sgy*) extension is the only supported extension and the Inline, Crossline, CDPX and CDPY memory location must be 189,193,181,185 respectively by default. The size of each data should be 4 bytes.

- Choose the appropriate *.sgy* file and click ***Open*** to load.

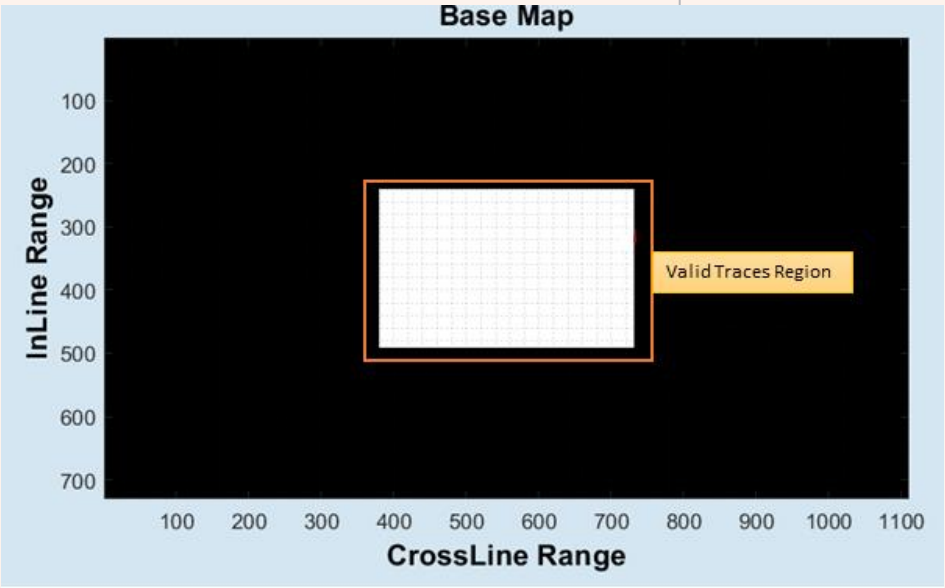


If the seismic data is appropriate, the header information will be displayed in the Seismic Data section. The user can choose to proceed with this data or change the header information by clicking ***Change*** button. User can change the time range and the CDPX and CDPY by choosing the multiplier.

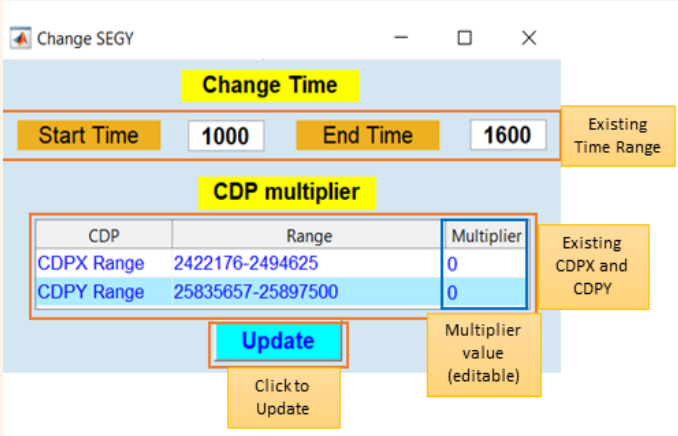


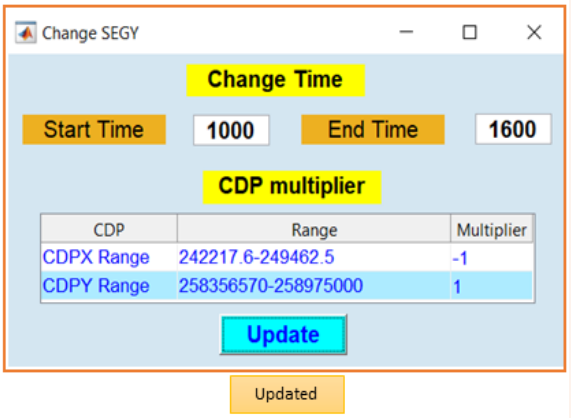
To view the data geometry, press the ***View Base Map*** button.

It shows the top-view of Seismic data. User can verify whether all the traces contained in the data-set have been loaded properly.



If user wants to edit the header information i.e. CDPX, CDPY and time range values, click the ***Change*** button. A pop-up will appear showing the existing values. User can change the time values directly whereas the CDPX and CDPY headers can only be multiplied with an exponent of 10. User just needs to select the exponent value.

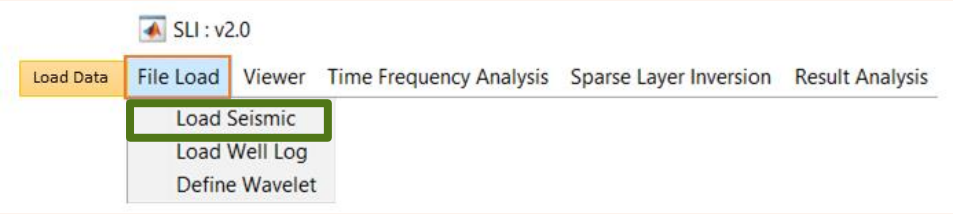




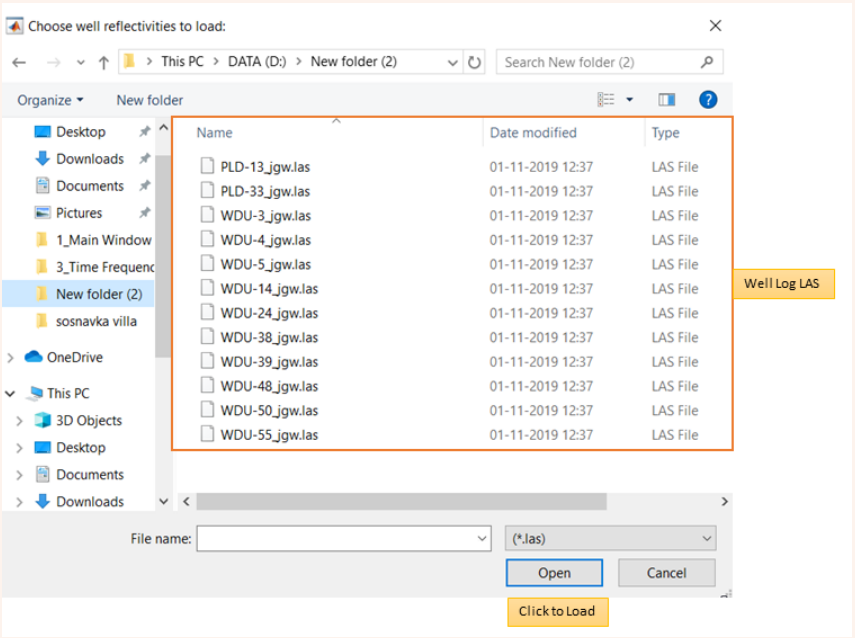
User can verify the changes by clicking on the ***Update*** button. The range value in the table will change according to the value given by the user in the editable Multiplier section.

b. Well Data Loading

Well log data can be loaded into SLI by choosing ***File Load >> Load Well log***

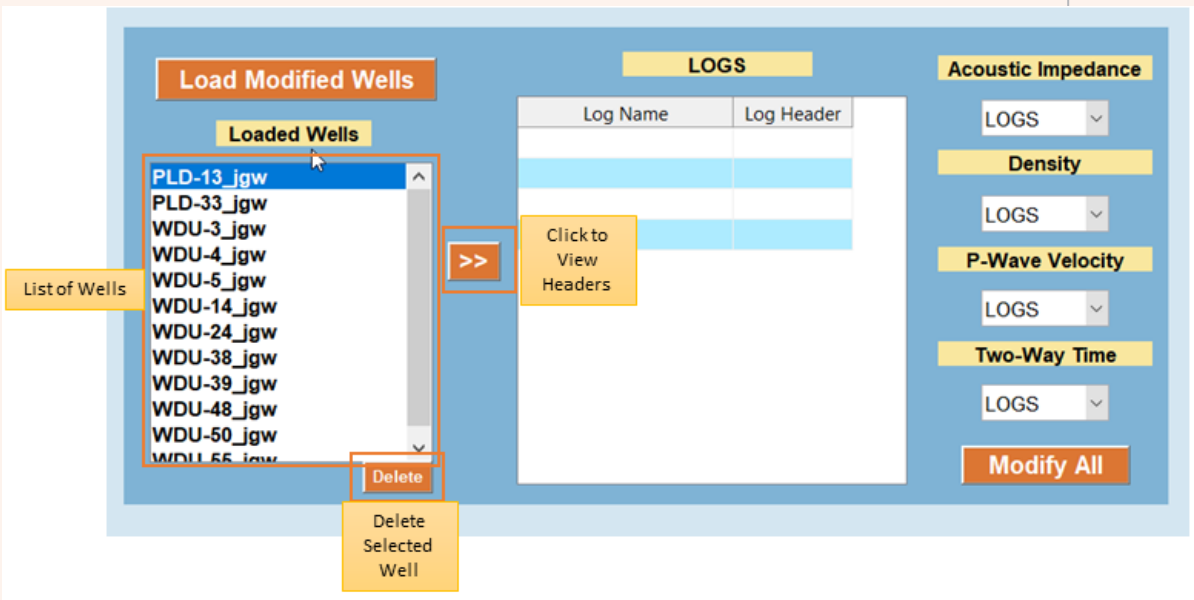


- Choose the appropriate *.las* files and click ***Open*** to load.

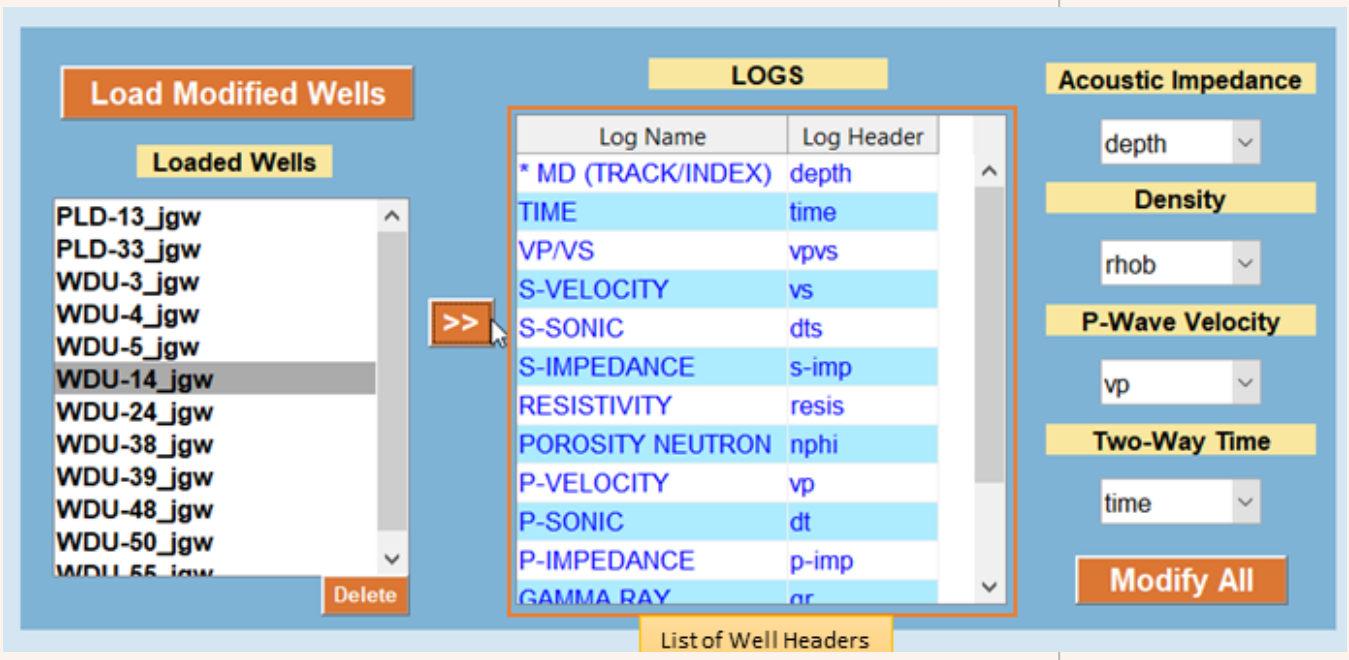


User can select multiple files to be loaded into SLI. All the well logs will be loaded into SLI and the names will appear in the list provided in Well Log Section.

List of wells loaded by the user is shown in the Loaded Wells list. User can delete a specified well by clicking on it and pressing ***Delete*** button.



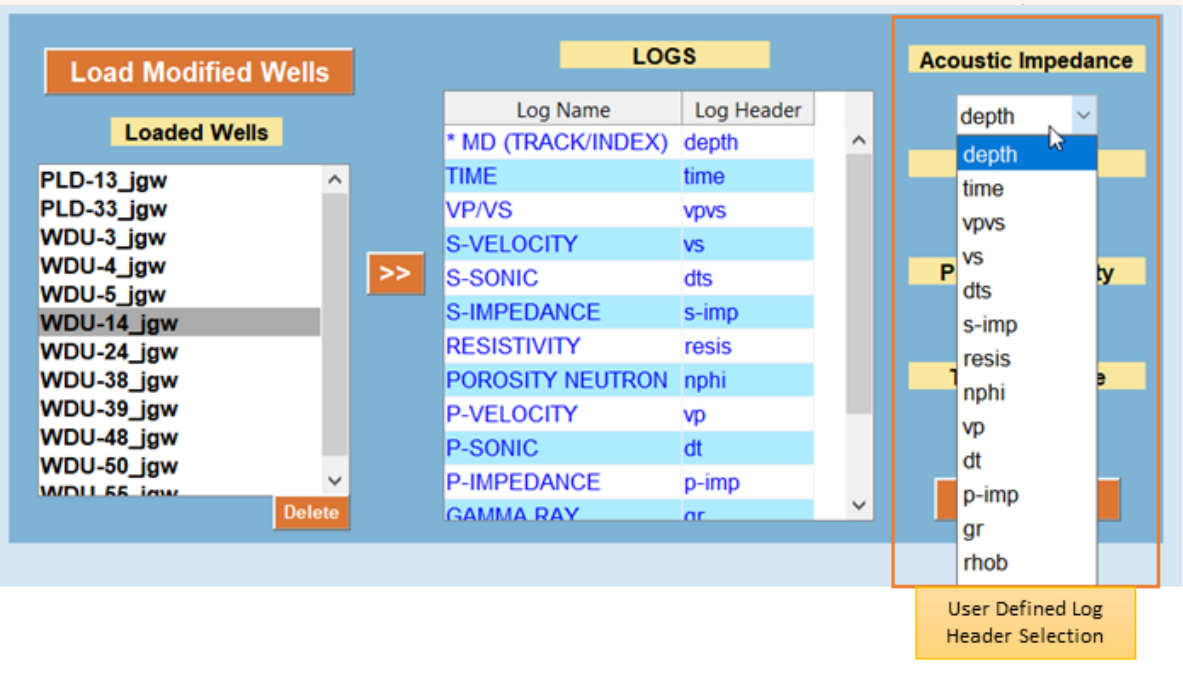
Press the **>>** button to proceed into the log header section. There are certain restrictions on the well headers.



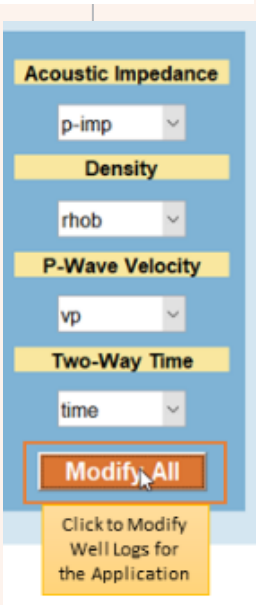
- **<u>Restrictions on Well Header</u>**
  - The wells must correspond to the Seismic data loaded by the user. If the well location doesn't fall in the Seismic data range, error message will be shown regarding out of bound.
  - The wells must have the same header information. Modifying the wells will modify all the headers in the loaded data. If there is a header mismatch, that will lead to a faulty operation.

The required four logs are given as Acoustic Impedance, Density, P-Wave Velocity and Two-way time. User has been given the choice to select these logs manually. If the log header matches the default format,

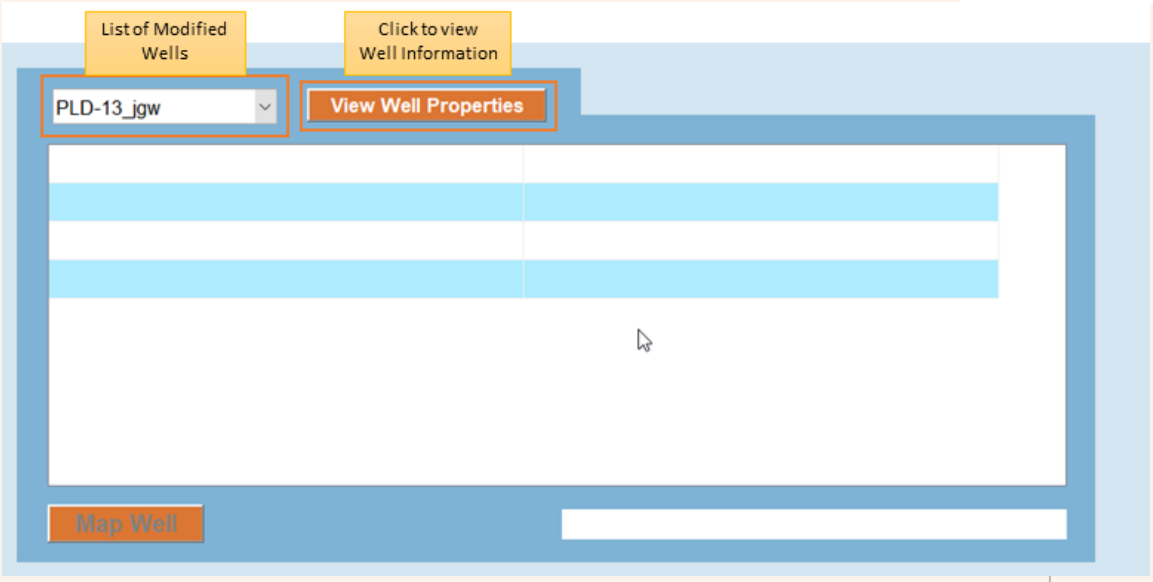
it will appear directly in the required header section. If the header is different, user has to select the appropriate header from the dropdown menu.



- Press the Modify All button to save all these wells in a format that can be used in the further sections of the software.

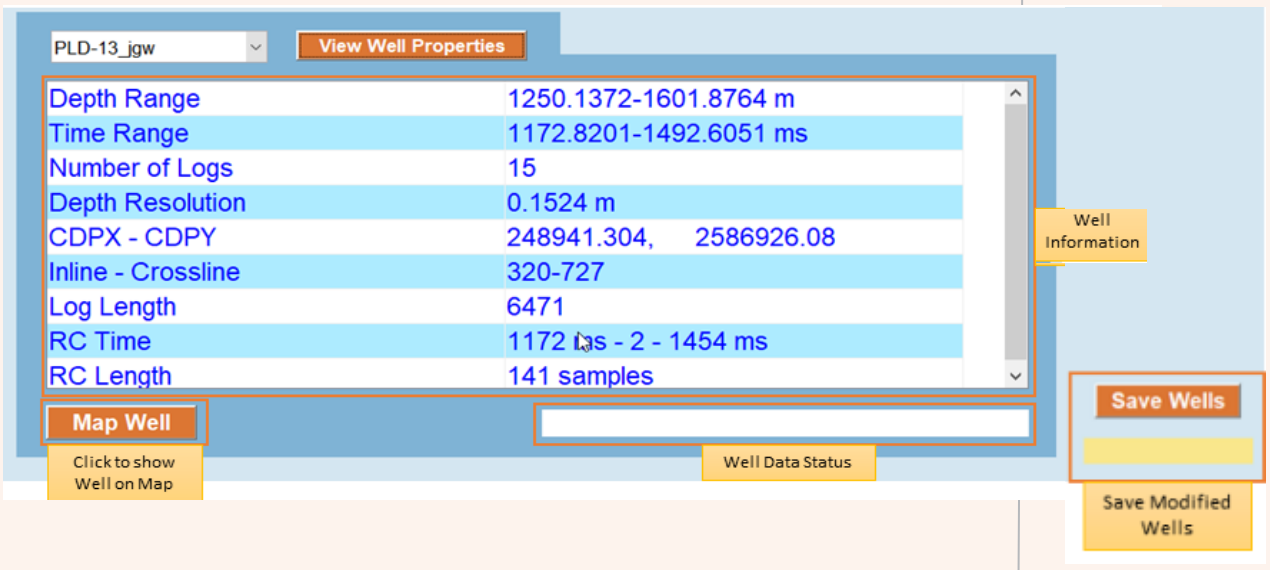


- It creates a structure of all the well files where each well is saved as an object. The Inline and Crossline data of the well is derived and stored according to the preloaded Seismic data.

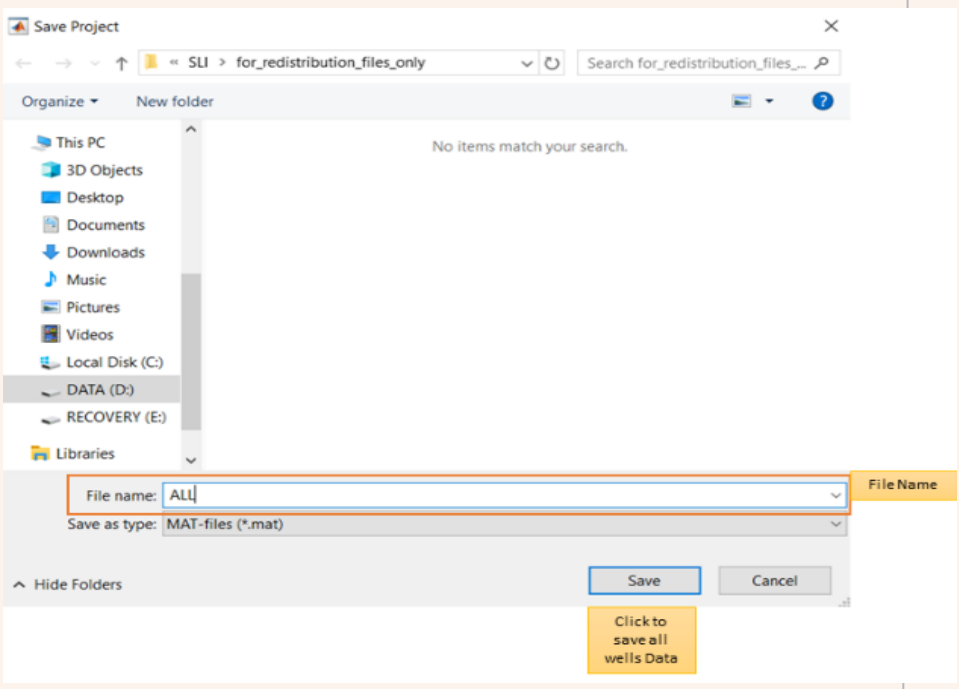


User can check each and every well individually in the well properties section. Select the name of the well from the drop down menu and press ***View Well Properties*** button.

The well properties of the selected well are shown as:

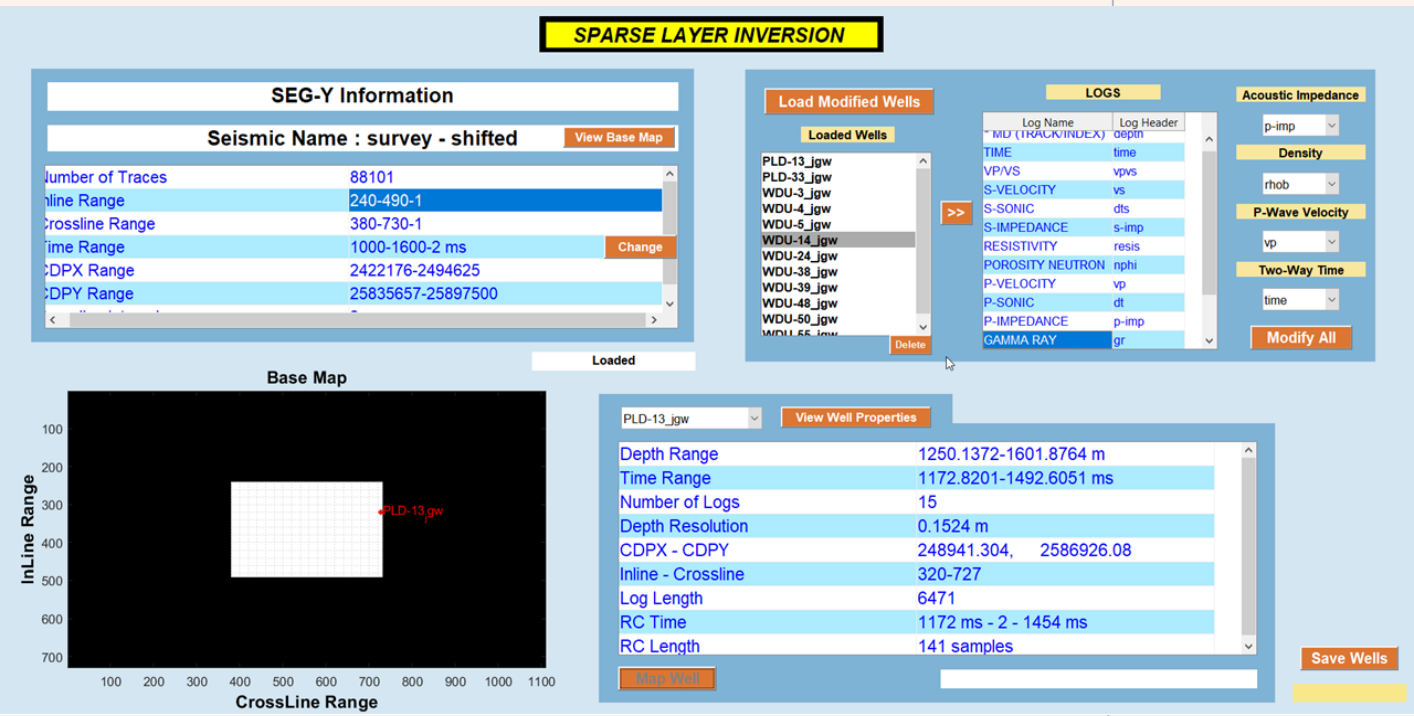


Click on ***Save Wells*** to save all the wells in a *.mat* file. This can be further used in different user interfaces of the software.



- Choose the proper name *.mat* and click ***Save*** to save.

The main window after modifying all the loaded data should look like the following:



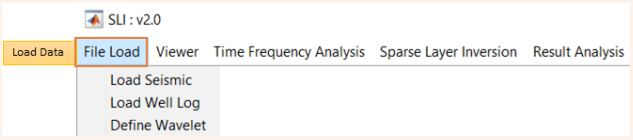
- **Operation Flow**

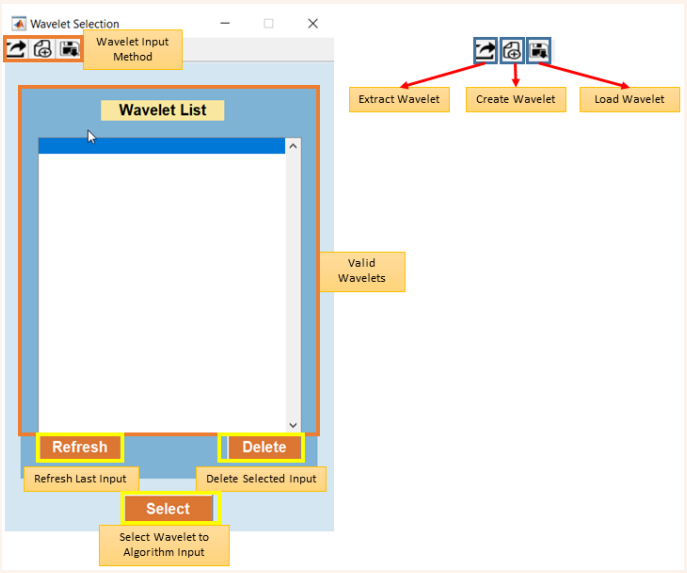
  - User must operate with the workflow mentioned.
  - The wells must only be loaded after the seismic file is completely loaded. Well Inline and crossline locations can't be determined without that.
  - There are two ways to load a certain number of wells to the GUI.
    - Direct loading requires modification of well headers in the modify column.
    - If the user has a modified wells file in .mat format saved from the 'Save Wells' button, there is no need to modify them again after loading them from 'Load Modified Wells'.
  - 'Map Well' must be clicked after the 'View Base Map'. The well shouldn't be displayed before the seismic mapping.
  - Once the 'Map Well' button is used to view the well on seismic, the button is disabled until the user selects another well. This is to avoid the overlapping of the same well on the seismic and click 'View Well Properties'.

1.1 Wavelet Selection Section

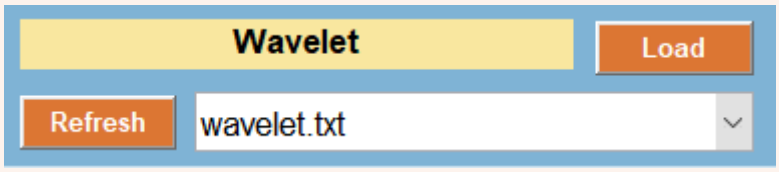
Wavelet selection section is provided in many sections of the GUI. This leads to the wavelet panel where user can extract, create or load a specific wavelet into the GUI. It is provided in the main window in the data load section.

File Load >> Define Wavelet





In other windows, it can be accessed from the following section by clicking on *'Open'.*



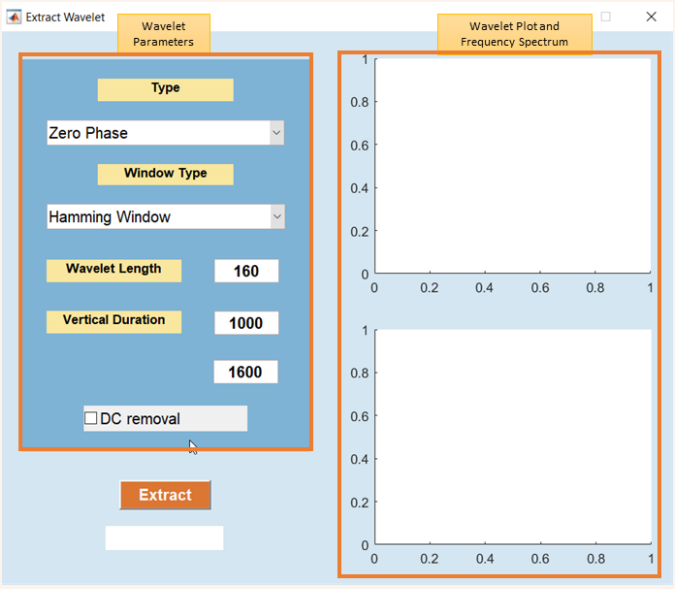
After exporting a wavelet, user needs to click on the refresh button to list the wavelet in the dialog box. The highlighted Wavelet can be deleted by clicking *'Delete'.* There are 3 different ways to add a wavelet to the list.

Wavelet list contains the ORMSBY wavelet (10-20-40-60) Hz as default wavelet from the beginning. User can click on 'Refresh' to see the wavelet from the beginning.

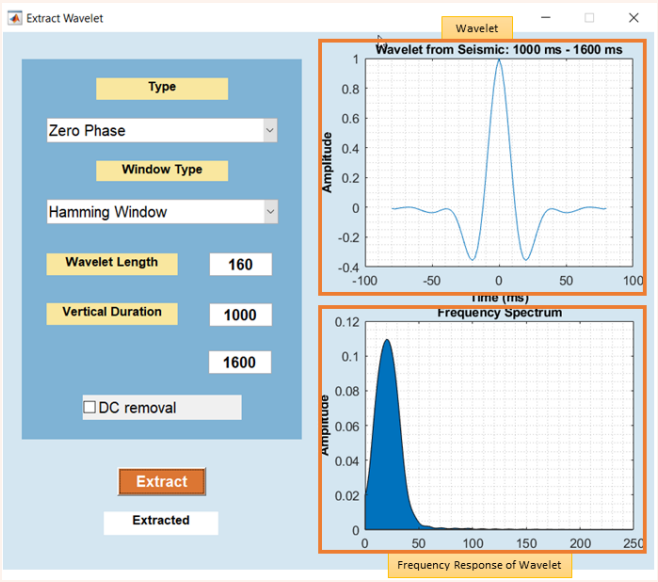
- **Wavelet Section Restrictions**
  - If the user wants to extract wavelet from a seismic section, the seismic section needs to be loaded first. Same restriction doesn't apply to other methods of listing a wavelet.
  - In algorithms section, user needs to highlight the wavelet and click *'Select'* button to feed that wavelet into the inversion system.

- **Extract Wavelet**

This window requires a seismic file to be loaded beforehand. Wavelet can be extracted from a vertical section of the seismic data. Click on the first icon to proceed into this window.



User can choose the extraction parameters and the vertical duration from which the wavelet is to be extracted. Click on *'Extract'* to evaluate the wavelet and the frequency spectrum of the wavelet. It would be plotted in the plot section.

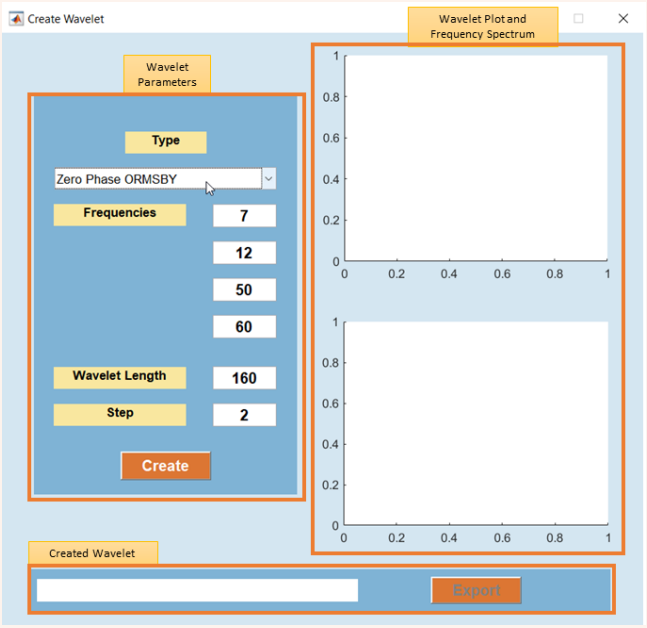


The extracted wavelet will be automatically exported to the wavelet selection window.

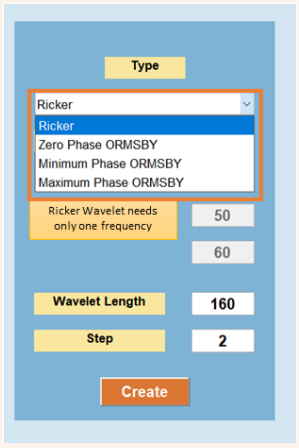
The vertical duration values during opening contain the actual duration the complete seismic data. User needs to see the range and apply ranges that are greater than 1000 and less than 1600 in this case.

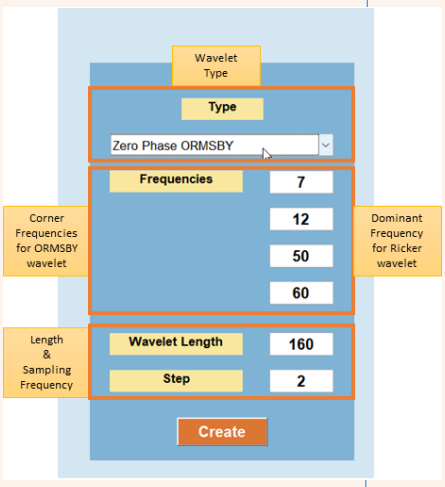
- **Create Wavelet**

This window doesn't require a seismic file to be loaded beforehand. Wavelet can be created by choosing the appropriate parameters of the wavelet.

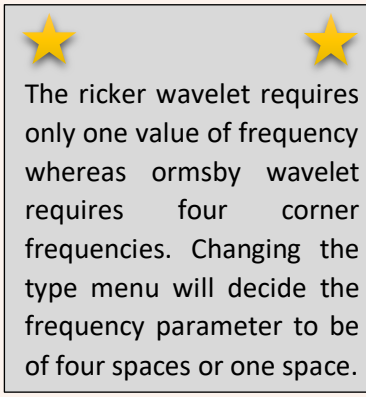


User can choose the wavelet to be ***'Ricker'*** or ***'ORMSBY'*** to change the dominant frequency box to corner frequencies boxes. Ricker wavelet will only require one frequency whereas ORMSBY wavelet will require four frequencies irrespective of the phase.

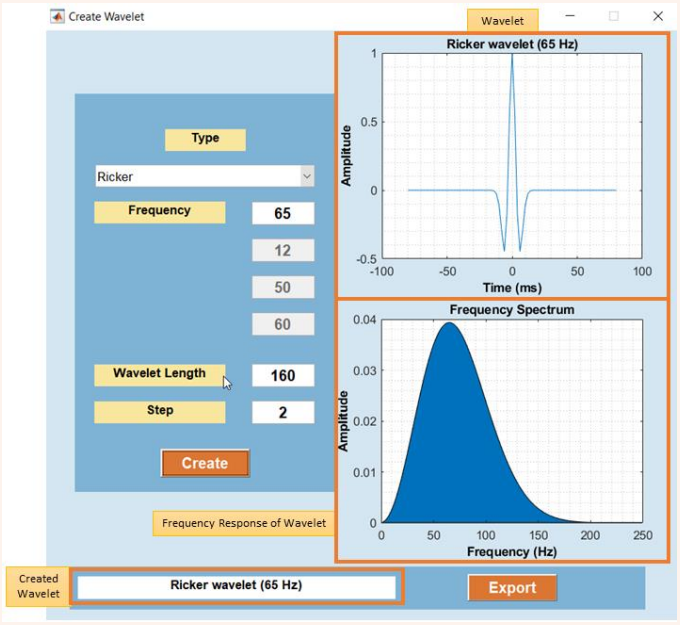




Click on *'Create'* button to plot the wavelet with the frequency spectrum.



The ricker wavelet requires only one value of frequency whereas ormsby wavelet requires four corner frequencies. Changing the type menu will decide the frequency parameter to be of four spaces or one space.

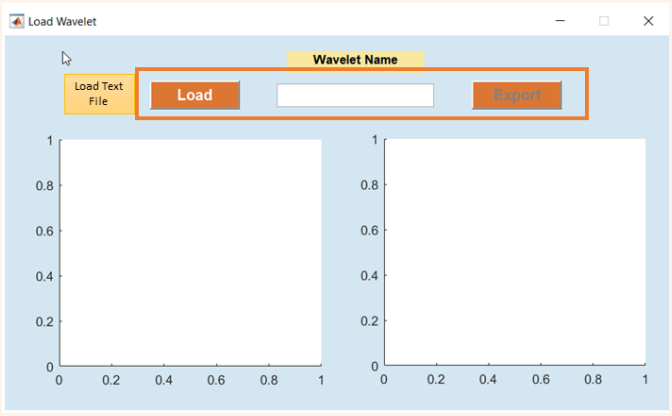


A wavelet can be exported only once. After successful export, this button will be disabled until user creates another wavelet successfully.

Click on *'Export'* to add this wavelet to the main list.

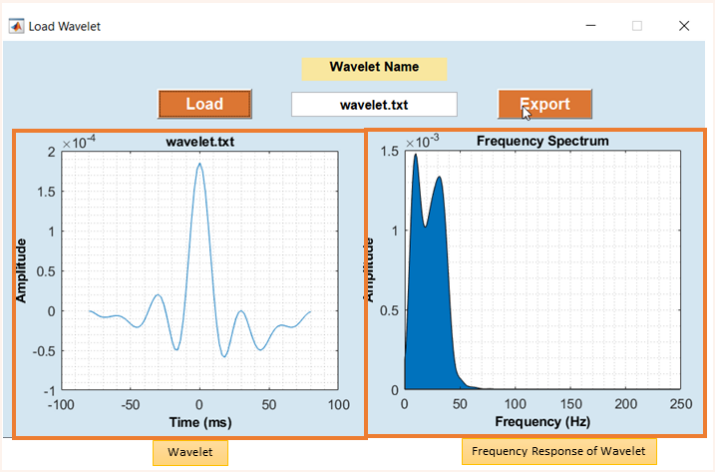
- **Load Wavelet**

This window requires a wavelet in *.txt* format obtained from HRS. It will be directly converted to a valid wavelet and added to the list.

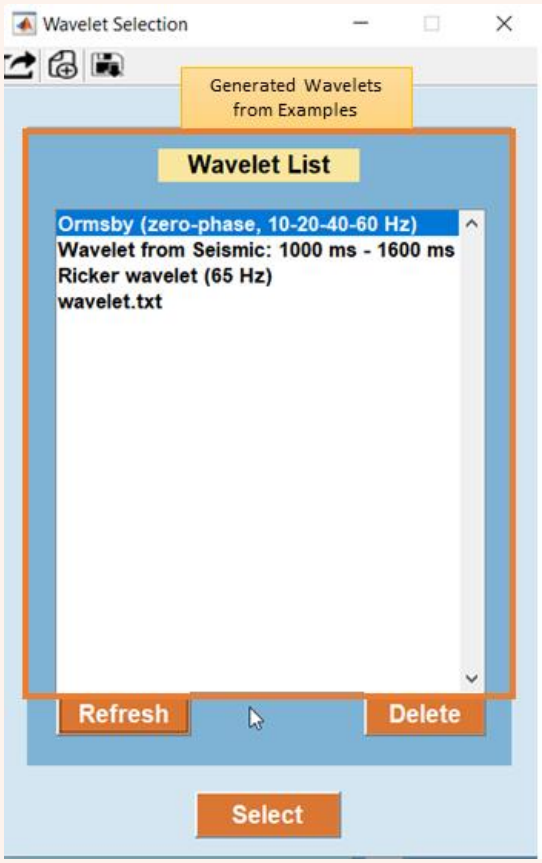


A wavelet can only be loaded if it is obtained from the Hampson-Russell software in *.txt* format

User has to click *'Load'* and choose the text file that contains the wavelet. The Wavelet and frequency spectrum will be plotted in the plot section. Click *'Export'* to add.



After all the wavelets are generated from three different sections. User can go back to the main wavelet window and press the *'Refresh'* button. It will enlist all the wavelets and assure that user can use them in further stages.

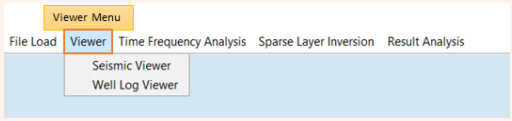


2. Viewer

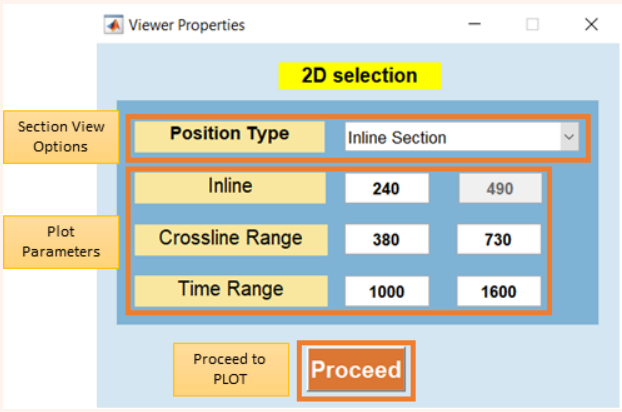
Before proceeding to the viewer section, the user must have loaded the relevant data successfully. Otherwise error message will appear. The well log data can't be loaded directly from las. User must modify the headers in the main window before getting into the viewer.

a. Seismic Data Viewer

User can visualize the loaded seismic data by choosing ***Viewer >> Seismic Viewer.***

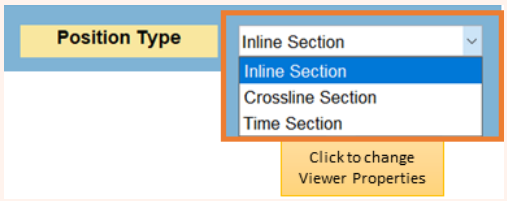


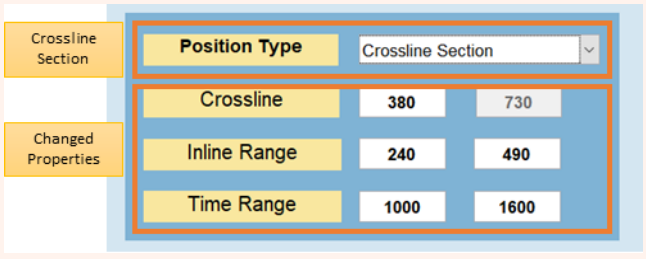
A data selection window will appear prompting the user to select the section. The user can also change the position of viewer from the dropdown menu. The values in the text box are predefined according to the data set for the user to know the range.

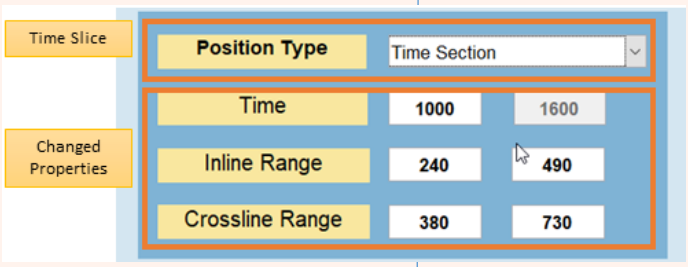


The data selection window opens with the default range of the dataset. User must choose a range between the two values shown. The position value in the first row is set to minimum.

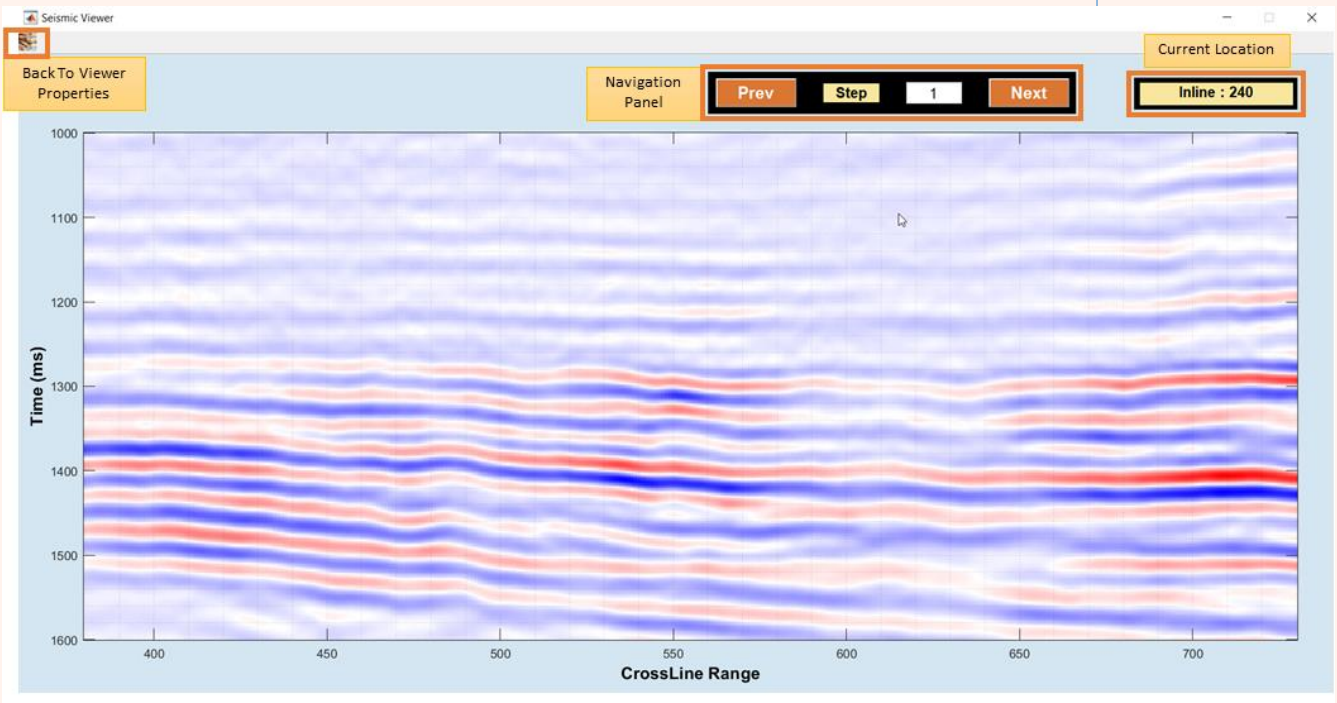
The first parameter is the position index where the viewer will be placed. Second and third parameter defines the range of dataset that the viewer will show at that position. User can change the position to 'Inline', 'Crossline' and 'Time' Section by clicking from the drop down menu.



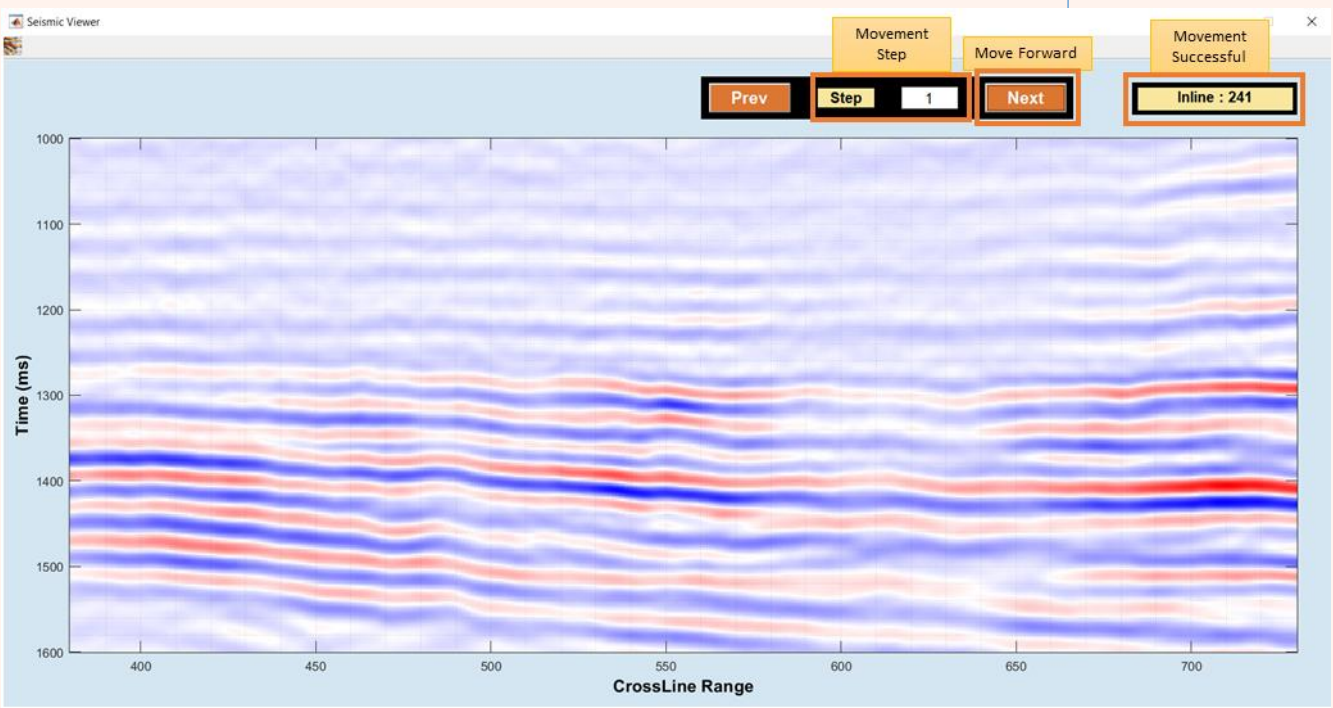




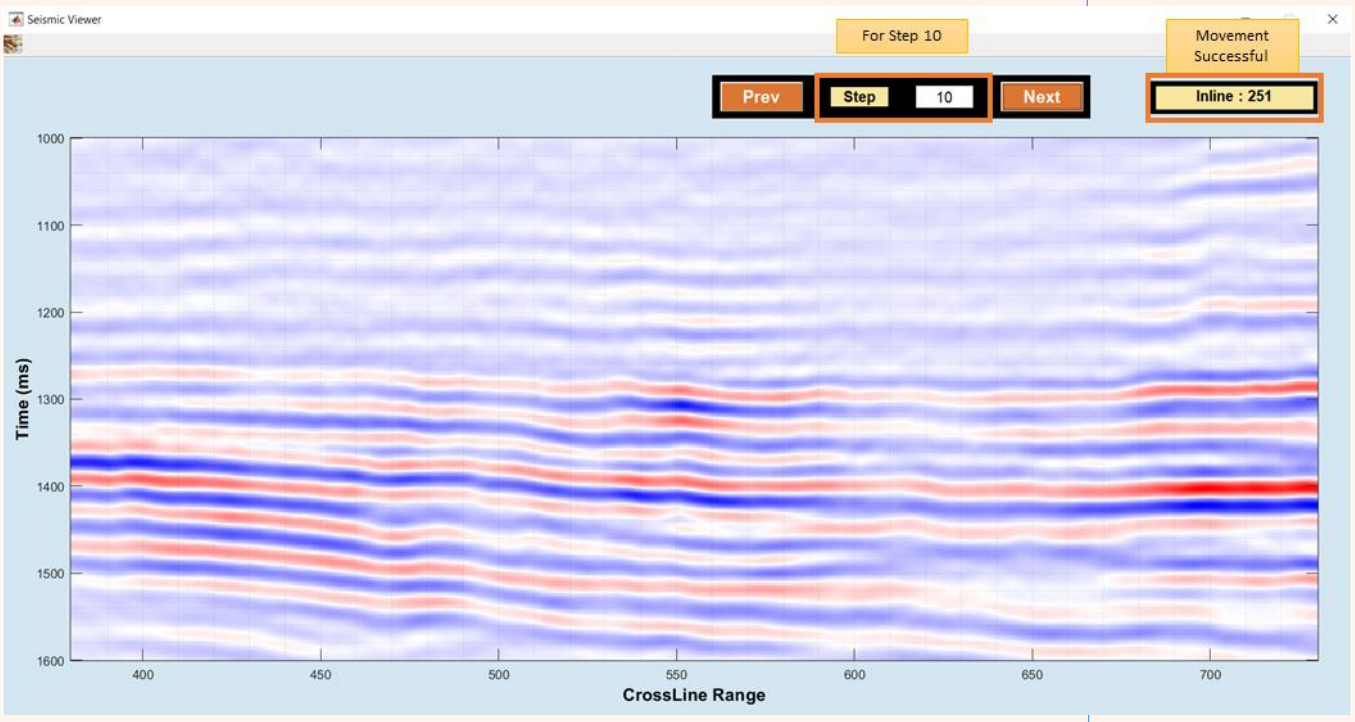
With each selected option, the input properties change. The lower and upper range are already given in the text box. User must provide data in this range. Click Proceed to plot in viewer.



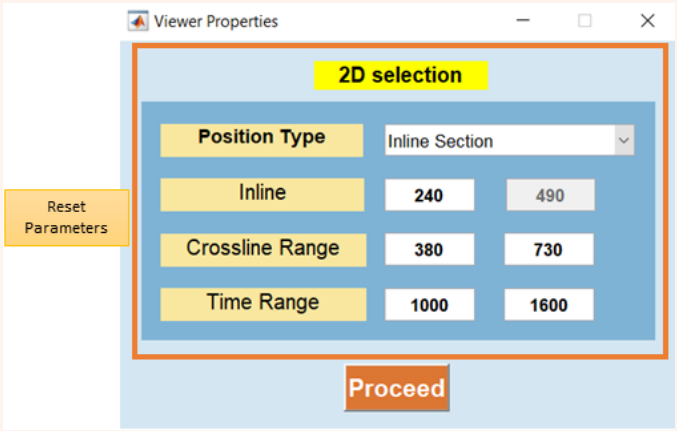
Press Next or Prev for the next or previous section respectively. The step value is set to 1 by default. It will show the immediate following or preceding section to the current data in the viewer.



User can change the step value as per wish. The higher limit of step is the size of dataset. If the user presses Next or Prev outside the data limit, blank data will be shown in the viewer. For a step of 10, the seismic viewer is shown for Next button.



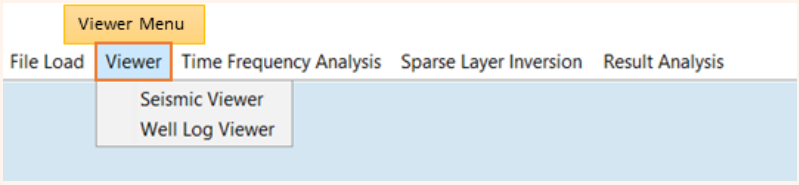
If the user wants to change the viewer data, a seismic icon is provided in the menu bar. Click on the Seismic icon to open the view the 2D selection window. The selection window will appear with initial parameters.



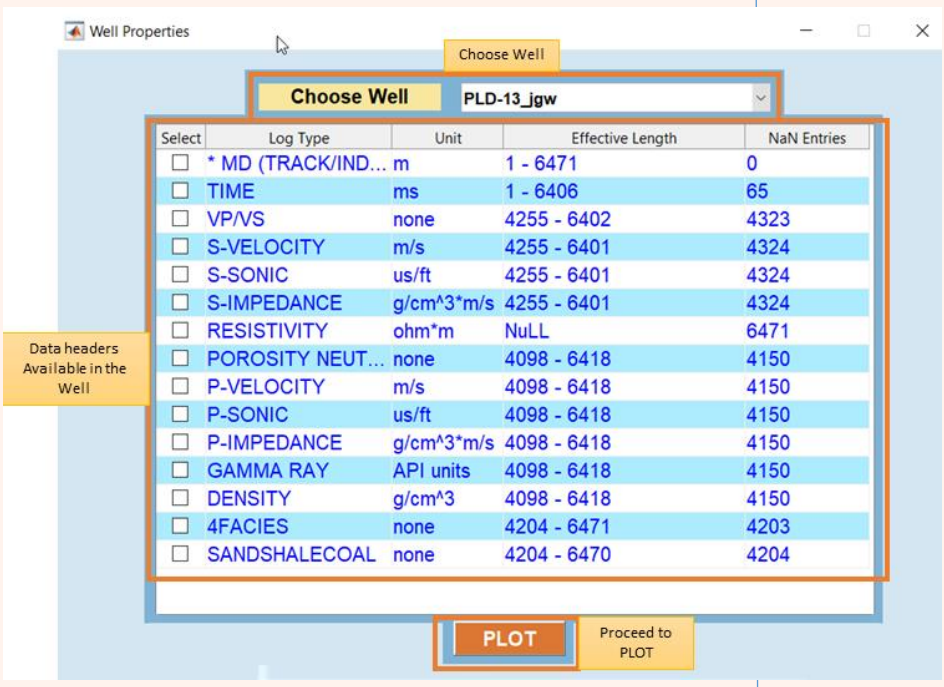
b. Well Log Data Viewer

Before proceeding to the Well data viewer section, the user needs to load the las files and modify all the headers in the main window. If the user has pre-modified well log file consisting of various wells, he can load them directly in the main window and go into the well log viewer section.

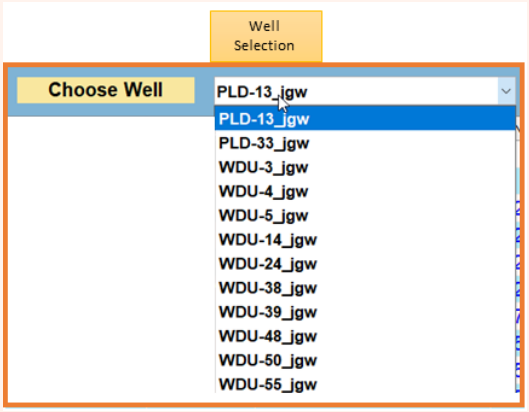
User can visualize the loaded seismic data by choosing ***Viewer >> Well Log Viewer.***

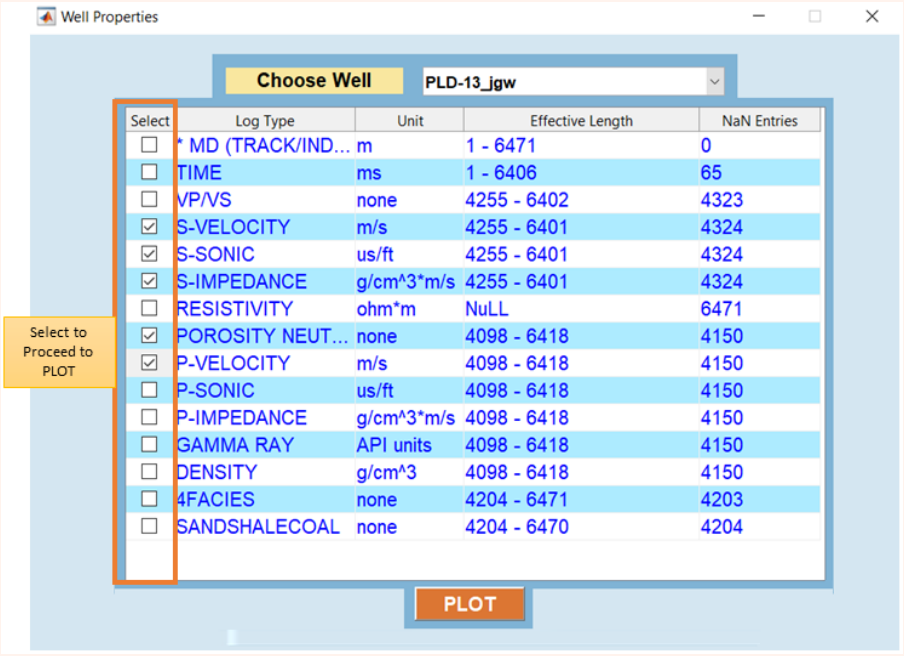


A well selection window will appear consisting all the header data and range. User can select the desired well and the header information will appear.



The other loaded wells can be selected from the dropdown menu as follows.



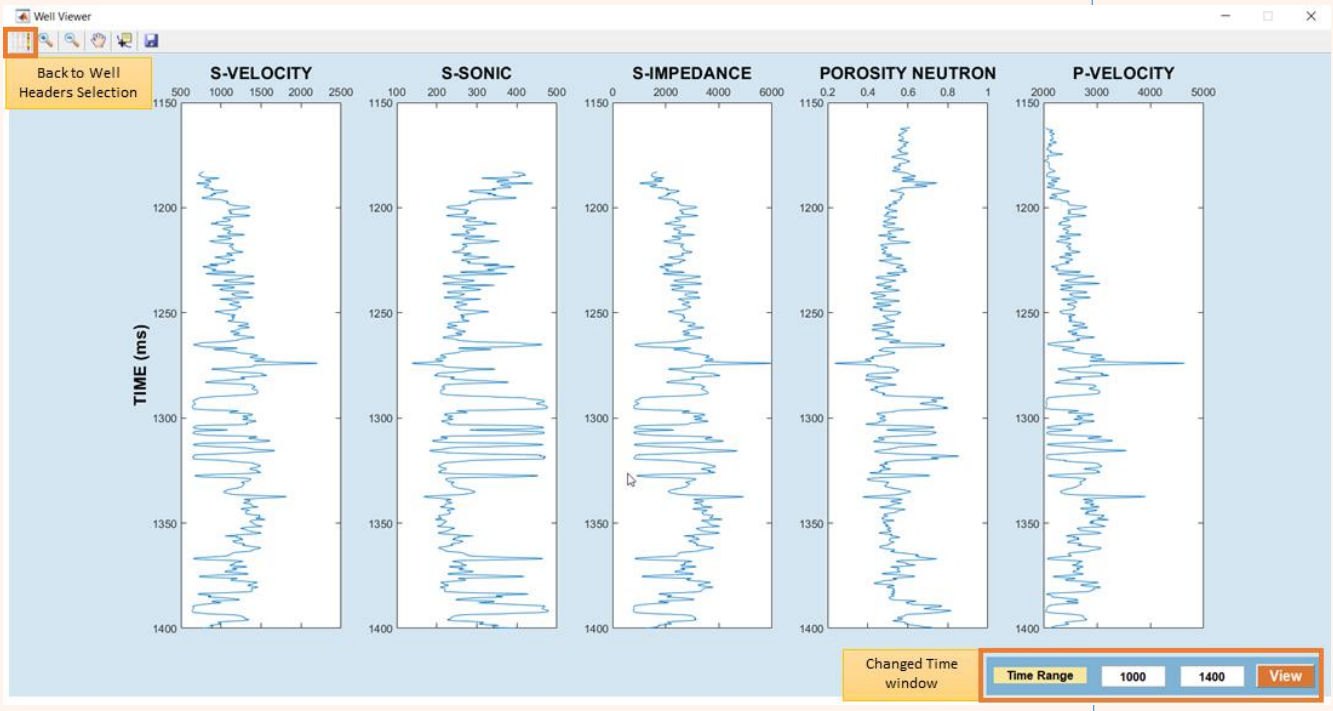


While selecting the well header, user is advised to select the headers with the same effective length. Otherwise the plot would be inconsistent.

After Selecting a number of logs, click PLOT to view all the logs simultaneously.

Initially, the plot will be presented for the entire log. If the user wants to view a specific section, the time range needs to be chosen from the bottom. Range of data is shown in the textbox below. User needs to give time range and click View to show the Desired Plot.

While selecting the well header, user is advised to select the headers with the same effective length. Otherwise the plot would be inconsistent.



- **<u>Time Window Changes</u>**
  - User can zoom in all windows simultaneously by choosing a time range shown in the bottom right section.
  - If the plot section is inconsistent, user needs to put a value that satisfies all the data ranges to have a consistent plot.

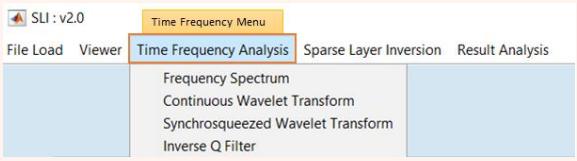
3. Time-Frequency Analysis

Before proceeding to the time-frequency section, the user must have loaded the seismic data successfully. Otherwise error message will appear.

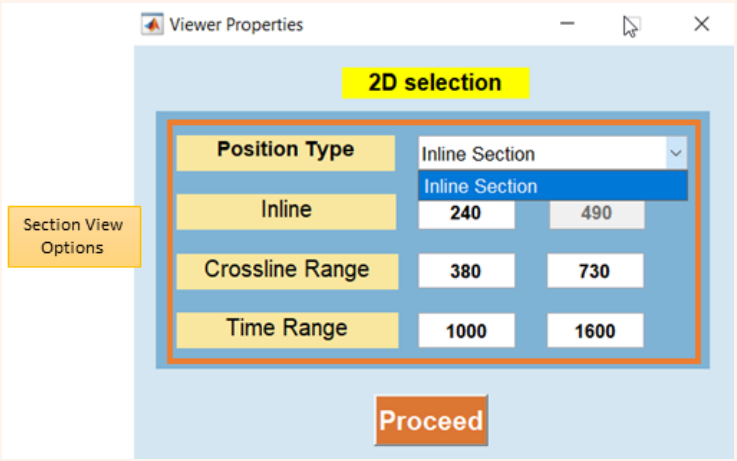
a. Fourier Spectrum

User can visualize the frequency spectrum of loaded seismic data by choosing

Time Frequency Analysis >> Frequency Spectrum.



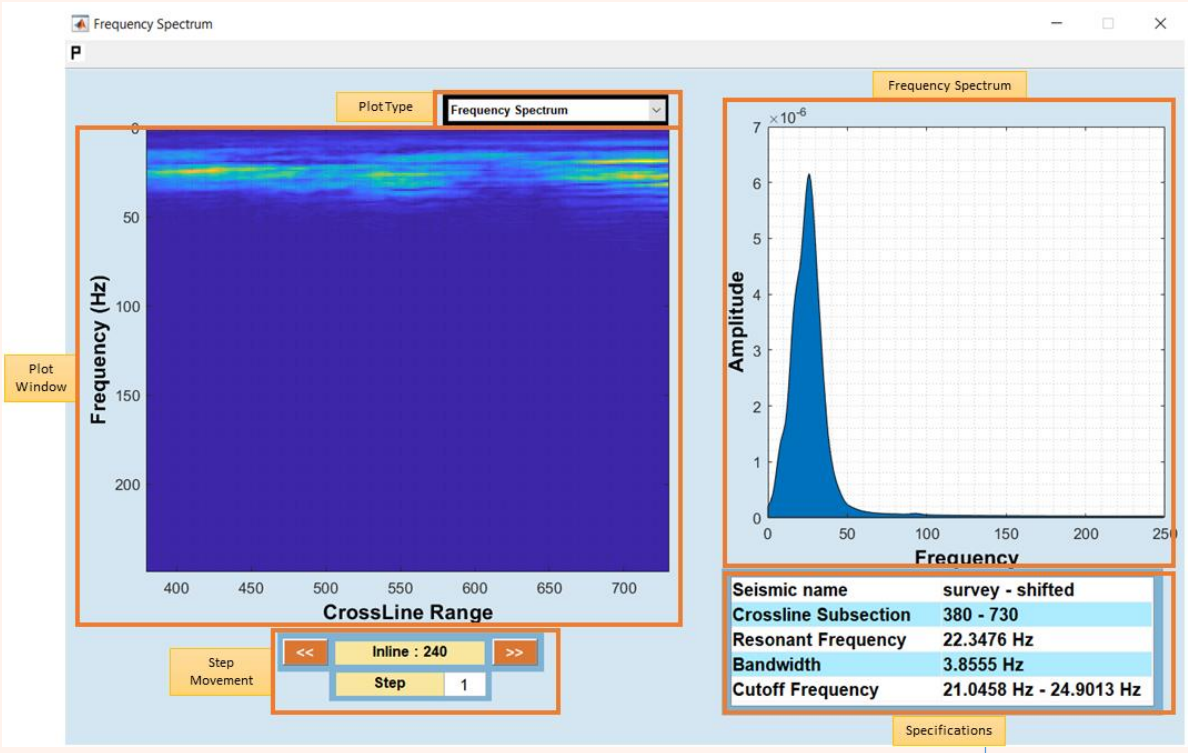
A data selection window will appear prompting the user to select the section. The user can also change the position of viewer from the dropdown menu. The values in the text box are predefined according to the data set for the user to know the range.



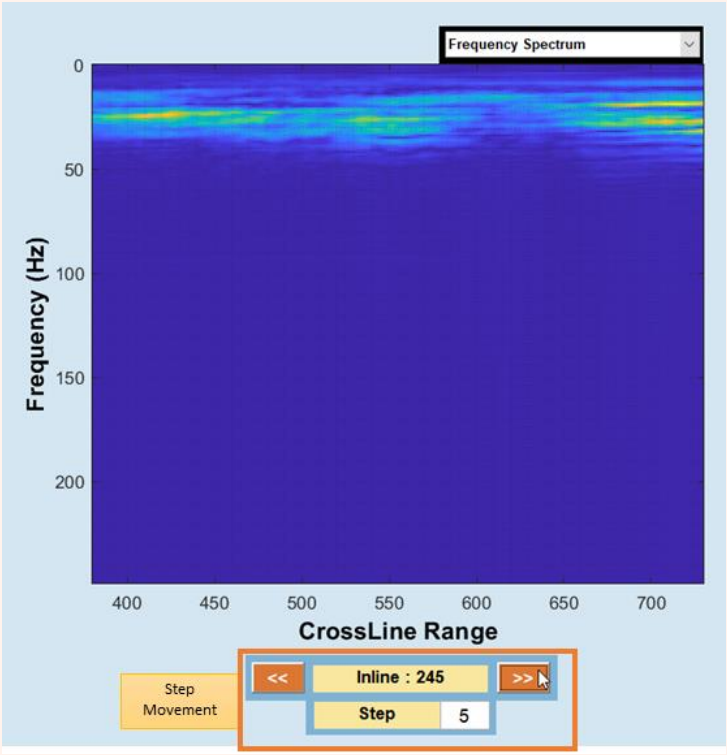
The position is set to Inline Section only. User can only select the Crossline range and the Time Range. Click *'Proceed'* to evaluate the frequency spectrum of the selected section.

User can only select the crossline and time ranges in this data selection window. All the inline sections in the given range would be given to the inversion.

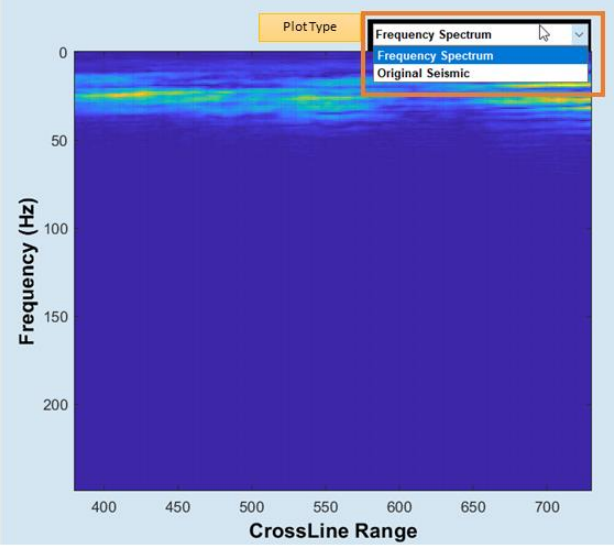
- **Frequency Response Parameters**
  - FFT (Fast Fourier Transform) is used to determine the frequency spectrum of the loaded seismic data. This method determines all the frequency components under the nyquist frequency range.

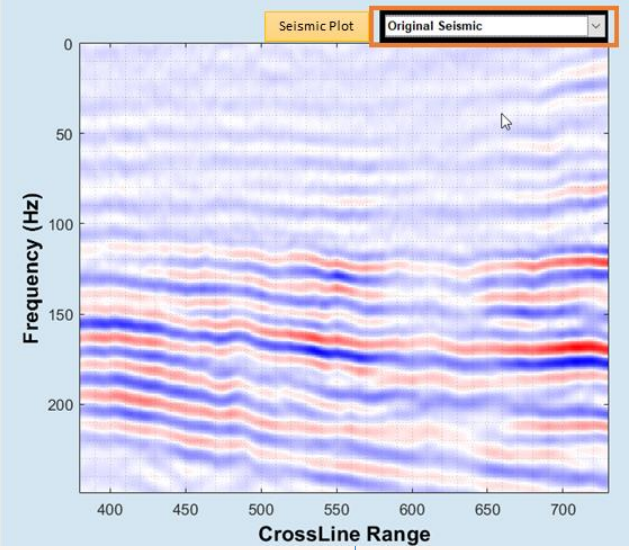


The user can choose the step value and click *'<<' or '>>'* buttons to view the subsequent sections.



The plot type can be set from the top menu. User can visualize the frequency spectrum or the original seismic corresponding to that frequency spectrum by clicking on *'Original Seismic'* from the dropdown menu.





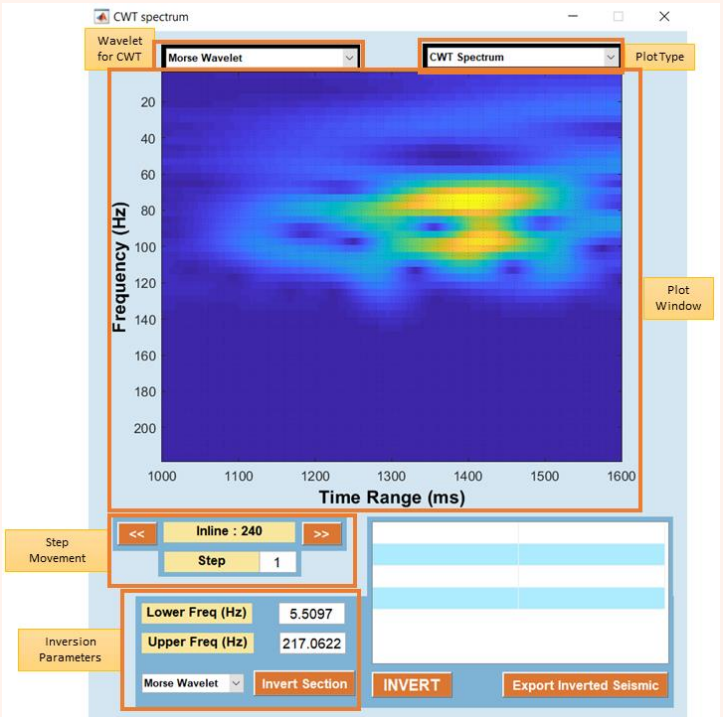
The frequency domain specifications after FFT is given in the specifications tab as presented in the bottom left corner.

b. Continuous Wavelet Transform

User can visualize the frequency spectrum of loaded seismic data by choosing

Time Frequency Analysis >> Continuous Wavelet Transform.

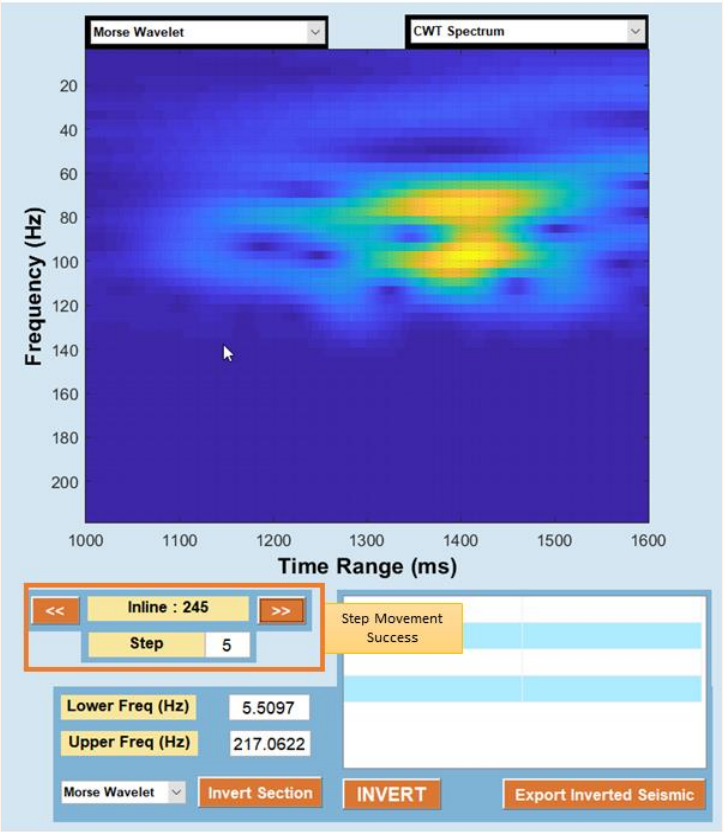
A data selection window will appear prompting the user to select the section as in Fig. 3(b). The user can also change the position of viewer from the dropdown menu. The values in the text box are predefined according to the data set for the user to know the range. The position is set to Inline Section only. User can only select the Crossline range and the Time Range. Click *'Proceed'* to evaluate the CWT of the selected section.



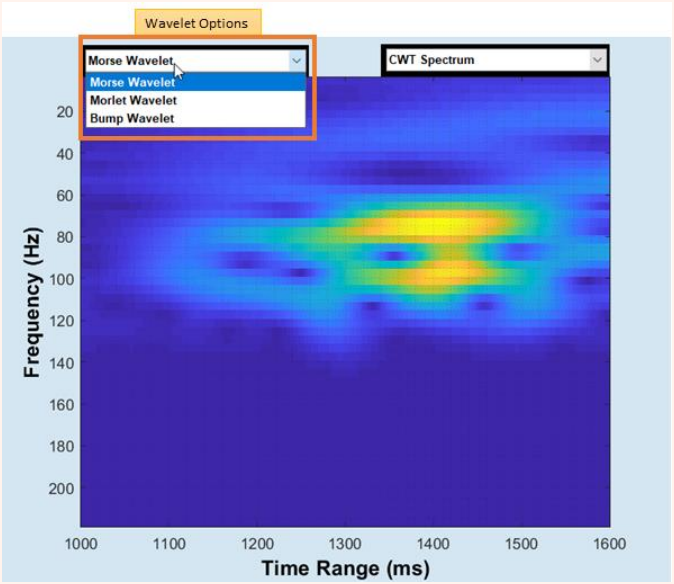
The available wavelets for CWT are

- Morse
- Morlet
- Bump

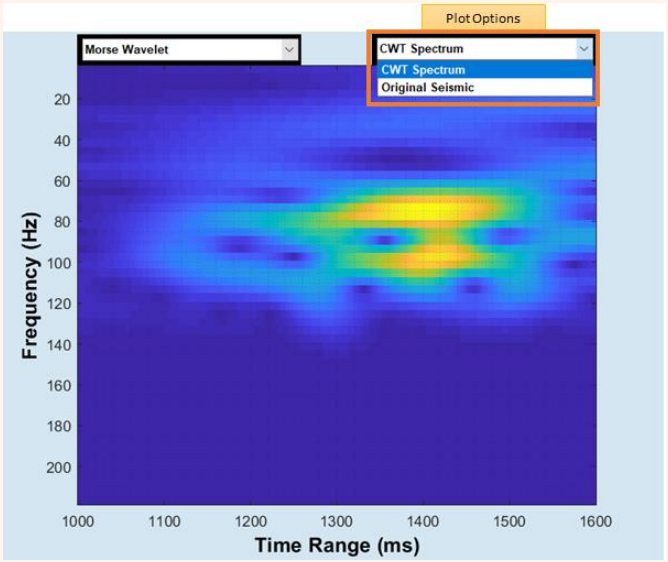
The user can choose the step value and click *'<<' or '>>'* buttons to view the subsequent sections.

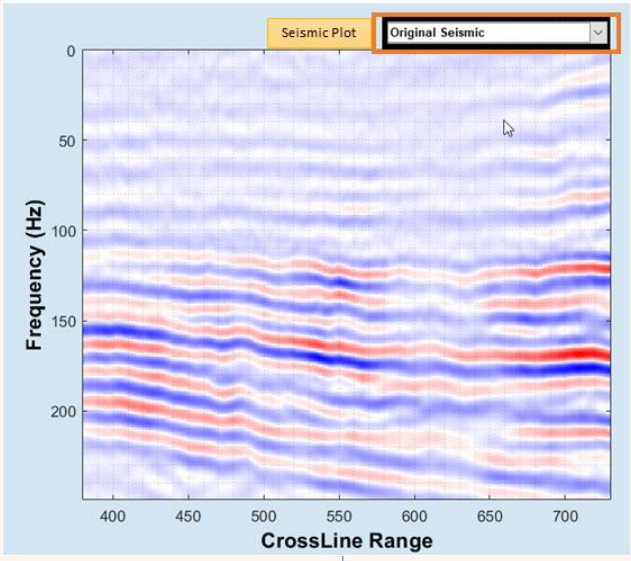


The user can choose the wavelet for CWT from the dropdown menu provided at the top left corner of the plot. The default wavelet estimated at initial is the Morse Wavelet.

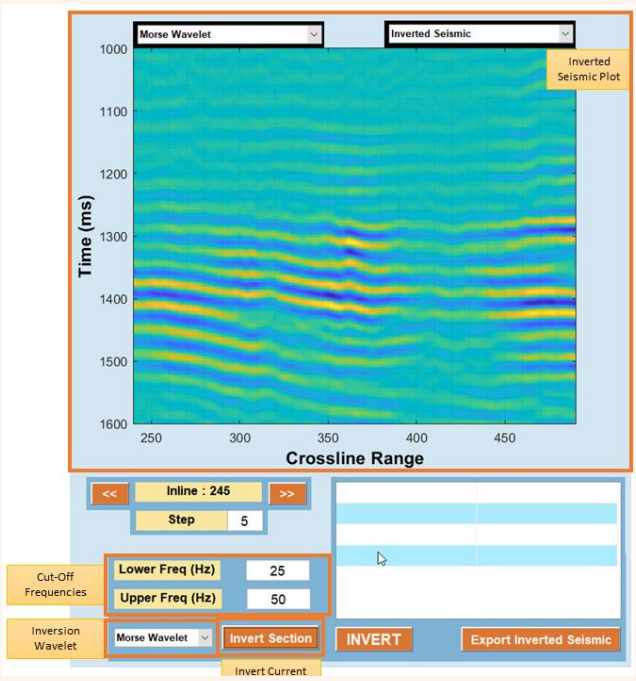


The plot type can be set from the top menu. User can visualize the frequency spectrum or the original seismic corresponding to that frequency spectrum by clicking on *'Original Seismic'* from the dropdown menu.





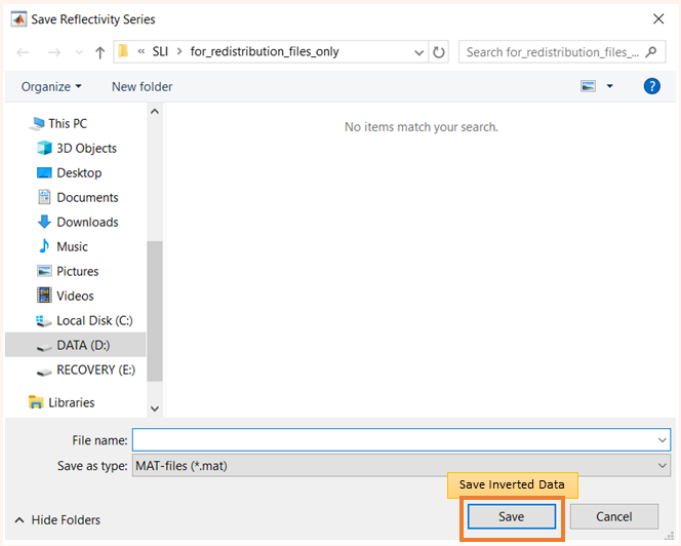
CWT inversion can be performed by inverting the CWT spectrum within a defined frequency range and a specific wavelet. User needs to give two frequency spectrums and a wavelet type from the dropdown menu as input. To invert the section shown in the plot box, click on *'Invert Section'*. The plot type will change to Inverted Seismic and the result will be displayed.



If the inversion is satisfactory, user can go for complete inversion of the volume by clicking on the *'INVERT'* button. After the inversion is complete, the specifications of the inverted data will appear in the bottom left section.

The frequency range of CWT is shown in the Frequency boxes. User needs to select a frequency range between these two values and click 'Invert Section' to check the inversion result first and compare with the original seismic.

After complete inversion of data, user can save the inverted section by clicking on the *'Export Inverted Seismic'* button. It will be saved in .mat format which can be converted to SEGY format in the Results Analysis section.

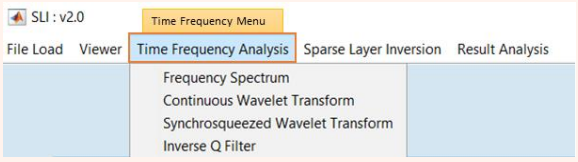


Click on 'INVERT' will begin the CWT inversion for the complete section. User has the option to change the wavelet of inversion rather than inverting with the same wavelet.

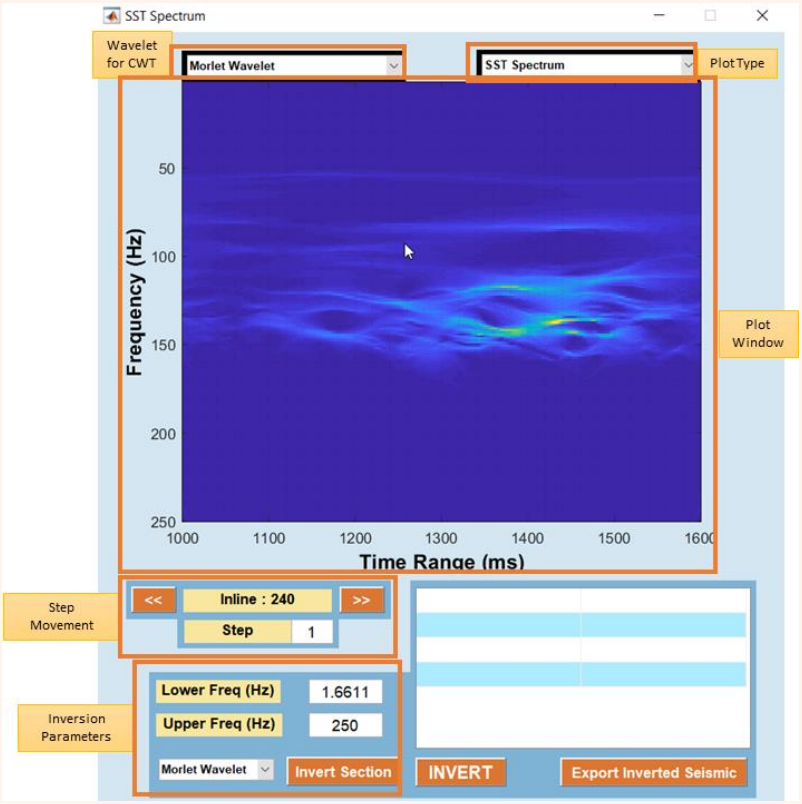
c. Synchro-squeezed Wavelet Transform

User can visualize the frequency spectrum of loaded seismic data by choosing

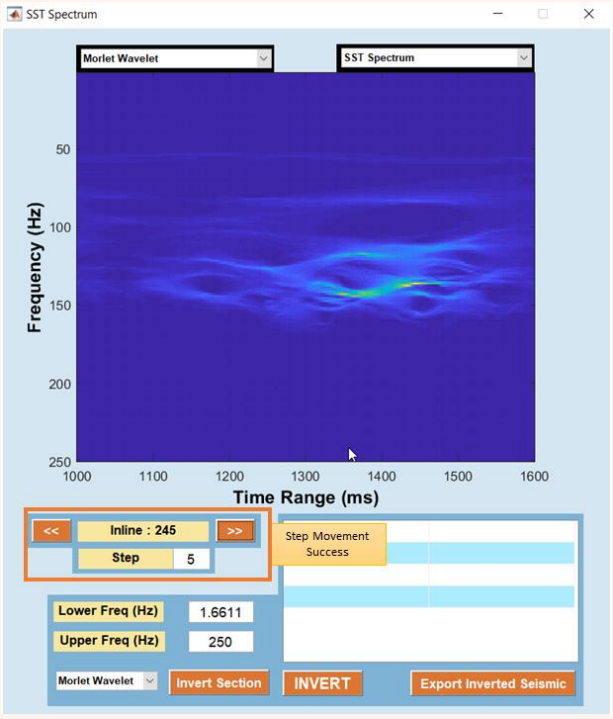
Time Frequency Analysis >> Synchro-squeezed Wavelet Transform.



A data selection window will appear prompting the user to select the section as in Fig. 3(b). The user can also change the position of viewer from the dropdown menu. The values in the text box are predefined according to the data set for the user to know the range. The position is set to Inline Section only. User can only select the Crossline range and the Time Range. Click *'Proceed'* to evaluate the SST of the selected section.

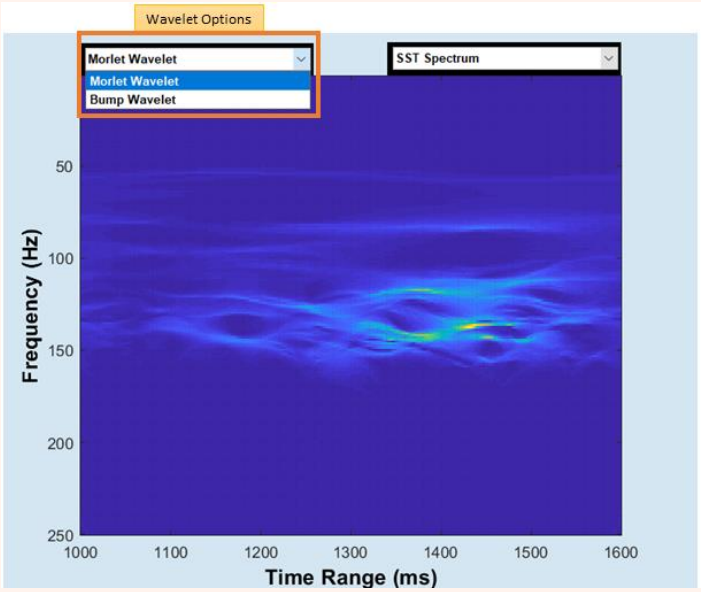


The user can choose the step value and click *'<<' or '>>'* buttons to view the subsequent sections.

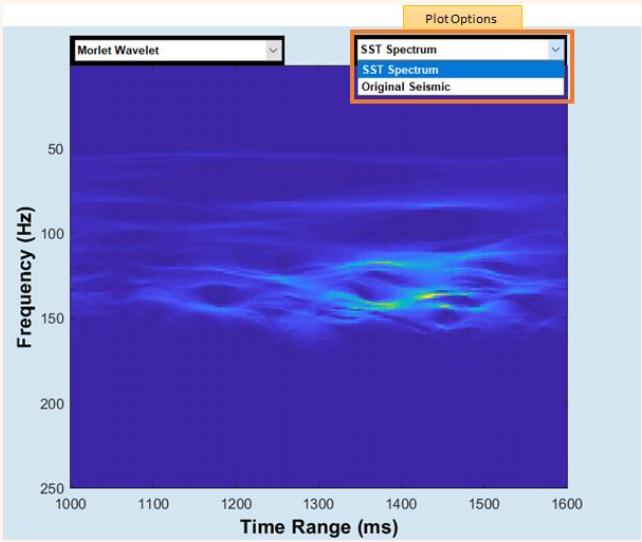


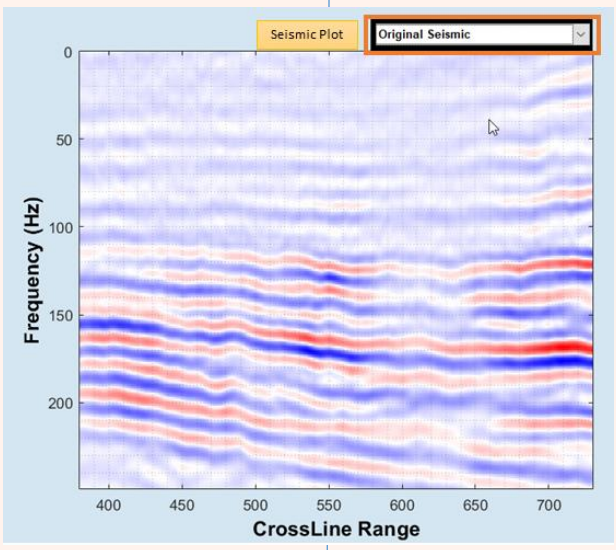
The operation of SST is same as that of CWT. The only difference is that Morse wavelet isn't available for SST or SST inversion.

The user can choose the wavelet for SST from the dropdown menu provided at the top left corner of the plot. The default wavelet estimated at initial is the Morse Wavelet.

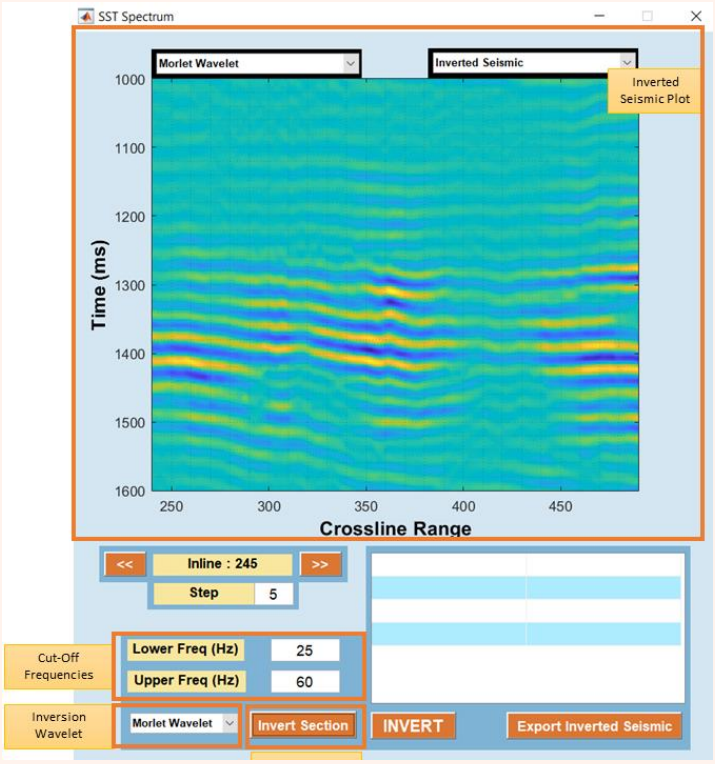


The plot type can be set from the top menu. User can visualize the frequency spectrum or the original seismic corresponding to that SST spectrum by clicking on *'Original Seismic'* from the dropdown menu.

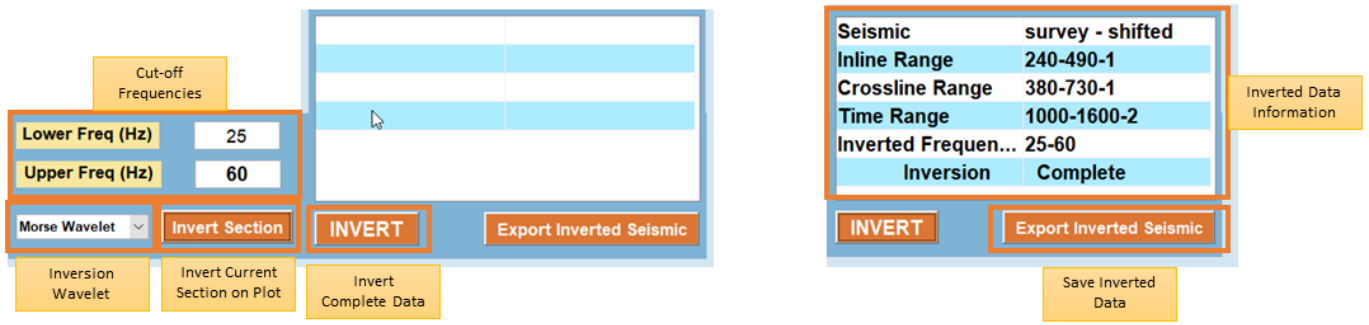




SWT inversion can be performed by inverting the SST spectrum within a defined frequency range and a specific wavelet. User needs to give two frequency spectrums and a wavelet type from the dropdown menu as input. To invert the section shown in the plot box, click on *'Invert Section'*. The plot type will change to Inverted Seismic and the result will be displayed.



If the inversion is satisfactory, user can go for complete inversion of the volume by clicking on the *'INVERT'* button. After the inversion is complete, the specifications of the inverted data will appear in the bottom left section.



After complete inversion of data, user can save the inverted section by clicking on the *'Export Inverted Seismic'* button. It will be saved in .mat format which can be converted to SEGY format in the Results Analysis section.

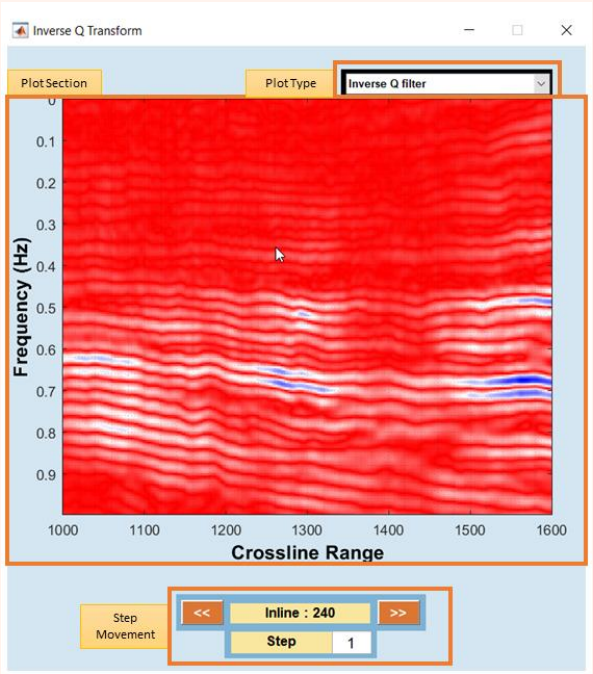
- **Inverted Dataset Analysis**
  - The inverted dataset obtained from these sections are different from that of algorithms section. This is complete seismic data. No wavelet is required to be convolved into this dataset for seismic export.
  - This inverted data should be saved in .mat format and in the export section, it should be converted to SEGY directly.

d. Inverse Q Filter

User can visualize the frequency spectrum of loaded seismic data by choosing

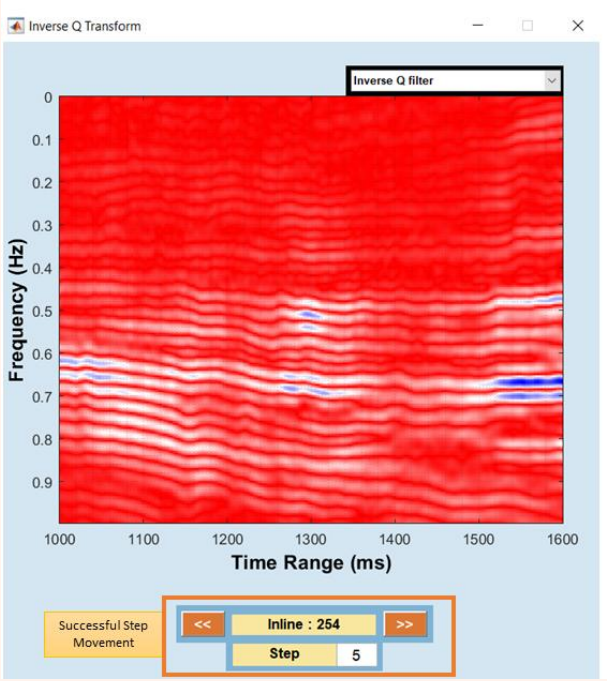
Time Frequency Analysis >> Inverse Q Filter.

A data selection window will appear prompting the user to select the section as in Fig. 3(b). The user can also change the position of viewer from the dropdown menu. The values in the text box are predefined according to the data set for the user to know the range. The position is set to Inline Section only. User can only select the Crossline range and the Time Range. Click *'Proceed'* to evaluate the inverse Q transform of the selected section.

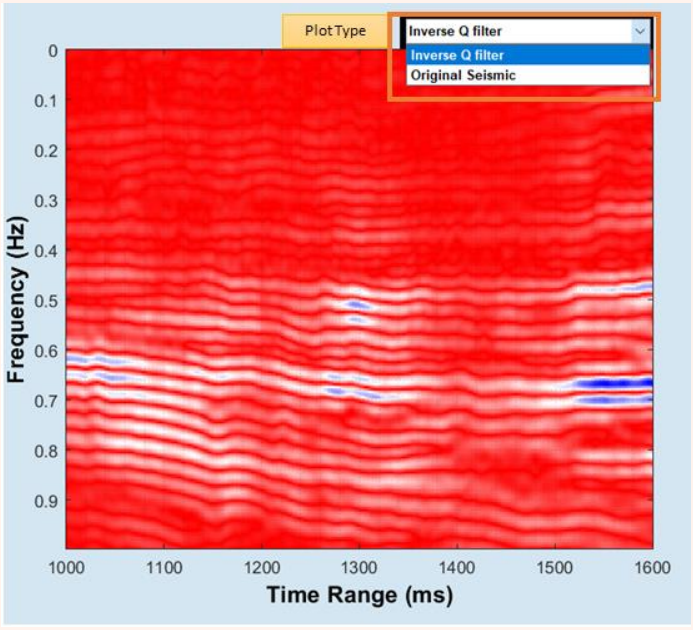


- **<u>Unsatisfactory Algorithm</u>**
  - This is the only algorithm that doesn't give satisfactory results and hence the inverted dataset is unavailable for SEGY export.
  - It will be investigated further and added to the software in future versions.

The user can choose the step value and click *'<<' or '>>'* buttons to view the subsequent sections.



The plot type can be set from the top menu. User can visualize the frequency spectrum or the original seismic corresponding to that SST spectrum by clicking on *'Original Seismic'* from the dropdown menu.

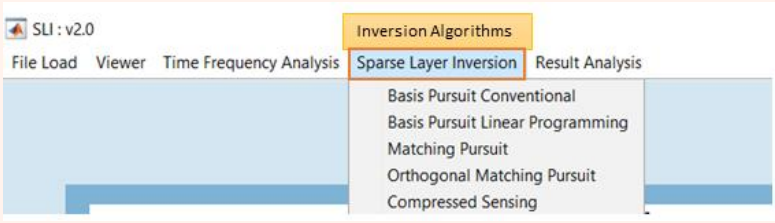


4. Algorithms

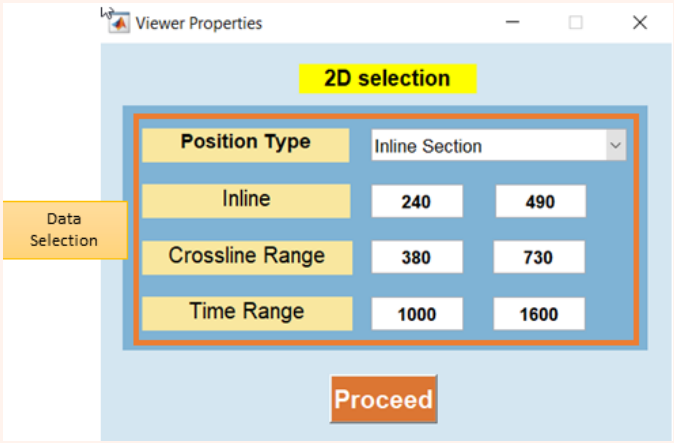
Before proceeding to the viewer section, the user must have loaded the relevant data successfully. Otherwise error message will appear. The well log data can't be loaded directly from las. User must modify the headers in the main window before getting into the viewer.

a. Data Selection

User has to select an algorithm from the list given below.

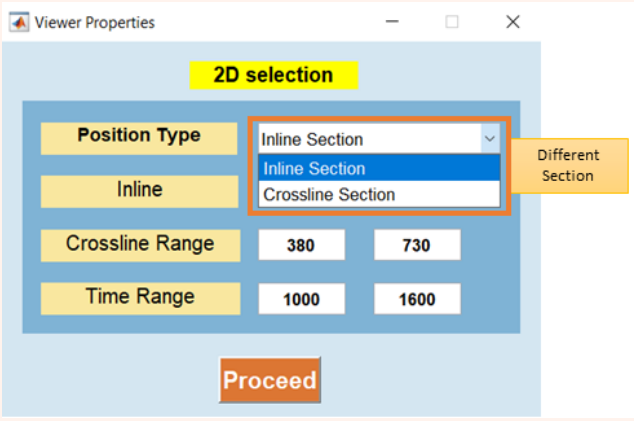


After selecting the algorithm of inversion, a data selection window will appear with specified inline and crossline ranges according to the data loaded in the main window.



User has the option to choose Inline or Crossline Section. All the data ranges of the seismic are given in the edit boxes

User can change the position of dataset by clicking on the dropdown menu. All the ranges of the dataset are shown in the edit-box.



After selecting the data range, click on *'Proceed'* to go into the algorithm page.

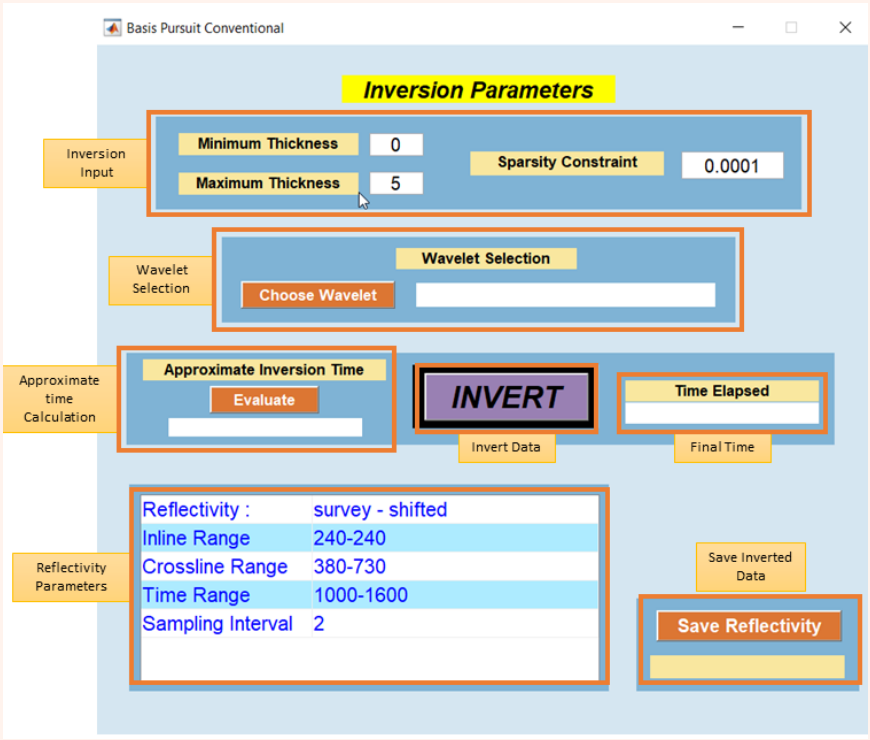
b. Algorithms

Each algorithm page consists of different sections.

- Algorithm Parameters Section
- Wavelet Selection Section
- Inversion Section
- Reflectivity Export Section

Only algorithm parameters section is different for all the algorithms. Other sections of inversion remain the same. In the manual, the Wavelet Selection Section, Inversion Section and Reflectivity Export Section will be explained for the conventional Basis Pursuit algorithm only.

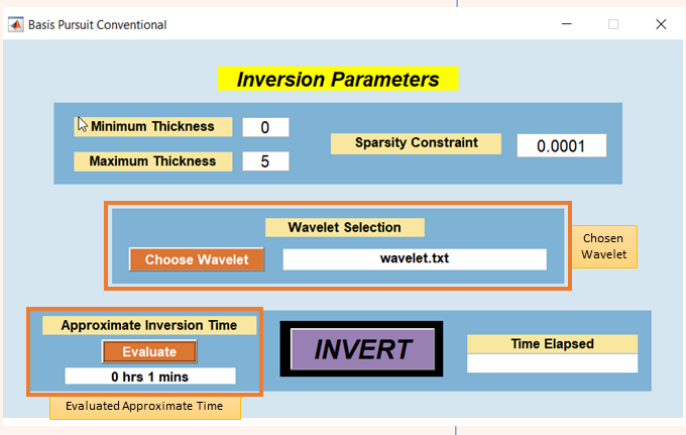
A. Basis Pursuit Conventional



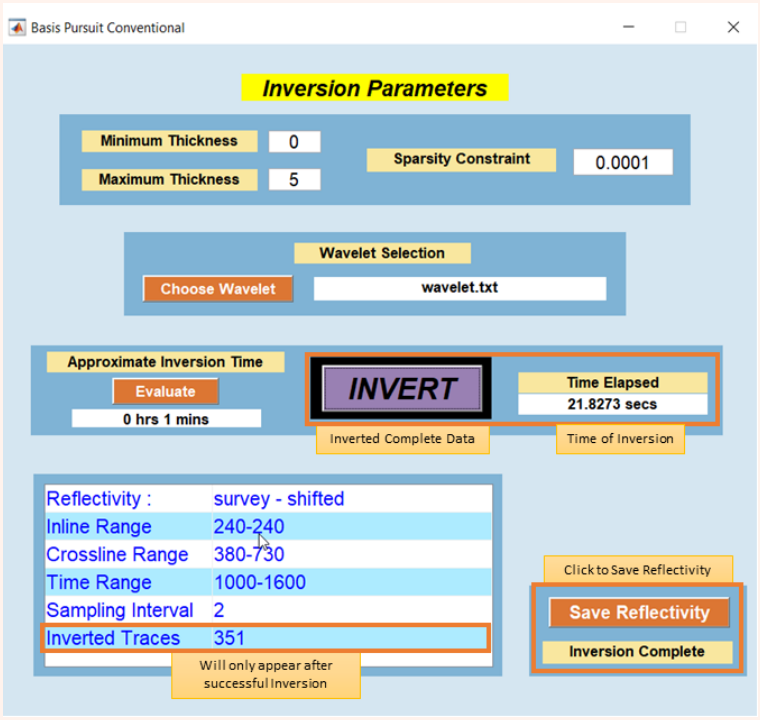
User has the option to parametrize in the linear programming section only. The same sparsity constraint can also be used in this segment

The dictionary parameters are pre-set to 0 and 5. User can select the Wavelet in the Wavelet Section by clicking *'Choose Wavelet'* button. Click on *'Select'* in the Wavelet menu to select the highlighted Wavelet.

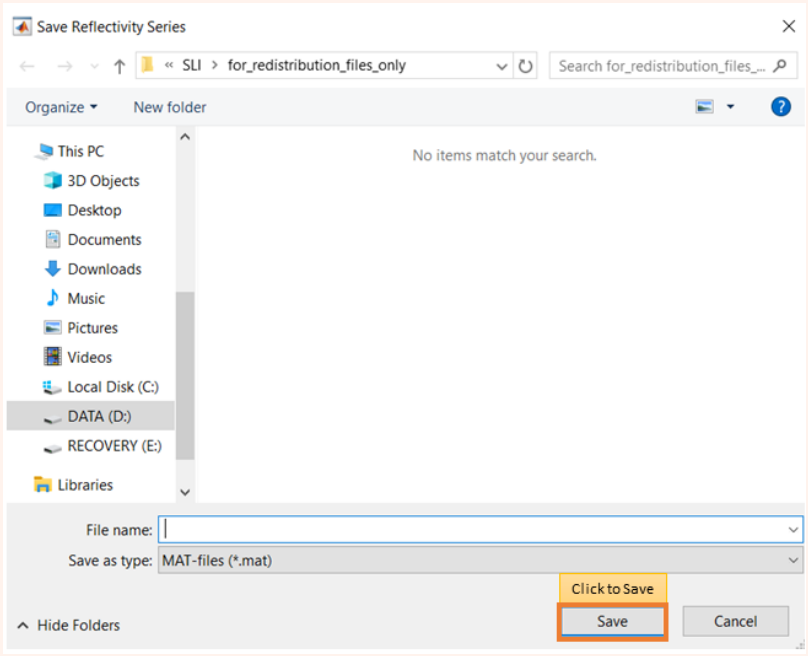
- **<u>Wavelet Section</u>**
  - After selecting the wavelet in Wavelet Menu, the name of the wavelet will only appear in the wavelet selection after the user clicks *'Evaluate' or 'Invert'.*



Click on ‘Evaluate’ button to calculate the time required for inversion. User has the choice to alter the parameters to reduce the time for inversion. Click on *‘Invert’* to invert the complete section. The parallel operation will begin with a progress bar. After the process of inversion completes, the specifications of inverted data will be shown in the table.



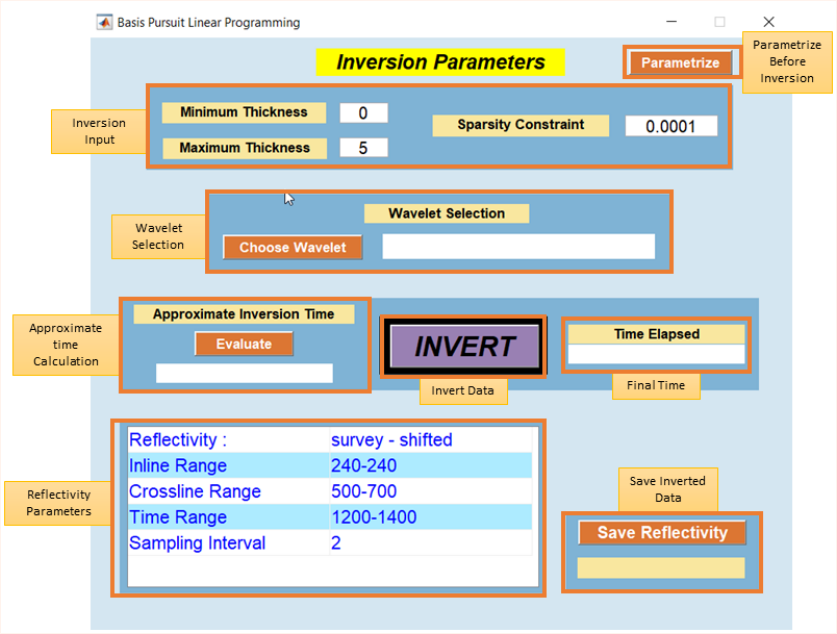
Click on *‘Save Reflectivity’* to export the inverted data to a MAT file. This can be used in the Result Analysis section.



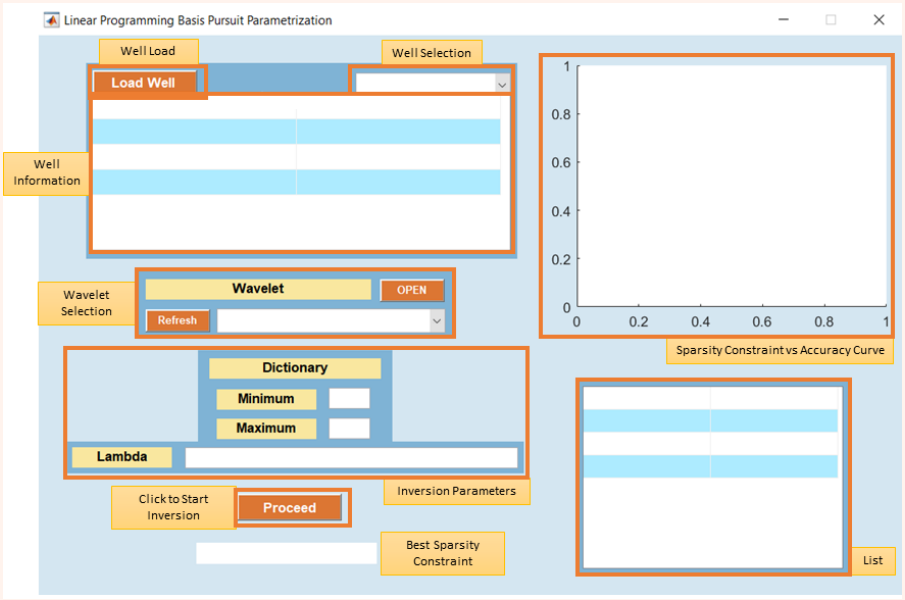
The inverted traces row in the reflectivity table will only be visible after successful inversion of the complete dataset.

B. Basis Pursuit Linear Programming

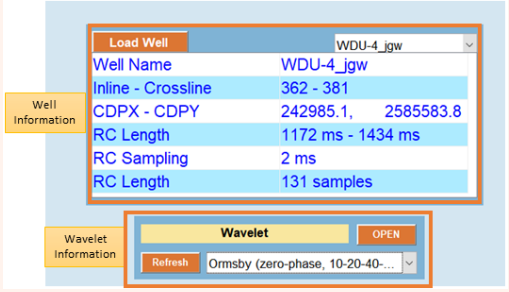
The user is provided with the *'Parametrize'* option in this algorithm. The sparsity constraint can be evaluated before proceeding into the inversion process. User needs to have a modified well in .mat format before evaluating the sparsity constraint for a given

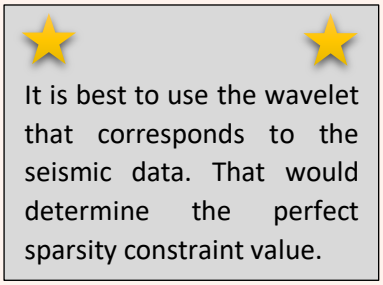


After clicking on *'Parametrize'*, the following window appears.

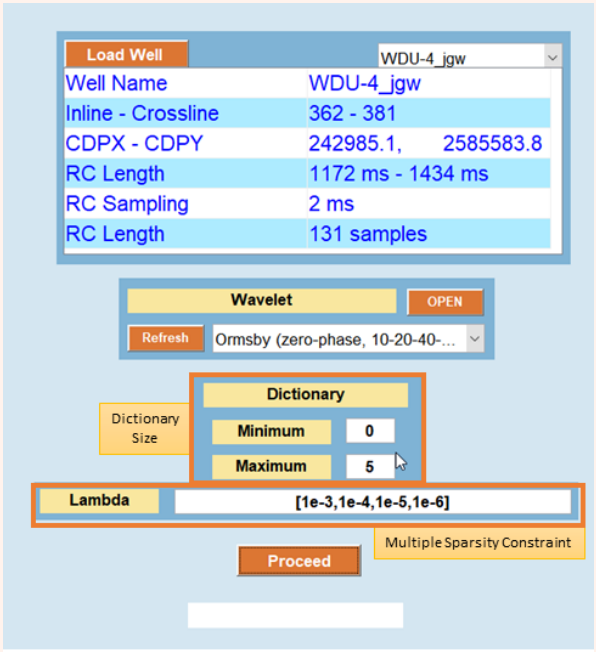


User needs to load the well first. It will appear on the top left table. User can select to proceed with the desired well by clicking the drop down menu for well selection.

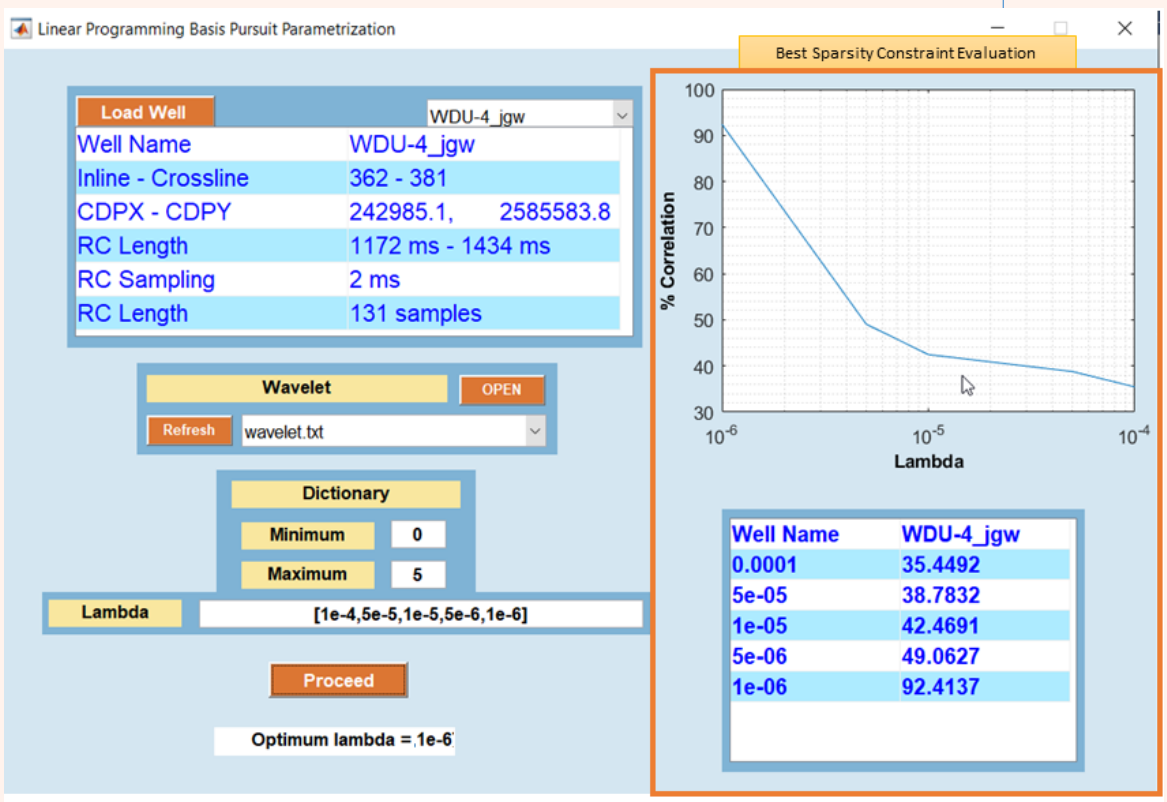




After the well is selected, User can select the wavelet from the wavelet selection panel. The inversion parameters are for the user to choose. The matrix dictionary range can be from 0-5 or 0-10. The former can't accommodate thick layers whereas the dictionary range of 0-10 will consume more time. User has the option to select multiple sparsity constraints in the following format.



After selecting the parameters, user can click *'Proceed'* to evaluate the sparsity constraint that produces the best correlation. The constraint VS correlation graph will be shown and the best value will be shown below the 'Proceed' icon.



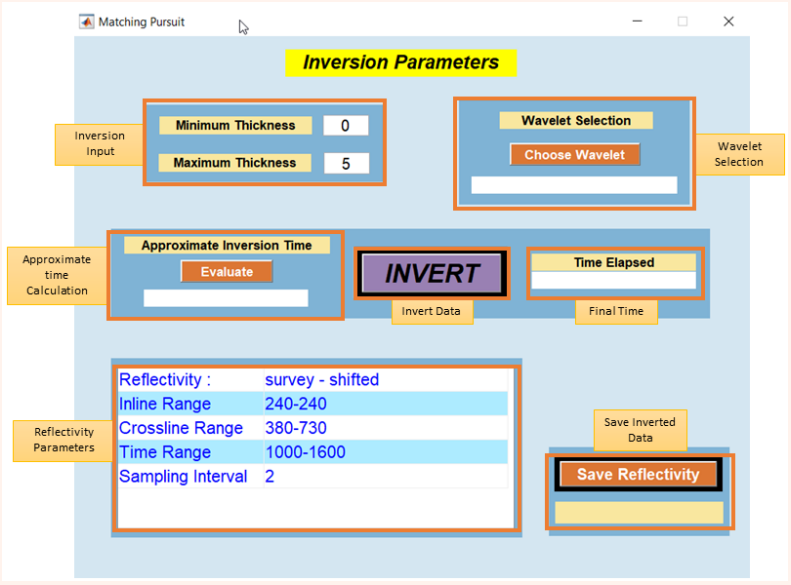
The optimum lambda can be chosen for the inversion of complete dataset.

★ ★

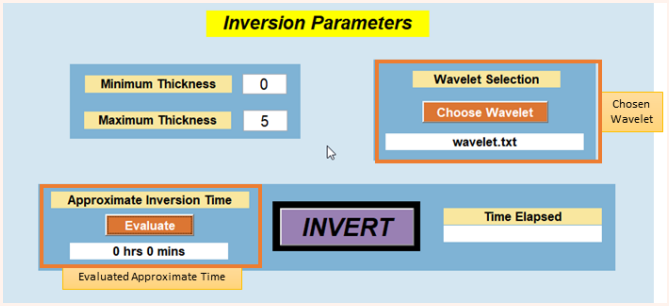
The sparsity constraint values given by the user must be feasible for the system to continue. A range of $100\ to\ 10^{-6}$ is feasible for most of the datasets

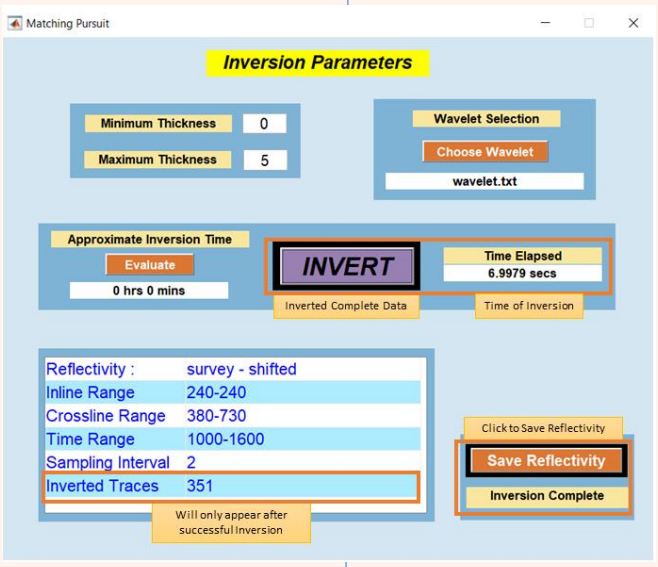
C. Matching Pursuit

Matching Pursuit algorithm uses only a dictionary to resolve the layers. There is no sparsity constraint available for the user. The inversion process is as follows.



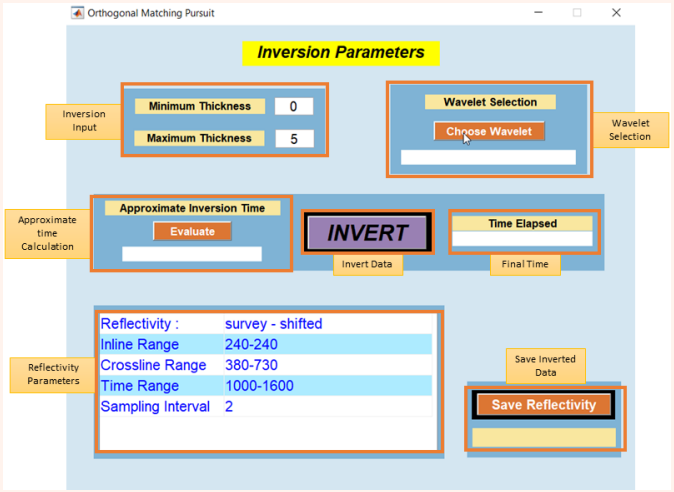
Matching Pursuit and Orthogonal Matching Pursuit are identical algorithms except the residue formation. The dictionary value should be chosen according to the dataset.

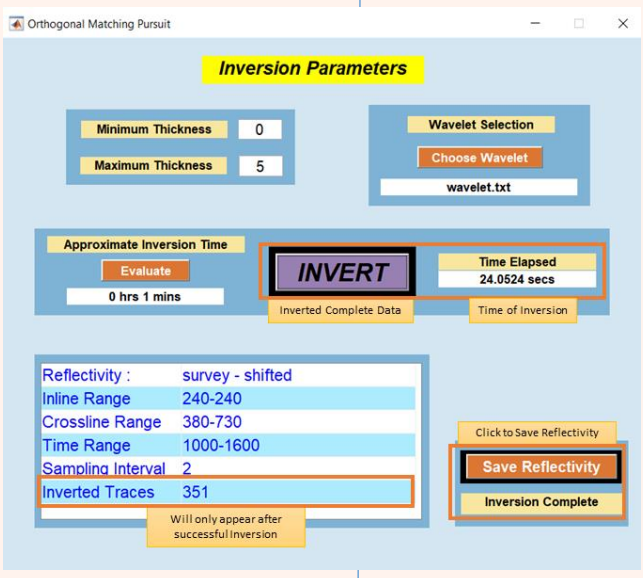


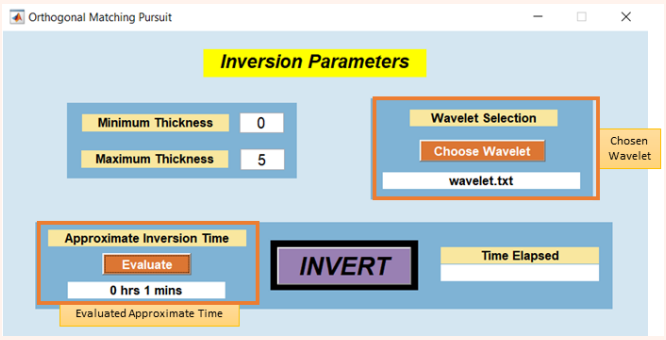


D. Orthogonal Matching Pursuit

Orthogonal Matching Pursuit is identical to the Matching Pursuit Algorithm. User has to select the dictionary parameters and the wavelet to run the inversion. The reflectivity will be shown in the same format as there in the matching pursuit algorithm.

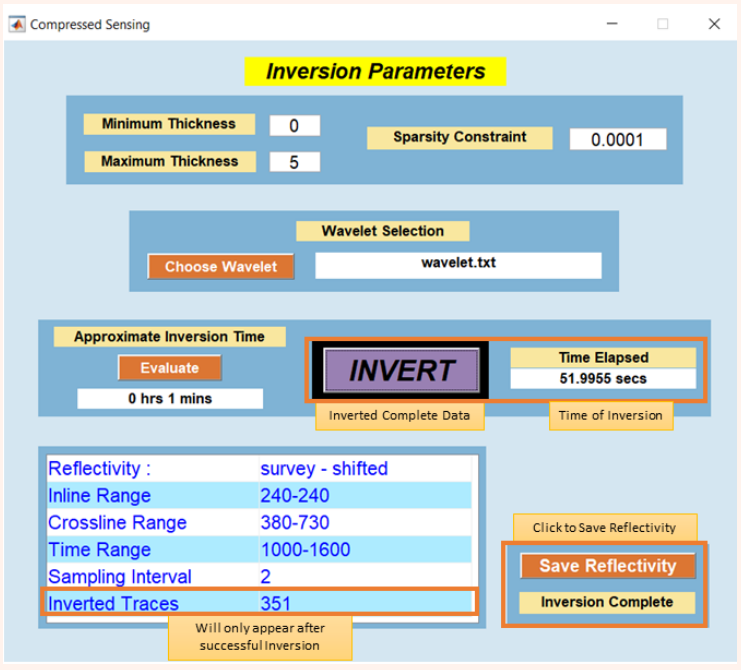






E. Compressed Sensing

In compressed Sensing algorithm, the Douglas Rachford compressed sensing has been used. User has the option to build a dictionary and present a sparsity constraint for the algorithm to invert the desired data.



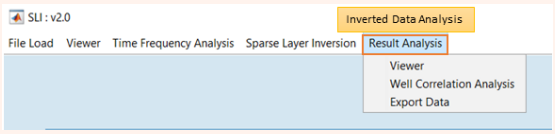
5. Results Analysis

Before proceeding to the result analysis section, the user must have loaded the relevant data successfully. However if the user needs only to export the inverted reflectivity, there is no need of a parent seismic file. The only restriction is that the inverted reflectivity must have been derived from the parent seismic. The header information should match exactly.

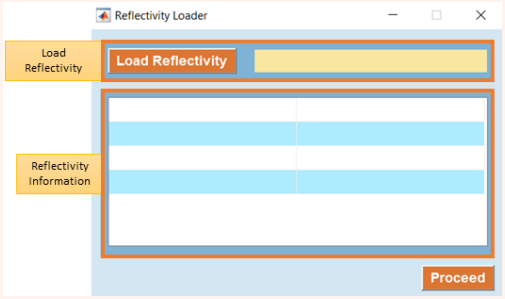
a. Results Viewer

User can visualize the frequency spectrum of loaded seismic data by choosing

Result Analysis >> Viewer

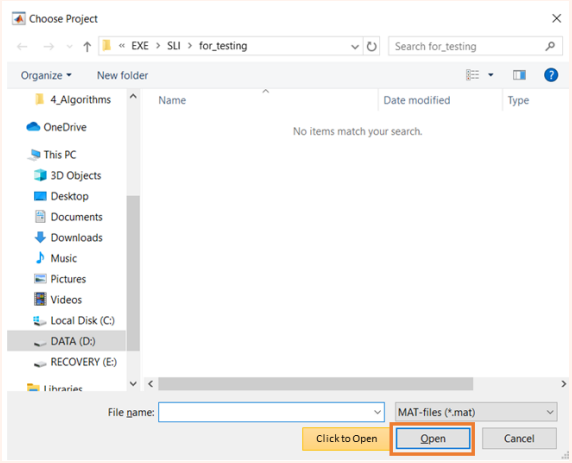


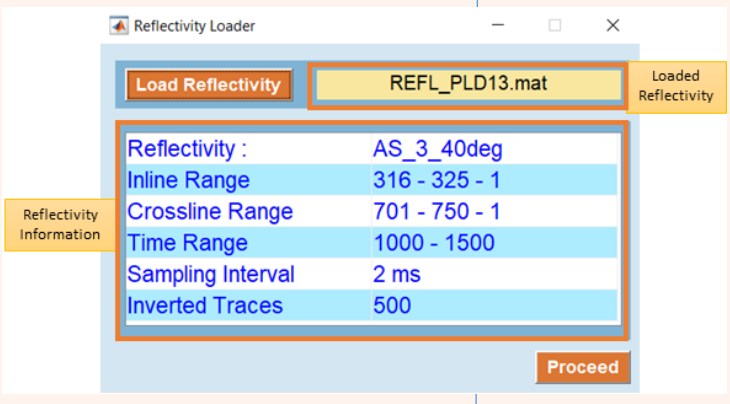
After selecting the Viewer option, a window will appear which will load the inverted reflectivity data to the viewer.



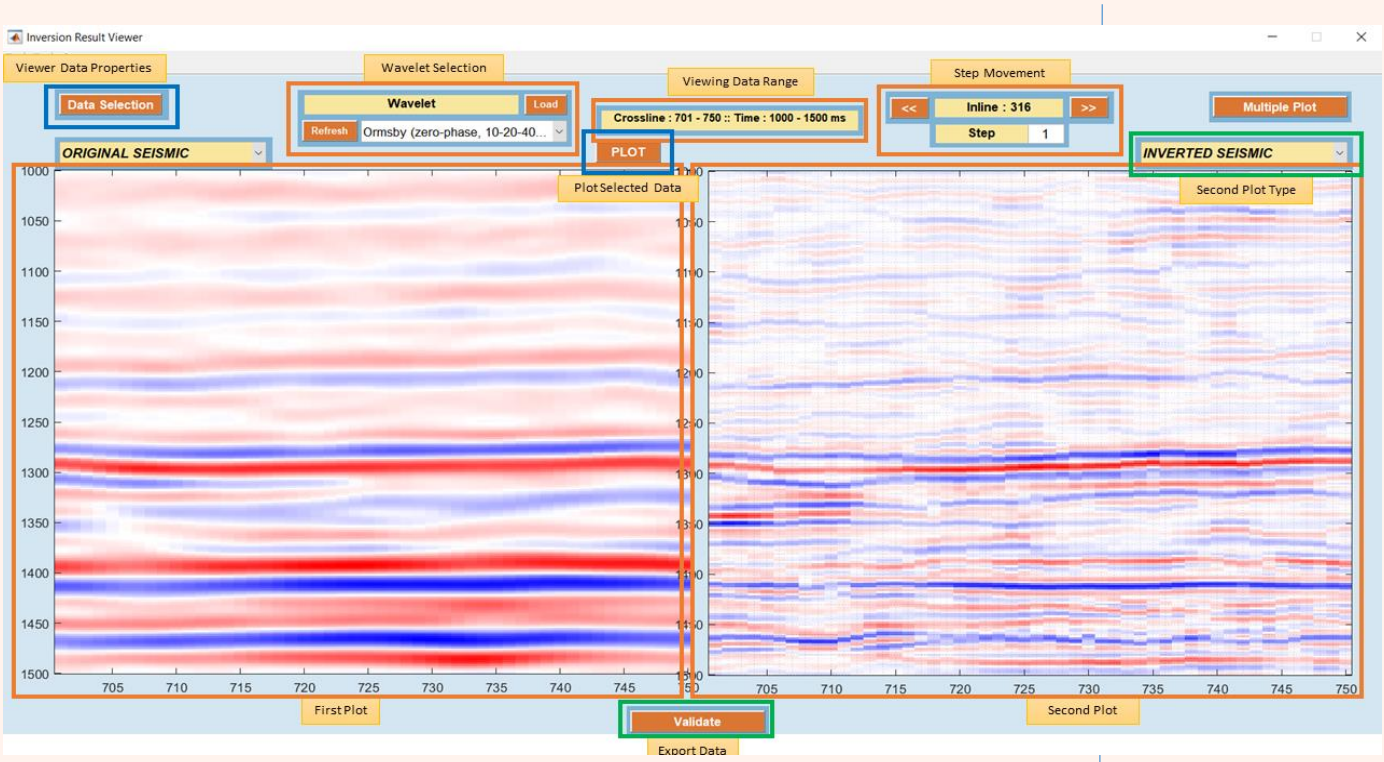
The inverted data obtained from Time-frequency analysis and Sparse Layer Inversion section can both be loaded to the software using this window.

User needs to upload the inverted data obtained from the sparse layer inversion section or time frequency analysis section in *.mat* format.



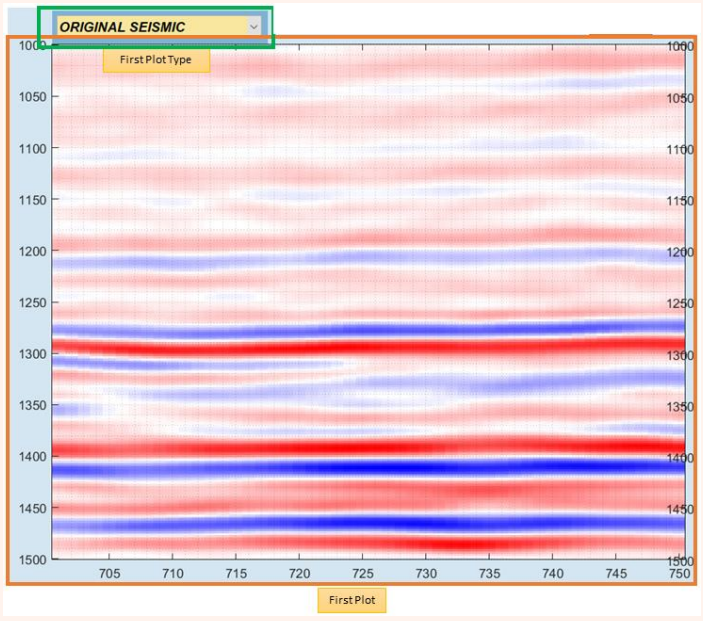


After selecting the desired reflectivity, click *'Proceed'* to open the viewer with first Inline section on display with predefined Wavelet of the software which is a zero phase ORMSBY wavelet with (10-20-40-60) corner frequencies.

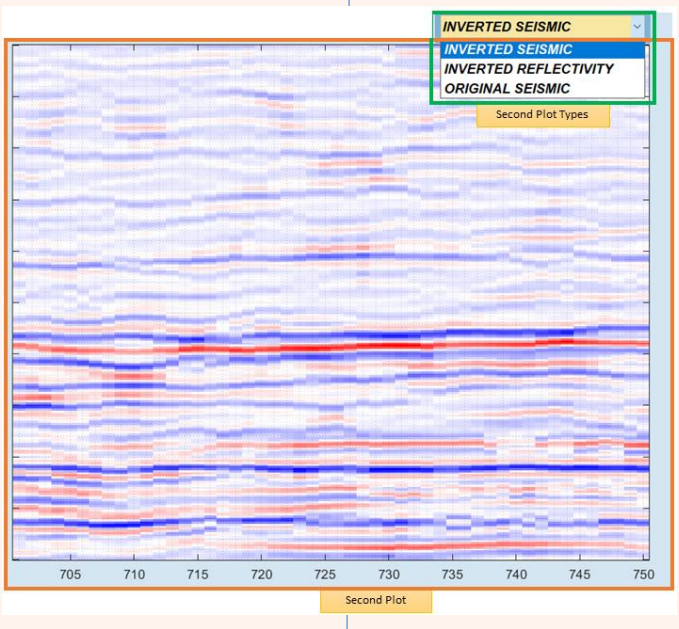


There are two plots shown in the viewer. The left plot indicates the original seismic section which is obtained from the parent seismic data. Right plot is the convolution of the inverted reflectivity data loaded by the user with the predefined wavelet. The plot type can be changed from the dropdown menu provided on the top of each plot. The available plots are the following.

Original Seismic:

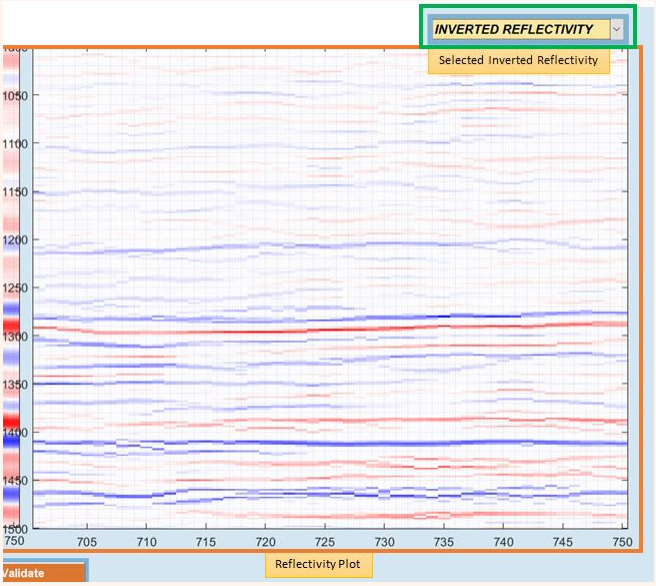


Inverted Seismic:



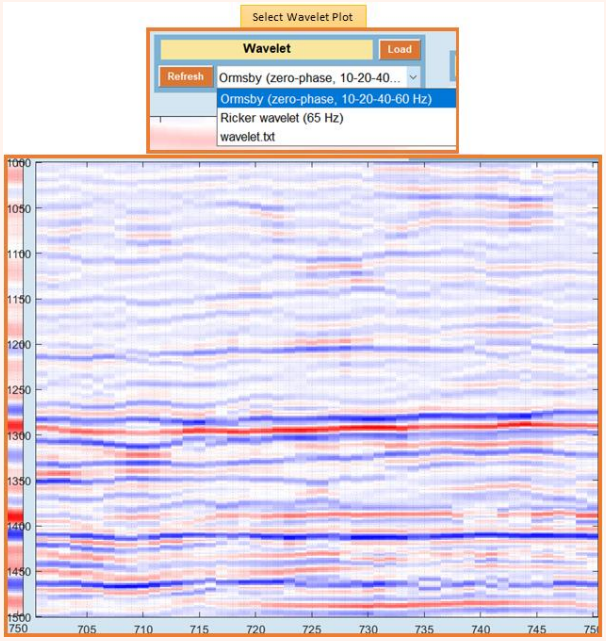
- **Data Export**
  - If the results are satisfactory, user can export it directly by clicking on the *'Export'* button.

Inverted Reflectivity:

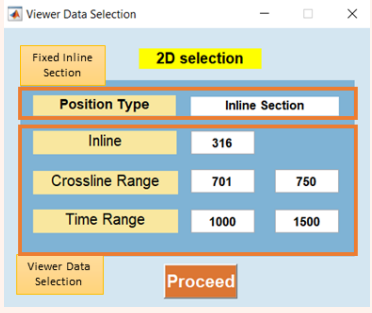


> The inverted reflectivity is not available to plot in case of data obtained from TF Inversion.

User has the option to change the wavelet from the wavelet selection panel. The inverted seismic plot will change when the user selects other wavelet. If the selecting the wavelet doesn't change the inverted seismic plot, User needs to click the 'Plot' button.



User can plot different sections by clicking on *'Data Selection'*. A dialogue will appear where user can put all the desired plot ranges.



After selecting the plot range, click on *'Proceed'* to go to the main viewer. The plot will be changed to desired range once the user clicks on *'Plot'*.

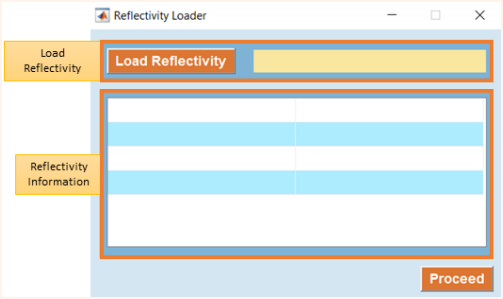
> The viewer can't update the selected data range unless the user clicks on 'Plot' in the viewer window

b. Well Correlation Panel

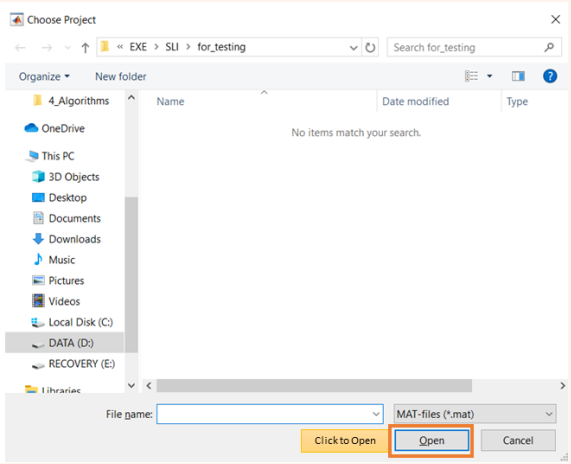
User can visualize the frequency spectrum of loaded seismic data by choosing

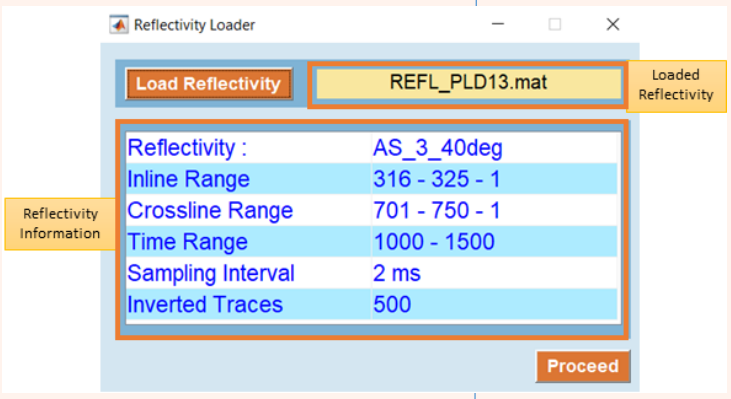
Result Analysis >> Well Correlation Analysis

After selecting the Viewer option, a window will appear which will load the inverted reflectivity data to the viewer.

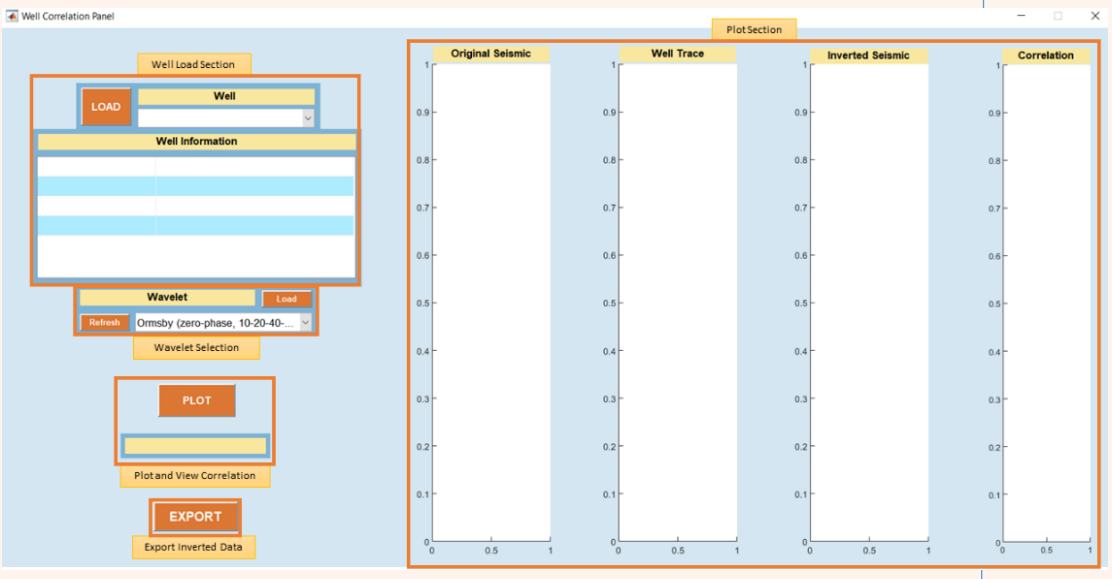


User needs to upload the inverted data obtained from the sparse layer inversion section or time frequency analysis section in *.mat* format.

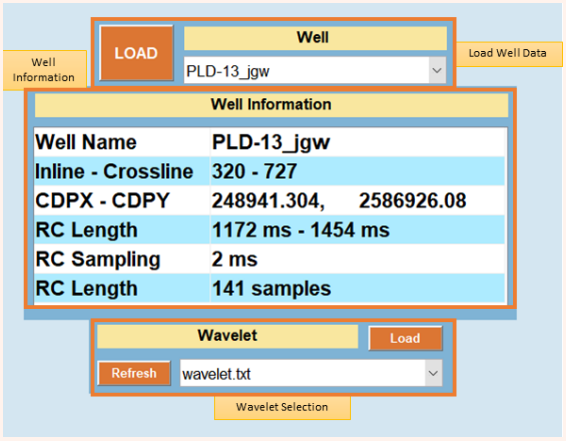


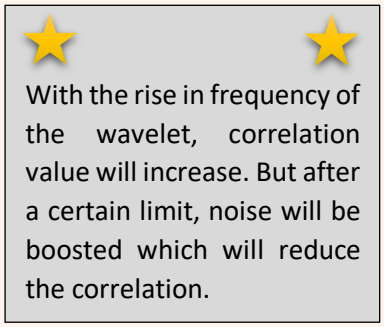


Click on 'Proceed' to open the well correlation panel

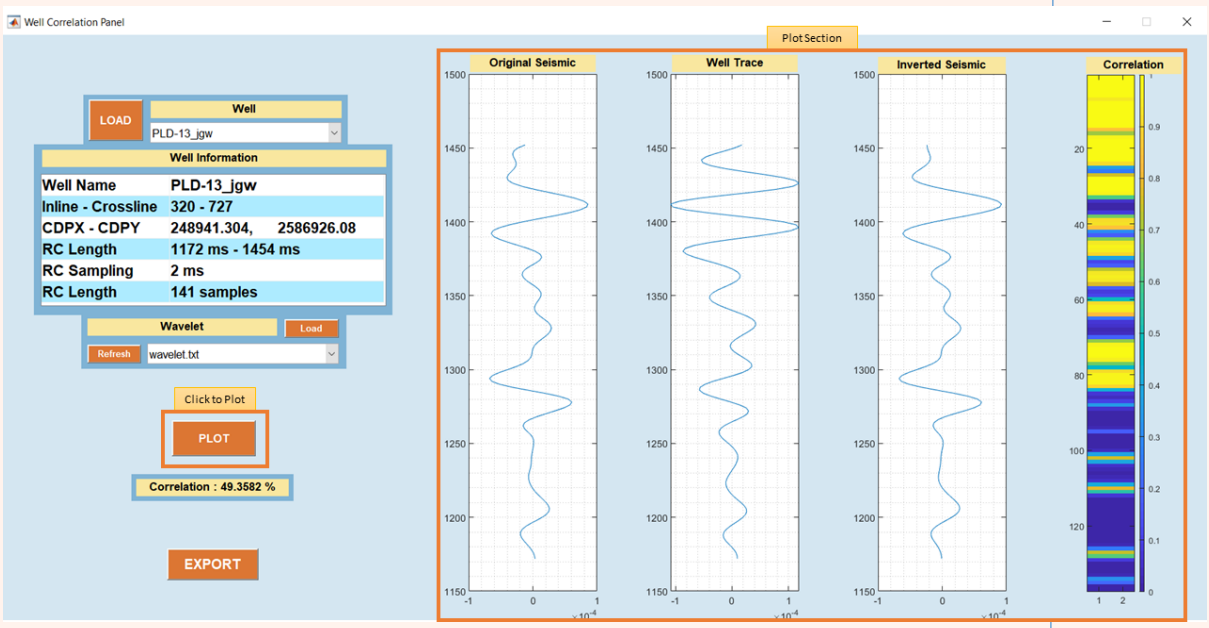


In the well correlation panel, user needs to load the modified wells in .mat format. After selecting the desired well from the dropdown menu. User has to select the wavelet in the wavelet selection panel.





Click *'Plot'* to show the Correlation value along with the data.

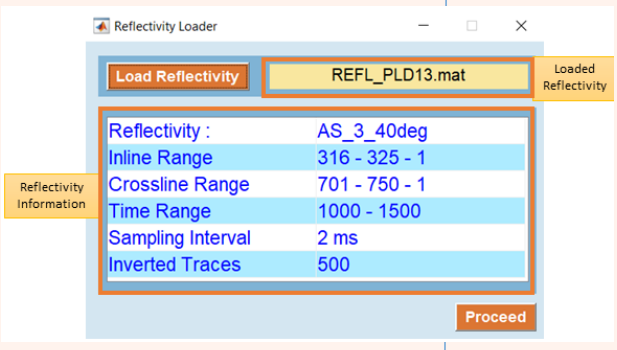


Click *'Export'* to proceed to data export section directly.

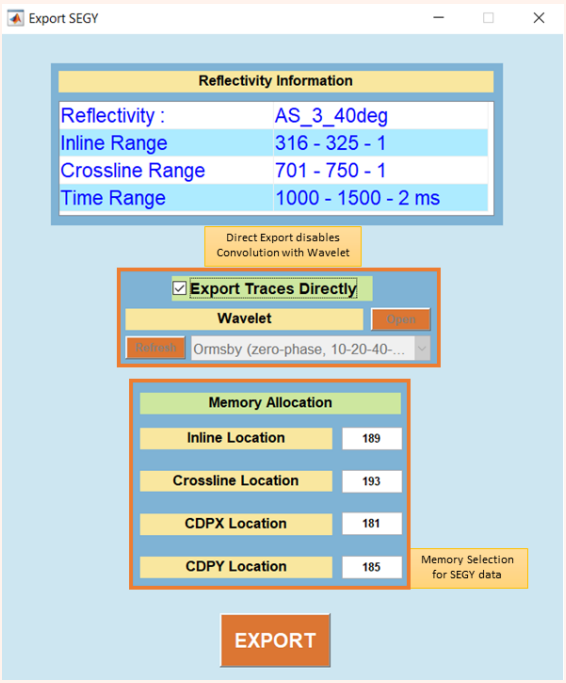
c. Export Data

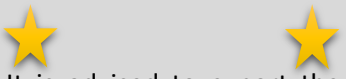
This section doesn't require a parent seismic file. User can just upload the inverted reflectivity from the following menu by choosing

Result Analysis >> Export Data



The export data window will be shown.

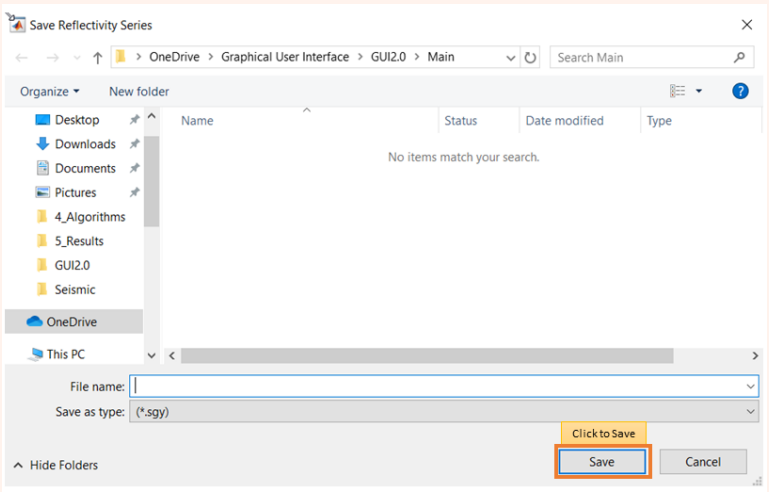




It is advised to export the SEGY data in the default memory location format. Otherwise user has to change the memory byte locations while loading the exported SEGY data back into the software.

User can select the wavelet from the wavelet selection section. It has an option to bypass the wavelet convolution process. Click on the *'Export Traces Directly'* check box to export the inverted reflectivity into SEGY file as it is.

Choose the memory location of the shown headers and click *'Export'* to save the reflectivity in SEGY format.



The exported SEGY can be reused in the GUI main window.